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About this Guide

This preface describes the System Administration Guide, how it is organized and its document conventions.

The System Administration Guide describes how to generally configure and maintain StarOS running on an ASR 5500 platform. It also includes information on monitoring system performance and troubleshooting.
Conventions Used

The following tables describe the conventions used throughout this documentation.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Notice Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Information Note" /></td>
<td>Information Note</td>
<td>Provides information about important features or instructions.</td>
</tr>
<tr>
<td><img src="image" alt="Caution" /></td>
<td>Caution</td>
<td>Alerts you of potential damage to a program, device, or system.</td>
</tr>
<tr>
<td><img src="image" alt="Warning" /></td>
<td>Warning</td>
<td>Alerts you of potential personal injury or fatality. May also alert you of potential electrical hazards.</td>
</tr>
</tbody>
</table>

**Typeface Conventions**

<table>
<thead>
<tr>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text represented as a screen display</td>
<td>This typeface represents displays that appear on your terminal screen, for example: Login:</td>
</tr>
<tr>
<td>Text represented as commands</td>
<td>This typeface represents commands that you enter, for example: show ip access-list. This document always gives the full form of a command in lowercase letters. Commands are not case sensitive.</td>
</tr>
<tr>
<td>Text represented as a command variable</td>
<td>This typeface represents a variable that is part of a command, for example: show card slot_number. slot_number is a variable representing the desired chassis slot number.</td>
</tr>
<tr>
<td>Text represented as menu or sub-menu names</td>
<td>This typeface represents menus and sub-menus that you access within a software application, for example: Click the File menu, then click New</td>
</tr>
</tbody>
</table>
MIOs and DPCs

The ASR 5500 supports a variety of Management Input/Output and Data Processing Card types. The currently supported Management Input/Output card types include:

- Management Input/Output (MIO)
- Universal Management Input/Output (UMIO)

MIO and UMIO card types differ only by the UMIO requirement for a Universal chassis license.

The currently supported Data Processing Card types include:

- Data Processing Card (DPC)
- Universal Data Processing Card (UDPC)
- Data Processing Card version 2 (DPC2)
- Universal Data Processing Card version 2 (UDPC2)

DPC and UDPC card types differ only by the UDPC requirement for a Universal chassis license. DPC2 and UDPC2 card types differ only by the UDPC2 requirement for a Universal chassis license. The DPC2/UDPC2 is only supported on ASR 5500 running StarOS release 18.2+.

When reference is made to an MIO card or DPC in this guide, it is presumed to apply to all types of these cards as identified above.

Related Documentation

The most up-to-date information for this product is available in the product Release Notes provided with each software release.

The following user documents are available on www.cisco.com:

- ASR 5500 Installation Guide
- AAA Interface Administration and Reference
- Command Line Interface Reference
- GTPP Interface Administration and Reference
- IPSec Reference
- Release Change Reference
- SNMP MIB Reference
- Statistics and Counters Reference
- Thresholding Configuration Guide
- Product-specific and feature-specific Administration guides
Contacting Customer Support

Use the information in this section to contact customer support.

Refer to the support area of http://www.cisco.com for up-to-date product documentation or to submit a service request. A valid username and password are required to access this site. Please contact your Cisco sales or service representative for additional information.
Chapter 1
System Operation and Configuration

The ASR 5500 is designed to provide subscriber management services for high-capacity 4G wireless networks.

Before you connect to the command line interface (CLI) and begin system configuration, you must understand how the system supports these services. This chapter provides terminology and background information to consider before you configure the system. The following sections are included:

- Terminology
- How the System Selects Contexts
- Understanding the ASR 5500 Boot Process
- Understanding Configuration Files
- IP Address Notation
- Alphanumeric Strings
Terminology

This section defines important terms used throughout this guide.

Contexts

A context is a logical grouping or mapping of configuration parameters that pertain to various physical ports, logical IP interfaces, and services. A context can be thought of as a virtual private network (VPN).

The system supports the configuration of multiple contexts. Each context is configured and operates independently of the others. Once a context has been created, administrative users can configure services, logical IP interfaces, and subscribers for that context and then bind the logical interfaces to physical ports.

You can also assign a domain alias to a context; if a subscriber’s domain name matches one of the configured alias names for a context, that context is used.

Ports

Ports are the physical connectors on line cards that support remote access and subscriber traffic. Port configuration includes traffic profiles, data encapsulation methods, media type, and other information for physical connectivity between the system and the rest of the network.

Ports are identified by the chassis slot number for the Management Input/Output (MIO/UMIO) card, followed by the physical connector number. For example, Port 5/10 identifies connector number 10 on the MIO/UMIO card in slot 5.

Associate ports with contexts through bindings. For additional information on bindings, refer to the Bindings section below. You can configure each physical port to support multiple logical IP interfaces, each with up to 17 IP addresses (one primary and up to 16 secondaries).

For complete information on line cards and port assignments, refer to the ASR 5500 Installation Guide.

Important: UMIO cards and UDPC/UDPC2s are direct replacements for MIO cards and DPC/DPC2s. However, a special Universal PID license must be purchased and installed on the chassis for each installed UMIO and UDPC/UDPC2. Contact your Cisco account representative for additional licensing information.

Important: Throughout this guide, any reference to an MIO card or DPC is assumed to also refer to the UMIO and UDPC/UDPC2 respectively.

Logical Interfaces

You must associate a port with a StarOS virtual circuit or tunnel called a logical interface before the port can allow the flow of user data. Within StarOS, a logical interface is a named interface associated with a virtual router instance that provides higher-layer protocol transport, such as Layer 3 IP addressing. Interfaces are configured as part of VPN contexts and are independent from the physical ports that will be used to bridge the virtual interfaces to the network.

Logical interfaces are associated with ethernet+ppp+tunnel addresses and are bound to a specific port during the configuration process. Logical interfaces are also associated with services through bindings. Services are bound to an IP
address that is configured for a particular logical interface. When associated, the interface takes on the characteristics of
the functions enabled by the service.

There are several types of logical interfaces to configure to support Simple and Mobile IP data applications. These are
briefly defined below.

**Management Interface**

This interface provides the point of attachment to the management network. The interface supports remote access to the
command line interface (CLI). It also supports Common Object Request Broker Architecture (CORBA)-based
management via the Web Element Manager application, and event notification via the Simple Network Management
Protocol (SNMP).

Define management interfaces in the *local* context and bind them to the ports on the Management Input/Output
(MIO/UMIO) cards.

**Bindings**

A binding is an association between elements within the system. There are two types of bindings: static and dynamic.

*Static binding* is accomplished through system configuration. Static bindings associate:

- A specific logical interface (configured within a particular context) to a physical port. Once the interface is
  bound, traffic can flow through the context as if it were any physically-defined circuit. Static bindings support
  any encapsulation method over any interface and port type.
- A service to an IP address assigned to a logical interface within the same context. This allows the interface to
  take on the characteristics (that is, support the protocols) required by the service.

*Dynamic binding* associates a subscriber to a specific egress context based on the configuration of their profile or
system parameters. This provides a higher degree of deployment flexibility, as it allows a wireless carrier to support
multiple services and facilitates seamless connections to multiple networks.

Management ports can only be bound in the local context. Traffic or subscriber ports can only be bound in a non-local
context.

**Services**

Configure services within a context to enable certain functionality. The following are examples of services you can
configure on the system, subject to licensing availability and platform type:

- Gateway GPRS Support Node (GGSN) services
- Serving GPRS Support Node (SGSN) Services
- Packet Data Serving Node (PDSN) services
- Home Agent (HA) services
- Layer 2 Tunneling Protocol Access Concentrator (LAC) services
- Dynamic Host Control Protocol (DHCP) services
- PDN Gateway (P-GW) Services
- Serving Gateway (S-GW) Services
- Intelligent Policy Control Function (IPCF) Services (PCC-Service, PCC-Policy, PCC-AF)
AAA Servers

Authentication, Authorization and Accounting (AAA) servers store profiles, perform authentication, and maintain accounting records for each mobile data subscriber. The AAA servers communicate with the system over an AAA interface. The system supports the configuration of up to 128 interfaces to AAA servers.

It is important to note that for Mobile IP, there can be Foreign AAA (FAAA) and Home AAA (HAAA) servers. FAAA servers typically reside in the carrier’s network. HAAA servers could be owned and controlled by either the carrier or the home network. If the HAAA server is owned and controlled by the home network, accounting data is transferred to the carrier via an AAA proxy server.

**Important**: Mobile IP support depends on the availability and purchase of a standalone license or a license bundle that includes Home Agent (HA).

Subscribers

Subscribers are the end-users of the service; they gain access to the Internet, their home network, or a public network through the system.

There are three primary types of subscribers:

- **RADIUS-based Subscribers**: The most common type of subscriber, these users are identified by their International Mobile Subscriber Identity (IMSI) number, an Electronic Serial Number (ESN), or by their domain name or user name. They are configured on and authenticated by a RADIUS AAA server.

  Upon successful authentication, various attributes that are contained in the subscriber profile are returned. The attributes dictate such things as session parameter settings (for example, protocol settings and IP address assignment method), and what privileges the subscriber has.

  **Important**: Attribute settings received by the system from a RADIUS AAA server take precedence over local-subscriber attributes and parameters configured on the system.

- **Local Subscribers**: These are subscribers, primarily used for testing purposes, that are configured and authenticated within a specific context. Unlike RADIUS-based subscribers, the local subscriber’s user profile (containing attributes like those used by RADIUS-based subscribers) is configured within the context where they are created.

  When local subscriber profiles are first created, attributes for that subscriber are set to the system’s default settings. The same default settings are applied to all subscriber profiles, including the subscriber named default which is created automatically by the system for each system context. When configuring local profile attributes, the changes are made on a subscriber-by-subscriber basis.

  **Important**: Attributes configured for local subscribers take precedence over context-level parameters. However, they could be over-ridden by attributes returned from a RADIUS AAA server.

- **Management Subscribers**: A management user is an authorized user who can monitor, control, and configure the system through the CLI or Web Element Manager application. Management is performed either locally, through the system Console port, or remotely through the use of the Telnet or secure shell (SSH) protocols. Management users are typically configured as a local subscriber within the Local context, which is used exclusively for system management and administration. As with a local subscriber, a management subscriber’s user profile is configured within the context where the subscriber was created (in this case, the Local context).
However, management subscribers may also be authenticated remotely via RADIUS, if an AAA configuration exists within the local context, or TACACS+.

How the System Selects Contexts

This section describes the process that determines which context to use for context-level administrative users or subscriber sessions. Understanding this process allows you to better plan your configuration in terms of how many contexts and interfaces you need to configure.

Context Selection for Context-level Administrative User Sessions

The system comes configured with a context called `local` that you use specifically for management purposes. The context selection process for context-level administrative users (those configured within a context) is simplified because the management ports on the MIO are associated only with the Local context. Therefore, the source and destination contexts for a context-level administrative user responsible for managing the entire system should always be the local context.

A context-level administrative user can also connect through other interfaces on the system and still have full system management privileges.

A context-level administrative user can be created in a non-local context. These management accounts have privileges only in the context in which they are created. This type of management account can connect directly to a port in the context in which they belong, if local connectivity is enabled (SSHD, for example) in that context.

For all FTP or SFTP connections, you must connect through an MIO management interface. If you SFTP or FTP as a non-local context account, you must use the username syntax of `username@contextname`.

The context selection process becomes more involved if you are configuring the system to provide local authentication or work with a AAA server to authenticate the context-level administrative user.

The system gives you the flexibility to configure context-level administrative users locally (meaning that their profile will be configured and stored in its own memory), or remotely on an AAA server. If a locally-configured user attempts to log onto the system, the system performs the authentication. If you have configured the user profile on an AAA server, the system must determine how to contact the AAA server to perform authentication. It does this by determining the AAA context for the session.

The following table and flowchart describe the process that the system uses to select an AAA context for a context-level administrative user. Items in the table correspond to the circled numbers in the flowchart.
Figure 1. Context-level Administrative User AAA Context

1. Local Authentication enabled in local context?
   - Yes
   - No
   - Admin. User matches configured admin. user in local context?
     - Yes
     - No
2. Domain part of username?
   - Yes
   - No
3. Does Default Domain context match a configured context or domain?
   - Yes
   - No
4. Last Resort context configured for admin?
   - Yes
   - No

Use AAA policies defined within the context configured for the Default Domain.
Use AAA policies defined within that context.
Use AAA policies defined within the Last Resort context.
Table 1.  Context-level Administrative User AAA Context Selection

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>During authentication, the system determines whether local authentication is enabled in the local context. If it is, the system attempts to authenticate the administrative user in the local context. If it is not, proceed to item 2 in this table. If the administrative user’s username is configured, authentication is performed by using the AAA configuration within the local context. If not, proceed to item 2 in this table.</td>
</tr>
<tr>
<td>2</td>
<td>If local authentication is disabled on the system or if the administrative user’s username is not configured in the local context, the system determines if a domain was received as part of the username. If there is a domain and it matches the name of a configured context or domain, the systems uses the AAA configuration within that context. If there is a domain and it does not match the name of a configured context or domain, Go to item 4 in this table. If there is no domain as part of the username, go to item 3 in this table.</td>
</tr>
<tr>
<td>3</td>
<td>If there was no domain specified in the username or the domain is not recognized, the system determines whether an AAA Administrator Default Domain is configured. If the default domain is configured and it matches a configured context, the AAA configuration within the AAA Administrator Default Domain context is used. If the default domain is not configured or does not match a configured context or domain, go to item 4 item below.</td>
</tr>
<tr>
<td>4</td>
<td>If a domain was specified as part of the username but it did not match a configured context, or if a domain was not specified as part of the username, the system determines if the AAA Administrator Last Resort context parameter is configured. If a last resort, context is configured and it matches a configured context, the AAA configuration within that context is used. If a last resort context is not configured or does not match a configured context or domain, the AAA configuration within the local context is used.</td>
</tr>
</tbody>
</table>

Context Selection for Subscriber Sessions

The context selection process for a subscriber session is more involved than that for the administrative users. Subscriber session context selection information for specific products is located in the Administration Guide for the individual product.
Understanding the ASR 5500 Boot Process

Part of the configuration process requires that you allocate hardware resources for processing and redundancy. Therefore, before you configure the system, it is important to understand the boot process which determines how the hardware components are brought on line.

The following flowchart shows each step in the startup process. For additional information about system configuration files, refer to the Understanding Configuration Files section.

The following steps describe the system’s boot process:

**Step 1**  When power is first applied to the chassis, or after a reboot, only the MIO/UMIOs in slot 5 and slot 6 receive power.

**Step 2**  During the startup process, the MIO/UMIO performs a series of power-on self tests (POSTs) to ensure that its hardware is operational.

**Step 3**  If the MIO/UMIO in slot 5 successfully executes all POSTs, it becomes the active MIO. The MIO in slot 6 becomes the standby card. If there is a problem with the MIO in slot 5, the MIO in slot 6 becomes the active MIO.
Step 4  The active MIO/UMIO begins loading the operating system software image designated in the boot stack. The boot stack entries are contained in the boot.sys file that resides on flash memory on the MIO/UMIO. The standby MIO/UMIO observes the active card startup. If the file on the active MIO/UMIO is loads normally, the standby MIO/UMIO boots from the active card image. If the active MIO/UMIO experiences problems during this phase, the standby MIO/UMIO loads its software image designated by its own boot stack entry in its boot.sys file and takes over control of the system as the active MIO/UMIO.

Step 5  After the software image is loaded into its memory, the active MIO/UMIO determines whether other cards are installed in the chassis by applying power to the other chassis slots and signalling them. If the chassis slot contains a card, power is left On to that slot. All empty slots are powered off.

**Important:** If no MIOs are installed or if both fail to boot successfully, no other card installed in the system will boot.

Step 6  When power is applied to the DPC/UDPCs or DPC2/UDPC2s installed in the system, they each perform their own series of POSTs.

Step 7  After successful POST, each DPC/UDPC or DPC2/UDPC2 enters standby mode.

Step 8  After entering the standby mode, each of the control processors (CPs) on the DPC/UDPCs or DPC2/UDPC2s communicate with the active MIO/UMIO to receive the appropriate code.

Step 9  Upon successful loading of the software image, the system loads a configuration file designated in the boot stack (boot.sys file). If this is the first time the system is powered on and there is no configuration file, the active MIO/UMIO invokes the system’s Quick Setup wizard. Use the Quick Setup wizard to configure basic system parameters for communication across the management network.

The wizard creates a configuration file (system.cfg) that you can use as a starting point for subsequent configurations. This allows you to configure the system automatically by applying the configuration file during any subsequent boot. For additional information about system configuration files, refer to the *Understanding Configuration Files* section.
Understanding Configuration Files

The system supports the use of a file or script to modify configurable parameters. Using a file for offline system configuration reduces the time it takes to configure parameters on multiple systems.

A system configuration file is an ASCII text file that contains commands and configuration parameters. When you apply the configuration file, the system parses through the file line-by-line, testing the syntax and executing the command. If the syntax is incorrect, a message is displayed to the CLI and the system proceeds to the next command. Lines that begin with # are considered remarks and are ignored.

**Important:** Pipes ( | ), used with the `grep` and `more` keywords, can potentially cause errors in configuration file processing. Therefore, the system automatically ignores keywords with pipes during processing.

**Important:** Always save configuration files in UNIX format. Failure to do so can result in errors that prevent configuration file processing.

The commands and configuration data within the file are organized and formatted just as they would be if they were being entered at the CLI prompt. For example, if you wanted to create a context called `source` in the CLI, you would enter the following commands at their respective prompts:

```
[local]host_name# config
[local]host_name(config)# context source
[source]host_name(config-ctx)# end
```

To create a context called `source` using a configuration file, you would use a text editor to create a new file that consists of the following:

```
config

    context source

end
```

There are several important things to consider when using configuration files:

- The system automatically applies a configuration file at the end of the boot process. After the system boots up for the first time, a configuration file that you have created and that is tailored to your network needs, can be applied. To make the system use your configuration file, modify the system’s boot parameters according to the instructions located in Software Management Operations.

- In addition to being applied during the boot process, you can also apply configuration files manually at any time by executing the appropriate commands at the CLI prompt. Refer to the instructions in Software Management Operations.

**Important:** When you apply a configuration file after the boot process, the file does not delete the configuration loaded as part of the boot process. Only those commands that are duplicated are overwritten.
Configuration files can be stored in any of the following locations:

- **USB Memory Stick**: Supported via a USB port on the active MIO (/usb1).
- **Network Server**: Any workstation or server on the network that the system can access using the Secure File Transfer Protocol (SFTP). This is recommended for large network deployments in which multiple systems require the same configuration.
- **/flash**: a solid-state device with limited storage.
- **/hd-raid**: internal RAID storage.

Each time you save configuration changes you made during a CLI session, you can save those settings to a file which you can use as a configuration file.
IP Address Notation

When configuring a port interface via the CLI you must enter an IP address. The CLI always accepts an IPv4 address, and in some cases accepts an IPv6 address as an alternative.

For some configuration commands, the CLI also accepts CIDR notation. Always view the online Help for the CLI command to verify acceptable forms of IP address notation.

IPv4 Dotted-Decimal Notation

An Internet Protocol Version 4 (IPv4) address consists of 32 bits divided into four octets. These four octets are written in decimal numbers, ranging from 0 to 255, and are concatenated as a character string with full stop delimiters (dots) between each number.

For example, the address of the loopback interface, usually assigned the host name localhost, is 127.0.0.1. It consists of the four binary octets 01111111, 00000000, 00000000, and 00000001, forming the full 32-bit address.

IPv4 allows 32 bits for an Internet Protocol address and can, therefore, support \(2^{32}\) (4,294,967,296) addresses.

IPv6 Colon-Separated-Hexadecimal Notation

An Internet Protocol Version 6 (IPv6) address has two logical parts: a 64-bit network prefix, and a 64-bit host address part. An IPv6 address is represented by eight groups of 16-bit hexadecimal values separated by colons (:).

A typical example of a full IPv6 address is 2001:0db8:85a3:0000:0000:8a2e:0370:7334.

The hexadecimal digits are case-insensitive.

The 128-bit IPv6 address can be abbreviated with the following rules:

- Leading zeroes within a 16-bit value may be omitted. For example, the address fe80:0000:0000:0000:0202:b3ff:fe1e:8329 may be written as fe80::202:b3ff:fe1e:8329.

- One group of consecutive zeroes within an address may be replaced by a double colon. For example, fe80::0:0:0:202:b3ff:fe1e:8329 becomes fe80::202:b3ff:fe1e:8329.

IPv6 allows 128 bits for an Internet Protocol address and can support \(2^{128}\) \((340,282,366,920,938,000,000,000,000,000,000,000,000,000,000,000)\) internet addresses.

CIDR Notation

Classless Inter-Domain Routing (CIDR) notation is a compact specification of an Internet Protocol address and its associated routing prefix. It is used for both IPv4 and IPv6 addressing in networking architectures.

CIDR is a bitwise, prefix-based standard for the interpretation of IP addresses. It facilitates routing by allowing blocks of addresses to be grouped into single routing table entries. These groups (CIDR blocks) share an initial sequence of bits in the binary representation of their IP addresses.

CIDR notation is constructed from the IP address and the prefix size, the latter being the number of leading 1 bits of the routing prefix. The IP address is expressed according to the standards of IPv4 or IPv6. It is followed by a separator character, the slash (/) character, and the prefix size expressed as a decimal number.
The address may denote a single, distinct, interface address or the beginning address of an entire network. In the latter case the CIDR notation specifies the address block allocation of the network. The maximum size of the network is given by the number of addresses that are possible with the remaining, least-significant bits below the prefix. This is often called the host identifier.

For example:

- the address specification 192.168.100.1/24 represents the given IPv4 address and its associated routing prefix 192.168.100.0, or equivalently, its subnet mask 255.255.255.0.
- the IPv4 block 192.168.0.0/22 represents the 1024 IPv4 addresses from 192.168.0.0 to 192.168.3.255.
- the IPv6 block 2001:DB8::/48 represents the IPv6 addresses from 2001:DB8:0:0:0:0:0:0 to 2001:DB8:0:FFFF:FFFF:FFFF:FFFF.
- ::1/128 represents the IPv6 loopback address. Its prefix size is 128, the size of the address itself, indicating that this facility consists of only this one address.

The number of addresses of a subnet defined by the mask or prefix can be calculated as 2, in which the address size for IPv4 is 32 and for IPv6 is 128. For example, in IPv4, a mask of /29 gives 8 addresses.
Alphanumeric Strings

Some CLI commands require the entry of an alphanumeric string to define a value. The string is a contiguous collection of alphanumeric characters with a defined minimum and maximum length (number of characters).

Character Set

The alphanumeric character set is a combination of alphabetic (Latin letters) and/or numeric (Arabic digits) characters. The set consists of the numbers 0 to 9, letters A to Z (uppercase) and a to z (lowercase). The underscore character (_ _) and dash/hyphen (-) are also considered to be members of the alphanumeric set of characters.

Blank spaces (whitespaces or SPACE characters) should mostly be avoided in alphanumeric strings, except in certain ruledef formats, such as time/date stamps.

Do not use any of the following “special” characters in an alphanumeric string except as noted below:

- & (ampersand)
- ’ (apostrophe)
- <> (arrow brackets) [see exception below]
- * (asterisk) [see wildcard exception below]
- { } (braces)
- [ ] (brackets)
- $ (dollar sign) [see wildcard exception below]
- ! (exclamation point) [see exception below]
- () [parentheses]
- % (percent) [see exception below]
- # (pound sign) [see exception below]
- ? (question mark)
- ’ (quotation mark – single)
- “ (quotation mark – double)
- ; (semicolon)
- \ (slash – backward) [see exception below]
- / (slash – forward) [see exception below]
- ~ (tilde)
- | (vertical bar) [see exception below]

The following characters may appear in strings entered in ruledefs, APNs, license keys and other configuration/display parameters:

- <> (arrow brackets) [less than or greater than]
- * (asterisk) [wildcard]
- : (colon)
- $ (dollar sign) [wildcard]
• . (dot)
• = (equals sign)
• ! (exclamation point)
• % (percent)
• / (slash – forward)
• | (vertical bar)

The following characters may be used to delimit the domain from the user name for global AAA functions:

• @ (at sign)
• - (dash or hyphen)
• # (hash or pound sign)
• % [percent]
• \ (slash – backward) [must be entered as double slash “\\”]
• / (slash – forward)

### Quoted Strings

If descriptive text requires the use of spaces between words, the string must be entered within double quotation marks (“ “). For example:

```
interface "Rack 3 Chassis 1 port 5/2"
```
Chapter 2
Getting Started

Following successful installation of the system hardware, you must configure a set of software parameters. You then save these settings in a system configuration file that is launched whenever the system is reloaded.

This segment provides instructions for connecting to the console port and creating the initial local context management configuration. It includes the following sections:

- ASR 5500 Configuration
- Using the ASR 5500 Quick Setup Wizard
- Using the CLI for Initial Configuration
- Configuring the System for Remote Access
- Configuring the Management Interface with a Second IP Address
The first time power is applied to the system, the active Management Input/Output (MIO/UMIO/) card (typically the one installed in chassis slot 5) automatically launches a Quick Setup Wizard on its console port. This wizard guides you through the initial configuration of the system.

The serial console port (logical port 3) is located on the front panel of the MIO card.

You can choose not to use the wizard and perform the initial configuration by issuing commands via the command line interface (CLI). You can manually launch the wizard by running the `setup` command in the Exec mode. Refer to the Command Line Interface Reference for details.

The following sections describe how to configure the system.
Using the ASR 5500 Quick Setup Wizard

The Quick Setup Wizard consists of three parts:

- Configuring a context-level security administrator and hostname
- Configuring the Ethernet interface for out-of-band (OOB) management
- Configuring the system for remote CLI access

The following figure and table provides a flow diagram that shows the run logic of the wizard with supplemental notes.

Figure 3. ASR 5500 Quick Setup Wizard Logic Diagram
## Table 2. Quick Setup Wizard Logic Diagram Callout Descriptions

<table>
<thead>
<tr>
<th>Item</th>
<th>Task</th>
<th>Description/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Enter or exit the wizard.</td>
<td>Enter <strong>no</strong> at the prompt to automatically be directed to the command line interface (CLI). Proceed to Using the CLI for Initial Configuration for instructions on performing an initial system configuration with the CLI. Enter <strong>setup</strong> at the command prompt to re-invoke the wizard.</td>
</tr>
<tr>
<td>2</td>
<td>For release 19.2 and higher, configure a tech-support password.</td>
<td>The tech-support password is used to access cli test-commands. Configure an administrative username/password and a hostname for the system. The name of the default administrative user configured through the wizard is <strong>admin</strong>. Administrative user name is an alphanumeric string of 1 through 32 characters that is case sensitive. Administrative user password is an alphanumeric string of 1 through 63 characters that is case sensitive. Configure a valid, non-null hostname. The hostname is an alphanumeric string of 1 through 63 characters that is case sensitive.</td>
</tr>
<tr>
<td>3</td>
<td>Change chassis key value.</td>
<td>A unique chassis key is configured at the factory for each system. This key is used to decrypt encrypted passwords found in generated configuration files. The system administrator can create a unique chassis key that will be used to encrypt passwords stored in configuration files. Enter <strong>yes</strong> to set a new chassis key. Refer to the instructions in System Settings. Additional information can be found in the System Security chapter.</td>
</tr>
<tr>
<td>4</td>
<td>Configure a single Management Input/Output (MIO/UMIO) out-of-band management interface for out-of-band system management.</td>
<td>Traffic on the management LAN is not transferred over the same media as user data and control signaling. For security reasons, it is recommended that management functions be maintained on a separate network from user data and control signaling. MIO port 1 (mio1) is the 1000Base-T default management port. MIO port 2 (mio2) is available as a secondary management port. Use the RJ-45 interfaces to connect the system to the management network with CAT5 Ethernet cable. Configure an IP address, subnet mask, and gateway for the interface. Instructions for configuring the second management interface on the MIO can be found in the System Settings chapter.</td>
</tr>
<tr>
<td>5</td>
<td>Enable various remote access protocols for accessing the system.</td>
<td>Secure Shell (SSH) uses TCP port number 22 by default, if enabled. SSH V1 and/or V2 are supported. If SSH is enabled, you can also enable SSH File Transfer Protocol (SFTP) server functionality. <strong>Note:</strong> For maximum security, use only SSH v2.</td>
</tr>
<tr>
<td>Item</td>
<td>Task</td>
<td>Description/Notes</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td><strong>Secure File Transfer Protocol (SFTP)</strong> uses TCP port number 22 by default, if enabled [subsystem sftp].</td>
<td><strong>Note:</strong> For maximum system security, do not enable telnet protocol. Telnet uses TCP port number 23 by default, if enabled. <strong>Note:</strong> For maximum system security, do not enable FTP. File Transfer Protocol (FTP) uses TCP port number 21 by default, if enabled.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Review and/or modify the configuration of previous prompts.</strong></td>
<td>1. Enter the number of the prompt to be modified. 2. Configure the parameter. 3. <em>Optional.</em> Repeat step 1 and step 2 to modify additional settings. 4. Enter “done” when you have completed all changes.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Review the configure script created by the wizard based on your inputs.</strong></td>
<td>An example of a created script is displayed in the example below. Variables are displayed in italics (<em>variable</em>).</td>
</tr>
<tr>
<td>8</td>
<td><strong>Apply the configuration file to the system.</strong></td>
<td>Once applied, the parameter configuration is automatically saved to the system.cfg file stored in MIO/UMIO flash memory.</td>
</tr>
</tbody>
</table>
Figure 4. MIO Interfaces

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Console port [Port 3]</td>
</tr>
<tr>
<td>2</td>
<td>USB port</td>
</tr>
<tr>
<td>3</td>
<td>10 GbE ports, DC-1 [Ports 10 – 19]</td>
</tr>
<tr>
<td>4</td>
<td>10 GbE ports, DC-2 [Ports 20 – 29]</td>
</tr>
<tr>
<td>5</td>
<td>1 GbE ports (1000Base-T) [Ports 1 and 2]</td>
</tr>
</tbody>
</table>
Do you want to view the configuration script created[yes/no]: y

config
  system hostname hostname
  context local
    administrator admin_name password passwd
    interface miol
      ip address ip_address subnet
      #exit
    ip route 0.0.0.0 0.0.0.0 gw_address miol
    ssh key v1_key
    ssh key v2_rsa_key
    ssh key v2_dsa_key
    server sshd
    subsystem sftp
    #exit
    no server telnetd
    no server ftpd
    #exit
    port ethernet 5/1
    #exit
    bind interface miol local
    no shutdown
    #exit
end

Do you want to apply configuration script created[yes/no]:

*Important:* Once configuration using the wizard is complete, proceed to instructions on how to configure other system parameters.
Getting Started

Using the CLI for Initial Configuration

The initial configuration consists of the following:

- Configuring a context-level security administrator and hostname
- Configuring the Ethernet interface on the MIO/UMIO card
- Configuring the system for remote CLI access via Telnet, SSH, or FTP (secured or unsecured)

This section provides instructions for performing these tasks using the CLI.

Step 1 At the CLI prompt, enter:

    [local]host_name# configure
    [local]host_name(config)#

Step 2 Enter the context configuration mode by entering the following command:

    [local]host_name(config)# context local
    [local]host_name(config-ctx)#

The local context is the system’s management context. Contexts allow you to logically group services or interfaces. A single context can consist of multiple services and can be bound to multiple interfaces.

Step 3 Enter the following command to configure a context-level security administrator for the system:

    administrator user_name [ encrypted ] password password | [ ecs ] [ expiry-date date_time ] [ ftp ] [ li-administration ] [ nocli ] [ noecs ] [ timeoutabsolute timeout_absolute ] [ timeout-minabsolute timeout_min_absolute ] [ timeoutidle timeout_idle ] [ timeout-minidle timeout_min_idle ]

**Important:** You must configure a context-level security administrator during the initial configuration. After you complete the initial configuration process and end the CLI session, if you have not configured a security administrator, CLI access will be locked. For complete information about the commands in this section, see the Context Configuration Mode Commands chapter of the Command Line Interface Reference.

Step 4 Enter the following command at the prompt to exit the context configuration mode:

    [local]host_name(config-ctx)# exit
    [local]host_name(config)#

Step 5 Enter the following command to configure a hostname by which the system will be recognized on the network:

    [local]host_name(config)# system hostname host_name

*host_name* is the name by which the system will be recognized on the network. The hostname is an alphanumeric string of 1 through 63 characters that is case sensitive.

Step 6 Configure the network interfaces on the MIO/UMIO using the following instructions:

  **Step a** Enter the context configuration mode by entering the following commands:

    [local]host_name(config)# context local
    [local]host_name(config-ctx)#

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Step b  Enter the following command to specify a name for the interface:

```
[llocal]host_name(config-ctx)# interface interface_name
```

`interface_name` is the name of the interface expressed as an alphanumeric string of 1 through 79 characters that is case sensitive. The following prompt appears as the system enters the Ethernet Interface Configuration mode:

```
[llocal]host_name(config-if-eth)#
```

Step c  Configure an IP address for the interface configured in the previous step by entering the following command:

```
{ ip address | ipv6 address } ipaddress subnetmask
```

**Important:** If you are executing this command to correct an address or subnet that was mis-configured with the Quick Setup Wizard, you must verify the default route and port binding configuration. Use step 11 and step 6 of this procedure. If there are issues, perform steps 7e through 7k to reconfigure the information.

Step d  Enter the following command to exit the Ethernet interface configuration mode:

```
[llocal]host_name(config-if-eth)# exit
[llocal]host_name(config-ctx)#
```

Step e  Configure a static route, if required, to point the system to a default gateway. Entering the following command:

```
{ ip | ipv6 } route gw_address interface_name
```

Step f  Enter the following to exit from the context configuration mode:

```
[llocal]host_name(config-ctx)# exit
[llocal]host_name(config)#
```

Step g  Enter the Ethernet Port Configuration mode:

```
port ethernet slot#/port#
```

Step h  Bind the port to the interface that you created in step 7b. Binding associates the port and all of its settings to the interface. Enter the following command:

```
[llocal]host_name(config-port-<slot#/port#>)# bind interface interface_name local
[llocal]host_name(config-port-<slot#/port#>)# no shutdown
```

`interface_name` is the name of the interface that you configured in step 7b.

Step i  Exit the Ethernet Interface Configuration mode by entering the command:

```
[llocal]host_name(config-port-<slot#/port#>)# exit
[llocal]host_name(config)#
```

**Important:** Refer below for instructions on configuring the MIO/UMIO management interface with a second IP address.
Configuring the System for Remote Access

Configure the system for remote access. An administrative user may access the system from a remote location over a local area network (LAN) or wide area network (WAN):

- Telnet
- Secure Shell (SSH)
- File Transfer Protocol (FTP) (secured or unsecured)
- Trivial File Transfer Protocol (TFTP)

**Important:** If there are two simultaneous telnet sessions, and one administrator deletes the context into which the other administrator is logged, the administrator in the deleted context will not be automatically kicked into the local context. Although the deleted context will still appear in the CLI prompt, context specific commands will generate errors.

**Important:** For maximum security, use SSH v2.

**Step 1**
Enter the context configuration mode by entering the following command:

```
[local] host_name(config)# context local
```

**Step 2**
If desired, configure the system to allow Telnet access:

```
[local] host_name(config-ctx)# server telnetd
```

**Important:** For maximum system security, you should not enable telnet.

**Step 3**
Configure the system to allow SSH access, if desired:

```
[local] host_name(config-ctx)# ssh generate key [ type { v1-rsa | v2-rsa | v2-dsa } ]
```

**Important:** v2-rsa is the recommended key type.

```
[local] host_name(config-ctx)# server sshd
[local] host_name(config-sshd)# subsystem sftp
[local] host_name(config-sshd)# exit
```

**Step 4**
Configure the system to allow FTP access, if desired, by entering the following command:

```
[local] host_name(config-ctx)# server ftpd
```

**Important:** For maximum system security, you should not enable FTP.
Step 5  Exit the configuration mode by entering the following command:

```
[local]host_name(config-ctx)# end
[local]host_name#
```

Step 6  Verify the configuration by entering the following command:

```
[local]host_name# show configuration
```

The CLI output should be similar to the sample output:

```
context local
  interface interface_name
    ip address ipaddress subnetmask
  exit
  subscriber default
  exit
  administrator admin_name password admin_password
  no server telnetd
  no server ftpd
  ssh generate key
  server sshd
  subsystem sftp
  exit
  port ethernet 5/1
    bind interface interface_name local
  exit
  port ethernet 5/1
  no shutdown
  exit
  snmp engine-id local 800007e580ed826c191ded2d3d
end
```

Step 7  Verify the configuration of the IP routes by entering the following command:

```
[local]host_name# show ip route
```

The CLI output should be similar to the sample output:

```
* indicates the Best or Used route.

<table>
<thead>
<tr>
<th>Destination</th>
<th>Nexthop</th>
<th>Protocol</th>
<th>Prec</th>
<th>Cost</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>*0.0.0.0/0</td>
<td>ipaddress</td>
<td>static</td>
<td>1</td>
<td>0</td>
<td>mio1</td>
</tr>
<tr>
<td>*network</td>
<td>0.0.0.0</td>
<td>connected</td>
<td>0</td>
<td>0</td>
<td>mio1</td>
</tr>
</tbody>
</table>
```

Step 8  Verify the interface binding by entering the following command:

```
[local]host_name# show ip interface name interface_name
```

`interface_name>` is the name of the interface that was configured in step 7b. The CLI output should be similar to the sample output:
Intf Name: mio1
Intf Type: Broadcast
Description:
IP State: UP (Bound to 5/1 untagged, ifIndex 83951617)
IP Address: ipaddress
Subnet Mask: subnetmask
Bcast Address: bcastaddress
MTU: 1500
Resoln Type: ARP
ARP timeout: 3600 secs
Number of Secondary Addresses: 0

Step 9  Save your configuration as described in *Verifying and Saving Your Configuration.*
Configuring the Management Interface with a Second IP Address

If necessary, you can configure a second IP address on the MIO/UMIO management interface.

**Step 1**    Enter the configuration mode by entering the following command at the prompt:

```
[local]host_name# configure
[local]host_name(config)#
```

**Step 2**    Enter the following to enter the context configuration mode:

```
[local]host_name(config)# context local
[local]host-name(config-ctx)#
```

**Step 3**    Enter the interface slot number and port number by entering the following command:

```
[local]host_name(config-ctx)# 5/1
[local]host_name(config-if-eth)#
```

**Step 4**    Enter the secondary IP address and subnet mask by entering the following command:

```
[local]host_name(config-if-eth)# { ip | ipv } address ipaddress subnet_mask secondary
```

**Step 5**    Exit the configuration mode by entering the following command:

```
[local]host_name(config-if-eth)# end
```

**Step 6**    Confirm the interface IP addresses by entering the following command:

```
[local]host_name# show config context local
```

The CLI output should look similar to this example:

```
config
context local
    interface interface_name
        ip address ipaddress subnetmask
        ip address ipaddress subnetmask secondary
    #exit
```

**Step 7**    Save your configuration as described in *Verifying and Saving Your Configuration*. 


Chapter 3
System Settings

This chapter provides instructions for configuring the following system options:

- Configuring a Second Management Interface
- Configuring System Timing
- Verifying and Saving Your Interface and Port Configuration
- Enabling CLI Timestamping
- Configuring CLI Confirmation Prompts
- Configuring System Administrative Users
- Configuring TACACS+ for System Administrative Users
- Configuring a Chassis Key
- Configuring MIO/UMIO Port Redundancy
- Configuring Data Processing Card Availability
- Configuring ASR 5500 Link Aggregation
- Configuring a Demux Card

It is assumed that the procedures to initially configure the system as described in Getting Started have been completed.

**Important:** The commands used in the configuration examples in this section are the most likely-used commands and/or keyword options. In many cases, other optional commands and/or keyword options are available. Refer to the Command Line Interface Reference for complete information.
Configuring a Second Management Interface

Refer to *Getting Started* for instructions on configuring a system management interface on the Management Input/Output (MIO/UMIO) card. This section provides described how to configure a second management interface.

Use the following example to configure a second management interface:

```plaintext
configure

context local

interface interface_name

   ip address ipaddress subnetmask

   exit

ip route 0.0.0.0 0.0.0.0 gw_address interface_name

exit

port ethernet slot#/port#

   bind interface interface_name local

   no shutdown

   media rj45

end
```

Notes:

- For `port ethernet slot#`, use the actual chassis slot in which the active MIO/UMIO resides (slot number 5 or 6).
- Enter IP addresses using IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation.
- For `port ethernet port#`, use the physical port on the MIO/UMIO card – port 1 or 2.
- The MIO/UMIO is equipped with RJ-45 (1000Base-T copper) interfaces. The RJ-45 interfaces connect the system to the management network via CAT3 or CAT5 Ethernet cable.
- *Option:* In the Ethernet Port configuration mode, configure the port speed, if needed, by entering the `medium` command. Refer to the *Command Line Interface Reference* for a complete explanation of this command.
- In the `{ ip | ipv6 } route` command, other keyword options, instead of the gateway IP address, are available and include: `next-hop` IP address, `point-to-point`, and `tunnel`. 
Verifying and Saving Your Interface and Port Configuration

Verify that your interface configuration settings are correct by entering the following command:

```
show ip interface
```

The output from this command should be similar to that shown below. In this example an interface named `mgmt2` was configured in the local context.

```
Intf Name: mgmt2
Intf Type: Broadcast
Description: management2
VRF: None
IP State: UP (Bound to 5/2)
IP Address: 192.168.100.3  Subnet Mask: 255.255.255.0
Bcast Address: 192.168.100.255  MTU: 1500
Resoln Type: ARP  ARP timeout: 60 secs
L3 monitor LC-port switchover: Disabled
Number of Secondary Addresses: 0
```

Verify that the port configuration settings are correct by entering the following command:

```
show configuration port slot#/port#
```

`slot#` is the chassis slot number of the line card where the physical port resides. `slot#` is either 5 or 6. `port#` is the number of the port (either 1 or 2).

This following command produces an output similar to the one shown below. It displays the configuration of port 2 of the MIO/UMIO installed in chassis slot 5. In this example, the port is bound to an interface called `mgmt2`.

```
config
  port ethernet 5/2
  description management2
  no shutdown
  bind interface mgmt2 local
end
```

Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.
Configuring System Timing

The system is equipped with a clock that supplies the timestamp for statistical counters, accounting records, logging, and event notification. After the initial configuration of the system clock, you can configure the system to communicate with one or more Network Time Protocol (NTP) server(s) to ensure that the clock is always accurate.

In the event of a power outage, the clock is maintained with an accuracy of \pm 1 \text{ minute per month} for up to 10 years. This ensures that when power is restored, the system is ready to process sessions and generate accounting, log, and event data with accurate timestamps.

In addition to configuring the timing source, you must configure the system’s time zone.

Setting the System Clock and Time Zone

Use the following command example to configure the system clock and time zone:

```
clock set date:time
configure
clock timezone timezone [ local ]
end
```

Notes:
- Enter the date and time in the format YYY/MM/DD:HH:mm or YYYY/MM/DD:HH:mm:ss.
- Refer to the online Help for the `clock timezone` command for a complete list of supported time zones.
- The optional `local` keyword indicates that the time zone specified is the local timezone.
- Daylight Savings Time is automatically adjusted for time zones supporting it.

Save your configuration as described in the Verifying and Saving Your Configuration chapter.

Verifying and Saving Your Clock and Time Zone Configuration

Enter the following command to verify that you configured the time and time zone correctly:

```
show clock
```

The output displays the date, time, and time zone that you configured.
Configuring Network Time Protocol Support

This section provides information and instructions for configuring the system to enable the use of the Network Time Protocol (NTP).

**Important:** Configure the system clock and time zone prior to implementing NTP support. This greatly reduces the time period that must be corrected by the NTP server.

Many of the services offered by the ASR 5x00 platform require accurate timekeeping derived through NTP. If the time reference(s) used by StarOS are not accurate, the services may be unreliable. For this reason it should be assumed that normal system operation requires that NTP be configured.

The system uses NTP to synchronize internal clocks on the chassis to external time sources (typically GPS NTP sources, or other Stratum 2 or 3 servers, switches or routers).

By default, NTP is not enabled externally and should be configured when the system is initially installed. When enabled, the active MIO/UMIO will synchronize with external sources. If not enabled, the active MIO/UMIO will use its local clock as a time source. In the event of an NTP server or network outage, an already running MIO/UMIO will continue to use NTP to maintain time accuracy, but in a holdover mode.

All cards with CPUs synchronize to the active MIO/UMIO internally. This occurs even if an external NTP server is not configured. In the event of a MIO/UMIO switchover, all other cards will start synchronizing with the newly active MIO/UMIO automatically.

The system should have:

- NTP enabled.
- NTP configured for use in the *local* context only. Use of other contexts (which can be specified in the enable configurable) will cause issues.
- NTP configured for at least three external NTP servers. With three or more servers, outlyers and broken or misconfigured servers can be detected and excluded. Generally, the more servers the better (within reason).

**Important:** Do not configure any external NTP servers using the *prefer* keyword. The NTP clock selection algorithms already have the built-in ability to pick the best server. Use of *prefer* usually results in a poorer choice than NTP can determine for itself.

**Important:** Do not change the *maxpoll*, *minpoll*, or *version* keyword settings unless instructed to do so by Cisco TAC.

Use the following example to configure the necessary NTP association parameters:

```plaintext
configure
ntp
  enable
  server ip_address1
  server ip_address2
```
server ip_address3
end

Notes:

- By default context_name is set to local. This is the recommended configuration.
- A number of options exist for the server command. Refer to the NTP Configuration Mode Commands chapter in the Command Line Interface Reference for more information.
- Enter the IP address of NTP servers using IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation.

**Important:** Configure the system with at least three (preferably four) NTP servers.

Save the configuration as described in the Verifying and Saving Your Configuration chapter.

### Configuring NTP Servers with Local Sources

NTP can use network peers, local external clocks (such as GPS devices), or a local clock with no external source. A local clock with no external source is usually a last-resort clock when no better clock is available. It is typically configured on a site's intermediate NTP server so that when a WAN network outage occurs, hosts within the site can continue to synchronize amongst themselves.

You can configure this in ntpd or on many commercially available NTP devices. This local clock should always have a high stratum number (8+) so that under normal conditions (when real sources are available) this local clock will not be used.

### Using a Load Balancer

The NTP daemon and protocol assume that each configured server is running NTP. If a NTP client is configured to synchronize to a load balancer that relays and distributes packets to a set of real NTP servers, the load balancer may distribute those packets dynamically and confuse the NTP client. NTP packets are latency and jitter sensitive. Relaying them through a load balancer can confuse the NTP client and is not a supported practice.

### Verifying the NTP Configuration

Verify the NTP configuration is correct. Enter the following command at the Exec mode prompt:

```
show ntp associations
```

The output displays information about all NTP servers. See the output below for an example deploying two NTP servers.
-----Peer Selection: ( ) - Rejected / No Response
|     | (x) - False Tick
|     | (.) - Excess
|     | (-) - Outlyer
|     | (+) - Candidate
|     | (#) - Selected
|     | (*) - System Peer
|     | (o) - PPS Peer

<table>
<thead>
<tr>
<th>remote</th>
<th>refid</th>
<th>st</th>
<th>t when</th>
<th>poll</th>
<th>reach</th>
<th>delay</th>
<th>offset</th>
<th>jitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.81.254.20</td>
<td>.INI</td>
<td>16</td>
<td>-10</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following table describes the parameters output by the `show ntp associations` command.

### Table 3. NTP Parameters

<table>
<thead>
<tr>
<th>Column Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>remote</td>
<td>List of the current NTP servers. One of these characters precedes each IP address to show the server’s current condition:</td>
</tr>
<tr>
<td></td>
<td>- ( ) Rejected/No response</td>
</tr>
<tr>
<td></td>
<td>- X False tick</td>
</tr>
<tr>
<td></td>
<td>- . Excess</td>
</tr>
<tr>
<td></td>
<td>- - Outlyer</td>
</tr>
<tr>
<td></td>
<td>- + Candidate</td>
</tr>
<tr>
<td></td>
<td>- # Selected</td>
</tr>
<tr>
<td></td>
<td>- * System peer</td>
</tr>
<tr>
<td></td>
<td>- (o) PPS peer</td>
</tr>
<tr>
<td>refid</td>
<td>Last reported NTP reference to which the server is synchronizing.</td>
</tr>
<tr>
<td>st</td>
<td>NTP server stratum level.</td>
</tr>
<tr>
<td>t</td>
<td>Communication type: broadcast, multicast, etc.</td>
</tr>
<tr>
<td>when</td>
<td>Number of seconds since the last contact.</td>
</tr>
<tr>
<td>poll</td>
<td>Polling interval between the system and the NTP server.</td>
</tr>
<tr>
<td>reach</td>
<td>Octal value of the reachability shift register indicating which responses were received for the previous eight polls to this NTP server.</td>
</tr>
<tr>
<td>delay</td>
<td>Round-trip delay (in milliseconds) for messages exchanged between the system and the NTP server.</td>
</tr>
<tr>
<td>offset</td>
<td>Number of milliseconds by which the system clock must be adjusted to synchronize it with the NTP server.</td>
</tr>
<tr>
<td>jitter</td>
<td>Jitter in milliseconds between the system and the NTP server.</td>
</tr>
</tbody>
</table>
Enabling CLI Timestamping

To display a timestamp (date and time) for every command that is executed on the CLI, enter the following command at the root prompt for the Exec mode:

```
timestamps
```

The date and time appear immediately after you execute the command.

Save the configuration as described in the *Verifying and Saving Your Configuration* chapter.

Configuring CLI Confirmation Prompts

A number of Exec mode and Global Configuration mode commands prompt users for a confirmation (Are you sure? [Yes|No]:) prior to executing the command.

This section describes configuration settings that:

- Automatically confirm commands for the current CLI session (Exec mode) or for all CLI sessions and users (Global Configuration mode).
- Requires confirmation prompting only for the Exec mode `configure` command and `autoconfirm` command.

Enabling Automatic Confirmation

You can use the `autoconfirm` command to disable confirmation prompting for configuration commands. The `autoconfirm` command is available in the Exec mode and Global Configuration mode. Enabling the autoconfirm feature automatically supplies a “Yes” response to configuration command prompts, including for critical commands such as `reload` and `shutdown`. By default autoconfirm is disabled.

In the Exec mode, autoconfirm applies only to the current interactive CLI session.

In the Global Configuration mode, autoconfirm applies to all CLI sessions for all CLI users:

```
configure
    autoconfirm
end
```

To disable autoconfirm once it has been enabled, use the `no autoconfirm` command.

**Important:** If commandguard is enabled, autoconfirm will disable commandguard.

Autoconfirm is intended as an “ease-of-use” feature. It presumes that the answer to “Are you sure? [Y/N]” prompts will be “Yes”, and skips the prompt. Its use implies that the user is an expert who does not need these “safety-net” prompts.
Requiring Confirmation for autoconfirm and configure Commands

You can require confirmation prompting for the **autoconfirm** (Exec mode and Global Configuration mode) and **configure** (Exec mode) commands via the Global Configuration mode **commandguard** command.

**Important:** If autoconfirm is enabled, commandguard will not take effect until autoconfirm is disabled in both Exec and Global Configuration modes.

The following command sequence enables the commandguard feature:

```
configure
    commandguard
end
```

With commandguard enabled the confirmation prompt appears as shown in the example below:

```
[local]host_name# configure
Are you sure? [Yes|No]: yes
[local]host_name(config)#
```

To disable commandguard once it has been enabled, use the **no commandguard** command.

The status of **commandguard** is output in **show configuration** commands.

Configuring System Administrative Users

*Getting Started* describes how to configure a context-level security administrator for the system.

This section provides instructions for configuring additional administrative users having the following privileges:

- **Security Administrators**: have read-write privileges and can execute all CLI commands, including those available to Administrators, Operators, and Inspectors.
- **Administrators**: have read-write privileges and can execute any command in the CLI except for a few security-related commands that can only be configured by Security Administrators. Administrators can configure or modify system settings and execute all system commands, including those available to the Operators and Inspectors.
- **Operators**: have read-only privileges to a larger subset of the Exec Mode commands. They can execute all commands that are part of the inspector mode, plus some system monitoring, statistic, and fault management functions. Operators do not have the ability to enter the Config Mode.
- **Inspectors**: are limited to a few read-only Exec Mode commands. The bulk of these are **show** commands for viewing a variety of statistics and conditions. An Inspector cannot execute **show configuration** commands and does not have the privilege to enter the Config Mode.

Configuration instructions are categorized according to the type of administrative user: context-level or local-user.

**Important:** For information on the differences between these user privileges and types, refer to *Getting Started*. 
Configuring Context-level Administrative Users

This section contains information and instructions for configuring context-level administrative user types.

Configuring Context-level Security Administrators

Use the example below to configure additional security administrators:

```
configure
  context local
    administrator user_name { [ encrypted ] [ nopassword ] password password }
  end
```

Notes:

- Additional keyword options are available that identify active administrators or place time thresholds on the administrator. Refer to the Command Line Interface Reference for more information about the administrator command.

- The nopassword option allows you to create an administrator without an associated password. Enable this option when using ssh public keys (authorized key command in SSH Configuration mode) as a sole means of authentication. When enabled this option prevents someone from using an administrator password to gain access to the user account.

Save the configuration as described in the Verifying and Saving Your Configuration chapter.

Configuring Context-level Administrators

Use the example below to configure context-level configuration administrators:

```
configure
  context local
    config-administrator user_name { [ encrypted ] [ nopassword ] password password }
  end
```

Notes:

- Additional keyword options are available that identify active administrators or place time thresholds on the administrator. Refer to the Command Line Interface Reference for more information about the config-administrator command.

- The nopassword option allows you to create a config-administrator without an associated password. Enable this option when using ssh public keys (authorized key command in SSH Configuration mode) as a sole means of authentication. When enabled this option prevents someone from using a config-administrator password to gain access to the user account.

Save the configuration as described in the Verifying and Saving Your Configuration chapter.
Configuring Context-level Operators

Use the example below to configure context-level operators:

```plaintext
configure
  context local
    operator user_name { [ encrypted ] [ nopassword ] password password }
  end
```

Notes:

- Additional keyword options are available that identify active administrators or place time thresholds on the administrator. Refer to the Command Line Interface Reference for more information about the `operator` command.
- The `nopassword` option allows you to create an operator without an associated password. Enable this option when using ssh public keys (authorized key command in SSH Configuration mode) as a sole means of authentication. When enabled this option prevents someone from using an operator password to gain access to the user account.

Save the configuration as described in the Verifying and Saving Your Configuration chapter.

Configuring Context-level Inspectors

Use the example below to configure context-level inspectors:

```plaintext
configure
  context local
    inspector user_name { [ encrypted ] [ nopassword ] password password }
  end
```

Notes:

- Additional keyword options are available that identify active administrators or place time thresholds on the administrator. Refer to the Command Line Interface Reference for more information about the `inspector` command.
- The `nopassword` option allows you to create an inspector without an associated password. Enable this option when using ssh public keys (authorized key command in SSH Configuration mode) as a sole means of authentication. When enabled this option prevents someone from using an inspector password to gain access to the user account.

Save the configuration as described in the Verifying and Saving Your Configuration chapter.
Verifying Context-level Administrative User Configuration

Verify that the configuration was successful by entering the following command:

```
show configuration context local
```

This command displays all of the configuration parameters you modified within the Local context during this session. The following displays sample output for this command. In this example, a security administrator named testadmin was configured.

```
config
context local
  interface mgmt1
    ip address 192.168.1.10 255.255.255.0
#exit
subscriber default
#exit
administrator testadmin encrypted password fd01268373c5da85
inspector testinspector encrypted password 148661a0bb12cd59
exit
port ethernet 5/1
  bind interface mgmt1 local
#exit
```

Configuring Local-User Administrative Users

Use the example below to configure local-user administrative users:

```
configure

  local-user username name

end
```

Notes:

- Additional keyword options are available identify active administrators or place time thresholds on the administrator. Refer to the Command Line Interface Reference for more information about the `local-user username` command.

Save the configuration as described in the Verifying and Saving Your Configuration chapter.

Verifying Local-User Configuration

Verify that the configuration was successful by entering the following command:

```
show local-user verbose
```

This command displays information on configured local-user administrative users. A sample output for this command appears below. In this example, a local-user named SAUser was configured.
Updating Local User Database

Update the local user (administrative) configuration by running the following Exec mode command. This command should be run immediately after creating, removing or editing administrative users.

```
update local-user database
```

Restricting User Access to a Specified Root Directory

By default an admin user who has FTP/SFTP access can access and modify any files under the /mnt/user/ directory. Access is granted on an “all-or-nothing” basis to the following directories: /flash, /cdrom, /hd-raid, /records, /usb1 and /usb2

An administrator or configuration administrator can create a list of SFTP subsystems with a file directory and access privilege. When a local user is created, the administrator assigns an SFTP subsystem. If the user’s authorization level is not security admin or admin, the user can only access the subsystem with read-only privilege. This directory is used as the user’s root directory. The information is set as environmental variables passed to the openssh sftp-server.

You must create the SFTP root directory before associating it with local users, administrators and config administrators. You can create multiple SFTP directories; each directory can be assigned to one or more users.

Configuring an SFTP root Directory

The `subsystem sftp` command allows the assignment of an SFTP root directory and associated access privilege level.

```
configure

context local

server sshd

    subsystem sftp [ name sftp_name root-dir pathname mode { read-only | readwrite } ]
```

Notes:

- `sftp_name` is an alphanumeric string that uniquely identifies this subsystem.
- `pathname` specifies the root directory to which SFTP files can be transferred. Options include:
  - `/hd-raid/records/cdr`
  - `/flash`
Associating an SFTP root Directory with a Local User

The local-user username command allows an administrator to associate an SFTP root directory with a specified username.

```
configure

    local-user username user_name authorization-level level ftp sftp-server
    sftp_name password password

    exit
```

Associating an SFTP root Directory with an Administrator

The administrator command allows an administrator to associate an SFTP root directory for a specified administrator.

```
configure

    context local

    administrator user_name password password ftp sftp-server sftp_name

    exit
```

Associating an SFTP root Directory with a Config Administrator

The config-administrator command allows an administrator to associate an SFTP root directory with a specified configuration administrator.

```
configure

    context local

    config-administrator user_name password password ftp sftp-server sftp_name

    exit
```
Configuring TACACS+ for System Administrative Users

This section describes TACACS+ (Terminal Access Controller Access Control System+) AAA (Authentication Authorization and Accounting) service functionality and configuration on the ASR 5x00.

Operation

TACACS+ is a secure, encrypted protocol. By remotely accessing TACACS+ servers that are provisioned with the administrative user account database, the ASR 5x00 can provide TACACS+ AAA services for system administrative users. TACACS+ is an enhanced version of the TACACS protocol that uses TCP instead of UDP.

The ASR 5x00 system serves as the TACACS+ Network Access Server (NAS). As the NAS the system requests TACACS+ AAA services on behalf of authorized system administrative users. For the authentication to succeed, the TACACS+ server must be in the same local context and network accessed by the system.

The system supports TACACS+ multiple-connection mode. In multiple-connection mode, a separate and private TCP connection to the TACACS+ server is opened and maintained for each session. When the TACACS+ session ends, the connection to the server is terminated.

TACACS+ is a system-wide function on the ASR 5x00. TACACS+ AAA service configuration is performed in TACACS Configuration Mode. Enabling the TACACS+ function is performed in the Global Configuration Mode. The system supports the configuration of up to three TACACS+ servers.

Once configured and enabled on the system, TACACS+ authentication is attempted first. By default, if TACACS+ authentication fails, the system then attempts to authenticate the user using non-TACACS+ AAA services, such as RADIUS.

**Important:** For releases after 15.0 MR4, TACACS+ accounting (CLI event logging) will not be generated for Lawful Intercept users with privilege level set to 15 and 13.

User Account Requirements

Before configuring TACACS+ AAA services on the ASR 5x00, note the following TACACS+ server and system user account provisioning requirements.

**TACACS+ User Account Requirements**

The TACACS+ server must be provisioned with the following TACACS+ user account information:

- A list of known administrative users.
- The plain-text or encrypted password for each user.
- The name of the group to which each user belongs.
- A list of user groups.
- TACACS+ privilege levels and commands that are allowed/denied for each group.
Important: TACACS+ privilege levels are stored as Attribute Value Pairs (AVPs) in the network’s TACACS+ server database. Users are restricted to the set of commands associated with their privilege level. A mapping of TACACS+ privilege levels to ASR 5x00 CLI administrative roles and responsibilities is provided in the table below.

Table 4. Default Mapping of TACACS+ Privilege Levels to CLI Administrative Roles

<table>
<thead>
<tr>
<th>TACACS+ Privilege Level</th>
<th>CLI Administrative Access Privileges</th>
<th>CLI Role</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CLI</td>
<td>FTP</td>
</tr>
<tr>
<td>0</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>1</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>11</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>15</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Important: TACACS+ priv-levels can be reconfigured from their default StarOS authorization values via the TACACS+ Configuration mode `priv-lvl` and `user-id` commands. For additional information, see the TACACS+ Configuration Mode Commands chapter of the Command Line Interface Reference.
User Account Requirements

TACACS+ users who are allowed administrative access to the system must have the following user account information defined on the ASR 5x00:

- username
- password
- administrative role and privileges

**Important:** For instructions on defining users and administrative privileges on the system, refer to *Configuring System Administrative Users.*

Configuring TACACS+ AAA Services

This section provides an example of how to configure TACACS+ AAA services for administrative users on the system.

**Caution:** When configuring TACACS+ AAA services for the first time, the administrative user must use non-TACACS+ services to log into the ASR 5x00. Failure to do so will result in the TACACS+ user being denied access to the system.

Log in to the system using non-TACACS+ services.

Use the example below to configure TACACS+ AAA services on the system:

```
configure
tacacs mode

server priority priority_number ip-address tacacs+srvr_ip_address

end
```

**Note:**

- **server priority priority_number:** Must be an integer from 1 to 3 (*releases prior to 18.2*) or 1 through 4 (*releases 18.2+*), that specifies the order in which this TACACS+ server will be tried for TACACS+ authentication. 1 is the highest priority, and 3 or 4 is the lowest. The priority number corresponds to a configured TACACS+ server.

- **ip-address:** Must be the IPv4 address of a valid TACACS+ server that will be used for authenticating administrative users accessing this system via TACACS+ AAA services.

- By default, the TACACS+ configuration will provide authentication, authorization, and accounting services.

Enable TACACS+ on the ASR 5x00:

```
configure

aaa tacacs+

end
```
Save the configuration as described in the *Verifying and Saving Your Configuration* chapter.

**Important:** For complete information on all TACACS+ Configuration Mode commands and options, refer to the *TACACS Configuration Mode Commands* chapter in the *Command Line Reference*.

### Verifying the TACACS+ Configuration

This section describes how to verify the TACACS+ configuration.

Log out of the system CLI, then log back in using TACACS+ services.

**Important:** Once TACACS+ AAA services are configured and enabled on the ASR 5x00, the system first will try to authenticate the administrative user via TACACS+ AAA services. By default, if TACACS+ authentication fails, the system then continues with authentication using non-TACACS+ AAA services.

At the Exec Mode prompt, enter the following command:

```
show tacacs [ client | priv-lvl | session | summary ]
```

The output of the *show tacacs* commands provides summary information for each active TACACS+ session such as username, login time, login status, current session state and privilege level. Optional filter keywords provide additional information.

An example of this command’s output is provided below. In this example, a system administrative user named *asradmin* has successfully logged in to the system via TACACS+ AAA services.

```
active session #1:
  login username         : asradmin
  login tty             : /dev/pts/1
  login server priority : 1
  current login status  : pass
  current session state : user login complete
  current privilege level: 15
  remote client application : ssh
  remote client ip address : 111.11.11.11
  last server reply status : -1
  total TACACS+ sessions : 1
```
**Configuring a Chassis Key**

A unique chassis key is configured at the factory for each system. This key is used to decrypt encrypted passwords found in generated configuration files. The system administrator can create a unique chassis key that will be used to encrypt passwords stored in configuration files.

**Important:** The Quick Setup Wizard also prompts the user to enter a chassis key value.

The Exec mode `chassis key value key_string` command identifies the chassis which can encrypt and decrypt encrypted passwords in the configuration file. If two or more chassis are configured with the same chassis key value, the encrypted passwords can be decrypted by any of the chassis sharing the same chassis key value. As a corollary to this, a given chassis key value will not be able to decrypt passwords that were encrypted with a different chassis key value.

The `key_string` is an alphanumeric string of 1 through 16 characters. The chassis key is stored as a one-way encrypted value, much like a password. For this reason, the chassis key value is never displayed in plain-text form.

The Exec mode `chassis keycheck key_string` command generates a one-way encrypted key value based on the entered `key_string`. The generated encrypted key value is compared against the encrypted key value of the previously entered chassis key value. If the encrypted values match, the command succeeds and keycheck passes. If the comparison fails, a message is displayed indicating that the key check has failed. If the default chassis key (no chassis key) is currently being used, this key check will always fail since there will be no chassis key value to compare against.

Use the `chassis keycheck` command to verify whether multiple chassis share the same chassis key value.

**Important:** Only a user with Security Administrator or Administrator privilege can execute the `chassis key value` and `chassis keycheck` commands.

For additional information, refer to the `Exec Mode Commands` chapter in the `Command Line Interface Reference`.

Beginning with Release 15.0, the chassis ID will be generated from an input chassis key using the SHA2-256 algorithm followed by base36 encoding. The resulting 44-character chassis ID will be stored in the same chassisid file in flash.

Release 14 and Release 15 chassis IDs will be in different formats. Release 15 will recognize a Release 14 chassis ID and consider it as valid. Upgrading from 14.x to 15.0 will not require changing the chassis ID or configuration file.

However, if the chassis key is reset in Release 15 through the setup wizard or `chassis-key` CLI command, a new chassis ID will be generated in Release 15 format (44 instead of 16 characters). Release14 builds will not recognize the 44-character chassis ID. If the chassis is subsequently downgraded to Release 14, a new 16-character chassis ID will be generated. To accommodate the old key format, you must save the configuration file in pre-v12.2 format before the downgrade. If you attempt to load a v15 configuration file on the downgraded chassis, StarOS will not be able to decrypt the password/secrets stored in the configuration file.
Configuring MIO/UMIO Port Redundancy

Port redundancy for MIO cards provides an added level of redundancy that minimizes the impact of network failures that occur external to the system. Examples include switch or router port failures, disconnected or cut cables, or other external faults that cause a link down error.

⚠️ Caution: To ensure that system card and port-level redundancy mechanisms function properly, disable the Spanning Tree protocol on devices connected directly to any system port. Failure to turn off the Spanning Tree protocol may result in failures in the redundancy mechanisms or service outage.

By default, the system provides port-level redundancy when a failure occurs, or you issue the **port switch to** command. In this mode, the ports on active and standby MIO/UMIO cards have the same MAC address, but since only one of these ports may be active at any one time there are no conflicts. This eliminates the need to transfer MAC addresses and send gratuitous ARPs in port failover situations. Instead, for Ethernet ports, three Ethernet broadcast packets containing the source MAC address are sent so that the external network equipment (switch, bridge, or other device) can re-learn the information after the topology change. However, if card removal is detected, the system sends out gratuitous ARPs to the network because of the MAC address change that occurred on the specific port.

With port redundancy, if a failover occurs, only the specific port(s) become active. For example, if port 5/1 fails, then port 6/1 becomes active, while all other active ports on the line card in slot 5 remain in the same active state. In port failover situations, use the **show port table** command to check that ports are active on both cards and that both cards are active.

Take care when administratively disabling a port that is one of a redundant pair. A redundant pair comprises both the active and standby ports—for example 5/1 and 6/1. If 5/1 is active, administratively disabling 5/1 through the CLI does not make 6/1 active. It disables both 5/1 and 6/1 because an action on one port has the same effect on both. Refer to *Creating and Configuring Ethernet Interfaces and Ports* in the *System Interface and Port Configuration Procedures*.

With automatic card-level redundancy, there is no port-level redundancy in an MIO/UMIO failover. The standby MIO/UMIO becomes active and all ports on that card become active. The system automatically copies all the MAC addresses and configuration parameters used by the failed MIO/UMIO to its redundant counterpart. The ports on MIOs keep their original MAC addresses, and the system automatically copies the failed MIO/UMIO’s configuration parameters to its redundant counterpart.

Port redundancy can be configured to be revertive or non-revertive. With revertive redundancy service is returned to the original port when service is restored.

This feature requires specific network topologies to work properly. The network must have redundant switching components or other devices that the system is connected to. The following diagrams show examples of a redundant switching topologies and how the system reacts to various external network device scenarios.
In the example above, an Ethernet cable is cut or unplugged, causing the link to go down. When this event occurs, the system, with port-mode redundancy enabled, recognizes the link down state and makes port 6/1 the active port. The switching device, using some port redundancy scheme, recognizes the failure and enables the port on the secondary switch to which the MIO/UMIO in slot 6 is connected, allowing it to redirect and transport data.
Configuring MIO/UMIO Port Redundancy Auto-Recovery

You can configure a port auto-recovery feature. When a port failure occurs and the preferred port is returned to service (link is up), control is automatically returned to that port. By default, ports are in a non-revertive state, meaning that no ports are preferred; a manual port switch is required to return use to the original port.

**Important:** This feature is applied on a per port basis (via the `preferred slot` keyword), allowing you to configure specific ports to be used on individual MIO cards. For example, you could configure ports 10 through 19 as preferred on the MIO/UMIO in slot 5, and configure ports 20 through 29 as the preferred ports on the MIO/UMIO in slot 6.

Use the following example to configure a preferred port for revertive, automatic return to service when a problem has cleared:

```
configure
  port ethernet slot#/port#
    preferred slot slot#
  end
```

Notes
- If you do specify a preference, redundancy is revertive to the specified card. If you do not specify a preference, redundancy is non-revertive.
- Repeat for each additional port that you want to make preferred.

Save the configuration as described in the *Verifying and Saving Your Configuration* chapter.
Verifying Port Redundancy Auto-Recovery

Verify port information by entering the following command

```
show port info slot#/port#
```

*slot#* is the chassis slot number of the MIO/UMIO card on which the physical port resides.

*port#* is the physical port on the MIO/UMIO.

The following shows a sample output of this command for port 1 on the MIO/UMIO in slot 5:

```
[local]host_name# show port info 5/1
Port: 5/1
    Port Type                     : 1000 Ethernet
    Role                          : Management Port
    Description                  : (None Set)
    Redundancy Mode              : Port Mode
    Redundant With               : 6/1
    Preferred Port               : Non-Revertive
    Physical ifIndex             : 83951616
    Administrative State         : Enabled
    Configured Duplex            : Auto
    Configured Speed             : Auto
    Configured Flow Control      : Enabled
    Interface MAC Address        : 02-05-47-B8-2F-41
    Fixed MAC Address            : 02-05-47-B8-2F-41
    Link State                   : Up
    Link Duplex                  : Full
    Link Speed                   : 1000 Mb
    Flow Control                 : Disabled
    Link Aggregation Group       : None
    Logical ifIndex              : 83951617
    Operational State            : Up, Active
```
Configuring Data Processing Card Availability

As discussed in the Understanding the System Boot Process section of Understanding System Operation and Configuration, when the system initially boots up, all installed DPC/UDPCs or DPC2/UDPC2s are placed into standby mode. You must activate some of these cards in order to configure and use them for session processing. One DPC/UDPC or DPC2/UDPC2 may remain in standby mode for redundancy.

This section describes how to activate DPC/UDPCs or DPC2/UDPC2s and specify their redundancy.

**Important:** Refer to the ASR 5500 Installation Guide for information about system hardware configurations and redundancy.

Enter the following command to check the operational status of all DPC types:

```
show card table
```

This command lists the DPC types installed in the system by their slot number, their operational status, and whether or not the card is a single point of failure (SPOF).

Use the following example to configure DPC/UDPC or DPC2/UDPC2 availability:

```
configure
card slot#
    mode { active | standby }
end
```

**Notes:**
- When activating cards, remember to keep at least one DPC/UDPC or DPC2/UDPC2 in standby mode for redundancy.
- Repeat for every other DPC/UDPC or DPC2/UDPC2 in the chassis that you wish to activate.

Save the configuration as described in the Verifying and Saving Your Configuration chapter.

**Verifying Card Configurations**

Verify that the configuration was successful. Enter the following command:

```
show card table
```

Any DPC/UDPC or DPC2/UDPC2 that you made active should now have an operational status of *Active*.
Configuring ASR 5500 Link Aggregation

A Link Aggregation Group (LAG) works by exchanging control packets via Link Aggregation Control Protocol (LACP) over configured physical ports with peers to reach agreement on an aggregation of links as defined in IEEE 802.3ad. The LAG sends and receives the control packets directly on physical ports.

Link aggregation (also called trunking or bonding) provides higher total bandwidth, auto-negotiation, and recovery by combining parallel network links between devices as a single link. A large file is guaranteed to be sent over one of the links, which removes the need to address out-of-order packets.

LAG and Master Port

Logical port configurations (VLAN and binding) are defined in the master port of the LAG. If the master port is removed because of a card removal/failure, another member port becomes the master port (resulting in VPN binding change and outage), unless there is a redundant master port available.

**Important:** The master port on which VLAN can be created for VPN binding must always be configured on the active/master MIO/UMIO. The redundancy between the MIO/UMIO in slot 5 and the MIO/UMIO in slot 6 automatically causes both ports to be the master with the same VLANs configured and active.

LAG and Port Redundancy

ASR 5500 LAG implementation assumes that:

- LAG ports on MIO/UMIO-slot 5 and MIO/UMIO-slot 66 are connected to two Ethernet switches.
- LAG ports on MIO/UMIO-slot 5 and MIO/UMIO-slot 6 are both active at the same time.
- Ports on MIO/UMIO-slot 5 and MIO/UMIO-slot 6 are redundant with each other.

All ports in a LAG can be auto-switched to another MIO/UMIO when certain active port counts or bandwidth thresholds are crossed.

LAG and Multiple Switches

This feature connects subscriber traffic ports on MIOs to ports on Ethernet switches. A port failure/switch forces all ports in a LAG to switch to the other MIO/UMIO when a specified threshold is crossed. This works in a way similar to the auto-switch feature for port redundancy. LACP runs between the ASR 5500 and the Ethernet switch, exchanging relevant pieces on information, such as health status.

The following table summarizes typical LAG functionality on an MIO/UMIO card.
Table 5. MIO/UMIO LAG Functionality

<table>
<thead>
<tr>
<th>ASR 5500 Port</th>
<th>LAGID</th>
<th>Ethernet Switch A</th>
<th>Ethernet Switch B</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIO/UMIO Port 11</td>
<td>1</td>
<td>Port 1</td>
<td>----</td>
</tr>
<tr>
<td>MIO/UMIO Port 12</td>
<td>1</td>
<td>Port 2</td>
<td>----</td>
</tr>
<tr>
<td>MIO/UMIO Port 13</td>
<td>1</td>
<td>----</td>
<td>Port 1</td>
</tr>
</tbody>
</table>

Multiple Switches with L2 Redundancy

To handle the implementation of LACP without requiring standby ports to pass LACP packets, two separate instances of LACP are started on redundant cards. The two LACP instances and port link state are monitored to determine whether to initiate an auto-switch (including automatic L2 port switch).

The figure below shows an LAG established across two MIO/UMIO daughter card ports with L2 redundancy.

Figure 8. LAG with L2 Redundancy, Two Ethernet Switches

An LACP implementation with L2 redundancy cannot pass traffic even though standby ports have link up. For example, with two MIO/UMIO cards connected to two different Ethernet switches and all ports in the same LAG, failure of ports would not trigger a LAG switch until the active port number ratio flipped (more ports down than up).

Port States for Auto-Switch

Ports are classified in one of four states to determine whether to start auto-switching. See the table below.

For counters, State(x) represents the number of ports on a card in that state.
### Table 6. Auto-Switch Port States

<table>
<thead>
<tr>
<th>State</th>
<th>Counter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link</td>
<td>L(x)</td>
<td>Physical link up</td>
</tr>
<tr>
<td>Standby</td>
<td>S(x)</td>
<td>Link up but in standby mode</td>
</tr>
<tr>
<td>Waiting</td>
<td>W(x)</td>
<td>Waiting for Link Aggregation Control Protocol negotiation</td>
</tr>
<tr>
<td>Aggregated</td>
<td>A(x)</td>
<td>Aggregation formed</td>
</tr>
</tbody>
</table>

#### Hold Time

Once the LAG manager switches to another LACP instance, it does not consider another change for a short period to let link and LACP negotiation settle down. This “hold time” is configurable.

The LAG manager also enters/extends the hold period when an administrator manually switches ports to trigger a card switch.

#### Preferred Slot

You can define which card is preferred per LAG group as a **preferred slot**. When a preferred MIO/UMIO slot is specified, it is selected for the initial timeout period to make the selection of a switch less random.

Port preference is **not** allowed in this mode.

#### Auto-Switch Criteria

The following criteria determine the switching of card x to card y to provide better bandwidth while allowing manual intervention. The evaluation of the criteria occurs outside of the hold period.

Ports are automatically switched from card x to card y when A(y) = 1, at least one port is in aggregated state on card y, and one of the following conditions is true (in order of precedence):

- L(x) L(y) Less ports with link Up on card x than card y
- S(x) S(y) More ports in Standby state on card x than card y
- W(x) W(y) More ports in Waiting state on card x than card y
- A(x) A(y) Fewer ports in Aggregated state on card x than card y
- Card y is preferred
- Card y is selected.
Link Aggregation Control

One port in an aggregation group is configured as a master so that all traffic (except control traffic) in the aggregation group logically passes through this port. It is recommended that you configure link-aggregation on the master port first when enabling LAG, and unconfigure the master port last when disabling LAG.

The following command creates link aggregation group N with port slot#/port# as master. Only one master port is allowed for a group. N must be in the range of [1–255].

```
configure

    port ethernet slot#/port#
        link-aggregation master group N

    exit
```

**Important:** Link Aggregation Control Protocol (LACP) starts running only when the master port is enabled.

Use the following command to add a port as member of link aggregation group number N only if the master port is assigned. Otherwise, it is added to the group when the master port is assigned:

```
port ethernet slot#/port#

    link-aggregation member group N

    exit
```

**Important:** The VPN can only bind the master port, and a VLAN can only be created on the master port. A failure message is generated if you attempt to bind to a link aggregation member port.

Each system that participates in link aggregation has a unique system ID that consists of a two-byte priority (where the lowest number [0] has the highest priority) and a six-byte MAC address derived from the first port’s MAC address. The following command sets the system priority used to form the system ID. P is a hex in the range [0x0000..0xFFFF]. The default is 0x8000.

```
card slot#

    link-aggregation system-priority P
```

Ports in a system are assigned keys. The group number maps directly to the key, whereupon only ports with the same key can be aggregated. Ports on each side of the link use a different aggregation key.

The system ID, port key and port ID of two peers form the Link Aggregation Group Identifier (LAGID). You can aggregate links having the same LAGID. Systems are often configured initially with each port in its own aggregation (requiring a separate key per port), or with all ports in the same aggregation (a single key for all ports). Negotiation via LACP would qualify the actual aggregation.

Systems exchange information about system ID, port key and port ID with peers across the physical links using LACP. LACP packets are defined with the Slow Protocol format. Each system sends out its own (“actor”) information and its last received information about its peer (“partner”) over the physical link.
Use the following commands to set the LACP parameters. LACP can run in active mode to send LACP packets periodically, or in passive mode, in which it only responds to LACP packets it receives.
LACP can send packets at either a auto (30s) or fast (1s) rate. The defaults for this release are Active and Auto; see the sample configuration below:

```
config

port ethernet slot#/port#

link-aggregation lacp { active | passive } [ rate { auto | fast } ] [ timeout { long | short } ]
```

Peers send out LACP packets when the state changes or if a difference is found from a received LACP packet about its own state.

Corresponding ports on an MIO/UMIO redundant pair cannot be active at the same time. Redundant ports share the same MAC address, so after a failover is resolved, the original port rejoins the link aggregation group.

**Redundancy Options**

For L2 redundancy set the following option on the master port for use with the whole group:

```
link-aggregation redundancy standard [hold-time sec ] [preferred slot { card_number | none }]
```

Standard redundancy treats all cards in the group as one group.

**Horizontal Link Aggregation with Two Ethernet Switches**

When a LAG contains two sets of ports each connecting to a different switch, the operator has the ability to specify the slot/port (connected to the destination switch) when switching ports.

The Exec mode `link-aggregation port switch to slot/port` command configures this option. The `slot/port` is any valid port connected to the destination switch. The following criteria apply to the setting of this option:

- `slot/port` must support LAG.
- `slot/port` must be configured with LAG.
- `slot/port` must not be already actively distributing
- `slot/port` must have negotiated a link aggregation partner in standard mode.
- `slot/port's partner` must have an equal or higher in standard mode.
- `slot/port's partner bundle` must have equal or higher bandwidth in standard mode.
- Switching to `slot/port` must not violate preference within hold-time in standard mode.
Link Aggregation Status

To check the status of link aggregation, use the following commands:

- `show port table`
- `show port info slot/port`

A single character is used to display LAG physical port status in the output of the `show port table` command. See the table below.

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA+</td>
<td>Port is actively used for distributing.</td>
</tr>
<tr>
<td>LA-</td>
<td>Port failed to negotiate LACP.</td>
</tr>
<tr>
<td>LA~ (tilde)</td>
<td>Port negotiated LACP but another peer was selected.</td>
</tr>
<tr>
<td>LA*</td>
<td>Port is (re)negotiating LACP.</td>
</tr>
</tbody>
</table>
Configuring a Demux Card

You can dedicate a DPC/UDPC or DPC2/UDPC2, or MIO/UMIO to function as a demux card. Demux is a generic term for signal demultiplexing tasks. These are the tasks are responsible for parsing call setup (signaling packets) and distributing the calls internally. For this reason there almost as many tasks running on a demux card as there are services.

The vpnmgr tasks responsible for each context also run on the demux card. The number of vpnmgr tasks correspond to the number of contexts. A vpnmgr is responsible for IP address assignment to mobile equipment, IP routing (such as BGP, OSPF), as well as a variety of associated tasks.

Overview

Designating a DPC/UDPC or DPC2/UDPC2, or MIO/UMIO as a demux card frees up resources for session handling, which has the potential to increase system throughput. However, there is no increased support in total subscriber capacity due to other system resource restrictions.

This feature is disabled by default and can be enabled via the Global Configuration mode require demux command. It is only supported for a limited number of products. Refer to the product Administration Guide for additional information.

To support this feature session recovery must also be enabled via the Global Configuration mode require session recovery command.

Important: After enabling demux card and session recovery, you must save the configuration and reboot the ASR 5500 to enable this feature.

Caution: Enabling the Demux on MIO/UMIO feature changes resource allocations within the system. This directly impacts an upgrade or downgrade between StarOS versions in ICSR configurations. Contact Cisco TAC for procedural assistance prior to upgrading or downgrading your ICSR deployment.

MIO Demux Restrictions

The following restrictions apply when enabling an MIO/UMIO as a demux card:

- The require demux management-card command must be configured before any service or contexts have been created on the system. The command will not execute after a mode of operation has been selected for the chassis.
- Only the following services currently support the designation of an MIO/UMIO card for demux functions: GGSN, SGW, PGW, HA, SAE-GW and L2TP LNS. These services are supported only when they are deployed as consumer gateways.
- SGSN, MME, HNBGW, HeNBGW, SaMOG, PDG, PDIF, ePDG, IPSG, PDSN, HSGW, L2TP LAC, NEMO, CSCF, FA, and WSG are not supported. Enterprise or corporate gateways (GGSN, HA, PGW, etc.) are also not supported.
- You should not enable demux functionality on MIO/UMIO for configurations that require a large number of tunnels.
• After the ASR 5500 has booted with demux functions running on an MIO/UMIO, you cannot configure non-supported services. A maximum of eight Demux Managers are supported. Any attempt to add more than eight Demux Managers will be blocked.

• Service/products requiring a large number of VPN Managers, VRFs and/or Demux Managers must not enable demux functions on an MIO/UMIO.

• With demux functions running on an MIO/UMIO, the ASR 5500 supports a maximum of 10 contexts, 64 interfaces per context, and 250 VRFs per system.

• ICSR upgrades require compatible configurations and Methods of Procedure (MOPs).

Implementation of this feature assumes that CEPS (Call Events Per Second) and the number of subscribers will remain constant, and only the data rate will increase. This ensures that the CPU demand will not increase on the MIO/UMIO.

Important: Contact Cisco TAC for additional assistance when assessing the impact to system configurations when enabling the Demux on MIO/UMIO feature.

Configuration

For releases prior to 15.0, to configure a DPC/UDPC as a demux card enter the following CLI commands:

```
configure
    require demux card
end
```

For release 15.0+, to configure a DPC/UDPC as a demux card enter the following CLI commands:

```
configure
    require demux processing-card
end
```

For release 18.0+, to configure a DPC/2UDPC2 as a demux card enter the following CLI commands:

```
configure
    require demux processing-card
end
```

To configure an MIO/UMIO as a demux card enter the following CLI commands:

```
configure
    require demux management-card
end
```
Chapter 4
Management Settings

This chapter provides instructions for configuring Object Request Broker Element Management (ORBEM) and Simple Network Management Protocol (SNMP) options.

This chapter includes the following sections:

- ORBEM
- SNMP Support
ORBEM

The system can be managed by a Common Object Broker Request Architecture (CORBA)-based, Element Management System (EMS).

You must configure the ORBEM settings on the ASR 5x00 that allow the system to communicate with the server running the EMS application.

Important: Commands used in the configuration samples in this section provide base functionality. The most common commands and keyword options are presented. In many cases, other optional commands and keyword options are available. Refer to the Command Line Interface Reference for detailed information about all commands.

To configure the system to communicate with an EMS:

Step 1 Set client ID parameters and configure the STOP/TCP port settings by applying the example configuration in Configuring Client and Port Parameters.

Step 2 Configure Internet Inter-ORB Protocol (IIOP) transport parameters by applying the example configuration in Configuring Internet Inter-ORB Protocol (IIOP) Transport Parameters.

Step 3 View your new ORBEM configuration by following the steps in Verifying ORBEM Parameters.

Step 4 Save the configuration as described in Verifying and Saving Your Configuration.

Configuring ORBEM Client and Port Parameters

Use the following example to set client ID parameters and configure the SIOP/TCP port settings:

```bash
configure

orbem

client id encrypted password password
max-attempt number
session-timeout time
siop-port port_number
event-notif-siop-port siopnotif_port
event-notif-service
end
```

Notes:

- You can issue the client id command multiple times to configure multiple clients.
- If a client ID is de-activated due to reaching the configured maximum number of attempts, use the activate client id command to reactivate it.
• If a firewall exists between the system and the EMS, open the SIOP port number and the TCP port number 15011.

• If the ORB Notification Service is enabled via the `event-notif-service` command, you can set filters to determine which events are to be sent. By default, the Service sends all error and higher level events, “info” level events for the ORBS facility, CLI command logs, and license change logs. Optionally, configure a filter by including the `event-notif-service filter` command. Enter this command for each filter you need to configure.

### Configuring IIOP Transport Parameters

Use the following example to configure Internet Inter-ORB Protocol (IIOP) transport parameters that enable ORB-based management to be performed over the network:

```
configure
orbem
  iiop-transport
  iiop-port iiop_port_number
  event-notif-iiop-port iiop_notif_port
end
```

**Notes:**

• If you are using the Secure Sockets Layer (SSL) option, do not enable the IIOP transport parameter.

• You configure the ORBEM interface to use SSL by specifying a certificate and private key.

### Verifying ORBEM Parameters

**Step 1** Run the `show orbem client table` command to verify that the client was configured properly. This command lists the configured ORBEM clients and displays their state and privileges.

**Step 2** Run the `show orbem status` command to verify the ORBEM parameter configuration. The following displays a sample of this command’s output.

```
<table>
<thead>
<tr>
<th>Service State</th>
<th>On</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Functions</td>
<td>FCAPS</td>
</tr>
<tr>
<td>IOP Address</td>
<td>192.168.1.150</td>
</tr>
<tr>
<td>SSL Port</td>
<td>14131</td>
</tr>
<tr>
<td>TCP Port</td>
<td>14132</td>
</tr>
<tr>
<td>Notification SSL Port</td>
<td>7777</td>
</tr>
<tr>
<td>Notification TCP Port</td>
<td>7778</td>
</tr>
<tr>
<td>Session Timeout</td>
<td>86400 secs</td>
</tr>
<tr>
<td>Max Login Attempts</td>
<td>5</td>
</tr>
<tr>
<td>IIOP Transport</td>
<td>On</td>
</tr>
<tr>
<td>Notification</td>
<td>On</td>
</tr>
<tr>
<td>Debug Level</td>
<td>Off</td>
</tr>
<tr>
<td>IDL Version Check</td>
<td>On</td>
</tr>
<tr>
<td>Number of Current Sessions</td>
<td>1</td>
</tr>
</tbody>
</table>
```
Number of Event Channels Open : 0
Number of Operations Completed : 2895
Number of Events Processed : 0
Avg Operation Processing time : 87214 usecs
(last 1000) : 87950 usecs
SNMP Support

The system uses the SNMP to send traps or events to the EMS server or an alarm server on the network. You must configure SNMP settings to communicate with those devices.

**Important:** Commands used in the configuration samples in this section provide base functionality. The most common commands and keyword options are presented. In many cases, other optional commands and keyword options are available. Refer to the Command Line Interface Reference for complete information.

The SNMP MIB Reference describes the MIBs and SNMP traps supported by the ASR 5x00 platform.

To configure the system to communicate with the EMS server or an alarm server:

**Step 1** Set SNMP parameters such as UDP port, and alarm server target by applying the example configuration in Configuring SNMP and Alarm Server Parameters.

**Step 2** To view your new SNMP configuration, follow the steps in Verifying SNMP Parameters.

**Step 3** Save the configuration as described in Verifying and Saving Your Configuration.

### Configuring SNMP and Alarm Server Parameters

Use the following example to set SNMP and alarm server parameters:

```
configure
  system contact contact_name
  system location location_name
  snmp authentication-failure-trap
  snmp community community_string
  snmp server port port_number
  snmp target name ip_address
  snmp engine-id local id_string
  snmp notif-threshold value low low_value period time_period
  snmp user user_name
  snmp mib mib_name
  snmp runtime-debug [ debug-tokens token_id token_id token_id...token_id
end
```
Notes:

- The **system contact** is the name of the person to contact when traps are generated that indicate an error condition.
- An **snmp community** string is a password that allows access to system management information bases (MIBs).
- The system can send SNMPv1, SNMPv2c, or SNMPv3 traps to numerous target devices. However, an EMS may only process SNMP version 1 (SNMPv1) and SNMP version 2c (SNMPv2c) traps. If the SNMP target you are configuring is the EMS application, use the **snmp target** command to configure use of version 1 or version 2c. Issue this command as many times as you need to configure multiple targets. If you configure multiple targets, generated alarms are sent to every configured target.
- The **snmp notif-threshold** command configures the number of SNMP notifications that need to be generated for a given event and the number of seconds in the monitoring window size (default = 300), before the notification is propagated to the SNMP users (default = 300).
- The **snmp engine-id local** command is optional. It is only required if your network requires SNMP v3 support. The engine ID uniquely identifies the SNMP engine and associated SNMP entities, thus providing a security association between the two for the sending and receiving of data.
- The **snmp user** name is for SNMP v3 and is optional. There are numerous keyword options associated with this command.
- Use the **snmp mib** command to enable other industry standard and Cisco MIBs. By default only the STARENT-MIB is enabled.
- By default SNMP runtime debugging always runs and consumes CPU cycles for event logging. To control CPU usage you can set **no snmp runtime-debug** to disable runtime debugging. An option to this command allows you to specify SNMP token values that will locate and parse specified MIBs.

**Important**: SNMPv3 traps may not be supported by some EMS applications.

## Verifying SNMP Parameters

**Step 1** Run the **show snmp server** command to verify that the SNMP server information is correctly configured. The following displays a sample output of this command.

```
SNMP Server Configuration:
  Server State : enabled
  SNMP Port : 161
  sysLocation : chicago
  sysContact : admin
  authenticationFails traps : Enabled
  EngineID : 123456789
  Alert Threshold : 100 alerts in 300 seconds
  Alert Low Threshold : 20 alerts in 300 seconds
SNMP Agent Mib Configuration:
  STARENT-MIB : Enabled
  IF-MIB : Disabled
  ENTITY-MIB : Disabled
  ENTITY-STATE-MIB : Disabled
  ENTITY-SENSORE-MIB : Disabled
  HOST-RESOURCES-MIB : Disabled
  CISCO-MOBILE-WIRELESS-SERVICE-MIB : Disabled
```
Step 2 Verify that the SNMP community(ies) were configured properly by entering the following command:

   show snmp communities

The output of this command lists the configured SNMP communities and their corresponding access levels.

Step 3 Verify that the SNMP transports are configured properly by entering the following command:

   show snmp transports

The following displays a sample output:

   Target Name: rms1
   IP Address: 192.168.1.200
   Port: 162
   Default: Default
   Security Name: public
   Version: 1
   Security: View:
   Notif Type: traps

Controlling SNMP Trap Generation

The system uses SNMP traps (notifications) to indicate that certain events have occurred. By default, the system enables the generation of all traps. However, you can disable individual traps to allow only traps of a certain type or alarm level to be generated. This section provides instructions for disabling/enabling SNMP traps.

**Important:** Commands used in the configuration samples in this section provide base functionality. The most common commands and keyword options are presented. In many cases, other optional commands and keyword options are available. Refer to the *Command Line Interface Reference* for complete information regarding all commands.

To configure SNMP trap generation:

Step 1 Set parameters by applying the following example configuration:

   configure

   snmp trap suppress

   snmp trap suppress trap_name1 trap_name2 ... trap_nameN

**Important:** If at a later time you wish to re-enable a trap that was previously suppressed, use the `snmp trap enable` command.

   snmp trap enable trap_name1 trap_name2 ... trap_nameN target target-name

Step 2 Save the configuration as described in *Verifying and Saving Your Configuration*. 
Chapter 5
Verifying and Saving Your Configuration

This chapter describes how to save your system configuration and includes the following sections:

- Verifying the Configuration
- Synchronizing File Systems
- Saving the Configuration
Verifying the Configuration

You can use a number of commands to verify the configuration of your feature, service, or system. Many are hierarchical in their implementation and some are specific to portions of or specific lines in the configuration file.

Feature Configuration

In many configurations, you have to set and verify specific features. An example includes IP address pool configuration. Using the example below, enter the listed commands to verify proper feature configuration.

Enter the `show ip pool` command to display the IP address pool configuration. The output from this command should look similar to the sample shown below. In this example, all IP pools were configured in the `isp1` context.

```
context : isp1:
+-----Type: (P) - Public    (R) - Private
|    (S) - Static    (E) - Resource
|+-----State: (G) - Good    (D) - Pending Delete    (R) - Resizing
||
|||+--Priority: 0..10 (Highest (0) .. Lowest (10))
||||+--Busyout: (B) - Busyout configured
vvvvvv Pool Name        Start Address     Mask/End Address Used    Avail
----- ------------------- ------------------------ -------- -----
PG00 ipsec             12.12.12.0       255.255.255.0           0       254
PG00 pool1             10.10.0.0       255.255.0.0             0       65534
SG00 vpnpool           192.168.1.250   192.168.1.254            0        5

Total Pool Count: 5
```

**Important:** To configure features on the system, use the `show` commands specifically for these features. Refer to the *Exec Mode show Commands* chapter in the *Command Line Interface Reference* for complete information.

Service Configuration

Verify that your service was created and configured properly by entering the following command:

```
show service_type service_name
```

The output is a concise listing of the service parameter settings similar to the sample displayed below. In this example, a P-GW service called `pgw` is configured.
Context Configuration

Verify that your context was created and configured properly by entering the `show context name name` command.

The output shows the active context. Its ID is similar to the sample displayed below. In this example, a context named `test1` is configured.

<table>
<thead>
<tr>
<th>Context Name</th>
<th>ContextID</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>test1</td>
<td>2</td>
<td>Active</td>
</tr>
</tbody>
</table>

System Configuration

Verify that your entire configuration file was created and configured properly by entering the `show configuration` command.

This command displays the entire configuration including the context and service configurations defined above.

Finding Configuration Errors

Identify errors in your configuration file by entering the `show configuration errors` command.

This command displays errors it finds within the configuration. For example, if you have created a service named “service1”, but entered it as “srv1” in another part of the configuration, the system displays this error.

You must refine this command to specify particular sections of the configuration. Add the `section` keyword and choose a section from the help menu as shown in the examples below.

```
show configuration errors section ggsn-service
```

or

```
show configuration errors section aaa-config
```

If the configuration contains no errors, an output similar to the following is displayed:

```
##############################################################################
Displaying Global
AAA-configuration errors
##############################################################################
Total 0 error(s) in this section!
```
### Synchronizing File Systems

Whenever changes are made to a configuration or StarOS version boot order in a system with redundant management cards, the file systems must be synchronized across the management cards. This assures that the changes are identically maintained across the management cards.

Enter the following Exec mode command to synchronize the local file systems:

```
[local]host_name# filesystem synchronize all
```

The `filesystem` command supports multiple keywords that allow you to check for and repair file system corruption, as well as synchronize a file system with a specific storage device. For additional information, see the *Exec Mode Commands* chapter in the *Command Line Interface Reference*. 
Saving the Configuration

These instructions assume that you are at the root prompt for the Exec mode:

```
[local]host_name#
```

To save your current configuration, enter the following command:

```
save configuration url [ obsolete-encryption | showsecrets | verbose ]
[ -redundant ] [ -noconfirm ]
```

$url$ specifies the location in which to store the configuration file. It may refer to a local or a remote file.

For complete information about the above command, see the `Exec Mode Commands` chapter of the Command Line Interface Reference.

---

**Important:** Do not use the “/” (forward slash), “:” (colon) or “@” (at sign) characters when entering a string for the following URL fields: directory, filename, username, password, host or port#.

---

**Important:** The `-redundant` keyword is only applicable when saving a configuration file to a local device (usb1 or usb2) that is installed on both MIO/UMIO cards. This command does not synchronize the local file system. If you have added, modified, or deleted other files or directories to or from a local device for the active MIO/UMIO, you must synchronize the local file system on both MIO/UMIOs. See Synchronizing File Systems.

To save a configuration file called `system.cfg` to a directory that was previously created called `cfgfiles` to the flash memory on the active MIO/UMIO, enter the following command:

```
save configuration /flash/cfgfiles/system.cfg
```

To save a configuration file called `simple_ip.cfg` to a directory called `host_name_configs`, using an FTP server with an IP address of `192.168.34.156`, on which you have an account with a username of `administrator` and a password of `secure`, use the following command:

```
save configuration sftp://administrator:secure@192.168.34.156/host_name_configs/simple_ip.cfg
```

To save a configuration file called `init_config.cfg` to the root directory of a TFTP server with a hostname of `config_server`, enter the following command:

```
save configuration tftp://config_server/init_config.cfg
```
Chapter 6
System Interfaces and Ports

This chapter describes how to create a context and configure system interfaces and ports within the context. Before beginning these procedures, refer to your product-specific administration guide for configuration information for your product.

This chapter includes the following:

- Contexts
- Ethernet Interfaces and Ports

**Important:** Make sure at least one Data Processing Card (DPC/UDPC or DPC2/UDPC2) is active before you configure system interfaces and ports. Refer to System Settings in this guide for information and instructions on activating DPCs.
## Contexts

Even though multiple contexts can be configured to perform specific functions, they are all created using the same procedure.

### Creating Contexts

**Important:** Commands used in the configuration examples in this section represent the most common or likely commands and/or keyword options. In many cases, other commands and/or keyword options are available. Refer to the Command Line Interface Reference for complete information regarding all commands.

To create a context, apply the following example configuration:

```
configure

context name

end
```

Repeat to configure additional contexts.

### Viewing and Verifying Contexts

**Step 1** Verify that your contexts were successfully created by entering the following command:

```
[local] host_name# show context all
```

The output is a two-column table similar to the example below. This example shows that two contexts were created: one named `source` and one named `destination`.

<table>
<thead>
<tr>
<th>Context Name</th>
<th>ContextID</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>local</td>
<td>1</td>
<td>Active</td>
</tr>
<tr>
<td>source</td>
<td>2</td>
<td>Active</td>
</tr>
<tr>
<td>destination</td>
<td>3</td>
<td>Active</td>
</tr>
</tbody>
</table>

The left column lists the contexts that are currently configured. The center column lists the corresponding context ID for each of the configured contexts. The third column lists the current state of the context.

**Step 2** Save your configuration as described in the Verifying and Saving Your Configuration chapter.

**Step 3** Now that the context has been created, interfaces and specific functionality can be configured within the context. Proceed to other sections for instructions on configuring specific services and options.
Ethernet Interfaces and Ports

Regardless of the type of application interface, the procedure to create and configure it consists of the following:

**Step 1**
Create an interface and assign an IP address and subnet mask to it by applying the example configuration in [Creating an Interface](#).

**Step 2**
Assign a physical port for use by the interface and bind the port to the interface by applying the example configuration in [Configuring a Port and Binding It to an Interface](#).

**Step 3**
Optionally configure a static route for the interface by applying the example configuration in [Configuring a Static Route for an Interface](#).

**Step 4**
Repeat the above steps for each interface to be configured.

---

**Important:** This section provides the minimum instructions for configuring interfaces and ports to allow the system to communicate on the network. Commands that configure additional interface or port properties are described in the *Ethernet Port Configuration Mode Commands* and *Ethernet Interface Configuration Mode Commands* chapters of the Command Line Interface Reference.

---

**Caution:** To ensure that system line card and port-level redundancy mechanisms function properly, the Spanning Tree protocol must be disabled on devices connected directly to any system port. Failure to turn off the Spanning Tree protocol may result in failures in the redundancy mechanisms or service outage.

---

### Creating an Interface

Use the following example to create a new interface in a context:

```plaintext
configure
  context name
    interface name
      { ip | ipv6 } address address subnetmask [ secondary ]
    end
end
```

**Notes:**

- **Optional:** Add the `loopback` keyword option to the `interface name` command, to set the interface type as “loopback” which is always UP and not bound to any physical port.

- **Optional:** Add the `secondary` keyword to the `{ ip | ipv6 } address` command, to assign multiple IP addresses to the interface. IP addresses can be entered using IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation.

- **Optional:** In the interface config mode, add the `port-switch-on-L3-fail address` command, to configure the interface for switchover to the port on the redundant line card if connectivity to a specified IP address is lost. This IP address can be entered using IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation.
Configuring a Port and Binding It to an Interface

Use the following example configuration to configure and assign a port to an interface:

```plaintext
configure

port ethernet slot#/port#

description description

no shutdown

bind interface interface_name context_name

end
```

Notes:
- For `port ethernet slot#`, use the actual chassis slot in which the MIO/UMIO card is installed; this could be 5 or 6.
- For `port ethernet port#`, use ports 10 to 19 (DC1) or 20 to 29 (DC2).
- Optional: In the Ethernet Port configuration mode, add the preferred `slot slot#` command if you want to specify a port preference.
- Binding associates the port and all of its settings to the named interface.

Configuring a Static Route for an Interface

Use the following example to configure a static route for an interface:

```plaintext
configure

context name

{ ip | ipv6 } route ip_address netmask next-hop gw_address interface_name

end
```

Notes:
- `ip_address` and `netmask` are the IP address and subnet mask of the target network. This IP address can be entered using IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation.
- `gw_address` is the IP address of the default gateway or next-hop route. This IP address can be entered using IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation.
- To configure a route to the gateway router, use `0.0.0.0` for the network and mask variables.
- Repeat as needed. Multiple static routes can be configured to the same destination to provide an alternative means of communication in case the preferred route fails.
Viewing and Verifying Port Configuration

Step 1  Verify that your interface configuration settings are correct by entering the following commands:

```
[local]host_name# context context_name
[context_name]host_name# show { ip | ipv6 } interface
```

*context_name* represents the name of the context in which the interface was created. The output from these commands should be similar to the following example.

In this example an interface named *mgmt1* was configured in the local context.

<table>
<thead>
<tr>
<th>Intf Name:</th>
<th>mgmt1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intf Type:</td>
<td>Broadcast</td>
</tr>
<tr>
<td>IP State:</td>
<td>UP (Bound to 5/11 untagged, ifIndex 285278209)</td>
</tr>
<tr>
<td>IP Address:</td>
<td>192.168.100.3</td>
</tr>
<tr>
<td>Bcast Address:</td>
<td>192.168.100.255</td>
</tr>
<tr>
<td>MTU:</td>
<td>1500</td>
</tr>
<tr>
<td>Resoln Type:</td>
<td>ARP</td>
</tr>
<tr>
<td>ARP timeout:</td>
<td>3600 secs</td>
</tr>
<tr>
<td>Number of Secondary Addresses:</td>
<td>0</td>
</tr>
<tr>
<td>Total interface count:</td>
<td>1</td>
</tr>
</tbody>
</table>

Step 2  Verify that your port configuration settings are correct by entering the following command:

```
[context_name]host_name# show configuration port slot#/port#
```

*slot#* is the chassis slot number of the MIO/UMIO on which the physical port resides. *slot#* can be 5 or 6.

This command produces an output similar to that displayed in the following example that shows the configuration for port 11 on the MIO/UMIO installed in chassis slot 5.

In this example, the port is bound to an interface called *rp1* configured in a context called *source*.

```
cfg
dev port ethernet 5/11
description MIO5/11_RP1
no shutdown
bind interface rp1 source
#end
```

Step 3  Verify that your static route(s) was configured properly by entering the following command:

```
[context_name]host_name# show ip static-route
```

This command produces an output similar to that displayed in the following example that shows a static route to a gateway with an IP address of 192.168.250.1.

<table>
<thead>
<tr>
<th>Destination</th>
<th>Nexthop</th>
<th>Protocol</th>
<th>Prec</th>
<th>Cost</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0.0.0/0</td>
<td>192.168.250.1</td>
<td>Static</td>
<td>0</td>
<td>0</td>
<td>MIO1</td>
</tr>
<tr>
<td>0.0.0.0/0</td>
<td>192.168.250.1</td>
<td>Static</td>
<td>0</td>
<td>0</td>
<td>rp1 source</td>
</tr>
</tbody>
</table>

Step 4  Save the configuration as described in the *Verifying and Saving Your Configuration* chapter.
Chapter 7
System Security

This chapter describes the security features supported on the ASR 5500 platform.

This chapter explores the following topics:

- Per-Chassis Key Identifier
- Encrypted SNMP Community Strings
- Lawful Intercept Restrictions
- Adding, Modifying and Removing Users
- Test-Commands
Per-Chassis Key Identifier

A user can set a unique chassis key which will work only for a chassis or for any set of chassis that will share the same configuration information.

The chassis key consists of 1 to 16 alphanumeric ASCII characters. The chassis key plain-text value is never displayed to the user; it is entered interactively and not echoed to the user.

On the ASR5500 the encrypted chassis key is stored in the midplane EEPROM and shared by both MIO/UMIOs.

If the chassis key identifier stored in the header comment line of the configuration file does not match the chassis key, an error message is displayed to the user. The user can change the chassis key value simply by entering the chassis key again. The previous chassis key is replaced by a new chassis key. The user is not required to enter a chassis key.

If the user does not configure a chassis key, the system generates a unique value for that chassis.

---

**Important:** Changing a chassis key may invalidate previously generated configurations. This is because any secret portions of the earlier generated configuration will have used a different encryption key. For this reason the configuration needs to be recreated and restored.

**Important:** To make password configuration easier for administrators, the chassis key should be set during the initial chassis set-up.

The configuration file contains a one-way encrypted value of the chassis key (the chassis key identifier) and the version number in a comment header line. These two pieces of data determine if the encrypted passwords stored within the configuration will be properly decrypted.

While a configuration file is being loaded, the chassis key used to generate the configuration is compared with the stored chassis key. If they do not match the configuration is not loaded.

The user can remove the chassis key identifier value and the version number header from the configuration file. Also, the user may elect to create a configuration file manually. In both of these cases, the system will assume that the same chassis key will be used to encrypt the encrypted passwords. If this is not the case, the passwords will not be decrypted due to resulting non-printable characters or memory size checks. This situation is only recoverable by setting the chassis key back to the previous value, editing the configuration to have the encrypted values which match the current chassis key, or by moving the configuration header line lower in the configuration file.

Beginning with Release 15.0, the chassis ID will be generated from an input chassis key using the SHA2-256 algorithm followed by base36 encoding. The resulting 44-character chassis ID will be stored in the same chassisid file in flash.

Release 14 and Release 15 chassis IDs will be in different formats. Release 15 will recognize a Release 14 chassis ID and consider it as valid. Upgrading from 14.x to 15.0 will not require changing the chassis ID or configuration file.

However, if the chassis-key is reset in Release 15 through the setup wizard or `chassis-key` CLI command, a new chassis ID will be generated in Release 15 format (44 instead of 16 characters). Release14 builds will not recognize the 44-character chassis ID. If the chassis is subsequently downgraded to Release 14, a new 16-character chassis ID will be generated. To accommodate the old key format, you must save the configuration file in pre-v12.2 format before the downgrade. If you attempt to load a v15 configuration file on the downgraded chassis, StarOS will not be able to decrypt the password/secrets stored in the configuration file.
MIO Synchronization

On boot up both MIO/UMIOs automatically read the chassis key configured on the ASR 5500 midplane.

Protection of Passwords

Users with privilege levels of Inspector and Operator cannot display decrypted passwords in the configuration file via the ASR 5500 command line interface (CLI).

Secure Password Encryption

By default the system encrypts passwords using an MD5-based cipher. These passwords also have a random 64-bit (8-byte) salt added to the password. The chassis key is used as the encryption key.

Using the chassis key allows for an encryption method where the decryption requires the knowledge of a “shared secret”. Only a chassis with knowledge of this shared secret can access the passwords. To decipher passwords, a hacker who knew the chassis key would still need to identify the location of the 64-bit random salt value within the encryption.

Passwords encrypted with MD-5 will have “+A” prefixes in the configuration file to identify the methodology used for encrypting.

For release 15.0 and higher, another type of encryption algorithm can be specified. The Global Configuration mode cli-encrypt-algorithm command allows an operator to configure the password/secret encryption algorithm. The default encryption/password algorithm is MD-5 as described above (option A). A second password encryption algorithm (option B) uses AES-CBC-128 for encryption and HMAC-SHA1 for authentication. The encryption key protec secrecy of passwords, while the authentication key protects their integrity. Passwords encrypted with this key will have “+B” prefixes in the configuration file.

The syntax for the cli-encrypt-algorithm command is:

```
config

cli-encrypt-algorithm { A | B }
```

Support for Non-Current Encryptions and Decryptions

The system supports previously formatted encrypted passwords. The syntax of the encrypted passwords indicates to the ASR 5500 which methodology was used for encryption. If the system does not see a prefix before the encrypted password, the earlier encryption method using a fixed key will be used. If the encrypted password includes the “+A” prefix, the decryption method uses the chassis key and random salt.

If the user saves a new configuration, the generated file will always contain passwords encrypted by the most recent method. The user cannot generate the earlier DES-based encryption values. However, all future StarOS releases will continue to support plain-text password entry for all two-way encryptable passwords.

The recommended process for changing the chassis key without causing a “lock-out” state is as follows:

- Load the configuration file of the last good configuration using the previous chassis key.
- Change the chassis key to the new desired value.
- Save the configuration with this new chassis key.

Refer to Configuring a Chassis Key in System Settings for additional information.
Support for ICSR Configurations

Inter-Chassis Session Recovery (ICSR) is a redundancy configuration that employs two identically configured ASR 5500 chassis as a redundant pair.

ICSR chassis share the same chassis key. If the ISCR detects that the two chassis have incompatible chassis keys, an error message is logged but the ICSR system will continue to run. Without the matching chassis key, the standby ICSR chassis can recover services if the active chassis goes out of service; the standby chassis will still have access to the passwords in their decrypted form.

ICSR chassis use Service Redundancy Protocol (SRP) to periodically check to see if the redundancy configuration matches with either decrypted passwords or DES-based two-way encryption strings. Since the configuration is generated internally to the software, users are not able to access the configuration used to check ICSR compatibility.
Encrypted SNMP Community Strings

Simple Network Management Protocol (SNMP) uses community strings as passwords for network elements. Although these community strings are sent in clear-text in the SNMP PDUs, the values can be encrypted in the configuration file. The `snmp community encrypted name` command enables the encryption of SNMP community strings. For additional information, see the `Global Configuration Mode Commands` chapter in the `Command Line Interface Reference`.

Lawful Intercept Restrictions

This section describes some of the security features associated with the provisioning of Lawful Intercept (LI). For additional information, refer to the `Lawful Intercept Configuration Guide`.

LI Server Addresses

An external authenticating agent (such as RADIUS or Diameter) sends a list of LI server addresses as part of access-accept. For any intercept that was already installed or will be installed for that subscriber, a security check is performed to match the LI server address with any of the LI-addresses that were received from the authenticating agent. Only those addresses that pass this criteria will get the intercepted information for that subscriber.

While configuring a campon trigger, the user will not be required to enter the destination LI server addresses. When a matching call for that campon trigger is detected, a security check is done with the list received from the authentication agent. The LI-related information is only forwarded if a matching address is found.

When an active-only intercept is configured, if a matching call is found, a security check is made for the LI address received from the authentication agent and the intercept configuration will be rejected.

If no information related to LI server addresses is received for that subscriber, LI server addresses will not be restricted.

**Important:** A maximum of five LI server addresses are supported via an authenticating agent.

Modifying Intercepts

One LI administrator can access and/or modify the intercepts created by another LI administrator. Whenever an intercept is added, removed or modified, an event log is displayed across LI administrators about the change. An SNMP trap is also generated.
Adding, Modifying and Removing Users

It is considered uncommon for a user to be added or removed from the ASR 5500. Likewise, it is considered uncommon for a user's privileges to modified. However, if the system is compromised, it is common for attackers to add or remove a privileged user, raise their privileges or lower the privileges of others.

As a general rule, lower privileged users should not be allowed to increase their privileges or gain access to sensitive data, such as passwords, which were entered by higher privileged users.

**Important:** The ASR 5500 can only detect changes in users and user attributes, such as privilege level, when these users are configured through the ASR 5500.

Notification of Users Being Added or Deleted

Users with low level authorization should not be able to create users with high level authorization. However, if a malicious actor were to be able to create a high level authorized user, they could then delete the other high level authorized users, thereby locking them out of the system.

The following SNMP traps notify an administrator when users are added or removed:

- **starLocalUserAdded** – indicates that a new local user account has been added to the system.
- **starLocalUserRemoved** – indicates that a local user account has been removed from the system.

Notification of Changes in Privilege Levels

Whenever a user's privilege level is increased or decreased, an SNMP notification will be sent out. A malicious actor may gain access to more privileged commands by somehow promoting” their privileges. Once this is done, they could then “demote” the privileges of all the other users, thereby locking the proper administrators out of the system.

The **starLocalUserPrivilegeChanged** trap indicates that a local user's privilege level has been changed.

User Access to Operating System Shell

The **starOsShellAccessed** trap indicates that a user has accessed the operating system shell.
Test-Commands

Users with Security Administrator or Administrator privilege can enable the display of previously hidden test-commands. The CLI test-commands mode displays new command keywords for existing commands, as well as new commands.

⚠️ Caution: CLI test-commands are intended for diagnostic use only. Access to these commands is not required during normal system operation. These commands are intended for use by Cisco TAC personnel only. Some of these commands can slow system performance, drop subscribers, and/or render the system inoperable.

Enabling cli test-commands Mode

To enable access to test-commands, a Security Administrator must log into the Global Configuration mode and enter cli hidden.

This command sequence is shown below.

```
[local]host_name# config
[local]host_name(config)# cli hidden
[local]host_name(config)#
```

By default cli-hidden is disabled.

ℹ️ Important: Low-level diagnostic and test commands/keywords will now be visible to a user with Administrator or higher privilege. There is no visual indication on the CLI that the test-commands mode has been enabled.

Enabling Password for Access to CLI-test commands

A Security Administrator can set a plain-text or encrypted password for access to CLI test commands. The password value is stored in /flash along with the boot configuration information. The show configuration and save configuration commands will never output this value in plain text.

The Global Configuration mode command tech-support test-commands [encrypted] password new_password sets an encrypted or plain-text password for access to CLI test-commands.

This command sequence is shown below.

```
[local]host_name# config
[local]host_name(config)# tech-support test-commands password new_password
[local]host_name(config)#
```

When a test-commands password is configured, the Global Configuration mode command cli test-commands [encrypted] password password requires the entry of the password keyword. If the encrypted keyword is specified, the password argument is interpreted as an encrypted string containing the password value. If the encrypted keyword is not specified, the password argument is interpreted as the actual plain text value

ℹ️ Important: If tech-support test-commands password is never configured, cli-test commands will always fail. If the password keyword is not entered for cli test-commands, the user is prompted (no-echo) to enter the password. Also, cli hidden must be enabled by a Security Administrator to access the CLI test-commands.
Exec Mode cli test-commands

Exec mode commands are available to a privileged user who enters the command cli test-commands from Exec mode.

```
[local]host_name# cli test-commands [encrypted] password password
```

Warning: Test commands enables internal testing and debugging commands

USE OF THIS MODE MAY CAUSE SIGNIFICANT SERVICE INTERRUPTION

**Important:** An SNMP trap (starTestModeEntered) is generated whenever a user enters CLI test-commands mode.

---

Configuration Mode cli test-commands

Configuration commands which provided access to low-level software parameters are accessible only after a privileged user enters the command cli test-commands from Global Configuration mode.

```
[local]host_name# config
[local]host_name(config)# cli test-commands [encrypted] password password
```

Warning: Test commands enables internal testing and debugging commands

USE OF THIS MODE MAY CAUSE SIGNIFICANT SERVICE INTERRUPTION

**Important:** An SNMP trap (starTestModeEntered) is generated whenever a user enters CLI test-commands mode.
Chapter 8
Software Management Operations

This chapter provides information about software management operations on the system. Software management sections include:

- Understanding the Local File System
- Maintaining the Local File System
- Configuring the Boot Stack
- Upgrading the Operating System Software
- Performing Dynamic Software Updates
- Managing License Keys
- Managing Local-User Administrative Accounts
Understanding the Local File System

The Management Input/Output (MIO/UMIO) card provides control and management for the system. The local file system is made up of files that are stored on one or more of the following:

- `/flash` - Flash memory located on the circuit board of the MIO/UMIO, is the default storage media for the operating system software image, CLI configuration, and crash log files used by the system.
- `/usb1` - This device is available when a USB memory stick is inserted on the front panel of the active MIO/UMIO.
- `/hd-raid` - This is the solid state hard disk array supported by the Fabric and Storage Cards (FSCs) and accessed via the active MIO/UMIO.

File Types Used by the Local File System

The following file types can be located in the local file system:

- **Operating System Software Image File**: This binary file type is identified by its `.bin` extension. The file is the operating system that is loaded by the system upon startup or reloading. This is an executable, read-only file that cannot be modified by end users.
- **CLI Configuration File**: This file type is identified by its `.cfg` extension. These are text files that contain CLI commands that work in conjunction with the operating system software image. These files determine services to be provided, hardware and software configurations, and other functions performed by the system. The files are typically created by the end user. You can modify the files both on and off-line and use descriptive long filenames.
- **System File**: Only one file identified by a `.sys` extension is used by the system. The boot.sys file contains system-specific information, which describes how the system locates, and in what priority it loads, file groups (paired `.bin` and `.cfg` files) from its boot stack.
- **Abridged Crash Log**: The abridged crash log, identified by its `crashlog` filename, contains summary information about software or hardware failures that occur on the system. This file is located in the `/flash/crash2/` directory on the device. You can view the contents of this file through the CLI, but you cannot modify the file.

Understanding the `boot.sys` File

The system uses the `boot.sys` file to store the prioritized boot stack parameters and file groups the system uses during startup. Modify this file only through system CLI commands and not through external means. Boot parameters contain information the system needs to locate the operating system image file, including:

- **bootmode**: This setting is typically configured to normal, and identifies how the system starts.
- **network interface configuration**: Use these optional boot method settings when you configure the system to obtain its operating system image from an external network server that is using one of the management LAN interfaces on the MIO/UMIO card.
- **boot stack information**: The boot stack is made up of prioritized file group entries that designate the operating system image file and the CLI configuration file to load.
When a system is unpacked and started for the first time, the boot.sys file is configured to use the normal boot mode and load the operating system software image from the /flash directory.

There is no CLI configuration file contained on the local file system. This causes the system to automatically start its CLI-based Quick Setup Wizard upon the first successful boot. Refer to *Getting Started* for more information on using the Quick Setup Wizard.
Maintaining the Local File System

Use CLI commands to manage and maintain the devices that make up the local file system. Execute all the commands described in this section in the Exec Mode. Unless otherwise specified, you must have security administrator or administrator privileges to execute these commands.

File System Management Commands

Use the commands in this section to manage and organize the local file system.

**Important:** For complete information on the commands listed below, see the *Exec Mode Commands* chapter of the *Command Line Interface Reference.*

Synchronizing the File System

Commands are supported for mirroring the local file systems from the active MIO/UMIO to the standby MIO/UMIO in systems containing two cards. Use these commands to synchronize any or all of the local devices.

**Important:** Crash log files are not synchronized when these commands are executed.

The following Exec mode command synchronizes the file systems between two MIO/UMIOs:

```
[local]host_name# filesystem synchronize [ /flash | /usb1 | all ] [ checkonly ]
[ from card_num | to card_num ] [ -noconfirm ]
```

Only filesystems on matching local devices are synchronized. For example, if the active MIO/UMIO contains two local devices (/flash and /usb1) and the standby MIO/UMIO contains only one local device (/flash), then synchronization only occurs on the matching local device (/flash).

The following command synchronizes the file systems on two MIO/UMIO flash devices.

```
[local]host_name# filesystem synchronize /flash
```

Creating Directories

Use the `mkdir` command to create a new directory on the specific local device. This directory can then be incorporated as part of the path name for any file located in the local file system.

```
[local]host_name# mkdir { /flash | /usb1 | /hd-raid } /dir_name
```

Use the following command to create a directory named `configs`:

```
[local]host_name# mkdir /flash/configs
```
Renaming Files and Directories

Use the `rename` command to change the name of a file from its original name to a different name. Remember to use the same file extension, if applicable, to ensure that the file type remains unchanged.

```
[local]host_name# rename { /flash | /usb1 | /hd-raid } /src_filename { /flash | /usb1 | /hd-raid } /dst_filename [-noconfirm]
```

Use the following command to rename a file named `iot_test.cfg` to `iot_accept.cfg` on the `/flash` local device.

```
[local]host_name# rename /flash/iot_test.cfg /flash/iot_accept.cfg -noconfirm
```

**Important:** Use the `rename` command only within the same local device. You cannot rename a file and place it onto another local device at the same time. To move a renamed file, you must use the `copy` command.

Copying Files on the ASR 5500 Chassis

These instructions assume that you are at the root prompt for the Exec mode. To save your current configuration, enter the following command:

```
[local]host_name# copy from_url to_url [-noconfirm]
```

To copy a configuration file called `system.cfg` from a directory that was called `cfgfiles` to a directory named `configs_old` on the flash memory in the MIO/UMIO, enter the following command:

```
[local]host_name# copy /flash/cfgfiles/system.cfg /flash/configs_old/system_2011.cfg
```

To copy a configuration file called `simple_ip.cfg` from a directory called `host_name_configs` to an FTP server with an IP address of `192.168.34.156`, on which you have an account with a username of `administrator` and a password of `secure`, use the following command:

```
[local]host_name# copy /flash/host_name_configs/simple_ip.cfg ftp://administrator:secure@192.168.34.156/host_name_configs/ simple_ip.cfg
```

To copy a configuration file called `init_config.cfg` to the root directory of a TFTP server with a hostname of `config_server`, enter the following command:

```
[local]host_name# copy /flash/cfgfiles/init_config.cfg tftp://config_server/init_config.cfg
```
Deleting Files

The `delete` command removes a designated file from its specified location on the local file system.

**Important:** This command does not support wildcard entries; each filename must be specified in its entirety.

**Caution:** Do not delete the boot.sys file. If deleted, the system will not reboot on command and will be rendered inoperable.

```bash
[local]host_name# delete { /flash | /usb1 | /hd-raid }/filename [-noconfirm]
```

The following command deletes a file named `test.cfg` from the `/flash` directory.

```bash
[local]host_name# delete /flash/test.cfg
```

Removing Directories

The `rmdir` command deletes a current directory on the specific local device. This directory can then be incorporated as part of the path name for any file located in the local file system.

**Important:** The directory you want to remove (delete) must be empty before executing the `rmdir` command. If the directory is not empty, the CLI displays a “Directory not empty” message and will not execute.

```bash
[local]host_name# rmdir url /dir_name
```

The following command deletes an empty directory named `configs` in the `/flash` directory.

```bash
[local]host_name# rmdir /flash/configs
```

Formatting Local Devices

The `format` command performs a low-level format of a local device. This operation formats the device to use the FAT16 formatting method, which is required for proper read/write functionality with the operating system.

**Important:** Local devices that have been formatted using other methods such as NTFS or FAT32 may be used to store various operating system, CLI configuration, and crash log files. However, when placing a new local device into the MIO/UMIO for regular use, you should format the device via the system prior to use. This ensures that the proper file allocation table format is used, preventing any possible discrepancies between other formats used with other operating systems.

**Caution:** The `filesystem format` command removes all files and information stored on the device.

To format a local device for use by the local file system, enter the following command:

```bash
[local]host_name# filesystem format { /flash | /usb1 | /hd-raid }
```
Applying Pre-existing CLI Configuration Files

A pre-existing CLI configuration file is any .cfg file created to provide utility functions (such as clearing all statistics during testing) or created off-line using a text editor. There may be pre-existing configuration files stored on the local file system that can be applied to a running system at any time.

⚠️ **Caution:** If a configuration file is applied to a system currently running another CLI configuration, any like contexts, services, logical interfaces, physical ports, IP address pools, or other configured items will be overwritten if the same command exists in the configuration file being applied. Take caution to ensure that you are knowledgeable of the contents of the file being applied and understand what the service ramifications are if a currently running command is overwritten. Also note that changes will not be saved automatically.

A CLI configuration file, or script containing CLI commands, can be applied to a running system by entering the following command at the Exec mode prompt:

```
[local]host_name# configure url [ verbose ]
```

`url` specifies the location of the CLI configuration file to be applied. It may refer to a local or a remote file.

The following command applies a pre-existing CLI configuration file named `clearcmds.cfg` in the `/flash` directory.

```
[local]host_name# configure /flash/clearcmds.cfg
```

Viewing Files on the Local File System

This section describes how to view a variety of files.

**Viewing the Contents of a Local Device**

The contents, usage information, and file system directory structure of any local device can be viewed by entering the following command at the Exec mode prompt:

```
directory { /flash | /usb1 | /hd-raid }
```

**Viewing CLI Configuration and boot.sys Files**

The contents of CLI configuration and boot.sys files, contained on the local file system, can be viewed off-line (without loading them into the OS) by entering the following command at the Exec mode prompt:

```
[local]host_name# show file url { /flash | /usb1 | /hd-raid } /filename
```

Where: `url` is the path name for the location of the file and `filename` is the name of the file, including any extension.

⚠️ **Important:** Operator and inspector-level users can execute the `show file` command but cannot execute the `directory` command.
Validating an Operating System File

The operating system software image file, identified by its .bin extension, is a non-readable, non-editable file that executes on the system, creating its runtime operating system (OS).

It is important to verify a new operating system image file before attempting to load it. To accomplish this, a proprietary checksum algorithm is used to create checksum values for each portion of the application stored within the .bin file during program compilation.

This information can be used to validate the actual file against the checksum values stored within the file during its compilation. If any portion of the image file has become corrupted (for example, the file was truncated or was transferred using ASCII mode instead of binary mode), then this information is reported and the file is deemed unusable.

To validate an operating system software image file, enter the following command at the Exec mode prompt:

```
[local].host_name# show version { /flash | /usb1 | /hd-raid }
[/directory]/filename [all]
```

The output of this command displays the following information:

- Version number
- Description
- Date
- Boot Image
- Size
- Flags
- Platform – ASR5500

If an invalid file is found, the system displays a failure message similar to these:

```
Failure: Image /flash/image_version.bin CRC check failed!
Failure: /flash/image_version.bin, has a bad magic number
```
Configuring the Boot Stack

The boot stack consists of a prioritized listing of operating system software image-to-CLI configuration file associations. These associations determine the software image and configuration file that gets loaded during system startup or upon a reload/reboot. Though multiple associations can be configured, the system uses the association with the highest priority. In the event that there is an error processing this association (for example, one of the files cannot be located), the system attempts to use the association with the next highest priority. Priorities range from 1 to 100, with 1 being the highest priority. The maximum number of boot stack entries that may be configured in the boot.sys file is 10.

Boot stack information is contained in the boot.sys file, described in Understanding the boot.sys File. In addition to boot stack entries, the boot.sys file contains any configuration commands required to define the system boot method as explained in the section that follows.

System Boot Methods

The local-boot method uses software image and configuration files stored locally on the system. Upon system startup or reboot, the system looks on one of its local devices or /hd-raid located on the active MIO/UMIO for the specific software image and accompanying configuration text file. When using the local-booting method, you only need to configure boot stack parameters.

The system can also be configured to obtain its software image from a specific external network server while it is paired with a configuration text file that resides on the system. When using network booting, you need to configure the following:

- Boot stack parameters, which define the files to use and in what priority to use them
- Boot interface and network parameters defining the MIO/UMIO remote management LAN interface and the methods to use to reach the external network server
- Network booting delay time and optional name server parameters defining the delay period (in seconds) to allow for network communications to be established, and the IP address of any Domain Name Service (DNS) name server that may be used

Detailed information on how to configure the system to use the network booting method appears in Network Booting Configuration Requirements.

Viewing the Current Boot Stack

To view the boot stack entries contained in the boot.sys file run the Exec mode show boot command.

Important: Operator and inspector-level users can execute the show boot command.

The examples below shows the command output for a local booting configuration. Notice that in these examples both the image file (operating system software) and configuration file (CLI commands) are located on the /flash device.

Important: The StarOS image filename scheme changed with release 16.1. Pre-16.1, format = “production.image.bin”. For 16.1 onwards, format = “asr5500-image_number.bin”. This change is reflected in the examples provided below.
Example 1 – StarOS releases prior to 16.1:

```bash
boot system priority 18 \
    image /flash/15-0-builds/production.45666.bin \
    config /flash/general_config.cfg

boot system priority 19 \
    image /flash/15-0-builds/production.45717.bin \
    config /flash/general_config_3819.cfg

boot system priority 20 \
    image /flash/15-0-builds/production.45069.bin \
    config /flash/general_config_3665.cfg
```

Example 2 – StarOS release 16.1 onwards:

```bash
boot system priority 18 \
    image /flash/16-1-builds/asr5500-16.1.3.bin \
    config /flash/general_config.cfg

boot system priority 19 \
    image /flash/16-1-builds/asr5500-16.1.1.bin \
    config /flash/general_config_3819.cfg

boot system priority 20 \
    image /flash/16-1-builds/asr5500-16.1.0.bin \
    config /flash/general_config_3665.cfg
```

The example below shows the output for a combination network booting and local booting configuration. Notice in this example that the first two boot stack entries (Priorities 18 and 19) load the image file (operating system software) from an external network server using the Trivial File Transfer Protocol (TFTP), while all configuration files are located on the /flash device.

Also notice the boot network interface and boot network configuration commands located at the top of the boot stack. These commands define what MIO/UMIO remote management LAN interface(s) to use and information about communicating with the external network server that hosts the operating system software image file.

```bash
boot networkconfig static ip address mio1 192.168.1.150 netmask 255.255.255.0
boot delay 15
```

```bash
show boot initial-config
```

To identify the boot image priority that was loaded at the initial boot time enter:

```bash
show boot initial-config
```

The example below displays the output:

```
[local]host_name# show boot initial-config
Initial (boot time) configuration:
    image tftp://192.168.1.161/tftpboot/image_version.bin \
    config /flash/config_name.cfg
    priority 1
```
Adding a New Boot Stack Entry

**Important:** Before performing this procedure, verify that there are less than 10 entries in the boot.sys file and that a higher priority entry is available (i.e. that minimally there is no priority 1 entry in the boot stack). Refer to *Viewing the Current Boot Stack* for more information.

If priority 1 is in use, then you must renumber the existing entry(ies) to ensure that at least that priority is available. The maximum number of boot stack entries that can be contained in the `boot.sys` file is 10. If there are already 10 entries in the boot stack, you must delete at least one of these entries (typically, the lowest priority) and, if necessary, renumber some or all of the other entries before proceeding. Refer to *Deleting a Boot Stack Entry* for more information.

This procedure details how to add new boot stack entries to the `boot.sys` file. Make sure you are at the Exec mode prompt and enter the following commands:

```plaintext
configure
   boot system priority number image image_url config config_url
```

The following command creates a new boot stack entry, using a boot priority of 3.

```
boot system priority 3 image /flash/image_filename.bin config /flash/config_name.cfg
```

**Important:** Boot stack changes saved to the boot.sys file are not executed until the system is rebooted.

Synchronize the local file systems on the MIO/UMIOs with the following command:

```
fielsystem synchronize all
```

Deleting a Boot Stack Entry

This procedure details how to remove an individual boot stack entry from the boot.sys file. Make sure you are at the Exec mode prompt and enter the following commands:

```plaintext
configure
   no boot system priority number
```

Where `number` specifies the boot priority used for the boot stack entry. This command removes that specific entry from the boot stack, causing the boot.sys file to be overwritten.
Network Booting Configuration Requirements

Configuring the Boot Interface

Boot interface parameters define the MIO/UMIO management LAN interface that the system will use to communicate with the management network when using the network booting method.

This procedure details how to configure the boot interface for reliable communications with your network server. Make sure you are at the Exec mode prompt.

Step 1  Enter the Global Configuration mode by entering the following command:

```plaintext
[local]host_name# configure
```

The following prompt appears:

```plaintext
[local]host_name(config)#
```

Step 2  Enter the following command:

```plaintext
[local]host_name(config)#boot interface { local-eth1 | local-eth2 } medium
{ auto | speed { 10 | 100 | 1000 } duplex { full | half } } media { rj45 | sfp }
```

**Important:** For complete information about the above command, see the Global Configuration Mode Commands chapter in the Command Line Interface Reference.

Use port 1 for network booting.

If the speed is manually configured, you must also configure the duplex mode. In addition, you must ensure that the network server configuration supports the speed and duplex configuration.

Network speed for MIO/UMIO is fixed at 1000.

Ethernet networking rules dictate that if a device’s interface is configured for auto-negotiation is communicating with a device that is manually configured to support full duplex, the first device will negotiate to the manually configured speed of the second device, but will only communicate in half duplex mode.

The media for MIO/UMIO port 1 is fixed at rj45.

Step 3  Save the configuration as described in the Verifying and Saving Your Configuration chapter.

Configuring the Boot Network

Boot network parameters define the protocols and IP address information for MIO/UMIO interfaces used to reach the external network server that hosts the operating system software image file. To configure boot network parameters, make sure you are at the Exec mode prompt.

Step 1  Enter the Global Configuration mode by entering the following command:

```plaintext
[local]host_name(config)#configure
```
The following prompt appears:

```
[local]host_name(config)#
```

**Step 2** Enter the following command:

```
[local]host_name(config)# boot networkconfig { dhcp | { { dhcp-static-fallback | static } ip address mio5 ip_address5 [ mio6 ip_address6 ] netmask subnet_mask [ gateway gw_ip_address ] } }
```

**Important:** For complete information about the above command, see the *Global Configuration Mode Commands* chapter in the *Command Line Interface Reference*.

The following command configures the boot network to communicate using DHCP, with a static-fallback IP address for MIO/UMIO in slot 5 of 192.168.206.101 and a Class C netmask.

```
[local]host_name(config)# boot networkconfig dhcp-static-fallback ip address mio5 192.168.206.101 netmask 255.255.255.0
```

The next example uses static IP addresses for MIO/UMIO in slot 5, which can access the external network server through a gateway whose IP address is 135.212.10.2.

```
[local]host_name(config)# boot networkconfig static ip address mio5 192.168.206.101 netmask 255.255.255.0 gateway 135.212.10.2
```

**Step 3** Save the configuration as described in the *Verifying and Saving Your Configuration* chapter.

### Configuring Boot Network Delay Time

An optional delay period, in seconds, can be configured for systems booting from a network. The purpose of this parameter is to allow time for external devices, such as switches, that use the Spanning Tree Protocol (STP) to determine the network route to a specified IP address.

To configure a boot network delay, enter the following command from the Global Configuration mode prompt.

```
[local]host_name(config)# boot delay time
```

Where `time` is an integer from 1 to 300 seconds before attempting to contact the external network server. If your network uses STP, a typical delay time of 30 seconds should suffice.

**Important:** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

### Configuring a Boot Nameserver

To enter the hostname of the network server that hosts the operating system software image, first configure the IP address of the Domain Name Service (DNS) server, referred to as a name server, that can resolve the host name for the machine.
To configure a boot nameserver address, enter the following command from the Global Configuration mode prompt.

```
[local] host_name(config)# boot nameserver ip_address
```

Where `ip_address` is the IP address of the DNS server entered in IPv4 dotted-decimal notation.

**Important:** Save the configuration as described in the *Verifying and Saving Your Configuration* chapter.
Upgrading the Operating System Software

The following information is required prior to performing a software upgrade:

- Current operating system version
- New operating system version
- Upgrade method

Identifying OS Release Version and Build Number

The operating system can be configured to provide services and perform pre-defined functions through commands issued from the CLI or through the Web Element Manager application.

The operating system software is delivered as a single binary file (.bin file extension) and is loaded as a single instance for the entire system.

- For StarOS releases prior to 16.1, the image filename is identified by its release version and corresponding build number. For example: `production.build_number.asr5500.bin`.
- For StarOS release 16.1 onwards, the image filename is identified by its platform type and release number. For example, `asr5500-release_number.bin`.

The software version information can be viewed from the CLI in the Exec mode by entering the `show version` command.

```
[local]host_name# show version
```

Verify Free Space on the /flash Device

Verify that there is enough free space on the /flash device to accommodate the new StarOS image file by entering the following Exec mode command:

```
[local]host_name# directory /flash
```

The following is an example of the type of directory information displayed:

```
-rwrxrwx-x 1 root root 7334 May  5 17:29 asr-config.cfg
-rwrxrwx-x 1 root root 399 Jun  7 18:32 system.cfg
-rwrxrwx-x 1 root root 10667 May 14 16:24 testconfig.cfg
-rwrxrwx-x 1 root root 10667 Jun  1 11:21 testconfig_4.cfg
-rwrxrwx-x 1 root root 5926 Apr  7 16:27 tworpcontext.cfg
-rwrxrwx-x 1 root root 15534 Aug  4 13:31 test_vlan.cfg
-rwrxrwx-x 1 root root 2482 Nov 18 11:09 gateway2.cfg
-rwrxrwx-x 1 root root 159106048 Dec 31 2011 image_filename
1136352 /flash
Filesystem 1k-blocks Used Available Use% Mounted on
/var/run/storage/flash/part1 3115468 1136352 30018336 4%
/mnt/user/.auto/onboard/flash
```
Note the “Available” blocks in the last line of the display. After displaying the directory information, the CLI returns to root and the following prompt appears:

[local]host_name#

Download the Software Image from the Support Site

Access to the Cisco support site and download facility is username and password controlled. You must have an active customer account to access the site and download the StarOS image.

Download the software image to a network location or physical device (USB stick) from which it can be uploaded to the /flash device.

Contact your Cisco representative or Cisco TAC for additional information.

Transfer StarOS Image to /flash on the Chassis

Transfer the new operating system image file to the /flash device on the MIO/UMIO using one of the following methods:

- Copy the file from a network location or local device plugged in into the MIO/UMIO by entering the following command:

[local]host_name# copy from_url to_url [-noconfirm]

- Transfer the file to the /flash device using an FTP client with access to the system.

  Important: Whenever transferring an operating system software image file using the file transfer protocol (FTP), the FTP client must be configured to transfer the file using binary mode. Failure to use binary transfer mode will make the transferred operating system image file unusable.

- Transfer the file to the /flash device using an SFTP client with access to the system.

Verify that the image file was successfully transferred to the /flash device by running the following Exec mode command:

[local]host_name# directory /flash

The image filename should appear in the displayed output.

Run the show version /flash/image_filename command to verify the build information.

[local]host_name# show version /flash/image_filename.bin

Saving a Copy of the Current Configuration File

Prior to upgrading to a new software release, you should copy and rename the current configuration file to the /flash device and to an off-chassis location (external memory device or network URL). This renamed copy assures that you will have a fallback, loadable configuration file should a problem be encountered during the upgrade.
Downgrading from Release 15.0 to 14.0

Release 14 and Release 15 chassis IDs use different encryption formats. Release 15 will recognize a Release 14 chassis ID and consider it as valid. Upgrading from 14.x to 15.0 will not require changing the chassis ID or configuration file.

However, if the chassis key is reset in Release 15 through the setup wizard or `chassis-key` CLI command, a new chassis ID will be generated in Release 15 format (44 instead of 16 characters). Release 14 builds will not recognize the 44-character chassis ID. If the chassis is subsequently downgraded to Release 14, a new 16-character chassis ID will be generated. To accommodate the old key format, you must save the configuration file in pre-v12.2 format before the downgrade. If you attempt to load a v15 configuration file on the downgraded chassis, StarOS will not be able to decrypt the password/secrets stored in the configuration file.

Off-line Software Upgrade

An off-line software upgrade can be performed for any system, upgrading from any version of operating system software to any version, regardless of version number. This process is considered off-line because while many of the steps can be performed while the system is currently supporting sessions, the last step of this process requires a reboot to actually apply the software upgrade.

This procedure assumes that you have a CLI session established and are placing the new operating system image file onto the local file system. To begin, make sure you are at the Exec mode prompt:

```
[local]host_name#
```

Configure a Newcall Policy

Configure a newcall policy from the Exec mode to meet your service requirements. When enabled the policy redirects or rejects new calls in anticipation of the chassis reload that completes the upgrade process. This reduces the amount of service disruption to subscribers caused by the system reload that completes the upgrade.

**Important:** Newcall policies are created on a per-service basis. If you have multiple services running on the chassis, you can configure multiple newcall policies.

The syntax for newcall policies is described below:

```
[local]host_name# newcall policy { asngw-service | asnpn-service | sgsn-service } { all | name service_name } reject

[local]host_name# newcall policy cscf-service { all | name service_name } { redirect target_ip_address [ weight weight_num ] ... target_ip_address16 [ weight weight_num ] | reject }

[local]host_name# newcall policy { fa-service | lns-service | mipv6ha-service } { all | name service_name } reject

[local]host_name# newcall policy { ha-service | pdsn-service} { all | name service_name } { redirect target_ip_address [ weight weight_num ] [ target_ip_address2 [ weight weight_num ] ... target_ip_address16 [ weight weight_num ] | reject }
```
Upgrading the Operating System Software

[local]host_name# newcall policy ggsn-service { apn name apn_name | all | name service_name } reject

[local]host_name# newcall policy hnbgw-service { all | name service_name } reject

[local]host_name# newcall policy { pcc-af-service | pcc-policy-service | all | name service_name } reject

[local]host_name# newcall policy {pcc-af-service | pcc-policy-service | all | name service_name } reject

[local]host_name# newcall policy mme-service {all | name service_name } reject

For complete information about the above commands, see the Exec Mode Commands chapter of the Command Line Interface Reference.

Configure a Message of the Day Banner

Optional: Configure a “Message of the Day” banner informing other management users that the system will be rebooted by entering the following command from the Global Configuration mode prompt.

[local]host_name(config)# banner motd “banner_text”

banner_text is the message that you would like to be displayed and can be up to 2048 alphanumeric characters. Note that banner_text must begin with and end in quotation marks (“ “). For more information in entering CLI banner information, see the CLI Reference. The banner is displayed when an administrative user logs onto the CLI.

Back up the Current CLI Configuration File

Back up the current CLI configuration file by entering the following command:

[local]host_name# copy from_url to_url [-noconfirm]

This creates a mirror-image of the CLI configuration file linked to the operating system defined in the current boot stack entry.

The following command example creates a backup copy of a file called general.cfg located on the /flash device to a file called general_3652.cfg:

[local]host_name# copy /flash/general.cfg /flash/general_3652.cfg

Create a New Boot Stack Entry

Create a new boot stack entry for the new file group, consisting of the new operating system image file and the currently used CLI configuration file by entering the following Global Configuration command:

[local]host_name(config)# boot system priority number image image_url /flash filename config cfg_url /flash,filename

Assign the next highest priority to this entry, by using the <N-1> method, wherein you assign a priority number that is one number less than your current highest priority.
Important: Run the Exec mode `show boot` command to verify that there are less than 10 entries in the boot.sys file and that a higher priority entry is available (minimally there is no priority 1 entry in the boot stack).

If priority 1 is in use, you must renumber the existing entries to ensure that at least that priority is available.

The maximum number of boot stack entries that can be contained in the boot.sys file is 10. If there are already 10 entries in the boot stack, you must delete at least one of these entries (typically, the lowest priority) and, if necessary, renumber some or all of the other entries before proceeding. Use the `no boot system priority` command to delete a boot stack entry.

```
[local]host_name# configure
[local]host_name(config)# no boot system priority number
```

To add new boot stack entries to the boot.sys file enter the following commands:

```
[local]host_name# configure
[local]host_name(config)# boot system priority number image image_url config
cfg_url
```

For information on using the `boot system priority` command, refer to the Adding a New Boot Stack Entry section.

Synchronize File Systems

Synchronize the local file systems on the management cards by entering the following command:

```
[local]host_name# filesystem synchronize all
```

Save the Running Configuration

Save the currently running, upgraded configuration prior to rebooting the chassis.

To save the running configuration to the current configuration file, enter the following command:

```
[local]host_name# save configuration /flash
```

Reboot the Chassis

Reboot the chassis by entering the following command:

```
[local]host_name# reload [-noconfirm]
```

As the system reboots, it loads the new operating system software image and its corresponding CLI configuration file using the new boot stack entry configured earlier.

After the system reboots, establish a CLI session and enter the `show version` command to verify that the active software version is correct.

Optional for PDSN: If you are using the IP Pool Sharing Protocol during your upgrade, refer to Configuring IPSP Before the Software Upgrade in the PDSN Administration Guide.
Verify the Running Software Version

After the system has successfully booted, verify that the new StarOS version is running by executing the Exec mode `show version` command.

```
[localhost_name#] show version
```

Restoring the Previous Software Image

If for some reason you need to undo the upgrade, perform the upgrade again except:

- Specify the locations of the upgrade software image and configuration files.
  then
- Specify the locations of the original software image and configuration files.

Upgrading ICSR Chassis

The procedure for upgrading primary and backup ICSR chassis is described in *Interchassis Session Recovery*. Essentially the procedure requires upgrading the primary and standby chassis using the off-line method while each is in standby mode.

Performing Dynamic Software Updates

StarOS allows the runtime loading of plugins. All StarOS builds include a “default” baseline plugin.

This feature is currently used to dynamically update the detection logic used to filter P2P applications via the Application Detection and Control (ADC) feature.

Patching is the process used to install a plugin as an incremental update to a StarOS release. One plugin can be provided to multiple, compatible, concurrent product releases. A plugin is distributed in the form of a compressed distribution kit via the internet or by other means (USB stick, CD, etc.).

A plugin is a functional software entity that provides incremental updates to a pre-existing StarOS software component. Plugins have the characteristic of being dynamically loadable at runtime and do not require a system restart. A plugin has a name and one or more versions. All plugin names are known to the system at product release.

For complete information on the Dynamic Software Update process, refer to the *ADC Administration Guide*. 
Managing License Keys

License keys define capacity limits (number of allowed subscriber sessions) and available features on your system. Adding new license keys allows you to increase capacity and add new features as your subscriber base grows.

New System License Keys

New systems are delivered with no license keys installed. In most cases, you receive the license key in electronic format (usually through e-mail).

When a system boots with no license key installed a default set of restricted session use and feature licenses is installed. The following Exec Mode command lists the license information:

```
[local]host_name# show license information
```

**Important:** With no license key installed, the session use licenses for PDSN, HA, GGSN, and L2TP LNS are limited to 10,000 sessions.

The license keys on the ASR 5500 are stored in EEPROM on the chassis midplane. Both MIO/UMIOs access this EEPROM when booting.

Session Use and Feature Use Licenses

Session use and feature use licenses are software mechanisms that provide session limit controls and enable special features within the system. These electronic licenses are stored in the system's configuration file that is loaded as part of the system software each time the system is powered on or restarted.

- Session use licenses limit the number of concurrent sessions that a system is capable of supporting per service type and are acquired on an as-needed basis. This allows carriers to pay only for what they are using and easily increase capacity as their subscriber base grows.
- Feature use licenses enable specific features/functionality within the system and are distributed based on the total number of sessions supported by the system.

Installing New License Keys

Use the instructions below to install a new license key.

Cutting and Pasting the Key

If you have a copy of the license, use the following configuration to cut and paste just the license key part:

**Step 1**

From the Exec mode, enter the following:

```
configure

license key license

exit
```
**Managing License Keys**

`license` is the license key string. The license can be an alphanumeric string of 1 through 1023 characters that is case sensitive. Copy the license key as shown in the example below, including the “\" (double-quote slash). Please note: this is not a functional license.

```
"\VER=1|C1M=000-0000-00|C1S=03290231803|C2M=11-1111-11-1|C2S=\STCB21M82003R0411A4|DOI=0000000000|DOE=00000000|ISS=1|NUM=13459|00000000000000|LSP=00000000|LSH=00000000|LSG=5000000|LSL=5000000|FIS=Y|FR4=Y|FP=0|FS=0|FTC=Y|FME=Y|FCR=Y|FSR=Y|FPM=Y|FID=Y|SIG=MCwCF\Esnq6BzXdmyfLe7rHcD4sVP2bzAhQ3IeHDoyyd6388jHsHD99sg36SG267gshssja77
```

**Step 2** Verify that the license key just entered was accepted by entering the following command at the Exec mode prompt:

```
[local]\host_name# show license key
```

The new license key should be displayed. If it is not, return to the Global configuration mode and re-enter the key using the `license key` command.

**Important:** An invalid license will not be accepted. A Failure error will appear in the output of the `license key` command when you attempt to configure an invalid license key. If you use the `-force` option to install an expiring license key, the license will be placed into a 30-day grace period. StarOS will generate daily syslog error messages and SNMP traps during the grace period. The output of the `show license information` command will indicate “License State” as “Not Valid”.

**Step 3** Verify that the license key enabled the correct functionality by entering the following command:

```
[local]\host_name# show license information
```

All license keys and the new session capacity or functionality enabled should be listed. If the functionality or session capacity enabled by the new key is incorrect, please contact your service representative.

**Step 4** Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

**Caution:** Failure to save the new license key configuration in the current CLI configuration file will result in the loss of any of the new features enabled by the license key once the system is reloaded.

**Adding License Keys to Configuration Files**

License keys can be added to a new or existing configuration file.

**Important:** License key information is maintained as part of the CLI configuration. Each time a key is installed or updated, you must re-save the configuration file.

**Step 1** Open the configuration file to which the new license key commands are to be copied.

**Step 2** Copy the license as shown in the example, including the “\" (double-quote slash). Please note: this is not a functional license.
Software Management Operations

Managing License Keys

Step 3  Paste the license key into the configuration

**Important**: Paste the license key information at the beginning of the configuration file to ensure the system has the expected capacity and features before it configures contexts.

Step 4  Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

License Expiration Behavior

When a license expires, there is a built-in grace period of 30 days that allows normal use of the licensed session use and feature use licenses. This allows you to obtain a new license without any interruption of service.

The following Exec mode command lists the license information including the date the grace period is set to expire:

```
show license information
```

Requesting License Keys

License keys for the system can be obtained through your Cisco account representative. Specific information is required before a license key may be generated:

- Sales Order or Purchase Order information
- Desired session capacity
- Desired functionality
- Midplane (chassis) serial number

To obtain the ASR 5500 chassis serial number, at the Exec mode prompt enter the `show card hardware 5` command. Look under the “MEC” heading for the “UDI Serial Number” as shown in the example below:

```
MEC:
    Description : MEC
    Cisco Part Number : 73-14501-01 A0
    UDI Serial Number : FLM154300D8
    UDI Product ID : ASR55-MEC
    UDI Version ID : V01
```

Viewing License Information

To see the license detail, enter the following command from the Exec mode:

```
[local]host_name# show license information [ full | key [ full ] ]
```
Deleting a License Key

Use the procedure below to delete the session and feature use license key from a configuration. You must be a security administrator or administrator.

```
configure
    no license key
exit
show license key
```

The output of this command should display: “No license key installed”.

Management Card Replacement and License Keys

License keys are stored on a midplane EEPROM in the ASR 5500 chassis. The MIO/UMIOs share these license keys. There is no need to swap memory cards into replacement MIO/UMIOs.
Managing Local-User Administrative Accounts

Unlike context-level administrative accounts which are configured via a configuration file, information for local-user administrative accounts is maintained in a separate file in flash memory and managed through the software’s Shared Configuration Task (SCT). Because local-user accounts were designed to be compliant with ANSI T1.276-2003, the system provides a number of mechanisms for managing these types of administrative user accounts.

Configuring Local-User Password Properties

Local-user account password properties are configured globally and apply to all local-user accounts. The system supports the configuration of the following password properties:

- **Complexity**: Password complexity can be forced to be compliant with ANSI T1.276-2003.
- **History length**: How many previous password versions should be tracked by the system.
- **Maximum age**: How long a user can use the same password.
- **Minimum number of characters to change**: How many characters must be changed in the password during a reset.
- **Minimum change interval**: How often a user can change their password.
- **Minimum length**: The minimum number of characters a valid password must contain.

Refer to the `local-user password` command in the *Global Configuration Mode Commands* chapter of the *Command Line Interface Reference* for details on each of the above parameters.

Configuring Local-User Account Management Properties

Local-user account management includes configuring account lockouts and user suspensions.

Local-User Account Lockouts

Local-user accounts can be administratively locked for the following reasons:

- **Login failures**: The configured maximum login failure threshold has been reached. Refer to the `local-user max-failed-logins` command in the *Global Configuration Mode Commands* chapter of the *Command Line Interface Reference* for details.

- **Password Aging**: The configured maximum password age has been reached. Refer to the `local-user password` command in the *Global Configuration Mode Commands* chapter of the *Command Line Interface Reference* for details.

Accounts that are locked out are inaccessible to the user until either the configured lockout time is reached (refer to the `local-user lockout-time` command in the *Global Configuration Mode Commands* chapter of the *Command Line Interface Reference*) or a security administrator clears the lockout (refer to the `clear local-user` command in the *Exec Mode Commands* chapter of the *Command Line Interface Reference*).

**Important**: Local-user administrative user accounts could be configured to enforce or reject lockouts. Refer to the `local-user username` command in the *Global Configuration Mode Commands* chapter of the *Command Line Interface Reference* for details.
Local-User Account Suspensions

Local-user accounts can be suspended as follows:

```bash
configure
suspend local-user name
```

A suspension can be removed by entering:

```bash
configure
no suspend local-user name
```

Changing Local-User Passwords

Local-user administrative users can change their passwords using the `password change` command in the Exec mode. Users are prompted to enter their current and new passwords.

Security administrators can reset passwords for local-users by entering the following command from the root prompt in the Exec mode:

```bash
[local]host_name# password change username name
```

`name` is the name of the local-user account for which the password is to be changed. When a security administrator resets a local-user’s password, the system prompts the user to change their password the next time they login.

All new passwords must adhere to the password properties configured for the system.
Chapter 9
Monitoring the System

This chapter provides information for monitoring system status and performance using the show commands found in the Command Line Interface (CLI). These commands have many related keywords that allow them to provide useful information on all aspects of the system ranging from current software configuration through call activity and status.

The selection of keywords described in this chapter is intended to provide the most useful and in-depth information for monitoring the system. For additional information on these and other show command keywords, refer to the Exec Mode show Commands chapter of the Command Line Interface Reference.

This chapter includes the following sections:

- SNMP Notifications
- Monitoring System Status and Performance
- Clearing Statistics and Counters
- Monitoring ASR 5500 Hardware Status
SNMP Notifications

In addition to the CLI, the system supports Simple Network Management Protocol (SNMP) notifications that indicate status and alarm conditions. Refer to the SNMP MIB Reference for a detailed listing of these notifications.

Monitoring System Status and Performance

This section contains commands used to monitor the status of tasks, managers, applications and other software components in the system. Output descriptions for most of the commands are located in the Statistics and Counters Reference.

Table 8. System Status and Performance Monitoring Commands

<table>
<thead>
<tr>
<th>To do this:</th>
<th>Enter this command:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>View Administrative Information</strong></td>
<td></td>
</tr>
<tr>
<td>Display Current Administrative User Access</td>
<td></td>
</tr>
<tr>
<td>View a list of all administrative users currently logged on the system</td>
<td><code>show administrators</code></td>
</tr>
<tr>
<td>View the context in which the administrative user is working, the IP address from which the administrative user is accessing the CLI, and a system generated ID number</td>
<td><code>show administrators session id</code></td>
</tr>
<tr>
<td>View information pertaining to local-user administrative accounts configured for the system</td>
<td><code>show local-user verbose</code></td>
</tr>
<tr>
<td>View statistics for local-user administrative accounts</td>
<td><code>show local-user statistics verbose</code></td>
</tr>
<tr>
<td>View information pertaining to your CLI session</td>
<td><code>show cli</code></td>
</tr>
<tr>
<td><strong>Determining System Uptime</strong></td>
<td></td>
</tr>
<tr>
<td>View system uptime (time since last reboot)</td>
<td><code>show system uptime</code></td>
</tr>
<tr>
<td><strong>View NTP Server Status</strong></td>
<td></td>
</tr>
<tr>
<td>View NTP servers status</td>
<td><code>show ntp status</code></td>
</tr>
<tr>
<td><strong>View System Resources</strong></td>
<td></td>
</tr>
<tr>
<td>View all system resources such as CPU resources and number of managers created</td>
<td><code>show resources [ cpu ]</code></td>
</tr>
<tr>
<td><strong>View System Alarms</strong></td>
<td></td>
</tr>
<tr>
<td>View information about all currently outstanding alarms</td>
<td><code>show alarm outstanding all verbose</code></td>
</tr>
<tr>
<td>View system alarm statistics</td>
<td><code>show alarm statistics</code></td>
</tr>
</tbody>
</table>
### To do this: Enter this command:

<table>
<thead>
<tr>
<th><strong>View Congestion-Control Statistics</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>View Congestion-Control Statistics</td>
<td><code>show congestion-control statistics</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>View Remote Management Statistics</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Display SNMP Notification Statistics</td>
<td></td>
</tr>
<tr>
<td>View SNMP notification statistics</td>
<td><code>show snmp notifies</code></td>
</tr>
<tr>
<td>Display SNMP Access Statistics</td>
<td></td>
</tr>
<tr>
<td>View SNMP access statistics</td>
<td><code>show snmp accesses</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Display SNMP Trap History</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>View SNMP trap history</td>
<td><code>show snmp trap history</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Display ORBEM Information</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>View ORBEM client status</td>
<td><code>show orbem client id</code></td>
</tr>
<tr>
<td>View ORBEM session information</td>
<td><code>show orbem session table</code></td>
</tr>
<tr>
<td>View individual ORBEM sessions</td>
<td><code>show orbem session id orbem</code></td>
</tr>
<tr>
<td>View ORBEM status information</td>
<td><code>show orbem status</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>View Port Counters</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Port Datalink Counters</td>
<td></td>
</tr>
<tr>
<td>View datalink counters for a specific port</td>
<td><code>show port datalink counters slot#/port#</code></td>
</tr>
<tr>
<td>Display Port Network Processor Unit (NPU) Counters</td>
<td></td>
</tr>
<tr>
<td>View NPU counters for a specific port</td>
<td><code>show port npu counters slot#/port#</code></td>
</tr>
</tbody>
</table>

---

**Important:** The commands or keywords/variables that are available are dependent on platform type, product version, and installed license(s).

**Important:** Some commands have different outputs depending on the platform type.
Clearing Statistics and Counters

It may be necessary to periodically clear statistics and counters in order to gather new information. The system provides the ability to clear statistics and counters based on their grouping (PPP, MIPHA, MIPFA, etc.).

Statistics and counters can be cleared using the CLI clear command. Refer to the Exec Mode Commands chapter of the Command Line Interface Reference for detailed information on using this command.
Monitoring ASR 5500 Hardware Status

Use the commands contained in this section to monitor the status of the hardware components in the chassis. For output descriptions for most of the commands, refer to the Statistics and Counters Reference.

**Important:** The commands or keywords and variables are dependent on platform type, product version, and installed license(s). Some commands produce different outputs, depending on the platform type.

<table>
<thead>
<tr>
<th>To do this:</th>
<th>Enter this command:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>View the Status of the Power System</strong></td>
<td></td>
</tr>
<tr>
<td>View the status of the PFUs</td>
<td><code>show power chassis</code></td>
</tr>
<tr>
<td>View the power status of the individual chassis slots</td>
<td><code>show power all</code></td>
</tr>
<tr>
<td><strong>View the Status of the Fan Trays</strong></td>
<td></td>
</tr>
<tr>
<td>View the status of the fan trays, including current relative speeds and temperatures.</td>
<td><code>show fans</code></td>
</tr>
<tr>
<td><strong>Determine the Status of Installed Cards</strong></td>
<td></td>
</tr>
<tr>
<td>View a listing of installed application cards</td>
<td><code>show card table</code></td>
</tr>
<tr>
<td><strong>Perform a Hardware Inventory</strong></td>
<td></td>
</tr>
<tr>
<td>View all cards installed in the chassis and their hardware revision, part, serial, assembly, and fabrication numbers</td>
<td><code>show hardware inventory</code></td>
</tr>
<tr>
<td>View details of a specific card. Output contains same information as output of both show hardware inventory and show hardware version board</td>
<td><code>show hardware card slot_number</code></td>
</tr>
<tr>
<td><strong>View Card Diagnostics</strong></td>
<td></td>
</tr>
<tr>
<td>View boot, power and temperature diagnostics</td>
<td><code>show card diag slot_number</code></td>
</tr>
<tr>
<td>View runtime, or real time, information</td>
<td><code>show card info slot_number</code></td>
</tr>
<tr>
<td><strong>View the LED Status of All Installed Cards</strong></td>
<td></td>
</tr>
<tr>
<td>View the LED status for all installed cards</td>
<td><code>show leds all</code></td>
</tr>
<tr>
<td><strong>View Available Physical Ports</strong></td>
<td></td>
</tr>
<tr>
<td>View ports that are available to the system</td>
<td><code>show port table</code></td>
</tr>
<tr>
<td>View detailed information for a specific port</td>
<td><code>show port info slot_number/port_number</code></td>
</tr>
<tr>
<td><strong>View CPU Resource Information</strong></td>
<td></td>
</tr>
<tr>
<td>View CPU resource information</td>
<td><code>show resource cpu</code></td>
</tr>
<tr>
<td>View CPU resources</td>
<td>`show resources { cpu</td>
</tr>
</tbody>
</table>
To do this: | Enter this command:
--- | ---
View CPU usage information | `show cpu table; show cpu info`
**View Component Temperature Information**
View current component temperatures | `show temperature`
View maximum temperatures reached since last timestamp. | `show maximum-temperatures`
Chapter 10
Bulk Statistics

This chapter provides configuration information for:

- Configuring Communication with the Collection Server
- Viewing Collected Bulk Statistics Data
- Manually Gathering and Transferring Bulk Statistics
- Clearing Bulk Statistics Counters and Information
- Bulk Statistics Event Log Messages
Configuring Communication with the Collection Server

Two configuration methods are available for defining how bulk statistics are collected and managed. A “standard” configuration allows the system to automatically assign a number to the bulk statistics file. Optionally, a number can be specified by an administrator in the optional configuration method. Command details and descriptions of keywords and variables for commands in this chapter are located in the Bulk Statistics Configuration Mode Commands and Bulk Statistics File Configuration Mode Commands chapters in the Command Line Interface Reference.

Configuring Standard Settings

The configuration example in this section defines basic operation of the bulk statistics feature. Use the following example configuration to set up the system to communicate with the statistic collection server:

```
configure
  bulkstats mode
    schema name format format_string
    sample-interval time_interval
    transfer-interval xmit_time_interval
    limit mem_limit
  exit
  bulkstats collection
end
```

Configuring Optional Settings

This section describes optional commands that can be used within the Bulk Statistics Configuration mode. Specifically, bulk statistic “files” under which to group the bulk statistic configuration are configured using commands in this section. “Files” are used to group bulk statistic schema, delivery options, and receiver configuration. Because multiple “files” can be configured, this functionality provides greater flexibility in that it allows you to configure different schemas to go to different receivers.

```
configure
  bulkstats mode
    file number
      receiver ip_address { primary | secondary } [ mechanism { { ftp | sftp } login user_name [ encrypted ] password pwd } | tftp ] ]
      receiver mode { redundant | secondary-on-failure }
```
remotefile format naming_convention [ both-receivers | primary-receiver |
secondary-receiver ]

header format header_format

footer format footer_format

exit

name schema format format_string

sample-interval time_interval

transfer-interval xmit_time_interval

limit mem_limit

exit

bulkstats collection

end

Configuring Bulk Statistic Schemas

In each configuration example described in Configuring Standard Settings and Configuring Optional Settings, the following is the primary command used to configure the type of schema and the statistics collected:

name schema format format_string

Refer to the Bulk Statistics Configuration Mode Commands and Bulk Statistics File Configuration Mode Commands chapters in the Command Line Interface Reference for more information regarding supported schemas, available statistics, and proper command syntax.

Verifying Your Configuration

After configuring support for bulk statistics on the system, you can check your settings prior to saving them. Follow the instructions in this section to verify your bulk statistic settings. These instructions assume that you are at the root prompt for the Exec mode.

Check your collection server communication and schema settings by entering the following command:

show bulkstats schemas

The following is an example command output:
Bulk Statistics Server Configuration:
Server State: Enabled
File Limit: 6000 KB
Sample Interval: 15 minutes (0D 0H 15M)
Transfer Interval: 480 minutes (0D 0H 15M)
Collection Mode: Cumulative
Receiver Mode: Secondary-on-failure
Local File Storage: None

Bulk Statistics Server Statistics:
Records awaiting transmission: 114
Bytes awaiting transmission: 8092
Total records collected: 59926
Total bytes collected: 4190178
Total records transmitted: 59812
Total bytes transmitted: 4188512
Total records discarded: 0
Total bytes discarded: 0
Last collection time required: 2 second(s)
Last transfer time required: 0 second(s)
Last successful transfer: Wednesday December 7 12:14:30 EDT 2011
Last successful tx recs: 190
Last successful tx bytes: 13507
Last attempted transfer: Wednesday December 7 12:14:30 EDT 2011

File 1
Remote File Format: /users/ems/server/data/chicago/bulkstat%date%%time%.txt
File Header: "CHI_test %time%"
File Footer: ""

Bulkstats Receivers:
  Primary: 192.168.0.100 using FTP with username administrator
Records awaiting transmission: 0
Bytes awaiting transmission: 0
Total records collected: 0
Total bytes collected: 0
Total records transmitted: 0
Total bytes transmitted: 0
Total records discarded: 0
Total bytes discarded: 0
Last transfer time required: 0 second(s)
No successful data transfers
No attempted data transfers

File 2 not configured

File 3 not configured

File 4 not configured

Saving Your Configuration

Save the configuration as described in the Verifying and Saving Your Configuration chapter.
Viewing Collected Bulk Statistics Data

The system provides a mechanism for viewing data that has been collected but has not been transferred. This data is referred to as “pending data”.

View pending bulk statistics data per schema by entering the following:

```
show bulkstats data
```

The above command also shows the statistics of remote files, if configured as described in Configuring Optional Settings.

The following is a sample output:

```
Bulk Statistics Server Statistics:
 Records awaiting transmission: 1800
 Bytes awaiting transmission: 163687
 Total records collected: 1800
 Total bytes collected: 163687
 Total records transmitted: 0
 Total bytes transmitted: 0
 Total records discarded: 0
 Total bytes discarded: 0
 Last collection time required: 2 second(s)
 Last transfer time required: 0 second(s)
 No successful data transfers
 Last attempted transfer: Monday February 14 15:12:30 EST 2011

File 1
 Remote File Format: %date%%time%
 File Header: "Format 4.5.3.0"
 File Footer: ""
 Bulkstats Receivers:
   Primary: 192.168.1.200 using FTP with username root
 File Statistics:
 Records awaiting transmission: 1800
 Bytes awaiting transmission: 163687
 Total records collected: 1800
 Total bytes collected: 163687
 Total records transmitted: 0
 Total bytes transmitted: 0
 Total records discarded: 0
 Total bytes discarded: 0
 Last transfer time required: 0 second(s)
 No successful data transfers
 Last attempted transfer: Monday February 14 15:12:30 EST 2011

File 2 not configured

File 3 not configured

File 4 not configured
```
Manually Gathering and Transferring Bulk Statistics

There may be times where it is necessary to gather and transfer bulk statistics outside of the scheduled intervals. The system provides commands that allow you to manually initiate the gathering and transferring of bulk statistics.

These commands are issued from the Exec mode.

To manually initiate the gathering of bulk statistics outside of the configured sampling interval, enter the following command:

```
bulkstats force gather
```

To manually initiate the transferring of bulk statistics prior to reaching the maximum configured storage limit, enter the following command:

```
bulkstats force transfer
```

Clearing Bulk Statistics Counters and Information

It may be necessary to periodically clear counters pertaining to bulk statistics in order to gather new information or to remove bulk statistics information that has already been collected. The following command can be used to perform either of these functions:

```
clear bulkstats { counters | data }
```

The `clear bulkstats data` command clears any accumulated data that has not been transferred. This includes any "completed" files that have not been successfully transferred.

Bulk Statistics Event Log Messages

The stat logging facility captures several events that can be useful for diagnosing errors that could occur with either the creation or writing of a bulk statistic data set to a particular location.

The following table displays information pertaining to these events.

<table>
<thead>
<tr>
<th>Event</th>
<th>Event ID</th>
<th>Severity</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local File Open Error</td>
<td>31002</td>
<td>Warning</td>
<td>&quot;Unable to open local file filename for storing bulkstats data&quot;</td>
</tr>
<tr>
<td>Receiver Open Error</td>
<td>31018</td>
<td>Warning</td>
<td>&quot;Unable to open url filename for storing bulkstats data&quot;</td>
</tr>
<tr>
<td>Receiver Write Error</td>
<td>31019</td>
<td>Warning</td>
<td>&quot;Unable to write to url filename while storing bulkstats data&quot;</td>
</tr>
<tr>
<td>Receiver Close Error</td>
<td>31020</td>
<td>Warning</td>
<td>&quot;Unable to close url filename while storing bulkstats data&quot;</td>
</tr>
</tbody>
</table>
Chapter 11
System Logs

This chapter describes how to configure parameters related to the various types of logging and how to viewing their content. It includes the following sections:

- Configuring Event Logging Parameters
- Configuring Active Logs
- Specifying Facilities
- Configuring Trace Logging
- Configuring Monitor Logs
- Viewing Logging Configuration and Statistics
- Viewing Event Logs Using the CLI
- Configuring and Viewing Crash Logs
- Saving Log Files
- Event ID Overview
System Log Types

There are five types of logs that can be configured and viewed on the system:

- **Event**: Event logging can be used to determine system status and capture important information pertaining to protocols and tasks in use by the system. This is a global function that will be applied to all contexts, sessions, and processes.

- **Active**: Active logs are operator configurable on a CLI instance-by-CLI instance basis. Active logs configured by an administrative user in one CLI instance cannot be viewed by an administrative user in a different CLI instance. Each active log can be configured with filter and display properties that are independent of those configured globally for the system. Active logs are displayed in real time as events are generated.

- **Trace**: Trace logging can be used to quickly isolate issues that may arise for a particular connected subscriber session. Traces can be taken for a specific call identification (callid) number, IP address, mobile station identification (MSID) number, or username.

- **Monitor**: Monitor logging records all activity associated with a particular session. This functionality is available in order to comply with law enforcement agency requirements for monitoring capabilities of particular subscribers. Monitors can be performed based on a subscriber’s MSID or username.

- **Crash**: Crash logging stores useful information pertaining to system software crashes. This information is useful in determining the cause of the crash.

---

**Important**: Not all Event Logs can be configured on all products. Configurability depends on the hardware platform and licenses in use.
Configuring Event Logging Parameters

The system can be configured to generate logs based on user-defined filters. The filters specify the facilities (system tasks or protocols) that the system is to monitor and severity levels at which to trigger the generation of the event entries.

Event logs are stored in system memory and can be viewed via the CLI. There are two memory buffers that store event logging information. The first buffer stores the active log information. The second buffer stores inactive logging information. The inactive buffer is used as a temporary repository to allow you to view logs without having data be overwritten. Logs are copied to the inactive buffer only through manual intervention.

Each buffer can store up to 50,000 events. Once these buffers reach their capacity, the oldest information is removed to make room for the newest.

To prevent the loss of log data, the system can be configured to transmit logs to a syslog server over a network interface.

**Important:** For releases after 15.0 MR4, TACACS+ accounting (CLI event logging) will not be generated for Lawful Intercept users (priv-level 15 and 13).

Configuring Event Log Filters

Follow the example below to configure run time event logging parameters for the system:

```plaintext
configure

logging filter runtime facility facility level report_level

logging display { event-verbosity | pdu-data | pdu-verbosity }

end
```

Notes:

- Configure the logging filter that determines which system facilities should be logged and at what levels. For detailed information, see [Specifying Facilities](#) and [Event Severities](#).
- Repeat for every facility that you would like to log.
- Optional: Configure event ID restrictions by adding the `logging disable eventid` command. The system provides the ability to restrict the sending of a specific event ID or a range of event IDs to minimize the amount of data logged to that which is most useful. Repeat to disable logging for additional event IDs or event ID ranges.

Save the configuration as described in the [Verifying and Saving Your Configuration](#) chapter.
Configuring syslog Servers

Information generated by the run time event logging filters can be transmitted to a syslog server for permanent storage.

**Important:** The data transmitted to the syslog server is meant to be used for informational purposes. Functions such as billing and performance monitoring should not be based on syslogs.

**Important:** Although the system provides the flexibility to configure syslog servers on a context-by-context basis, it is recommended that all servers be configured in the local context in order to isolate the log traffic from the network traffic.

Use the following example to configure syslog servers:

```plaintext
configure
  context local
    logging syslog ip_address
  end
```

Notes:

- `ip_address` specifies the IP address of a system log server on the network in IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation.

- A number of keyword options/variables are available for the `logging syslog` command. Refer to the `Context Configuration Mode Commands` chapter in the `Command Line Interface Reference` for more information.

- Repeat as needed to configure additional syslog servers. There is no limit to the number of syslog servers that can be configured.

Save the configuration as described in the `Verifying and Saving Your Configuration` chapter.
Configuring Active Logs

Active logs are event logs that are operator configurable on a CLI instance-by-CLI instance basis. Active logs configured by an administrative user in one CLI instance are not displayed to an administrative user in a different CLI instance. Each active log can be configured with filter and display properties that are independent of those configured globally for the system. Active logs are displayed in real time as they are generated.

Active logs are not written to the active memory buffer by default. To write active logs to the active memory buffer execute the following command in the Global Configuration mode:

```
[local]host_name(config)# logging runtime buffer store all-events
```

When active logs are written to the active memory buffer, they are available to all users in all CLI instances.

Use the following example to configure active logging in Global Configuration mode:

```
[local]host_name(config)# logging filter runtime facility facility level report_level
```

Notes:

- Configure the logging filter that determines which system facilities should be logged and at what levels. For detailed information, see Specifying Facilities and Event Severities.
- Repeat for every facility that you would like to log.
- Optional: Configure event ID restrictions by adding the logging disable eventid command. The system provides the ability to restrict the sending of a specific event ID or a range of event IDs to minimize the amount of data logged to that which is most useful. Repeat to disable logging for additional event IDs or event ID ranges.
- A number of keyword options/variables are available for the Exec mode logging active command. Refer to the Exec Mode Commands chapter in the Command Line Interface Reference for more information.

Once all of the necessary information has been gathered, the Active log display can be stopped by entering the following command in the Exec mode:

```
no logging active
```
Specifying Facilities

**Important:** The actual facilities available for logging vary by platform type, StarOS version and installed product licenses.

The following facilities can be configured for logging event data:

- **a10**: A10 interface facility
- **a11**: A11 interface facility
- **a11mgr**: A11 Manager facility
- **aaa-client**: Authentication, Authorization and Accounting (AAA) client facility
- **aaamgr**: AAA manager logging facility
- **aaaproxy**: AAA Proxy facility
- **aal2**: ATM Adaptation Layer 2 (AAL2) protocol logging facility
- **acl-log**: Access Control List (ACL) logging facility
- **acscrtl**: Active Charging Service (ACS) Controller facility
- **acsmgr**: ACS Manager facility
- **afctrl**: Fabric Controller facility [ASR 5500 only]
- **afmgr**: Fabric Manager logging facility [ASR 5500 only]
- **alarmctrl**: Alarm Controller facility
- **alcap**: Access Link Control Application Part (ALCAP) protocol logging facility
- **alcapmgr**: ALCAP manager logging facility
- **all**: All facilities
- **asngwmgr**: Access Service Network (ASN) Gateway Manager facility
- **asnpcmgr**: ASN Paging Controller Manager facility
- **bfd**: Bidirectional Forwarding Detection (BFD) protocol logging facility
- **bgp**: Border Gateway Protocol (BGP) facility
- **bindmux**: IPCF BindMux-Demux Manager logging facility
- **bngmgr**: Broadband Network Gateway (BNG) Demux Manager logging facility
- **bssap+**: Base Station Sub-system Application Part+ protocol facility for the login interface between the SGSN and the MSC/VLR (2.5G and 3G)
- **bssgp**: Base Station Sub-system GPRS Protocol logging facility handles exchange information between the SGSN and the BSS (2.5G only)
- **callhome**: Call Home application logging facility
- **cap**: CAMEL Application Part (CAP) logging facility for protocol used in prepaid applications (2.5G and 3G)
- **cbsmgr**: Cell Broadcasting Service (CBS) logging facility [HNBGW]
- **cdf**: Charging Data Function (CDF) logging facility
- **cgw**: Converged Access Gateway (CGW) logging facility
- cli: Command Line Interface (CLI) logging facility
- cmp: Certificate Management Protocol (IPSec) logging facility
- connectedapps: SecGW ASR 9000 oneP communication protocol
- connproxy: Controller Proxy logging facility
- credit-control: Credit Control (CC) facility
- csf: IMS/MMD Call Session Control Function (CSCF)
- csfcpmgr: CSCFCPMGR logging facility
- csfmgr: SIP CSCF Manager facility
- csfnpdb: CSCF Number Portability Database (NPDB) logging facility
- csfrtcp: IMS/MMD CSCF RTCP log facility
- csfrtp: IMS/MMD CSCF RTP log facility
- csfttmgr: SIP CSCF Tunnel and Transport Manager facility
- csp: Card/Slot/Port controller facility
- css: Content Service Selection (CSS) facility
- css-sig: CSS RADIUS Signaling facility
- cx-diameter: Cx Diameter Messages facility [CSCF <--> HSS]
- data-mgr: Data Manager Framework logging facility
- dcardctrl: IPSec Daughter Card Controller logging facility
- dcardmgr: IPSec Daughter Card Manager logging facility
- demuxmgr: Demux Manager API facility
- dgmbmgr: Diameter Gmb Application Manager logging facility
- dhcp: Dynamic Host Configuration Protocol (DHCP) logging facility
- dhcpp6: DHCPv6
- dhost: Distributed Host logging facility
- diabase: Diabase messages facility
- diactrl: Diameter Controller proclet logging facility
- diameter: Diameter endpoint logging facility
- diameter-acct: Diameter Accounting
- diameter-auth: Diameter Authentication
- diameter-dns: Diameter DNS subsystem
- diameter-ees: ACS Diameter signaling facility
- diameter-engine: Diameter version2 engine logging facility
- diameter-hdd: Diameter Horizontal Directional Drilling (HDD) Interface facility
- diameter-svc: Diameter Service
- diamproxy: DiamProxy logging facility
- dpath: IPSec Data Path facility
- drvctrl: Driver Controller facility
• **dpath**: IPSec Data Path logging facility
• **drvctrl**: Driver Controller logging facility
• **doulosuemgr**: Doulos (IMS-IPSec-Tool) user equipment manager
• **eap-diameter**: Extensible Authentication Protocol (EAP) IPSec facility
• **eap-ipsec**: Extensible Authentication Protocol (EAP) IPSec facility
• **eap-sta-s6a-s13-s6b-diameter**: EAP/STA/S6A/S13/S6B Diameter messages facility
• **ecs-css**: ACSMGR <-> Session Manager Signalling Interface facility
• **egtp**: eGTP-C logging facility
• **egtpmgr**: enhanced GPRS Tunneling Protocol (eGTP) manager logging facility
• **embms**: evolved Multimedia Broadcast Multicast Services Gateway facility
• **embms**: eMBMS Gateway Demux facility
• **epdg**: evolved Packet Data (ePDG) gateway logging facility
• **event-notif**: Event Notification Interface logging facility
• **evlog**: Event log facility
• **famgr**: Foreign Agent manager logging facility
• **firewall**: Firewall logging facility
• **fng**: Femto Network Gateway (FNG) logging facility
• **gbmgr**: SGSN Gb Interface Manager facility
• **gmm**:
  - For 2.5G: Logs the GPRS Mobility Management (GMM) layer (above LLC layer)
  - For 3G: Logs the access application layer (above the RANAP layer)
• **gprs-app**: GPRS Application logging facility
• **gprs-ns**: GPRS Network Service Protocol (layer between SGSN and the BSS) logging facility
• **gq-rx-tx-diameter**: Gq/Rx/Tx Diameter messages facility
• **gss-gcdr**: GTPP Storage Server GCDR facility
• **gtpc**: GTP-C protocol logging facility
• **gtpcmgr**: GTP-C protocol manager logging facility
• **gtp**: GTP-prime protocol logging facility
• **gtpu**: GTP-U protocol logging facility
• **gtpumgr**: GTP-U Demux manager
• **gx-ty-diameter**: Gx/Ty Diameter messages facility
• **gy-diameter**: Gy Diameter messages facility
• **h248prt**: H.248 port manager facility
• **hamgr**: Home Agent manager logging facility
• **hat**: High Availability Task (HAT) process facility
• **hdctrl**: HD Controller logging facility
• **henbapp**: Home Evolved NodeB (HENB) App facility
• **henbgw**: HENB-GW facility
• **henbgw-pws**: HENB-GW Public Warning System logging facility
• **henbgw-sctp-acs**: HENB-GW access Stream Control Transmission Protocol (SCTP) facility
• **henbgw-sctp-nw**: HENBGW network SCTP facility
• **henbgwdemux**: HENB-GW Demux facility
• **henbgwmgr**: HENB-GW Manager facility
• **hnb-gw**: HNB-GW (3G Femto GW) logging facility
• **hnbmgr**: HNB-GW Demux Manager logging facility
• **hss-peer-service**: Home Subscriber Server (HSS) Peer Service facility
• **igmp**: Internet Group Management Protocol (IGMP)
• **ikev2**: Internet Key Exchange version 2 (IKEv2)
• **ims-authorizatn**: IP Multimedia Subsystem (IMS) Authorization Service facility
• **ims-sh**: HSS Diameter Sh Interface Service facility
• **imsimgr**: SGSN IMSI Manager facility
• **imsue**: IMS User Equipment (IMSUE) facility
• **ip-arp**: IP Address Resolution Protocol facility
• **ip-interface**: IP interface facility
• **ip-route**: IP route facility
• **ipms**: Intelligent Packet Monitoring System (IPMS) logging facility
• **ipne**: IP Network Enabler (IPNE) facility
• **ipsec**: IP Security logging facility
• **ipsecdemux**: IPSec demux logging facility
• **ipsg**: IP Service Gateway interface logging facility
• **ipsgmgr**: IP Services Gateway facility
• **ipsp**: IP Pool Sharing Protocol logging facility
• **kvstore**: Key/Value Store (KVSTORE) Store facility
• **l2tp-control**: Layer 2 Tunneling Precool (L2TP) control logging facility
• **l2tp-data**: L2TP data logging facility
• **l2tpdemux**: L2TP Demux Manager logging facility
• **l2tpmgr**: L2TP Manager logging facility
• **lagmgr**: Link Aggregation Group (LAG) manager logging facility
• **lcs**: Location Services (LCS) logging facility
• **ldap**: Lightweight Directory Access Protocol (LDAP) messages logging facility
• **li**: Refer to the *Lawful Intercept Interface Reference* for a description of this command.
• **linkmgr**: SGSN/BSS SS7 Link Manager logging facility (2.5G only)
- **llc**: Logical Link Control (LLC) Protocol logging facility; for SGSN: logs the LLC layer between the GMM and the BSSGP layers for logical links between the MS and the SGSN
- **local-policy**: Local Policy Service facility
- **location-service**: Location Services facility
- **m3ua**: M3UA Protocol logging facility
- **magmgr**: Mobile Access Gateway manager logging facility
- **map**: Mobile Application Part (MAP) protocol logging facility
- **megadiammgr**: MegaDiameter Manager (SLF Service) logging facility
- **mme-app**: Mobility Management Entity (MME) Application logging facility
- **mme-misc**: MME miscellaneous logging facility
- **mmedemux**: MME Demux Manager logging facility
- **mmemgr**: MME Manager facility
- **mmgr**: Master Manager logging facility
- **mobile-ip**: Mobile IP processes
- **mobile-ip-data**: Mobile IP data facility
- **mobile-ip6**: Mobile IPv6 logging facility
- **mpls**: Multiprotocol Label Switching (MPLS) protocol logging facility
- **mrme**: Multi Radio Mobility Entity (MRME) logging facility
- **mseg-app**: Mobile Services Edge Gateway (MSEG) application logging facility (This option is not supported in this release.)
- **mseg-gtpc**: MSEG GTP-C application logging facility (This option is not supported in this release.)
- **mseg-gtpu**: MSEG GTP-U application logging facility (This option is not supported in this release.)
- **msegmgr**: MSEG Demux Manager logging facility (This option is not supported in this release.)
- **mtp2**: Message Transfer Part 2 (MTP2) Service logging facility
- **mtp3**: Message Transfer Part 3 (MTP3) Protocol logging facility
- **multicast-proxy**: Multicast Proxy logging facility
- **nas**: Non-Access Stratum (NAS) protocol logging facility [MME 4G]
- **netwstrg**: Network Storage facility
- **npuctrl**: Network Processor Unit Control facility
- **npudrv**: Network Processor Unit Driver facility [ASR 5500 only]
- **npumgr**: Network Processor Unit Manager facility
- **npumgr-acl**: NPUMGR ACL logging facility
- **npumgr-drv**: NPUMGR DRV logging facility
- **npumgr-flow**: NPUMGR FLOW logging facility
- **npumgr-fwd**: NPUMGR FWD logging facility
- **npumgr-init**: NPUMGR INIT logging facility
- **npumgr-lc**: NPUMGR LC logging facility
• **npumgr-port**: NPUMGR PORT logging facility  
• **npumgr-recovery**: NPUMGR RECOVERY logging facility  
• **npumgr-rrri**: NPUMGR RRI (Reverse Route Injection) logging facility  
• **npumgr-vpn**: NPUMGR VPN logging facility  
• **npusim**: NPUSIM logging facility [ASR 5500 only]  
• **ntfy-intf**: Notification Interface logging facility [Release 12.0 and earlier versions only]  
• **ocsp**: Online Certificate Status Protocol logging facility.  
• **orbs**: Object Request Broker System logging facility  
• **ospf**: OSPF protocol logging facility  
• **ospfv3**: OSPFv3 protocol logging facility  
• **p2p**: Peer-to-Peer Detection logging facility  
• **pagingmgr**: PAGINGMGR logging facility  
• **pccmgr**: Intelligent Policy Control Function (IPCF) Policy Charging and Control (PCC) Manager library  
• **pdg**: Packet Data Gateway (PDG) logging facility  
• **pdgdmgr**: PDG Demux Manager logging facility  
• **pdfi**: Packet Data Interworking Function (PDIF) logging facility  
• **pgw**: Packet Data Network Gateway (PGW) logging facility  
• **pmm-app**: Packet Mobility Management (PMM) application logging facility  
• **ppp**: Point-To-Point Protocol (PPP) link and packet facilities  
• **pppe**: PPP over Ethernet logging facility  
• **proclet-map-frwk**: Proclet mapping framework logging facility  
• **push**: VPNMGR CDR push logging facility  
• **radius-acct**: RADIUS accounting logging facility  
• **radius-auth**: RADIUS authentication logging facility  
• **radius-coa**: RADIUS change of authorization and radius disconnect  
• **ranap**: Radio Access Network Application Part (RANAP) Protocol facility logging info flow between SGSN and RNS (3G)  
• **rct**: Recovery Control Task logging facility  
• **rdt**: Redirect Task logging facility  
• **resmgr**: Resource Manager logging facility  
• **rf-diameter**: Diameter Rf interface messages facility  
• **rip**: Routing Information Protocol (RIP) logging facility [RIP is not supported at this time.]  
• **rlf**: Rate Limiting Function (RLF) logging facility  
• **rohc**: Robust Header Compression (RoHC) facility  
• **rsvp**: Reservation Protocol logging facility  
• **rUA**: RANAP User Adaptation (RUA) [3G Femto GW - RUA messages] logging facility  
• **s102**: S102 protocol logging facility
specifying facilities

- s102mgr: S102Mgr logging facility
- s1ap: S1 Application Protocol (S1AP) Protocol logging facility
- sabp: Service Area Broadcast Protocol (SABP) logging facility
- saegw: System Architecture Evolution (SAE) Gateway facility
- sbc: SBe protocol logging facility
- sct: Shared Configuration Task logging facility
- scsp: Stream Control Transmission Protocol (SCTP) Protocol logging facility
- sef_ecs: Severely Errored Frames (SEF) APIs printing facility
- sess-gr: SM GR facility
- sessctrl: Session Controller logging facility
- sessmgr: Session Manager logging facility
- sesstrc: session trace logging facility
- sft: Switch Fabric Task logging facility
- sgs: SGs interface protocol logging facility
- sgsn-app: SGSN-APP logging various SGSN “glue” interfaces (for example, between PMM, MAP, GPRS-FSM, SMS).
- sgsn-failures: SGSN call failures (attach/activate rejects) logging facility (2.5G)
- sgsn-gtpc: SGSN GTP-C Protocol logging control messages between the SGSN and the GGSN
- sgsn-gtpu: SGSN GTP-U Protocol logging user data messages between the SGSN and GGSN
- sgsn-mbms-bearer: SGSN Multimedia Broadcast/Multicast Service (MBMS) Bearer app (SMGR) logging facility
- sgsn-misc: Used by stack manager to log binding and removing between layers
- sgsn-system: SGSN System Components logging facility (used infrequently)
- sgsn-test: SGSN Tests logging facility; used infrequently
- sgtpcmgr: SGSN GTP-C Manager logging information exchange through SGTPC and the GGSN
- sgw: Serving Gateway facility
- sh-diameter: Sh Diameter messages facility
- sitmain: System Initialization Task main logging facility
- sls: Service Level Specification (SLS) protocol logging facility
- sm-app: SM Protocol logging facility
- sms: Short Message Service (SMS) logging messages between the MS and the SMSC
- sndep: Sub Network Dependent Convergence Protocol (SNDCP) logging facility
- snmp: SNMP logging facility
- sprmgr: IPCF Subscriber Policy Register (SPR) manager logging facility
- srdb: Static Rating Database
- srp: Service Redundancy Protocol (SRP) logging facility
- **sscfnni**: Service-Specific Coordination Function for Signaling at the Network Node Interface (SSCF-NNI) logging facility
- **sscop**: Service-Specific Connection-Oriented Protocol (SSCOP) logging facility
- **ssh-ipsecc**: Secure Shell (SSH) IP Security logging facility
- **ssl**: Secure Socket Layer (SSL) message logging facility
- **stat**: Statistics logging facility
- **supserv**: Supplementary Services logging facility [H.323]
- **system**: System logging facility
- **tacacsplus**: TACACS+ Protocol logging facility
- **tcap**: TCAP Protocol logging facility
- **testctrl**: Test Controller logging facility
- **testmgr**: Test Manager logging facility
- **threshold**: threshold logging facility
- **ttg**: Tunnel Termination Gateway (TTG) logging facility
- **tucl**: TCP/UDP Convergence Layer (TUCL) logging facility
- **udr**: User Data Record (UDR) facility (used with the Charging Service)
- **user-data**: User data logging facility
- **user-l3tunnel**: User Layer 3 tunnel logging facility
- **usertcp-stack**: User TCP Stack
- **vim**: Voice Instant Messaging (VIM) logging facility
- **vinfo**: VINFO logging facility
- **vmgctrl**: Virtual Media Gateway (VMG) controller facility
- **vmgctrl**: VMG Content Manager facility
- **vpn**: Virtual Private Network logging facility
- **wimax-data**: WiMAX DATA
- **wimax-r6**: WiMAX R6
- **wsg**: Wireless Security Gateway (ASR 9000 Security Gateway)
- **x2gw-app**: X2GW (X2 proxy Gateway, eNodeB) application logging facility
- **x2gw-demux**: X2GW demux task logging facility
Configuring Trace Logging

Trace logging is useful for quickly resolving issues for specific sessions that are currently active. They are temporary filters that are generated based on a qualifier that is independent of the global event log filter configured using the `logging filter` command in the Exec mode. Like event logs, however, the information generated by the logs is stored in the active memory buffer.

All debug level events associated with the selected call are stored.

**Important:** Trace logs impact session processing. They should be implemented for debug purposes only.

Use the following example to configure trace logs in the Exec mode:

```
[local]host_name# logging trace { callid call_id | ipaddr ip_address | msid ms_id | username username }
```

Once all of the necessary information has been gathered, the trace log can be deleted by entering the following command:

```
[local]host_name# no logging trace { callid call_id | ipaddr ip_address | msid ms_id | username username }
```
Configuring Monitor Logs

Monitor logging records all activity associated with all of a particular subscriber’s sessions. This functionality is available in compliance with law enforcement agency requirements for monitoring capabilities of particular subscribers.

Monitors can be performed based on a subscriber’s MSID or username, and are only intended to be used for finite periods of time as dictated by the law enforcement agency. Therefore, they should be terminated immediately after the required monitoring period.

This section provides instructions for enabling and disabling monitor logs.

Enabling Monitor Logs

Use the following example to configure monitor log targets:

```
configure

logging monitor { ip_addr | IPv6_addr | msid id | username name }

end
```

Repeat to configure additional monitor log targets.

Disabling Monitor Logs

Use the following example to disable monitor logs:

```
configure

no logging monitor { ip_addr | IPv6_addr | msid id | username name }

end
```
Viewing Logging Configuration and Statistics

Logging configuration and statistics can be verified by entering the following command from the Exec mode:

```
[local]host_name# show logging [ active | verbose ]
```

When no keyword is specified, the global filter configuration is displayed as well as information about any other type of logging that is enabled.

The following table provides information and descriptions of the statistics that are displayed when the `verbose` keyword is used.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Logging Statistics</strong></td>
<td></td>
</tr>
<tr>
<td>Total events received</td>
<td>Displays the total number of events generated by the system.</td>
</tr>
<tr>
<td>Number of applications receiving events</td>
<td>Displays the number of applications receiving the events.</td>
</tr>
<tr>
<td><strong>Logging Source Statistics</strong></td>
<td></td>
</tr>
<tr>
<td>Event sequence ids by process</td>
<td>Displays a list of system processes that have generated events and the reference identification number of the event that was generated.</td>
</tr>
<tr>
<td>Msg backlog stat with total cnt</td>
<td>Displays the number of event messages that have been back logged in comparison to the total number of events generated.</td>
</tr>
<tr>
<td>LS L2 filter drop rate</td>
<td>Displays the percentage of logging source (LS) layer 2 (L2) event drops.</td>
</tr>
<tr>
<td>Abnormal Log Source Statistics</td>
<td>Displays abnormal logging source (LS) statistics, if any.</td>
</tr>
<tr>
<td><strong>Runtime Logging Buffer Statistics</strong></td>
<td></td>
</tr>
<tr>
<td>Active buffer</td>
<td>Displays the number of events currently logged in the active memory buffer as well as a date/time timestamp for the oldest and most recent entries in the buffer.</td>
</tr>
<tr>
<td>Inactive buffer</td>
<td>Displays the number of events currently logged in the inactive memory buffer.</td>
</tr>
</tbody>
</table>
Viewing Event Logs Using the CLI

Event logs generated by the system can be viewed in one of the following ways:

- **From the syslog server:** If the system is configured to send logs to a syslog server, the logs can be viewed directly on the syslog server.
- **From the system CLI:** Logs stored in the system memory buffers can be viewed directly from the CLI.
- **From the console port:** By default, the system automatically displays events over the console interface to a terminal provided that there is no CLI session active.

This section provides instructions for viewing event logs using the CLI. These instructions assume that you are at the root prompt for the Exec mode.

**Step 1** Copy the active log memory buffer to the inactive log memory buffer.

When the active log memory buffer is copied to the inactive log memory buffer existing information in the inactive log memory buffer is deleted.

Both active and inactive event log memory buffers can be viewed using the CLI in Exec mode. However, it is preferable to view the inactive log in order to prevent any data from being over-written. The information from the active log buffer can be copied to the inactive log buffer by entering the following command:

```
[local]host_name# logs checkpoint
```

**Step 2** View the logs by entering the following command:

```
[local]host_name# show logs
```

**Important:** A number of optional keywords/variables are available for the `show logs` command. Refer to the [Exec Mode Show Commands](#) chapter in the [Command Line Interface Reference](#) for more information.
Configuring and Viewing Crash Logs

In the unlikely even of a software crash, the system stores information that could be useful in determining the reason for the crash. This information can be maintained in system memory or it can be transferred and stored on a network server. The system supports the generation of the following two types of logs:

- **Crash log:** Crash logs record all possible information pertaining to a software crash (full core dump). Due to their size, they can not be stored in system memory. Therefore, these logs are only generated if the system is configured with a Universal Resource Locator (URL) pointing to a local device or a network server where the log can be stored.

- **Abridged crash log:** Crash event records are automatically generated when a software crash occurs and are stored in flash memory on management cards. The abridged crash log contains a list crash event records along with associated dump files. This log allows you to view event records and dump files via CLI commands.

Crash Logging Architecture

The crash log is a persistent repository of crash event information. Each event is numbered and contains text associated with a CPU (minicore), NPU or kernel crash. The logged events are recorded into fixed length records and stored in /flash/crashlog2.

Whenever a crash occurs, the following crash information is stored:

1. The event record is stored in /flash/crashlog2 file (the crash log).
2. The associated minicore, NPU or kernel dump file is stored in the /flash/crsh2 directory.
3. A full core dump is stored in a user configured directory.

**Important:** The crashlog2 file along with associated minicore, NPU and kernel dumps are automatically synchronized across redundant management cards (SMC, MIO/UMIO). Full core dumps are not synchronized across management cards.

The following behaviors apply to the crash logging process.

- When a crash event arrives on an active management card, the event record is stored in its crashlog2 file along with the minicore, NPU, or kernel dump file in /flash/crsh2. The crash event and dump file are also automatically stored in the same locations on the standby management card.

- When a crash log entry is deleted via CLI command, it is deleted on both the active and standby management cards.

- When a management card is added or replaced, active and standby cards will automatically synchronize crash logs and dump files.

- When a crash event is received and the crash log file is full, the oldest entry in the crash log and its related dump file will be replaced with the latest arrived event and dump file on both management cards. Information for a maximum of 120 crash events can be stored on management cards.

- Duplicate crash events bump the count of hits in the existing record and update the new record with the old crash record. Additions to the count use the timestamp for the first time the event happened.
Configuring Software Crash Log Destinations

The system can be configured to store software crash log information to any of the following locations:

- On the ASR 5000:
  - **CompactFlash™**: Installed on the SMC (abridged crash log and associated dump files only)
  - **PCMCIA Flash Card**: Installed in the PCMCIA1 slot on the SMC

- On the ASR 5500:
  - **Flash memory**: Installed on the active MIO/UMIO (abridged crash log and associated dump files only)
  - **USB memory stick**: Installed in the USB slot on the active MIO/UMIO

- On VPC
  - **Flash memory**: Accessible by the virtual machine
  - **USB memory stick**: Installed in the USB slot of the platform (USB slot has been enabled via the hypervisor)

- **Network Server**: Any workstation or server on the network that the system can access using the Trivial File Transfer Protocol (TFTP), the File Transfer Protocol (FTP), the Secure File Transfer Protocol (SFTP), or the Hyper-Text Transfer Protocol (HTTP); this is recommended for large network deployments in which multiple systems require the same configuration.

Crash log files (full core dumps) are written with unique names as they occur to the specified location. The name format is crash-card-cpu-time-core. Where card is the card slot, cpu is the number of the CPU on the card, and time is the Portable Operating System Interface (POSIX) timestamp in hexadecimal notation.

Use the following example to configure a software crash log destination in the Global Configuration mode:

```
configure

    crash enable [ encrypted ] url crash_url

end
```

Notes:

- Refer to the **Global Configuration Mode Commands** chapter in the **Command Line Interface Reference** for more information on this command.

- Repeat to configure additional software crash log destinations. There is no limit to the number of destinations that can be configured.

Save the configuration as described in the **Verifying and Saving Your Configuration** chapter.

Viewing Abridged Crash Log Information Using the CLI

You can view abridged crash information that is stored as a set of event records in flash memory on management cards (/flash/crashlog2). Each crash event record has an associated dump file (minicore, NPU or kernel) that can also be displayed (/flash/crsh2)

Follow the instructions in this section to view software crash events that have occurred on the system. These instructions assume that you are at the root prompt for the Exec mode.
Step 1  View a list of software crash events by entering the following Exec mode command:

```
[local]host_name# show crash { all | list | number crash_num }
```

Notes:
- Run `show crash list` to obtain the number for a specific crash event.
- Run `show crash number crash_num` to display the output for the target crash event.

**Important:** Information about similar crash events is suppressed in the output of this command.

Step 2  View the dump file associated with a specific crash event.

The information contained in the dump file helps identify and diagnose any internal or external factors causing the software to crash.

- Crash # – unique number assigned by StarOS when logging the crash event
- SW Version – StarOS build release in format: RR.n(bbbbb)
- Similar Crash Count – number of similar crashes
- Time of first crash – timestamp when first crash occurred in format: YYYY-MMM-DD+hh:mm:ss
- Failure message – text of event message
- Function – code identifier
- Process – where the crash occurred (Card, CPU, PID, etc.)
- Crash time – timestamp for when the crash occurred in the format: YYYY-MMM-DD+hh:mm:ss time zone
- Recent errno – text of most recent error number.
- Stack – memory stack information
- Last Bounce – information about the messaging received prior to the crash
- Registers – memory register contents
- Current inbound message – hexadecimal information for the current inbound message
- Address Map
- Recent heap activity (oldest first)
- Recent events (oldest first)
- Profile depth

**Important:** The informational content of each crash log entry varies based on the type of crash and the StarOS release.
Saving Log Files

Log files can be saved to a file in a local or remote location specified by a URL. Use the following Exec mode command to save log files:

```
save logs { url } [active] [inactive] [callid call_id] [ event-verbosity evt_verboseness ] [ facility facility ] [ level severity_level ]
[ pdu-data pdu_format ] [ pdu-verbosity pdu_verboseness ] [ since from_date_time
[ until to_date_time ] ] [ ] { grep grep_options | more } ]
```

For detailed information on the `save logs` command, see the `Exec Mode Commands` chapter in the `Command Line Interface Reference`. 
Event ID Overview

**Important:** The use of event IDs depends on the platform type and the licenses running on the platform.

Identification numbers (IDs) are used to reference events as they occur when logging is enabled on the system. As described previously, logs are collected on a per facility basis. Each facility possesses its own range of event IDs as indicated in the following table.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Event ID Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>a10</td>
<td>A10 Protocol Facility</td>
<td>28000-28999</td>
</tr>
<tr>
<td>a11</td>
<td>A11 Protocol Facility</td>
<td>29000-29999</td>
</tr>
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<td>a11mgr</td>
<td>A11 Manager Facility</td>
<td>9000-9999</td>
</tr>
<tr>
<td>aaa-client</td>
<td>AAA Client Facility</td>
<td>6000-6999</td>
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<td>aaamgr</td>
<td>AAA Manager Facility</td>
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<td>aaaproxy</td>
<td>AAA Proxy Facility</td>
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<td>aal2</td>
<td>AAL2 Protocol Facility</td>
<td>173200-173299</td>
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<tr>
<td>acl-log</td>
<td>IP Access Control List (ACL) Facility</td>
<td>21000-21999</td>
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<td>Active Charging Service Controller (ACSCtrl) Facility</td>
<td>90000-90999</td>
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<td>Active Charging Service Manager (ACSMgr) Facility</td>
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<td>afctrl</td>
<td>Ares Fabric Controller (ASR 5500 only)</td>
<td>186000-186999</td>
</tr>
<tr>
<td>afmgr</td>
<td>Ares Fabric Manager (ASR 5500 only)</td>
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<td>alcap</td>
<td>Access Link Control Application Part (ALCAP) Protocol Facility</td>
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<td>ALCAP Manager Facility</td>
<td>160500-160899</td>
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<td>asfprt</td>
<td>ASFPRT Facility</td>
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<td>Access Service Network (ASN) Gateway Manager Facility</td>
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<td>asnpcmgr</td>
<td>ASN Paging/Location-Registry Manager Facility</td>
<td>100500-100999</td>
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<tr>
<td>bcmcs</td>
<td>Broadcast/Multicast Service (BCMCS) Facility</td>
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<td>bfd</td>
<td>Bidirectional Forwarding Detection (BFD) Protocol Facility</td>
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<td>Border Gateway Protocol (BGP) Facility</td>
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<td>bindmux</td>
<td>BindMux Manager Facility [Intelligent Policy Control Function (IPCF)]</td>
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<td>Facility</td>
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<td>Broadband Network Gateway (BNG) Manager Facility</td>
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<td>Base Station System Application Part+ (BSSAP+) Service Facilities</td>
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<td>Base Station System GPRS Protocol (BSSGP) Facility</td>
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<td>chatconf</td>
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<td>Command Line Interface (CLI) Facility</td>
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<td>connproxy</td>
<td>Connection Proxy Facility</td>
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<td>Credit Control Facility</td>
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<td>Call Session Control Function (CSCF) Facility</td>
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<td>CSCF CP Manager Facility</td>
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<td>CSCF TT Manager Facility</td>
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<td>Closed Subscriber Groups (CSG) Facility</td>
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<td>CSG Access Control List (ACL) Facility</td>
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<td>Card/Slot/Port (CSP) Facility</td>
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<td>Content Steering Service (CSS) Facility [ESC]</td>
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<td>Content Service Selection (CSS) RADIUS Signaling Facility</td>
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<td>Cx Diameter Message Facility</td>
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<td>Diameter Gmb (DGMB) Application Manager Facility</td>
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<td>Data Path for IPSec Facility</td>
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<td>Driver Controller Facility</td>
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<td>DS3 and DS3/E Line Card Manager Facility (part of NPU Manager Controller Facility)</td>
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<td>Extensible Authentication Protocol (EAP) Diameter Facility</td>
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<td>EAP IPSec Facility</td>
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<td>Event Data Record (EDR) Facility</td>
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<td>eGTP-C Facility</td>
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<td>eGTP Manager Facility</td>
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<td>eGTP-U Facility</td>
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<td>Evolved Packet Data Gateway (ePDG) Facility</td>
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<td>Foreign Agent (FA) Manager Facility</td>
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<td>Femto Network Gateway (FNG) Facility</td>
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<td>gbrmgr</td>
<td>Gb-Manager Facility</td>
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<td>GGSN-Charging Data Record (G-CDR) Facility</td>
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<td>General Packet Radio Service (GPRS) Application Facility</td>
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<td>GPRS-NS Protocol Facility</td>
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<td>gq-rx-tx-diameter</td>
<td>Gq/Rx/Tx Diameter Messages Facility</td>
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<td>GTPP Storage Server GCDR Facility</td>
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<td>gtpc</td>
<td>GTPC Protocol Facility</td>
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<td>gtpcmgr</td>
<td>GTPC Signaling Demultiplexer Manager Facility</td>
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<td>GTP-PRIME Protocol Facility</td>
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<td>GTPU Protocol Facility</td>
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<td>GTPU Manager Facility</td>
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<td>H.248 Protocol Facility</td>
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<td>High Availability Task (HAT) Facility</td>
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<td>Hard Disk (HD) Controller Facility</td>
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<td>HDD Share Facility</td>
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<td>henbgw mgr</td>
<td>Home eNodeB-GW Manager Facility</td>
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<td>Home NodeB (HNB) Gateway Facility</td>
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<td>HNB Manager Facility</td>
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<td>Home Subscriber Server (HSS) Facility [MME]</td>
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<td>Internet Group Management Protocol (IGMP) Facility</td>
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<td>International Mobile Subscriber Identity (IMSI) Manager Facility</td>
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<td>IP Address Resolution Protocol (ARP) Facility</td>
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<td>Key/Value Store (KVSTORE) Facility</td>
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<td>Link Aggregation Group (LAG) Manager Facility</td>
<td>179000-179999</td>
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<tr>
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<td>Lightweight Directory Access Protocol (LDAP) Request Facility</td>
<td>160000-160499</td>
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<tr>
<td>li</td>
<td>Lawful Intercept (LI) Log Facility</td>
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<td>Link Manager Facility</td>
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<td>Logical Link-Control (LLC) Layer Facility (GPRS)</td>
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<td>local-policy</td>
<td>Local Policy Configuration Facility</td>
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<td>Mobile Access Gateway (MAG) Manager Facility</td>
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<td>map</td>
<td>Mobile Application Part (MAP) Protocol Facility [SS7]</td>
<td>87100-87299</td>
</tr>
<tr>
<td>megadianmgr</td>
<td>MegaDiameter Manager Facility</td>
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</tr>
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<td>mme-app</td>
<td>Mobility Management Entity (MME) Application Facility</td>
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<td>MME Miscellaneous Facility</td>
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<td>mmedemux</td>
<td>MME Demux Manager Facility</td>
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<td>mmemgr</td>
<td>MME Manager Facility</td>
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<td>Mobile IP (MIP) Protocol Facility</td>
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<td>MIP Tunneled Data Facility</td>
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<td>Mobile IPv6 Facility</td>
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<td>MSEG GTPC Application Facility</td>
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<td>msgseg-gtpu</td>
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<td>msgmegr</td>
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<td>Facility</td>
<td>Description</td>
<td>Event ID Range</td>
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<td>mtp2</td>
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<td>Network Processing Unit (NPU) Control Facility</td>
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<td>NPU Driver Facility</td>
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<td>NPU Manager (NPUMGR) Facility</td>
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<td>NPUMGR ACL Facility</td>
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<td>NPUMGR Driver Facility</td>
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<td>NPUMGR Flow Facility</td>
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<td>npumgr-fwd</td>
<td>NPUMGR Forwarding Facility</td>
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<td>NPUMGR Initialization Facility</td>
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<td>ntfy-intf</td>
<td>Event Notification Interface Facility</td>
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<td>Object Request Broker (ORB) System Facility</td>
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<td>Open Shortest Path First (OSPF) Protocol Facility</td>
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<td>Peer-to-Peer (P2P) Facility</td>
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<td>Packet Data Gateway (PDG) Facility</td>
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<td>Packet Data Interworking Function (PDIF) Facility</td>
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<td>Packet Mobility Management (PMM) Application Facility [SGSN]</td>
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<td>Point-To-Point Protocol (PPP) Facility</td>
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<td>pppoe</td>
<td>Point-To-Point Protocol over Ethernet (PPPoE) Facility</td>
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<td>Facility</td>
<td>Description</td>
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<td>PUSH (VPNMgr CDR Push) Facility</td>
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<td>radius-acct</td>
<td>RADIUS Accounting Protocol Facility</td>
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<td>RADIUS Change of Authorization (CoA) and Disconnect Facility</td>
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<td>Resource Manager (RM) Facility</td>
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<td>Rf Diameter Messages Facility</td>
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<td>Routing Information Protocol (RIP) Facility</td>
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<td>Robust Header Compression (ROHC) Protocol Facility</td>
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<td>RANAP User Adaptation (RUA) Protocol Facility</td>
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<td>s1ap</td>
<td>S1 Application Protocol (S1AP) Facility</td>
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<td>System Architecture Evolution Gateway Facility</td>
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<td>Shared Configuration Task (SCT) Facility</td>
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<td>Stream Control Transmission Protocol ( SCTP) Protocol Facility</td>
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<td>sess-gr</td>
<td>SESS-GR Facility</td>
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<td>Session Controller Facility</td>
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<td>Session Manager Facility</td>
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<td>Session Trace Facility</td>
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<td>Switch Fabric Task (SFT) Facility</td>
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<td>SGSN Application Interface Facility</td>
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<td>SGSN Call Failures Facility</td>
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<td>SGSN GTP-C Protocol Facility</td>
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<td>SGSN GTP-U Protocol Facility</td>
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<td>SGSN MBMS Bearer Application (SMGR) Facility</td>
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<td>SGSN Miscellaneous Facility</td>
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<td>Facility</td>
<td>Description</td>
<td>Event ID Range</td>
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<td>sgsn-system</td>
<td>SGSN System Components Facility</td>
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<td>sgsn-test</td>
<td>SGSN Tests Facility</td>
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<td>sgsn2</td>
<td>SGSN2 Facility</td>
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<td>sgtpcmgr</td>
<td>SGSN GTP-C (SGTPC) Manager Facility</td>
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<td>sgw</td>
<td>Serving Gateway (SGW) Facility</td>
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<td>SIPCDPRT Facility</td>
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<td>sitmain</td>
<td>System Initiation Task (SIT) Main Facility</td>
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<td>sm-app</td>
<td>Short Message Service (SMS) Facility</td>
<td>88300-88499</td>
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<td>sms</td>
<td>SMS Service Facility</td>
<td>116800-116899</td>
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<td>snadcp</td>
<td>Sub Network Dependent Convergence Protocol (SNDCP) Facility</td>
<td>115800-115899</td>
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<td>snmp</td>
<td>Simple Network Management Protocol (SNMP) Facility</td>
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<td>sprmgr</td>
<td>Subscriber Policy Register (SPR) Manager Facility</td>
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<td>srdp</td>
<td>Static Rating Database Facility</td>
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<td>srp</td>
<td>Service Redundancy Protocol (SRP) Facility</td>
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<td>sscfini</td>
<td>SSCFNNI Protocol Facility [ATM]</td>
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<td>sscop</td>
<td>SSCOP Protocol Facility [ATM]</td>
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<td>ssh-ipscc</td>
<td>SSH IP Security Facility</td>
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<td>ssl</td>
<td>SSL Facility (this is a customer-specific facility)</td>
<td>156200-157199</td>
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<td>stat</td>
<td>Statistics Facility</td>
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<td>system</td>
<td>System Facility</td>
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<td>tacacs+</td>
<td>TACACS+ Protocol Facility</td>
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<td>taclcp</td>
<td>TACLCP Facility</td>
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<td>testctrl</td>
<td>Test Controller Facility</td>
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<tr>
<td>testmgr</td>
<td>Test Manager Facility</td>
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<td>threshold</td>
<td>Threshold Facility</td>
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<td>Tunnel Termination Gateway (TTG) Facility</td>
<td>130000-130999</td>
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<td>tucl</td>
<td>TCP/UDP Convergence Layer (TUCL) Facility [SS7]</td>
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<td>udr</td>
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<td>79000-79999</td>
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<td>user-data</td>
<td>User-Data Facility</td>
<td>51000-51999</td>
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### Event ID Overview

<table>
<thead>
<tr>
<th>Facility</th>
<th>Description</th>
<th>Event ID Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>user-l3tunnel</td>
<td>User L3 Tunnel Facility</td>
<td>75000-75999</td>
</tr>
<tr>
<td>usertcp-stack</td>
<td>User TCP Stack Facility</td>
<td>173300-173499</td>
</tr>
<tr>
<td>vim</td>
<td>Voice Instant Message (VIM) Facility</td>
<td>60000, 60999</td>
</tr>
<tr>
<td>vinfo</td>
<td>VINFO Facility</td>
<td>82000, 82999</td>
</tr>
<tr>
<td>vmgetrl</td>
<td>Virtual Media Gateway (VMG) Controller Facility</td>
<td>41000, 41999</td>
</tr>
<tr>
<td>vmgctxmgr</td>
<td>VMG Context Manager Facility</td>
<td>43000, 43999</td>
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<td>vpn</td>
<td>Virtual Private Network (VPN) Facility</td>
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<td>wimax-data</td>
<td>WiMAX DATA Facility</td>
<td>104900-104999</td>
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<td>wimax-r6</td>
<td>WiMAX R6 Protocol (Signaling) Facility</td>
<td>104000-104899</td>
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</tbody>
</table>

### Event Severities

The system provides the flexibility to configure the level of information that is displayed when logging is enabled. The following levels are supported:

- **critical**: Logs only those events indicating a serious error has occurred that is causing the system or a system component to cease functioning. This is the highest severity level.
- **error**: Logs events that indicate an error has occurred that is causing the system or a system component to operate in a degraded state. This level also logs events with a higher severity level.
- **warning**: Logs events that may indicate a potential problem. This level also logs events with a higher severity level.
- **unusual**: Logs events that are very unusual and may need to be investigated. This level also logs events with a higher severity level.
- **info**: Logs informational events and events with a higher severity level.
- **trace**: Logs events useful for tracing and events with a higher severity level.
- **debug**: Logs all events regardless of the severity.

Each of the above levels correspond to the “severity” level of the event ID. Therefore, only those event IDs with a “severity” level equal to the logging level are displayed.

### Understanding Event ID Information in Logged Output

This section explains the event information that is displayed when logging is enabled. The following displays a sample output for an event that was logged.

```
2011-Dec-11+5:18:41.993 [cli 30005 info] [8/0/609 cli:8000609
_commands_cli.c:1290] [software internal system] CLI session ended for Security
Administrator admin on device /dev/pts/2
```
The following table describes the elements of contained in the sample output.

**Table 13. Event Element Descriptions**

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-Dec-11+5:18:41.993</td>
<td>Date/Timestamp indicating when the event was generated</td>
</tr>
</tbody>
</table>
| [cli 30005 info] | Information about the event including:  
  - The facility the event belongs to  
  - The event ID  
  - The event’s severity level  
  In this example, the event belongs to the CLI facility, has an ID of 3005, and a severity level of “info”. |
| [8/0/609 cli:8000609 _commands_cli.c:1290] | Information about the specific CLI instance. |
| [software internal system] | Indicates that the event was generated because of system operation. |
| CLI session ended for Security Administrator admin on device /dev/pts/2 | The event’s details. Event details may, or may not include variables that are specific to the occurrence of the event. |
Chapter 12
Troubleshooting

This chapter provides information and instructions for using the system command line interface (CLI) for troubleshooting any issues that may arise during system operation.

Refer to the *ASR 5500 Installation Guide* for comprehensive descriptions of the hardware components addressed by these troubleshooting procedures.

The following topics are included:

- Detecting Faulty Hardware
- Taking Corrective Action
- Verifying Network Connectivity
- Using the System Diagnostic Utilities
Detecting Faulty Hardware

When power is applied to the chassis, power is sequentially applied to the Management I/O (MIO/UMIO) cards, Data Processing Cards (DPC/UDPC/DPC2/UDPC2s), Fabric and Storage Cards (FSCs), and System Status Cards (SSCs).

Each PFU and card installed in the system incorporates light emitting diodes (LEDs) that indicate its operating status. This section describes how to use these status LEDs to verify that all of the installed components are functioning properly.

**Important:** As the system progresses through its boot process, some cards will not exhibit immediate LED activity. Allow several minutes to elapse after a reboot is initiated before checking the LEDs on the various cards to verify that the boot process has successfully completed.

Licensing Issues

The system boot process is governed by StarOS licenses. During the startup process, each card performs a series of Power-On Self Tests (POSTs) to ensure that the hardware is operational. These tests also verify that the card meets all license requirements to operate in this chassis.

Refer to *Chassis Universal License Requirements* in the *ASR 5500 Installation Guide* for additional information on the effect licenses and card types have on the boot process.

Using the CLI to View Status LEDs

Status LEDs for all cards can be viewed via the CLI by entering the Exec mode `show leds all` command.

```
[local]host_name# show leds all
```

The following displays a sample of this command’s output.

```
Slot 01: Run/Fail: Green | Active: Off | Redundant: Green
Slot 02: Run/Fail: Green | Active: Off | Redundant: Green
Slot 03: Run/Fail: Green | Active: Off | Redundant: Green
Slot 05: Run/Fail: Green | Active: Green | Redundant: Green
     Master: Green
Slot 06: Run/Fail: Green | Active: Off | Redundant: Green
     Master: Off
Slot 08: Run/Fail: Green | Active: Off | Redundant: Green
Slot 11: Run/Fail: Green | Active: Green | Redundant: Green
     Status: Green     Service: Off
Slot 12: Run/Fail: Green | Active: Green | Redundant: Green
     Status: Green     Service: Off
Slot 13: Run/Fail: Green | Active: Green | Redundant: Green
Slot 14: Run/Fail: Green | Active: Green | Redundant: Green
Slot 15: Run/Fail: Green | Active: Green | Redundant: Green
Slot 16: Run/Fail: Green | Active: Green | Redundant: Green
Slot 17: Run/Fail: Green | Active: Green | Redundant: Green
```

The status of the two Power Filter Units (PFUs) can be viewed by entering the Exec mode `show power chassis` command.
Checking the LEDs on the PFU

Each PFU has four LEDs along the top edge of its front panel. You must unsnap the top front cover from the chassis to view these LEDs. Each LED is associated with one of the four -48 VDC power feeds connected to the PFU. Each LED on the PFU should illuminate blue for normal operating conditions.

Figure 9. PFU LEDs

The possible states for these LEDs are described in the following table. If the LED is not blue, use the troubleshooting information below to diagnose the problem.

Table 14. PFU LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Power feed is supplying -48VDC to this power plane</td>
<td>None needed.</td>
</tr>
<tr>
<td>None</td>
<td>PFU is not receiving power to one or more of its power planes.</td>
<td>Verify that each circuit breaker is in the ON position. Verify that the RTN and -48VDC lugs are attached properly to the posts on the upper rear of the chassis. Verify that the ground lug is attached properly. Use a voltmeter to verify that the power distribution panel is supplying the correct voltage and sufficient current to the terminals at the rear of the PFU. Check the cables from the power source to the rack for continuity. If a power distribution panel (PDP) is installed between the power distribution frame (PDF) and the chassis, verify that its circuit breakers are set to ON. If a PDP is installed between the PDF and the chassis, check the cables from the PDP to the chassis for continuity.</td>
</tr>
</tbody>
</table>
Troubleshooting

Detecting Faulty Hardware

If all of the above suggestions have been verified, then it is likely that the PFU is not functional. Please contact your service representative.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>If all of the above suggestions have been verified, then it is likely that the PFU is not functional. Please contact your service representative.</td>
</tr>
</tbody>
</table>

Checking the LEDs on the MIO Card

Each MIO/UMIO is equipped with the following LEDs:

- Run/Fail
- Active
- Redundancy
- Master
- Busy

Figure 10. MIO Card Status LEDs

The possible states for all MIO/UMIO LEDs are described in the sections that follow.

MIO Run/Fail LED States

The MIO/UMIO Run/Fail LED indicates the overall status of the card. This LED should be steady green for normal operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.
Table 15. MIO Run/Fail LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card powered with no errors detected</td>
<td>None needed.</td>
</tr>
<tr>
<td>Blinking Green</td>
<td>Card is initializing and/or loading software</td>
<td>This is normal operation during boot-up.</td>
</tr>
<tr>
<td>Red</td>
<td>Card powered with error(s) detected</td>
<td>Errors were detected during the Power On Self Tests (POSTs). It is likely that the errors were logged to the system's command line interface during boot.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power</td>
<td>Verify that the LEDs on the PFUs are blue. If they are not, refer to Checking the LEDs on the PFU for troubleshooting information. Verify that the power source is supplying ample voltage and current to the chassis. Verify that the card is properly installed per the instructions in the ASR 5500 Installation Guide. If all of the above suggestions have been verified, it is possible that the MIO is not functional. Please contact your service representative.</td>
</tr>
</tbody>
</table>

MIO Active LED States

The Active LED on the MIO/UMIO indicates that the software is loaded on the card and it is ready for operation. For the MIO installed in chassis slot 5, this LED should be green for normal operation. For the MIO installed in slot 6, this LED should be off for normal operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

Table 16. Active LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card is active</td>
<td>None needed for the MIO/UMIO in slot 5. If green for the MIO/UMIO in slot 6, verify that the MIO/UMIO in slot 5 is installed and licensed properly according to the instructions in the ASR 5500 Installation Guide.</td>
</tr>
<tr>
<td>Blinking Green</td>
<td>Tasks or processes being migrated from the active MIO to the standby MIO.</td>
<td>Refer to Monitoring the System for information on determining the status of the MIO/UMIO and system software processes.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power. OR Card has failed.</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to MIO Run/Fail LED States for troubleshooting information.</td>
</tr>
</tbody>
</table>
MIO Redundancy LED States

The Redundancy LED on the MIO/UMIO indicates that software is loaded on the card, but it is serving as a redundant component. For the MIO/UMIO installed in slot 6, this LED should be green for normal operation. For the MIO/UMIO installed in slot 8, this LED should be off for normal operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card is in redundant mode</td>
<td>None needed. If green for the MIO/UMIOs in slot 5 and slot 6, the cards and ports are fully backed up.</td>
</tr>
<tr>
<td>Amber</td>
<td>Card or port on this card is not backed up by other MIO.</td>
<td>Check the status of the other MIO/UMIO. If it has failed or one or more of its ports are no longer active, the system can continue to function but redundancy is compromised. Refer to Monitoring the System for information on determining the status of the MIO/UMIO and system software processes.</td>
</tr>
<tr>
<td>Blinking</td>
<td>Tasks or processes being migrated from the active MIO to the standby MIO.</td>
<td>Refer to Monitoring the System for information on determining the status of the MIO/UMIO and system software processes.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power. OR Card has failed.</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to MIO Run/Fail LED States for troubleshooting information on.</td>
</tr>
</tbody>
</table>

MIO Master LED States

The Master LED on the MIO/UMIO indicates whether the card is in Active or Standby mode.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information also provided to diagnose the problem.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>This card is the Active MIO.</td>
<td>None needed.</td>
</tr>
<tr>
<td>Blinking</td>
<td>Tasks or processes being migrated from the active MIO to the standby MIO.</td>
<td>Refer to Monitoring the System for information on determining the status of the MIO/UMIO and system software processes.</td>
</tr>
<tr>
<td>None</td>
<td>This card is the Standby MIO. OR Card has failed.</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to MIO Run/Fail LED States for troubleshooting information. Refer to Monitoring the System for information on determining the status of the MIO/UMIO and system software processes.</td>
</tr>
</tbody>
</table>
MIO Busy LED States

The *Busy* LED on the MIO/UMIO indicates that the card is accessing the RAID solid state drives on the FSCs. This LED is off when no file storage activity is occurring.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

Table 19. MIO Busy LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Files are being transferred to or accessed from the RAID configuration on the FSCs.</td>
<td>None required.</td>
</tr>
<tr>
<td>None</td>
<td>No RAID activity.</td>
<td>Checking the LEDs on the FSC</td>
</tr>
<tr>
<td></td>
<td>OR RAID configuration is unavailable.</td>
<td></td>
</tr>
</tbody>
</table>

MIO – Interface Link LED States

The *Link* LED associated with a 1000Base-T (management) or 10 Gigabit Ethernet port on an MIO/UMIO daughter card (subscriber traffic) indicates the status of the network link. This LED should be green for normal operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

Table 20. MIO – Interface Link LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Link is up</td>
<td>None needed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>NOTE:</strong> This LED will not indicate the presence of a network link until the interface parameters are set during the software configuration process.</td>
</tr>
<tr>
<td>None</td>
<td>No power to card. OR Link is down.</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power. If it is off, refer to MIO Run/Fail LED States for troubleshooting information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verify that the interface is cabled properly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verify that the device on which the interface is located is cabled and powered properly.</td>
</tr>
</tbody>
</table>

MIO – Interface Activity LED States

The *Activity* LED associated with a 1000Base-T (management) or 10 Gigabit Ethernet port on an MIO/UMIO daughter card (subscriber traffic) indicates the presence of traffic on the network link. This LED should be green when data is being transmitted or received over the interface.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.
Table 21. MIO – Interface Activity LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashing Green</td>
<td>Traffic is present on the link</td>
<td>None needed.</td>
</tr>
<tr>
<td>None</td>
<td>No traffic is present on the link</td>
<td>None needed if there is no activity on the link. Prior to interface configuration, this is normal operation.</td>
</tr>
</tbody>
</table>

Checking the LEDs on the DPC

Each DPC/UDPC or /DPC2/UDPC2 is equipped with status LEDs as listed below:

- Run/Fail
- Active
- Redundancy

The possible states for all of the DPC/UDPC or /DPC2/UDPC2 LEDs are described in the sections that follow.

DPC Run/Fail LED States

The DPC/UDPC or /DPC2/UDPC2 Run/Fail LED indicates the overall status of the card. This LED should be green for normal operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.
Table 22. DPC Run/Fail LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card powered up with no errors detected.</td>
<td>None needed.</td>
</tr>
<tr>
<td>Blinking Green</td>
<td>Card is initializing and/or loading software.</td>
<td>This is normal operation during boot-up.</td>
</tr>
<tr>
<td>Red</td>
<td>Card powered up with error(s) detected.</td>
<td>Errors were detected during the Power On Self Tests (POSTs). It is likely that the errors were logged to the system's command line interface during boot.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power.</td>
<td>Verify that the LEDs on the PFUs are blue. If they are not, refer to Checking the LEDs on the PFU for troubleshooting information. Verify that the power source is supplying ample voltage and current to the chassis. Verify that the card is properly installed and licensed per the instructions in the ASR 5500 Installation Guide. If all of the above suggestions have been verified, it is possible that the DPC/UDPC or /DPC2/UDPC2 is not functional. Please contact your service representative.</td>
</tr>
</tbody>
</table>

DPC Active LED States

The Active LED on the DDPC/UDPCPC or /DPC2/UDPC2 indicates that the software is loaded on the card and that the card is ready for operation. When the system first boots up, all installed DPC/UDPCs or /DPC2/UDPC2s are booted into standby mode. The system must then be configured as to which DPC/UDPCs or /DPC2/UDPC2s should serve as redundant components (remain in standby mode) and which should function as active components.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

Table 23. DPC Active LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card is active.</td>
<td>The first time power is applied to the system, all of the DPC/UDPCs or /DPC2/UDPC2s should be booted into the standby mode. Therefore, this LED should be off.</td>
</tr>
<tr>
<td>Blinking Green</td>
<td>Tasks or processes are being migrated from an active DPC to a standby DPC.</td>
<td>Verify that the Redundancy LED on a standby DPC/UDPC or /DPC2/UDPC2 is also blinking green. If so, there is an issue with the active DPC/UDPC or /DPC2/UDPC2 and it is transferring its processes. Refer to Monitoring the System for information on determining the status of the DPC/UDPC or /DPC2/UDPC2 and system software processes and functionality.</td>
</tr>
</tbody>
</table>
## Troubleshooting

### Detecting Faulty Hardware

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Card is not receiving power. OR Card is in Standby Mode.</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to <strong>DPC Run/Fail LED States</strong> for troubleshooting information. Check the state of the Redundancy LED. If it is green, the card is in standby mode. This is normal operation for the initial power-up. If needed, refer to the Configuring DPC Availability section of System Settings for information on making the card active.</td>
</tr>
</tbody>
</table>

### DPC Redundancy LED States

The *Redundancy* LED on the DPC/UDPC or /DPC2/UDPC2 indicates that software is loaded on the card, but it is serving as a standby component. DPC/UDPCs or /DPC2/UDPC2s support n:1 redundancy; the Redundancy LED should be green on only one DPC/UDPC or /DPC2/UDPC2 for normal system operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

#### Table 24. DPC Redundancy LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card is in standby mode.</td>
<td>None needed. There is at least one DPC/UDPC or /DPC2/UDPC2 in Standby mode.</td>
</tr>
<tr>
<td>Amber</td>
<td>Card is not backed up by a standby DPC.</td>
<td>Check the status of the other DPC/UDPCs or /DPC2/UDPC2s. If one DPC/UDPC or /DPC2/UDPC2 has failed or has been removed from the chassis, the system can continue to function but redundancy is compromised. Refer to <em>Monitoring the System</em> for information on determining the status of the DPC/UDPC or /DPC2/UDPC2 and system software processes.</td>
</tr>
<tr>
<td>Blinking Amber</td>
<td>Tasks or processes being migrated from an active DPC to the standby DPC.</td>
<td>Refer to <em>Monitoring the System</em> for information on determining the status of the DPC/UDPC or /DPC2/UDPC2 and system software processes.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power. OR Card has failed.</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to <strong>DPC Run/Fail LED States</strong> for troubleshooting information.</td>
</tr>
</tbody>
</table>
Checking the LEDs on the FSC

Each FSC is equipped with the following LEDs as shown in the accompanying figure:

- Run/Fail
- Active
- Redundancy
- Drive 1 Activity
- Drive 2 Activity

Figure 12. FSC Status LEDs

The possible states for all FSC LEDs are described in the sections that follow.

FSC Run/Fail LED States

The FSC Run/Fail LED indicates the overall status of the card. This LED should be green for normal operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.
Table 25. FSC Run/Fail LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card powered with no errors detected</td>
<td>None needed.</td>
</tr>
<tr>
<td>Blinking Green</td>
<td>Card is initializing and/or loading software</td>
<td>This is normal operation during boot-up.</td>
</tr>
<tr>
<td>Red</td>
<td>Card powered with error(s) detected</td>
<td>Errors were detected during the Power On Self Tests (POSTs). It is likely that the errors were logged to the system's command line interface during boot.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power</td>
<td>Verify that the LEDs on the PFUs are blue. If they are not, refer to Checking the LEDs on the PFU for troubleshooting information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verify that the power source is supplying ample voltage and current to the chassis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verify that the card is properly installed per the instructions in the ASR 5500 Installation Guide.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If all of the above suggestions have been verified, it is possible that the FSC is not functional. Please contact your service representative.</td>
</tr>
</tbody>
</table>

FSC Active LED States

The *Active* LED on the FSC indicates that the software is loaded on the card and that the card is ready for operation. When the system first boots up, all installed FSCs are booted into ready mode.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

Table 26. FSC Active LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card is active.</td>
<td>The first time power is applied to the system, all of the FSCs should be booted into the ready mode. Therefore, this LED should be on.</td>
</tr>
<tr>
<td>Blinking Green</td>
<td>Tasks or processes being migrated from an active FSC to a standby FSC.</td>
<td>Verify that the <em>Redundancy</em> LED on a standby FSC is also blinking green. If so, there is an issue with the active FSC and it is transferring its processes. Refer to Monitoring the System for information on determining the status of the FSC and system software processes and functionality.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power. OR Card is in Standby Mode.</td>
<td>Verify that the <em>Run/Fail</em> LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to FSC Run/Fail LED States for troubleshooting information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the state of the <em>Redundancy</em> LED. If it is green, the card is in standby mode.</td>
</tr>
</tbody>
</table>
FSC Redundancy LED States

The Redundancy LED on the FSC indicates that software is loaded on the card, but it is serving as a redundant component. FSC support n+1 redundancy; the Redundancy LED should be green on only one FSC for normal system operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card is in redundant mode</td>
<td>None needed. There is at least one FSC in Standby mode.</td>
</tr>
<tr>
<td>Amber</td>
<td>Card is not backed up by a standby FSC.</td>
<td>Check the status of the other FSCs. If one FSC has failed or has been removed from the chassis, the system can continue to function but redundancy is compromised. Refer to Monitoring the System for information on determining the status of the FSC and system software processes.</td>
</tr>
<tr>
<td>Blinking Amber</td>
<td>Tasks or processes being migrated from an active FSC to the standby FSC.</td>
<td>Refer to Monitoring the System for information on determining the status of the FSC and system software processes.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power. OR Card has failed.</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to FSC Run/Fail LED States for troubleshooting information.</td>
</tr>
</tbody>
</table>

FSC Drive n Activity LED States

The Drive 1 Activity and Drive 2 Activity LEDs on the FSC indicate that the RAID solid state drives (SSDs) are being accessed by the MIO. Drive 1 and Drive 2 on each FSC form a RAID 0 configuration.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information also provided to diagnose the problem.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Files are being transferred to or accessed from the RAID configuration by the MIO.</td>
<td>None required.</td>
</tr>
<tr>
<td>None</td>
<td>There is no RAID activity. OR RAID configuration is unavailable.</td>
<td>Check the LEDs on the MIO.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to FSC Run/Fail LED States for troubleshooting information.</td>
</tr>
</tbody>
</table>
Checking the LEDs on the SSC

Each SSC is equipped with the following LEDs as shown in the accompanying figure:

- Run/Fail
- Active
- Redundancy
- System Status
- System Service

Figure 13. SSC Status LEDs

The possible states for all SSC LEDs are described in the sections that follow.

SSC Run/Fail LED States

The SSC Run/Fail LED indicates the overall status of the card. This LED should be green for normal operation. The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.
Table 29. SSC Run/Fail LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card powered with no errors detected</td>
<td>None needed.</td>
</tr>
<tr>
<td>Blinking Green</td>
<td>Card is initializing and/or loading software</td>
<td>This is normal operation during boot-up.</td>
</tr>
<tr>
<td>Red</td>
<td>Card powered with error(s) detected</td>
<td>Errors were detected during the Power On Self Tests (POSTs). It is likely that the errors were logged to the system's command line interface during boot.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power</td>
<td>Verify that the LEDs on the PFUs are blue. If they are not, refer to Checking the LEDs on the PFU for troubleshooting information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verify that the power source is supplying ample voltage and current to the chassis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verify that the card is properly installed per the instructions in the ASR 5500 Installation Guide.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If all of the above suggestions have been verified, it is possible that the SSC is not functional. Please contact your service representative.</td>
</tr>
</tbody>
</table>

SSC Active LED States

The *Active* LED on the SSC indicates that the software is loaded on the card and that the card is ready for operation. When the system first boots up, both SSCs are booted into ready mode.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

Table 30. SSC Active LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card is active.</td>
<td>The first time power is applied to the system, both SSCs should be booted into the ready mode. Therefore, this LED should be on.</td>
</tr>
<tr>
<td>Blinking Green</td>
<td>Tasks or processes being migrated from an active FSC to a standby FSC.</td>
<td>Verify that the <em>Redundancy</em> LED on a Istanbul SSC is also blinking green. If so, there is an issue with the active SSC and it is transferring its processes. Refer to Monitoring the System for information on determining the status of the SSC and system software processes and functionality.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power. <strong>OR</strong> Card is in Standby Mode.</td>
<td>Verify that the <em>Run/Fail</em> LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to the <em>SSC Run/Fail LED States</em> section for troubleshooting information. Check the state of the <em>Redundancy</em> LED. If it is green, the card is in standby mode.</td>
</tr>
</tbody>
</table>
SSC Redundancy LED States

The Redundancy LED on the SSC indicates that software is loaded on the card, but it is serving as a standby component. SSC support 1:1 redundancy; the Redundancy LED should be green on the other SSC for normal system operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

Table 31. SSC Redundancy LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Card is in standby mode</td>
<td>None needed. The other SSC should be in Standby mode.</td>
</tr>
<tr>
<td>Amber</td>
<td>Card is not backed up by the standby SSC.</td>
<td>Check the status of the other SSC. If one it has failed or has been removed from the chassis, the system can continue to function but redundancy is compromised. Refer to Monitoring the System for information on determining the status of the SSC and system software processes.</td>
</tr>
<tr>
<td>Blinking Amber</td>
<td>Tasks or processes being migrated from the active SSC to the standby SSC.</td>
<td>Refer to Monitoring the System for information on determining the status of the SSC and system software processes.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power. OR Card has failed.</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to the SSC Run/Fail LED States section for troubleshooting information.</td>
</tr>
</tbody>
</table>

SSC System Status LED States

The System Status LED on the SSC indicates that there is a loss of service somewhere in the system. If this LED is red, the system requires maintenance or service (for example, the system could not locate a valid software image at boot-up, or a high temperature condition exists).

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information also provided to diagnose the problem.

Table 32. SSC System Status LED States

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>System is operating normally</td>
<td>None required.</td>
</tr>
<tr>
<td>Red</td>
<td>The system has experienced a loss of service.</td>
<td>Refer to Monitoring the System for information on determining the status of system hardware and software processes.</td>
</tr>
<tr>
<td>None</td>
<td>Card is not receiving power</td>
<td>Verify that the Run/Fail LED is green. If so, the card is receiving power and POST results are positive. If it is off, refer to the SSC Run/Fail LED States section for troubleshooting information.</td>
</tr>
</tbody>
</table>
SSC System Service LED States

The System Service LED on the SSC illuminates amber to indicate that the system has experienced a hardware component failure.

This LED is off during normal operation.

The possible states for this LED are described in the following table. If the LED is not green, use the troubleshooting information in the table to diagnose the problem.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amber</td>
<td>System requires maintenance (fan filter, temperature warning, PFU outage etc.).</td>
<td>Monitoring the System for show commands, the outputs of which will assist in further determining the problem. Refer to System Logs for information on how to view logs.</td>
</tr>
<tr>
<td>None</td>
<td>No component failures have been detected. OR Card is not receiving power.</td>
<td>No maintenance needed.</td>
</tr>
</tbody>
</table>

Testing System Alarm Outputs

The system provides the following two physical alarm mechanisms:

- **System Audible Alarm**: Located on the SSC, the speaker is used to provide an audible indicator that a minor, major, or critical alarm has occurred.

- **CO Alarms Interface**: Located on the SSC, this interface provides a DB-15 connector that enables three dry-contact relays (Form C) for the triggering of external audio and/or visual indicators. These indicators can be used to alert that either a minor, major, or critical alarm has occurred.

The operation of these alarms can be tested by issuing the following command:

```
[local]host_name# test alarm { audible | central-office [ critical | major | minor ] }
```

When this command is executed, the specified alarm is activated for a period of 10 seconds. After this time, the alarm will return to its previous condition.
Taking Corrective Action

In the event that an issue was discovered with an installed application or line card, depending on the severity, it may be necessary to take corrective action.

The system provides several redundancy and fail-over mechanisms to address issues with application and line cards in order to minimize system downtime and data loss. These mechanisms are described in the sections that follow.

Switching MIOs

When the system boots up, the MIO/UMIO installed in chassis slot 5 will boot into the Active mode and begin booting other system components. The MIO/UMIO installed in chassis slot 6 will automatically be booted into Standby mode dictating that it will serve as a redundant component. The active MIO/UMIO automatically synchronizes currently running tasks or processes with the standby MIO/UMIO.

In the event of a critical failure on the MIO/UMIO in slot 5, system control will be automatically switched to the standby MIO/UMIO in slot 6. This is a relatively seamless transition because the two are synchronized. The formerly active MIO will then enter the standby mode allowing it to be safely replaced or restored.

In the event that an issue arises that is not severe enough for the system to perform an automatic switchover, a manual switchover can be invoked by executing the following commands from the Exec mode prompt.

**Step 1** Initiate a manual MIO/UMIO switch over by entering the following command:

```
[local]host_name# card switch from <5 or 6> to <6 or 5>
```

You will receive the following prompt:

```
Are You Sure? [Yes|No]:
```

**Step 2** Press Y to start the switchover.

**Step 3** Verify that the switchover was successful by entering the `show card table` command at the Exec mode prompt:

Check the entry in the Oper State column next to the MIO/UMIO just switched. Its state should be Standby.

Busying Out a DPC

This busy-out command moves processes from the source DPC/UDPC to the destination DPC/UDPC, or disables the DPC/UDPC from accepting any new calls. When busy-out is enabled, the DPC/UDPC stops receiving new calls but continues to process calls until they are completed. The command prompt is returned once the command is initiated. The busy-out procedure is completed in background.

**Step 1** Initiate a busy-out by entering the following command:

```
[local]host_name# card busy-out slot_number
```

You will receive the following prompt:

```
Are You Sure? [Yes|No]:
```

**Step 2** Press Y to start the switchover.
Step 3 Verify that the busy-out was successful by entering the `show card table` command at the Exec mode prompt:

Check the entry in the `Oper State` column next to the DPC/UDPC just busied-out. Its state should be `Standby`.

**Migrating a DPC**

When the system boots up, all DPC/UDPCs enter the “standby” mode. The standby mode indicates that the card is available for use but is not configured for operation. Installed components can be made active through the software configuration process. Cards that are not configured to enter the “active” mode will remain in standby mode for use as redundant components.

In the event of the critical failure of a DPC/UDPC, tasks will be automatically be migrated from the active card to a redundant card in standby mode.

In the event that an issue arises that is not severe enough for the system to perform an automatic migration, a manual migration can be initiated. Follow the instructions below to manually initiate a DPC/UDPC migration. These instructions assume you are at the root prompt for the Exec mode.

**Step 1** Initiate a DPC/UDPC migration by entering the following command:

```
[local]host_name# card migration from original_slot# to final_slot#
```

You will receive the following prompt:

```
Are You Sure? [Yes|No]:
```

**Step 2** Press `Y` to start the migration.

**Step 3** Verify that the migration was successful by entering the `show card table` command at the Exec mode prompt.

Check the entry in the `Oper State` column next to the packet processing card that was just migrated from. Its state should be `Standby`. The state of the packet processing card migrated to should be `Active`.

**Halting Cards**

Cards other than MIO/UMIOs that are in either the Active or Standby modes can be halted. Halting these cards places them into the “offline” mode. In this mode, the card is unusable for session processing as either an active or redundant component.

If a card in the active mode is halted, its tasks, processes, or network connections will be migrated or switched to a redundant component prior to entering the offline mode.

This section describes how to initiate a card halt and restore halted components.

**Initiate a Card Halt**

_**Important:**_ Do not initiate a `card halt` for an active FSC if there are less than two active FSCs in the system. The system returns an error message if there are less than two active FSCs. There are similar restrictions when executing the `card reboot` or `card upgrade` commands on active FSCs. Refer to the `Command Line Interface Reference` for detailed information.
Follow the instructions below to manually initiate a card halt. These instructions assume you are at the root prompt for the Exec mode.

**Step 1**  Initiate a manual card migration by entering the following command:

```
[local]host_name# card halt slot#
```

*slot#* is the chassis slot number in which the card to be halted is installed. It can be any integer from 1 through 4, and 7 through 18. You will receive the following prompt:

```
Are You Sure? [Yes|No]:
```

**Step 2**  Press *Y* to initiate the halt operation.

**Step 3**  Verify that the migration was successful by entering the `show card table` command at the Exec mode prompt. Check the entry in the *Oper State* column next to the card that was just halted. Its state should be *Offline*. If the card was in active mode prior to the execution of this command, the state of the redundant component associated with it should now be *Active*.

---

**Restore a Previously Halted Card**

Follow the instructions below to restore a card that was previously halted. These instructions assume you are at the root prompt for the Exec mode.

**Step 1**  Reboot the card to be restored by entering the following command.

```
[local]host_name# card reboot slot# -force
```

You will receive the following prompt:

```
Are You Sure? [Yes|No]:
```

**Step 2**  Press *Y* to start the reboot of the card.

**Step 3**  Verify that the migration was successful by entering the `show card table` command at the prompt. Check the entry in the *Oper State* column next to the card that was just restored. Its state should be the state of that it was in before it was halted.
Verifying Network Connectivity

There are multiple commands supported by the system to verify and/or troubleshoot network connectivity. Note that network connectivity can only be tested once system interfaces and ports have been configured and bound.

The commands specified in this section should be issued on a context-by-context basis. Contexts act like virtual private networks (VPNs) that operate independently of other contexts. Ports, interfaces, and routes configured in one context cannot be tested from another context without additional configuration.

To switch between contexts enter the following command at the root prompt for the Exec mode:

```
[local]host_name# context context_name
```

`context_name` is the name of the context to which you wish to switch. The following prompt appears:

```
[context_name]host_name#
```

Using the ping or ping6 Command

The `ping` or `ping6` command verifies the system’s ability to communicate with a remote node in the network by passing data packets between and measuring the response. This command is useful in verifying network routing and if a remote node is able to respond at the IP layer.

Syntax

The `ping` command has the following syntax:

```
ping host_ipv4_address [ count num_packets ] [ flood ] [ pattern packet_pattern ]
[ size octet_count ] [ src { src_host_name | src_host_ipv4_address } ]
[ vrf vrf_nam ]
```

```
ping6 host_ipv6_address [ count num_packets ] [ flood ] [ pattern packet_pattern ]
[ size octet_count ] [ src { src_host_name | src_host_ipv6_address } ]
[ vrf vrf_nam ]
```

For complete information on the above commands, see the `Exec Mode Commands` chapter of the `Command Line Interface Reference`.

The following displays a sample of a successful `ping` (IPV4) response.

```
PING 192.168.250.1 (192.168.250.1): 56 data bytes
64 bytes from 192.168.250.1: icmp_seq=0 ttl=255 time=0.2 ms
64 bytes from 192.168.250.1: icmp_seq=1 ttl=255 time=0.2 ms
64 bytes from 192.168.250.1: icmp_seq=2 ttl=255 time=0.2 ms
64 bytes from 192.168.250.1: icmp_seq=3 ttl=255 time=0.2 ms
64 bytes from 192.168.250.1: icmp_seq=4 ttl=255 time=0.2 ms
--- 192.168.250.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 0.2/0.2/0.4 ms
```
Troubleshooting

If no response is received from the target follow these troubleshooting procedures:

- Verify that the correct IP address was entered.
- Attempt to ping a different device on the same network. If the ping was successful then it is likely that your system configuration is correct. Verify that the device you are attempting to ping is powered and functioning properly.
- Verify the port is operational.
- Verify that the configuration of the ports and interfaces within the context are correct.
- If the configuration is correct and you have access to the device that you’re attempting to ping, ping the system from that device.
- If there is still no response, it is likely that the packets are getting discarded by a network device. Use the `traceroute` or `traceroute6` and `show ip static-route` commands discussed in this chapter to further troubleshoot the issue.

Using the traceroute or traceroute6 Command

The `traceroute` or `traceroute6` command collects information on the route data will take to a specified host. This is a useful troubleshooting command that can be used to identify the source of significant packet delays or packet loss on the network. This command can also be used to identify bottle necks in the routing of data over the network.

**traceroute – IPv4**

The `traceroute` command has the following syntax:

```
traceroute { host_name | host_ipv4_address } [ count packets ] [ df ] [ maxttl max_ttl ] [ minttl min_ttl ] [ port port_number ] [ size octet_count ] [ src { src_host_name | src_host_ipv4_address } ] [ timeout seconds ] [ vrf vrf_nam ]
```

For complete information on the above command, see the *Exec Mode Commands* chapter of the *Command Line Interface Reference*.

The following displays a sample output.

```
traceroute to 192.168.250.1 (192.168.250.1), 30 hops max, 40 byte packets
1 192.168.250.1 (192.168.250.1) 0.446 ms 0.235 ms 0.178 ms
```

**traceroute6 – IPv6**

The `traceroute6` command has the following syntax:

```
traceroute6 { host_name | host_ipv6_address } [ count packets ] [ maxttl max_ttl ] [ port port_number ] [ size octet_count ] [ src { src_host_name | src_host_ipv6_address } ] [ timeout seconds ] [ vrf vrf_nam ]
```

For complete information on the above commands, see the *Exec Mode Commands* chapter of the *Command Line Interface Reference*. 
The following displays a sample output.

```
traceroute6 to 2001:4A2B::1f3F (2001:4A2B::1f3F), 30 hops max, 40 byte packets
1 2001:4A2B::1f3F (2001:4A2B::1f3F) 0.446 ms 0.235 ms 0.178 ms
```

**Viewing IP Routes**

The system provides a mechanism for viewing route information to a specific node or for an entire context. This information can be used to verify network connectivity and to ensure the efficiency of the network connection. The command has the following syntax:

```
show ip route [ route_ip_address ]
```

```
show ipv6 route [ route_ipv6_address ]
```

For complete information on the above commands, see the *Exec Mode show Commands* chapter of the *Command Line Interface Reference*.

If no keywords are specified, all IP routes within the context’s routing table are displayed.

The following displays a sample of this command’s output showing a context IPv4 routing table.

<table>
<thead>
<tr>
<th>Destination</th>
<th>Nexthop</th>
<th>Protocol</th>
<th>Prec</th>
<th>Cost</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>*0.0.0.0/0</td>
<td>10.0.4.1</td>
<td>static</td>
<td>0</td>
<td>0</td>
<td>SPI01</td>
</tr>
<tr>
<td>*10.0.4.0/24</td>
<td>0.0.0.0</td>
<td>kernel</td>
<td>0</td>
<td>0</td>
<td>SPI01</td>
</tr>
<tr>
<td>*10.0.4.0/32</td>
<td>0.0.0.0</td>
<td>kernel</td>
<td>0</td>
<td>0</td>
<td>SPI01</td>
</tr>
<tr>
<td>*10.0.4.3/32</td>
<td>0.0.0.0</td>
<td>kernel</td>
<td>0</td>
<td>0</td>
<td>SPI01</td>
</tr>
<tr>
<td>*10.0.4.255/32</td>
<td>0.0.0.0</td>
<td>kernel</td>
<td>0</td>
<td>0</td>
<td>SPI01</td>
</tr>
</tbody>
</table>

**Viewing the Address Resolution Protocol Table**

The system provides a mechanism for viewing Address Resolution Protocol (ARP) table information to a specific node or for an entire context. This information can be used to verify that when the system sends an ARP packet, it receives valid responses from other network nodes.

```
[local]host_name# show ip arp [ arp_ip_address ]
```

*arp_ip_address* specifies a specific network node for which to display ARP information. The address can be entered in IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation. If this keyword is not specified, all entries within the context’s ARP table are displayed.

---

**Important:** Restarting the VPN Manager removes all interfaces from the kernel which in turn removes all ARP entries. However, the NPU still retains all of the ARP entries so that there is no traffic disruption. From a user point of view, *show ip arp* is broken since this command gathers information from the kernel and not the NPU.
The following displays a sample of this command’s output showing a context’s ARP table.

Flags codes:
C - Completed, M - Permanent, P - Published, ! - Not answered
T - has requested trailers

<table>
<thead>
<tr>
<th>Address</th>
<th>Link Type</th>
<th>Link Address</th>
<th>Flags</th>
<th>Mask</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.0.4.240</td>
<td>ether</td>
<td>00:05:47:02:20:20</td>
<td>C</td>
<td></td>
<td>MIO1</td>
</tr>
<tr>
<td>10.0.4.7</td>
<td>ether</td>
<td>00:05:47:02:03:36</td>
<td>C</td>
<td></td>
<td>MIO1</td>
</tr>
<tr>
<td>10.0.4.1</td>
<td>ether</td>
<td>00:01:30:F2:7F:00</td>
<td>C</td>
<td></td>
<td>MIO1</td>
</tr>
</tbody>
</table>
Using the System Diagnostic Utilities

The system provides protocol monitor and test utilities that are useful when troubleshooting or verifying configurations. The information generated by these utilities can help identify the root cause of a software or network configuration issue.

This section describes how to use these utilities.

**Important:** Only an administrator with Operator or higher privilege can run the diagnostic utilities described in this section.

Using the Monitor Utility

For troubleshooting purposes, the system provides a protocol monitoring utility. This tool displays protocol information for a particular subscriber session or for every session being processed.

**Caution:** The monitor tool may cause session processing delays and/or data loss. Therefore, it should be used only when troubleshooting.

Using the Protocol Monitor

The protocol monitor displays information for every session that is currently being processed. Depending on the number of protocols monitored, and the number of sessions in progress, a significant amount of data is generated. It is highly recommended that logging be enabled on your terminal client in order to capture all of the information that is generated. Follow the instructions below to invoke and configure the protocol monitoring tool.

**Step 1** Invoke the protocol monitor from the Exec mode by entering the `monitor protocol` command.

```
[local] host_name# monitor protocol
```

An output listing all the currently available protocols, each with an assigned number, is displayed.

**Step 2** Choose the protocol that you wish to monitor by entering the associated number at the `Select:` prompt. A right arrow ( > ) appears next to the protocol you selected.

**Step 3** Repeat step 2 as needed to choose multiple protocols.

**Step 4** Press B to begin the protocol monitor.

```
WARNING!!! You have selected options that can DISRUPT USER SERVICE
Existing CALLS MAY BE DROPPED and/or new CALLS MAY FAIL!!!
(Under heavy call load, some debugging output may not be displayed)
Proceed? - Select (Y)es or (N)o
```
Troubleshooting

Step 5 Enter Y to proceed with the monitor or N to go back to the previous menu.

- C - Control Events (ON)
- D - Data Events (ON)
- E - EventID Info (ON)
- H - Display ethernet (ON)
- I - Inbound Events (ON)
- O - Outbound Events (ON)
- S - Sender Info (OFF)
- T - Timestamps (ON)
- X - PDU Hexdump (OFF)
- A - PDU Hex/Ascii (OFF)
- +/- Verbosity Level (1)
- L - Limit Context (OFF)
- M - Match Newcalls (ON)
- R - RADIUS Dict (no-override)
- G - GTPP Dict (no-override)
- Y - Multi-Call Trace (OFF)

(Q)uit, <ESC> Prev Menu, <SPACE> Pause, <ENTER> Re-Display Options

Step 6 Configure the amount of information that is displayed by the monitor. To enable or disable options, enter the letter associated with that option (C, D, E, etc.). To increase or decrease the verbosity, use the plus (+) or minus (-) keys.

The current state, ON (enabled) or OFF (disabled), is shown to the right of each option.

Step 7 Press the Enter key to refresh the screen and begin monitoring.

The monitor remains active until disabled. To quit the protocol monitor and return to the prompt, press q.

Using the Protocol Monitor for a Specific Subscriber

The protocol monitor can be used to display information for a specific subscriber session that is currently being processed. Depending on the number of protocols monitored, and the number of sessions in progress, a significant amount of data is generated. It is highly recommended that logging be enabled on your terminal client in order to capture all of the information that is generated.

Follow the instructions in this section to invoke and configure the protocol monitoring tool for a specific subscriber session.

Step 1 To invoke the session-specific protocol monitor from the Exec mode enter the monitor subscriber command.

[local]# host_name# monitor subscriber { callid | imei | imsi | ipaddr | ipv6addr | msid | misdsn | next-call | pcf | peer-fa | peer-lac | sgsn-address | type | username }

Step 2 Specify the method the monitor should use by entering the appropriate keyword.

Step 3 Select other options and/or enter the appropriate information for the selected keyword.

If no session matching the specified criteria was being processed when the monitor was invoked, a screen of available monitoring options appears.

Step 4 Configure the amount of information that is displayed by the monitor. To enable or disable options, enter the letter or 2-digit number associated with that option (C, D, E, 11, 12, etc.). To increase or decrease the verbosity, use the plus (+) or minus (-) keys.
The current state, ON (enabled) or OFF (disabled), is shown to the right of each option.

**Important:** Option Y for performing multi-call traces is only supported for use with the GGSN.

**Step 5** Repeat step 6 as needed to enable or disable multiple protocols.

**Step 6** Press Enter to refresh the screen and begin monitoring.

The following displays a portion of a sample of the monitor’s output for a subscriber named user2@aaa. The default protocols were monitored.

```
Incoming Call:
MSID: 0000012345 Callid: 002dc6c2
Username: user2@aaa SessionType: unknown
Status: Active Service Name: xxx1
Src Context: source Dest Context:

<<<<OUTBOUND 10:02:35:415 Eventid:25001(0)
PPP Tx PDU (9)
PAP 9: Auth-Ack(1), Msg=

<<<<OUTBOUND 10:02:35:416 Eventid:25001(0)
PPP Tx PDU (14)
IPCP 14: Conf-Req(1), IP-Addr=192.168.250.70

<<<<OUTBOUND 10:02:35:416 Eventid:25001(0)
PPP Tx PDU (27)
CCP 27: Conf-Req(1), MPPC, Stac-LZS, Deflate, MVRCA

INBOUND>>>>> 10:02:35:517 Eventid:25000(0)
PPP Rx PDU (30)
IPCP 30: Conf-Req(1), IP-Comp VJ-Comp, IP-Addr=0.0.0.0, Pri-DNS=0.0.0.0, Sec-DNS=0.0.0.0

<<<<OUTBOUND 10:02:35:517 Eventid:25001(0)
PPP Tx PDU (26)
IPCP 26: Conf-Rej(1), IP-Comp VJ-Comp, Pri-DNS=0.0.0.0, Sec-DNS=0.0.0.0

INBOUND>>>>> 10:02:35:518 Eventid:25000(0)
PPP Rx PDU (31)
LCP 31: Prot-Rej(1), Rejected-Protocol=CCP (0x80fd)

INBOUND>>>>> 10:02:35:518 Eventid:25000(0)
PPP Rx PDU (12)
IPCP 12: Conf-Req(2), IP-Addr=0.0.0.0
```
The monitor remains active until disabled. To quit the protocol monitor and return to the prompt, press q.
Chapter 13
System Recovery

This chapter describes how to recover a system after it has failed to complete a reboot following a power off cycle or interruption of the normal boot sequence following a `reload` command.

This chapter includes the following sections:

- Prerequisites
- Accessing the boot CLI
- Booting from a Selected Image

⚠️ **Caution:** This system recovery process interrupts subscriber service by dropping any existing flows and preventing traffic from being processed during the boot interval. It should only be initiated as an emergency measure.
Prerequisites

Successful recovery from a failed reboot requires that you have access to the system via a console port, and have an uncorrupted copy of the StarOS boot image file stored in flash memory on the management card, or accessible from an external memory device.

Console Access

The boot recovery sequence can only be executed via a terminal connected to the serial console port on the active management card. This connection can be through a terminal server that is accessible via a LAN interface.

The boot recovery sequence can only be viewed via the Console port.

Boot Image

The boot recovery command line interface allows you to specify from which boot image you would like to boot the system. If the system failed to reload following a software update, you can initiate a boot from a previously stored image.

The system recovery procedure will prompt you to enter the path name for the location of the StarOS boot image from which the system will boot. By default the boot command will timeout and attempt to reload the highest priority image from flash memory using the default configuration file.

The operating system software is delivered as a single binary file (.bin file extension) and is loaded as a single instance for the entire system.

- For StarOS releases prior to 16.1, the image filename is identified by its release version and corresponding build number. Format = production.build_number.platform.bin.
- For StarOS release 16.1 onwards, the image filename is identified by its platform type and release number. Format = platform-release_number.bin.

Refer to the Configuring the Boot Stack section in the Software Management Operations chapter for additional information on boot stack entries and prioritization.
Accessing the boot CLI

To access the boot CLI you must interrupt an in-progress reload (reboot) sequence.

⚠️ Caution: This system recovery process interrupts subscriber service by dropping any existing flows and preventing traffic from being processed during the boot interval. It should only be initiated as an emergency measure.

Initiate a Reboot

A reload can be initiated in one of two ways:

- Power cycle the chassis – Turn the circuit breakers on the power filter units (PFUs) Off (0) and then On (I).
- Execute a `reload` command

```
[local]host_name# reload -noconfirm
```

The boot sequence displays messages on the terminal as it steps through its processes.

Interrupt the Boot Sequence

When the “Booting priority” message line appears (and not before), press CTRL+C to break out of the boot process as shown in the example below:

```
Booting priority 8

image : /flash/image_filename.bin
config: /flash/system.cfg
Entry at 0x000000000cba45e0
```

Press CTRL+C at this point in the sequence.

A message similar to the following appears after the boot process has been interrupted:

```
*******9/0 Ctrl-C Pressed-----------------------------------------------------------
Failed.
    aborted by user
8/0:boot>
```

Enter CLI Mode

With the boot prompt displayed, enter `cli` to access the boot recovery CLI. The CLI prompt changes as shown below:

```
8/0:boot>cli
8/0:cli>
```
**boot Command Syntax**

The boot recovery command has the following syntax:

```
boot [ -show | -priority=* | -config=* | -noconfig ] { bootfile_URL }
```

The options for this command include:

- `-show`: displays the current boot configuration
- `-priority=`: selects the desired boot stack priority (*)
- `-config=`: enters the desired configuration filename (*), if not the default file
- `-noconfig`: boots using no configuration file

`bootfile_URL` is the URL for the location of the StarOS boot image file. It specifies the path and file name of the StarOS .bin file from which the system will be booted.

The URL may refer to a local file (flash) or an external file on a memory device attached to the management card. The URL must be entered in the following format:

```
{ /flash | /pcmcia1 | /usb1 }/filename
```
Booting from a Selected Image

You will issue a `boot` command via the boot CLI to initiate the system recovery process.

Boot Using No Configuration File

This procedure boots the system using the specified boot image without also loading a configuration file. A sample command string appears below:

```
8/0:cli>boot -noconfig /flash/image_filename.bin
```

The boot sequence ends with a prompt to enter the Quick Setup Wizard for creating a configuration file.

```
Launching StarOS
Starting program at 0x000000000100000
Starent Networks ASR5x00 Intelligent Mobile Gateway
management_card is starting up..........................
Starting software image_version_number...
No configuration found, press enter to continue.
1. Do you wish to continue with the Quick Setup Wizard[yes/no]:
```

You can exit the Quick Setup Wizard by entering `no` in response to the above prompt. Load a desired configuration file using the Exec mode `configure` command followed by the URL for the configuration file as shown in the example below:

```
[local]host_name# configure /flash/system.cfg
```

Boot Using A Specified Configuration File

This procedure boots the system using the specified boot image and configuration file. A sample command string appears below:

```
8/0:cli>boot -config=/flash/system.cfg /flash/image_filename.bin
```

The boot sequence ends with the appearance of the CLI prompt.

```
[local]host_name#
```

Confirm that the desired configuration has loaded by running the Exec mode `show configuration` command.
Chapter 14
Access Control Lists

This chapter describes system support for access control lists and explains how they are configured. The product administration guides provide examples and procedures for configuration of basic services on the system. You should select the configuration example that best meets your service model before using the procedures described below.

**Important:** You do not require a license to configure ACLs. However, the number of ACLs configured may impact performance significantly.

This chapter contains the following sections:

- Understanding ACLs
- Configuring ACLs on the System
- Applying IP ACLs

**Important:** Not all commands and keywords/variables may be available. Availability depends on the platform type.
Overview

IP access lists, commonly known as access control lists (ACLs), control the flow of packets into and out of the system. They are configured on a per-context basis and consist of “rules” (ACL rules) or filters that control the action taken on packets that match the filter criteria. Once configured, an ACL can be applied to any of the following:

- An individual interface
- All traffic facilitated by a context (known as a policy ACL)
- An individual subscriber
- All subscriber sessions facilitated by a specific context

Separate ACLs may be created for IPv4 and IPv6 access routes.
Understanding ACLs

This section discusses the two main aspects to ACLs on the system:

- Rule(s)
- Rule Order

**Important:** Refer to *ACL Configuration Mode Commands* and the *IPv6 ACL Configuration Mode Commands* chapter in the *Command Line Interface Reference* for the full command syntax.

Rule(s)

A single ACL consists of one or more ACL rules. Each rule is a filter configured to take a specific action when packets matching specific criteria. Up to 128 rules can be configured per ACL.

**Important:** Configured ACLs consisting of no rules imply a “deny any” rule. The *deny* action and *any* criteria are discussed later in this section. This is the default behavior for an empty ACL.

Each rule specifies the action to take when a packet matches the specified criteria. This section discusses the rule actions and criteria supported by the system.

Actions

ACLs specify that one of the following actions can be taken on a packet that matches the specified criteria:

- **Permit:** The packet is accepted and processed.
- **Deny:** The packet is rejected.
- **Redirect:** The packet is forwarded to the specified next-hop address through a specific system interface or to the specified context for processing.

**Important:** Redirect rules are ignored for ACLs applied to specific subscribers or all subscribers facilitated by a specific context, or APN for UMTS subscribers.

Criteria

Each ACL consists of one or more rules specifying the criteria that packets will be compared against.

The following criteria are supported:

- **Any:** Filters all packets
- **Host:** Filters packets based on the source host IP address
- **ICMP:** Filters Internet Control Message Protocol (ICMP) packets
- **IP:** Filters Internet Protocol (IP) packets
- **Source IP Address:** Filter packets based on one or more source IP addresses
• **TCP**: Filters Transport Control Protocol (TCP) packets
• **UDP**: Filters User Datagram Protocol (UDP) packets

Each of the above criteria are described in detail in the sections that follow.

---

**Important**: The following sections contain basic ACL rule syntax information. Refer to the *ACL Configuration Mode Commands* and *IPv6 ACL Configuration Mode Commands* chapters in the *Command Line Interface Reference* for the full command syntax.

---

- **Any**: The rule applies to all packets.
- **Host**: The rule applies to a specific host as determined by its IP address.
- **ICMP**: The rule applies to specific Internet Control Message Protocol (ICMP) packets, Types, or Codes. ICMP type and code definitions can be found at [www.iana.org](http://www.iana.org) (RFC 3232).
- **IP**: The rule applies to specific Internet Protocol (IP) packets or fragments.
- **IP Packet Size Identification Algorithm**: The rule applies to specific Internet Protocol (IP) packets identification for fragmentation during forwarding.
  
  This configuration is related to the “IP Identification field” assignment algorithm used by the system, when subscriber packets are being encapsulated (such as Mobile IP and other tunneling encapsulation). Within the system, subscriber packet encapsulation is done in a distributed way and a 16-bit IP identification space is divided and distributed to each entity which does the encapsulation, so that unique IP identification value can be assigned for IP headers during encapsulation.
  
  Since this distributed IP Identification space is small, a non-zero unique identification will be assigned only for those packets which may potentially be fragmented during forwarding (since the IP identification field is only used for reassembly of the fragmented packet). The total size of the IP packet is used to determine the possibility of that packet getting fragmented.
- **Source IP Address**: The rule applies to specific packets originating from a specific source address or a group of source addresses.
- **TCP**: The rule applies to any Transport Control Protocol (TCP) traffic and could be filtered on any combination of source/destination IP addresses, a specific port number, or a group of port numbers. TCP port numbers definitions can be found at [www.iana.org](http://www.iana.org)
- **UDP**: The rule applies to any User Datagram Protocol (UDP) traffic and could be filtered on any combination of source/destination IP addresses, a specific port number, or a group of port numbers. UDP port numbers definitions can be found at [www.iana.org](http://www.iana.org).

---

### Rule Order

A single ACL can consist of multiple rules. Each packet is compared against each of the ACL rules, in the order in which they were entered, until a match is found. Once a match is identified, all subsequent rules are ignored.

Additional rules can be added to an existing ACL and properly ordered using either of the following options:

- **Before**
- **After**

Using these placement options requires the specification of an existing rule in the ACL and the configuration of the new rule as demonstrated by the following flow:

```
[ before | after ] { existing_rule }
```
Configuring ACLs on the System

This section describes how to configure ACLs.

**Important**: This section provides the minimum instruction set for configuring access control list on the system. For more information on commands that configure additional parameters and options, refer to the *ACL Configuration Mode Commands* and *IPv6 ACL Configuration Mode Commands* chapters in the *Command Line Interface Reference*.

To configure the system to provide an access control list facility to subscribers:

**Step 1** Create the access control list by following the example configuration in Creating ACLs.

**Step 2** Specify the rules and criteria for action in the ACL list by following the example configuration in Configuring Action and Criteria for Subscriber Traffic.

**Step 3** Optional. The system provides an “undefined” ACL that acts as a default filter for all packets into the context. The default action is to “permit all”. Modify the default configuration for “unidentified” ACLs for by following the example configuration in Configuring an Undefined ACL.

**Step 4** Verify your ACL configuration by following the steps in Verifying the ACL Configuration.

**Step 5** Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode `save configuration` command. For additional information refer to the *Verifying and Saving Your Configuration* chapter.

Creating ACLs

To create an ACL, enter the following command sequence from the Exec mode of the system CLI:

```
configure

context acl_ctxt_name [ -noconfirm ]

{ ip | ipv6 } access-list acl_list_name

end
```

Notes:

- The maximum number of ACLs that can be configured per context is limited by the amount of available memory in the VPN Manager software task. Typically, the maximum is less than 200.
Configuring Action and Criteria for Subscriber Traffic

To create rules to deny/permit the subscriber traffic and apply the rules after or before action, enter the following command sequence from the Exec mode of the system CLI:

```
configure

context acl_ctxt_name [ -noconfirm ]

{ ip | ipv6 } access-list acl_list_name

deny { ip_address | any | host | icmp | ip | log | tcp | udp }

permit { ip_address | any | host | icmp | ip | log | tcp | udp }

after { deny | permit | readdress | redirect }

before { deny | permit | readdress | redirect }

end
```

Notes:

⚠️ **Caution:** The system does not apply a “deny any” rule, unless it is specified in the ACL. This behavior can be changed by adding a “deny any” rule at the end of the ACL.

- The maximum number of rules that can be configured per ACL varies depending on how the ACL is to be used. For more information, refer to the *Engineering Rules* chapter.
- Use the information provided in the *Actions* and *Criteria* to configure the rules that comprise the ACL. For more information, refer to the *ACL Configuration Mode Commands* and *IPv6 ACL Configuration Mode Commands* chapters in the *Command Line Interface Reference*.

Configuring an Undefined ACL

As discussed previously the system uses an “undefined” ACL mechanism for filtering the packet(s) in the event that an ACL that has been applied is not present. This scenario is likely the result of a mis-configuration such as the ACL name being mis-typed during the configuration process.

For these scenarios, the system provides an “undefined” ACL that acts as a default filter for all packets into the context. The default action is to “permit all”.

To modify the default behavior for unidentified ACLs, use the following configuration:

```
configure

context acl_ctxt_name [ -noconfirm]

access-list undefined { deny-all | permit-all }

end
```
Notes:

- Context name is the name of the context containing the “undefined” ACL to be modified. For more information, refer to the Context Configuration Mode Commands chapter in the Command Line Interface Reference.

Verifying the ACL Configuration

To verify the ACL configuration, enter the Exec mode `show { ip | ipv6 } access-list` command.

The following is a sample output of this command. In this example, an ACL named `acl_1` was configured.

```
ip access list acl_1
   deny host 10.2.3.4
   deny ip any host 10.2.3.4
   permit any 10.2.4.4
1 ip access-lists are configured.
```

Applying IP ACLs

Once an ACL is configured, it must be applied to take effect.

**Important:** All ACLs should be configured and verified according to the instructions in the Configuring ACLs on the System prior to beginning these procedures. The procedures described below also assume that the subscribers have been previously configured.

As discussed earlier, you can apply an ACL to any of the following:

- Applying an ACL to an Individual Interface
- Applying an ACL to All Traffic Within a Context (known as a policy ACL)
- Applying an ACL to an Individual Subscriber
- Applying a Single ACL to Multiple Subscribers
- Applying a Single ACL to Multiple Subscribers via APNs (for 3GPP subscribers only)

**Important:** ACLs must be configured in the same context in which the subscribers and/or interfaces to which they are to be applied. Similarly, ACLs to be applied to a context must be configured in that context.

If ACLs are applied at multiple levels within a single context (such as an ACL is applied to an interface within the context and another ACL is applied to the entire context), they will be processed as shown in the following figure and table.
Applying IP ACLs

Figure 14. ACL Processing Order

Table 34. ACL Processing Order Descriptions

<table>
<thead>
<tr>
<th>Order</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>An inbound ACL configured for the receiving interface in the Source Context is applied to the tunneled data (such as the outer IP header). The packet is then forwarded to the Destination Context.</td>
</tr>
<tr>
<td>2</td>
<td>An inbound ACL configured for the subscriber (either the specific subscriber or for any subscriber facilitated by the context) is applied.</td>
</tr>
<tr>
<td>3</td>
<td>A context ACL (policy ACL) configured in the Destination Context is applied prior to forwarding.</td>
</tr>
<tr>
<td>4</td>
<td>An outbound ACL configured on the interface in the Destination Context through which the packet is being forwarded, is applied.</td>
</tr>
</tbody>
</table>

Packet coming from the mobile node to the packet data network (left to right)

<table>
<thead>
<tr>
<th>Order</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>An inbound ACL configured for the receiving interface configured in the Destination Context is applied.</td>
</tr>
<tr>
<td>2</td>
<td>An outbound ACL configured for the subscriber (either the specific subscriber or for any subscriber facilitated by the context) is applied. The packet is then forwarded to the Source Context.</td>
</tr>
<tr>
<td>3</td>
<td>A context ACL (policy ACL) configured in the Source Context is applied prior to forwarding.</td>
</tr>
<tr>
<td>4</td>
<td>An outbound ACL configured on the interface in the Source Context through which the packet is being forwarded, is applied to the tunneled data (such as the outer IP header).</td>
</tr>
</tbody>
</table>

In the event that an IP ACL is applied that has not been configured (for example, the name of the applied ACL was configured incorrectly), the system uses an “undefined” ACL mechanism for filtering the packet(s).

This section provides information and instructions for applying ACLs and for configuring an “undefined” ACL.
Applying an ACL to an Individual Interface

This section provides information and instructions for applying one or more ACLs to an individual interface configured on the system.

**Important:** This section provides the minimum instruction set for applying the ACL list to an interface on the system. For more information on commands that configure additional parameters and options, refer to the *Ethernet Interface Configuration Mode Commands* chapter in the *Command Line Interface Reference*.

To configure the system to provide ACL facility to subscribers:

**Step 1**  
Apply the configured access control list by following the example configuration in Applying the ACL to an Interface.

**Step 2**  
Verify that ACL is applied properly on interface by following the steps in Verifying the ACL Configuration on an Interface.

**Step 3**  
Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode `save configuration` command. For additional information refer to the Verifying and Saving Your Configuration chapter.

Applying the ACL to an Interface

To apply the ACL to an interface, use the following configuration:

```
configure
  context acl_ctxt_name [ -noconfirm ]
  interface interface_name
    { ip | ipv6 } access-group acl_list_name { in | out } [ preference ]
  end
```

Notes:
- The context name is the name of the ACL context containing the interface to which the ACL is to be applied.
- The ACL to be applied must be configured in the context specified by this command.
- Up to eight ACLs can be applied to a group provided that the number of rules configured within the ACL(s) does not exceed the 128-rule limit for the interface.
Verifying the ACL Configuration on an Interface

This section describes how to verify the ACL configuration.

**Step 1**
In the Exec Mode, enter the following command:

```
[local]host_name# show configuration context context_name
```

*context_name* is the name of the context containing the interface to which the ACL(s) was/were applied.

The output of this command displays the configuration of the entire context. Examine the output for the commands pertaining to interface configuration. The commands display the ACL(s) applied using this procedure.

```
configure
context context_name
  ip access-list acl_name
deny host ip_address
deny ip any host ip_address
exit
ip access-group access_group_name
service-redundancy-protocol
exit
interface interface_name
  ip address ip_address/mask
exit
subscriber default
exit
aaa group default
exit
gtpp group default
end
```

Applying an ACL to All Traffic Within a Context

This section provides information and instructions for applying one or more ACLs to a context configured within a specific context on the system. The applied ACLs, known as policy ACLs, contain rules that apply to all traffic facilitated by the context.

---

**Important:** This section provides the minimum instruction set for applying the ACL list to all traffic within a context. For more information on commands that configure additional parameters and options, refer to the *Context Configuration Mode Commands* chapter in the *Command Line Interface Reference*.

---

To configure the system to provide access control list facility to subscribers:

**Step 1**
Apply the configured ACL as described in *Applying the ACL to a Context*.

**Step 2**
Verify that ACL is applied properly on interface as described in *Verifying the ACL Configuration in a Context*.

**Step 3**
Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode `save configuration` command. For additional information refer to the *Verifying and Saving Your Configuration* chapter.
Applying the ACL to a Context

To apply the ACLs to a context, use the following configuration:

```plaintext
configure

context acl_ctxt_name [ -noconfirm ]

{ ip | ipv6 } access-group acl_list_name [ in | out ] [ preference ]

end
```

Notes:

- The context name is the name of the ACL context containing the interface to which the ACL is to be applied.
- The context-level ACL is applied to outgoing packets. This applies to incoming packets also if the flow match criteria fails and forwarded again.

The `in` and `out` keywords are deprecated and are only present for backward compatibility.

Context ACL will be applied in the following cases:

- Outgoing packets to an external source.
- Incoming packets that fail flow match and are forwarded again. In this case, the context ACL applies first and only if it passes are packets forwarded.

  During forwarding, if an ACL rule is added with a destination address as a loopback address, the context ACL is also applied. This is because StarOS handles packets destined to the kernel by going through a forwarding lookup for them. To apply ACL rules to incoming packets, the interface ACL must be used instead of the context ACL.

- The ACL to be applied must be configured in the context specified by this command.
- Up to eight ACLs can be applied to a group provided that the number of rules configured within the ACL(s) does not exceed the 128-rule limit for the interface.

Verifying the ACL Configuration in a Context

To verify the ACL configuration:

**Step 1**  Verify that your ACL lists were applied properly by entering the following command in Exec Mode:

```plaintext
[local]host_name# show configuration context context_name
```

`context_name` is the name of the context to which the ACL(s) was/were applied.

The output of this command displays the configuration of the entire context. Examine the output for the commands pertaining to interface configuration. The commands display the ACL(s) applied using this procedure.
Applying an ACL to a RADIUS-based Subscriber

IP ACLs are applied to subscribers via attributes in their profile. The subscriber profile could be configured locally on the system or remotely on a RADIUS server.

To apply an ACL to a RADIUS-based subscriber, use the Filter-Id attribute.

For more details on this attribute, if you are using StarOS 12.3 or an earlier release, refer to the AAA and GTPP Interface Administration and Reference. If you are using StarOS 14.0 or a later release, refer to the AAA Interface Administration and Reference.

This section provides information and instructions for applying an ACL to an individual subscriber whose profile is configured locally on the system.

**Important:** This section provides the minimum instruction set for applying the ACL list to all traffic within a context. For more information on commands that configure additional parameters and options, refer to the Subscriber Configuration Mode Commands chapter in the Command Line Interface Reference.

To configure the system to provide access control list facility to subscribers:

**Step 1**  Apply the configured access control list by following the example configuration in Applying an ACL to an Individual Subscriber.

**Step 2**  Verify that ACL is applied properly on interface by following the steps in Verifying the ACL Configuration to an Individual Subscriber.

**Step 3**  Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode `save configuration` command. For additional information refer to the Verifying and Saving Your Configuration chapter.
Applying an ACL to an Individual Subscriber

To apply the ACL to an individual subscriber, use the following configuration:

```
configure
  context acl_ctxt_name [ -noconfirm ]
  subscriber name subs_name
    { ip | ipv6 } access-group acl_list_name [ in | out ]
end
```

Notes:
- The context name is the name of the ACL context containing the interface to which the ACL is to be applied.
- If neither the `in` nor the `out` keyword is specified, the ACL will be applied to all inbound and outbound packets.
- The ACL to be applied must be configured in the context specified by this command.
- Up to eight ACLs can be applied to a group provided that the number of rules configured within the ACL(s) does not exceed the 128-rule limit for the interface.

Verifying the ACL Configuration to an Individual Subscriber

These instructions are used to verify the ACL configuration.

**Step 1** Verify that your ACL lists were applied properly by entering the following command in Exec Mode:

```
[local]host_name# show configuration context context_name
```

`context_name` is the name of the context containing the subscriber `subs1` to which the ACL(s) was/were applied.

The output of this command displays the configuration of the entire context. Examine the output for the commands pertaining to interface configuration. The commands display the ACL(s) applied using this procedure.
Applying a Single ACL to Multiple Subscribers

As mentioned in the previous section, IP ACLs are applied to subscribers via attributes in their profile. The subscriber profile could be configured locally on the system or remotely on a RADIUS server.

The system provides for the configuration of subscriber functions that serve as default values when specific attributes are not contained in the individual subscriber’s profile. The following table describes these functions.

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscriber named default</td>
<td>Within each context, the system creates a subscriber called default. The profile for the subscriber named default provides a configuration template of attribute values for subscribers authenticated in that context. Any subscriber attributes that are not included in a RADIUS-based subscriber profile is configured according to the values for those attributes as defined for the subscriber named default. NOTE: The profile for the subscriber named default is not used to provide missing information for subscribers configured locally.</td>
</tr>
<tr>
<td>default subscriber</td>
<td>This command in the PDSN, FA, and HA service Configuration modes specifies a profile from a subscriber named something other than default to use a configuration template of attribute values for subscribers authenticated in that context. This command allows multiple services to draw “default” subscriber information from multiple profiles.</td>
</tr>
</tbody>
</table>

When configured properly, the functions described in the table above could be used to apply an ACL to:

- All subscribers facilitated within a specific context by applying the ACL to the profile of the subscriber named default.
- All subscribers facilitated by specific services by applying the ACL to a subscriber profile and then using the default subscriber command to configure the service to use that subscriber as the “default” profile.
Applying an ACL to the Subscriber Named default

This section provides information and instructions for applying an ACL to the subscriber named default.

Important: This section provides the minimum instruction set for applying the ACL list to all traffic within a context. For more information on commands that configure additional parameters and options, refer to Subscriber Configuration Mode Commands in the Command Line Interface Reference.

To configure the system to provide access control list facility to subscribers:

Step 1 Apply the configured access control list by following the example configuration in Applying an ACL to the Subscriber Named default.

Step 2 Verify that ACL is applied properly on interface by following the steps in Applying an ACL to the Subscriber Named default.

Step 3 Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode save configuration command. For additional information refer to the Verifying and Saving Your Configuration chapter.

Applying an ACL to the Subscriber Named default

To apply the ACL to the subscriber named default, use the following configuration:

```
configure

    context acl_ctxt_name [ -noconfirm ]

    subscriber name subs_name

        { ip | ipv6 } access-group acl_list_name [ in | out ]

    end
```

Notes:
- The context name is the name of the ACL context containing the interface to which the ACL is to be applied.
- If neither the in nor the out keyword is specified, the ACL will be applied to all inbound and outbound packets.
- The ACL to be applied must be configured in the context specified by this command.
- Up to eight ACLs can be applied to a group provided that the number of rules configured within the ACL(s) does not exceed the 128-rule limit for the interface.

Verifying the ACL Configuration to the Subscriber Named default

These instructions are used to verify the ACL configuration.

Step 1 Verify that your ACL lists were applied properly by entering the following command in Exec Mode:

```
[local]host_name# show configuration context context_name
```

context_name is the name of the context containing the subscriber default to which the ACL(s) was/were applied.
The output of this command displays the configuration of the entire context. Examine the output for the commands pertaining to interface configuration. The commands display the ACL(s) applied using this procedure.

```
configure
context context_name
 ip access-list acl_name
  deny host ip_address
  deny ip any host ip_address
 exit
 ip access-group access_group_name
 service-redundancy-protocol
 exit
 interface interface
  ip address ip_address/mask
 exit
 subscriber name default
  ip access-group access_group_name in
  ip access-group access_group_name out
 exit
 aaa group default
 exit
 gtpg group default
 exit
 content-filtering server-group cfsg_name
  response-timeout response_timeout
  connection retry-timeout retry_timeout
 end
```

**Applying an ACL to Service-specified Default Subscriber**

This section provides information and instructions for applying an ACL to the subscriber to be used as the “default” profile by various system services.

---

**Important:** This section provides the minimum instruction set for applying the ACL list to all traffic within a context. For more information on commands that configure additional parameters and options, refer to the Subscriber Configuration Mode Commands chapter in the Command Line Interface Reference.

To configure the system to provide access control list facility to subscribers:

**Step 1** Apply the configured access control list by following the example configuration in Applying an ACL to Service-specified Default Subscriber.

**Step 2** Verify that the ACL is applied properly on interface by following the steps in Verifying the ACL Configuration to Service-specified Default Subscriber.

**Step 3** Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode `save configuration` command. For additional information refer to the Verifying and Saving Your Configuration chapter.
Applying an ACL to Service-specified Default Subscriber

To apply the ACL to a service-specified Default subscriber, use the following configuration:

```
configure
context acl_ctxt_name [ -noconfirm ]
{ psdn-service | fa-service | ha-service } service_name
  default subscriber svc_default_subs_name
  exit
subscriber name svc_default_subs_name
  { ip | ipv6 } access-group acl_list_name [ in | out ]
end
```

Notes:
- The context name is the name of the ACL context containing the interface to which the ACL is to be applied.
- If neither the `in` nor the `out` keyword is specified, the ACL will be applied to all inbound and outbound packets.
- The ACL to be applied must be configured in the context specified by this command.
- Up to eight ACLs can be applied to a group provided that the number of rules configured within the ACL(s) does not exceed the 128-rule limit for the interface.

Verifying the ACL Configuration to Service-specified Default Subscriber

To verify the ACL configuration.

Step 1
Verify that your ACL lists were applied properly by entering the following command in Exec Mode:

```
[local]host_name# show configuration context context_name
```

`context_name` is the name of the context containing the service with the default subscriber to which the ACL(s) was/were applied.

The output of this command displays the configuration of the entire context. Examine the output for the commands pertaining to interface configuration. The commands display the ACL(s) applied using this procedure.

```
configure
context context_name
  ip access-list acl_name
    deny host ip_address
    deny ip any host ip_address
  exit
  ip access-group access_group_name
  interface interface
```
Applying an ACL to Multiple Subscriber via APNs

If IP ACLs are applied to subscribers via attributes in their profile, the subscriber profile could be configured locally on the system or remotely on a RADIUS server.

To reduce configuration time, ACLs can alternatively be applied to APN templates for GGSN subscribers. When configured, any subscriber packets facilitated by the APN template would then have the associated ACL applied.

This section provides information and instructions for applying an ACL to an APN template.

**Important:** This section provides the minimum instruction set for applying the ACL list to all traffic within a context. For more information on commands that configure additional parameters and options, refer to the *Subscriber Configuration Mode Commands* chapter in the Command Line Interface Reference.

To configure the system to provide access control list facility to subscribers:

**Step 1**  
Apply the configured access control list by following the example configuration in *[Applying an ACL to Multiple Subscriber via APNs]*.

**Step 2**  
Verify that ACL is applied properly on interface by following the steps in *[Verifying the ACL Configuration to APNs]*.

**Step 3**  
Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode `save configuration` command. For additional information refer to the *Verifying and Saving Your Configuration* chapter.

**Applying an ACL to Multiple Subscriber via APNs**

To apply the ACL to multiple subscribers via APN, use the following configuration:

```
cfg
   context dest_context_name [-noconfirm]

   apn apn_name

   { ip | ipv6 } access-group acl_list_name [ in | out ]

   end
```

```shell
ip address ip_address/mask
exit
subscriber default
exit
subscriber name subscriber_name
   ip access-group access_group_name in
   ip access-group access_group_name out
   exit
pdsn-service service_name
   default subscriber subscriber_name
end
```
Notes:
- The ACL to be applied must be in the destination context of the APN (which can be different from the context where the APN is configured).
- If neither the in nor the out keyword is specified, the ACL will be applied to all inbound and outbound packets.
- Up to eight ACLs can be applied to a group provided that the number of rules configured within the ACL(s) does not exceed the 128-rule limit for the interface.

**Verifying the ACL Configuration to APNs**

To verify the ACL configuration:

**Step 1**  Verify that your ACL lists were applied properly by entering the following command in Exec Mode:

```
show configuration context context_name
```

*context_name* is the name of the context containing the APN *apn1* having *default* subscriber to which the ACL(s) was/were applied.

The output of this command displays the configuration of the entire context. Examine the output for the commands pertaining to interface configuration. The commands display the ACL(s) applied using this procedure.

```
configure
  context context_name
    ip access-list acl_name
      deny host ip_address
      deny ip any host ip_address
    exit
  ip access-group access_group_name
  interface interface
    ip address ip_address/mask
    exit
  subscriber default
  exit
  apn apn_name
    ip access-group access_group_name in
    ip access-group access_group_name out
  end
```
Chapter 15
Congestion Control

This chapter describes the Congestion Control feature. It covers the following topics:

- Overview
- Configuring Congestion Control
Overview

Congestion Control monitors the system for conditions that could potentially degrade performance when the system is under heavy load. Typically, these conditions are temporary (for example, high CPU or memory utilization) and are quickly resolved. However, continuous or large numbers of these conditions within a specific time interval may impact the system’s ability to service subscriber sessions. Congestion control helps identify such conditions and invokes policies for addressing the situation.

Congestion control operation is based on configuring the following:

- **Congestion Condition Thresholds**: Thresholds dictate the conditions for which congestion control is enabled and establishes limits for defining the state of the system (congested or clear). These thresholds function in a way similar to operation thresholds that are configured for the system as described in the *Thresholding Configuration Guide*. The primary difference is that when congestion thresholds are reached, a service congestion policy and an SNMP trap (starCongestion) are generated. A threshold tolerance dictates the percentage under the configured threshold that must be reached in order for the condition to be cleared. An SNMP trap, starCongestionClear, is then triggered.

- **Port Utilization Thresholds**: If you set a port utilization threshold, when the average utilization of all ports in the system reaches the specified threshold, congestion control is enabled.

- **Port-specific Thresholds**: If you set port-specific thresholds, when any individual port-specific threshold is reached, congestion control is enabled system-wide.

- **Service Congestion Policies**: Congestion policies are configurable for each service. These policies dictate how services respond when the system detects that a congestion condition threshold has been crossed.

**Important**: This section provides the minimum instruction set for configuring congestion control. Commands that configure additional interface or port properties are provided in *Subscriber Configuration Mode* in the *Command Line Interface Reference*. Always refer to the Administration Guides for all of the licensed products running on this platform for additional configuration information with respect to congestion control. Congestion control functionality varies based on product and StarOS version.

For the MME three levels of congestion control thresholds are supported – critical, major and minor. By default only the critical threshold is supported for other products. SNMP traps also support major and minor congestion control thresholds. A set of *congestion-action-profile* commands allows an operator to establish additional actions to be taken for specific thresholds and threshold levels.
Configuring Congestion Control

To configure Congestion Control functionality:

Step 1 Configure congestion control thresholds as described in Configuring the Congestion Control Threshold.

Step 2 Configure service congestion policies as described in Configuring Service Congestion Policies.

Step 3 Enable redirect overload policies as described in Enabling Congestion Control Redirect Overload Policy.

Step 4 Configure disconnecting subscribers based on call or inactivity time as described in Disconnecting Subscribers Based on Call or Inactivity Time.

Step 5 Save your configuration as described in the Verifying and Saving Your Configuration chapter.

Configuring the Congestion Control Threshold

To configure congestion control threshold, apply the following example configuration in the Global Configuration mode of the CLI:

```
configure

congestion-control threshold max-sessions-per-service-utilization percent

congestion-control threshold tolerance percent

end
```

Notes:

- There are numerous threshold parameters. See Global Configuration Mode Commands in the Command Line Interface Reference for more information.
- The tolerance is the percentage under a configured threshold that dictates the point at which the condition is cleared.
- Multiple levels of congestion thresholds – critical, major and minor – are supported for various types of congestion control thresholds. If a threshold level is not specified, the default is critical. Currently, major and minor thresholds are only supported for the MME. The congestion-action-profile command under lte-policy defines the action to be taken when thresholds are exceeded. See Global Configuration Mode Commands, LTE Policy Configuration Mode Commands and Congestion Action Profile Configuration Mode Commands in the Command Line Interface Reference for more information.
- Repeat this configuration as needed for additional thresholds.
Configuring Service Congestion Policies

To create a congestion control policy, apply the following example configuration in the Global Configuration mode of the CLI:

```plaintext
configure

congestion-control policy service action { drop | none | redirect | reject }

end
```

Notes:
- When the redirect action occurs for PDSN services, the PDSN responds to the PCF with a reply code of 136, “unknown PDSN address” along with the IP address of an alternate PDSN.
- `redirect` is not available for PDIF. The default action for PDIF is “none.”
- When the redirect action occurs for HA services, the system responds to the FA with a reply code of 136, “unknown home agent address”.
- `redirect` cannot be used in conjunction with GGSN services.
- `redirect` is not available for the Local Mobility Anchor (LMA) service.
- When setting the action to `reject`, the reply code is 130, “insufficient resources”.
- For the GGSN, the reply code is 199, “no resources available”.
- For the SaMOG, MME, `redirect` is not available.
- For the MME, create action profiles for optional major and minor thresholds using the `congestion-action-profile` command under `lte-policy` in the Global Configuration mode.
- For the MME, you can specify `service` as `critical`, `major` or `minor` to set a policy and associate an action-profile for the respective threshold. See `Global Configuration Mode Commands` in the `Command Line Interface Reference` for more information.

Configuring Overload Reporting on the MME

When an overload condition is detected on an MME and the report-overload keyword is enabled in the `congestion-control policy` command, the system reports the condition to a specified percentage of eNodeBs and proceeds to take the configured action on incoming sessions. To create a congestion control policy with overload reporting, apply the following example configuration:

```plaintext
configure

congestion-control policy mme-service action report-overload reject-new-sessions enodeb-percentage percentage

end
```

Notes:
- Other overload actions include `permit-emergency-sessions` and `reject-non-emergency-sessions`.
Enabling Congestion Control Redirect Overload Policy

To create a congestion control policy and configure a redirect overload policy for the service, apply the following example configuration:

```
configure
congestion-control
context context_name
{service_configuration_mode}
    policy overload redirect address
end
```

Notes:
- **Optional**: If the congestion control policy action was configured to redirect, then a redirect overload policy must be configured for the service(s) that are affected.
- There are several service configuration modes that you can configure. See the Command Line Interface Reference for a complete list of modes.
- You can set various options for redirection. See the Command Line Interface Reference for more information.
- Repeat this configuration example to configure overload policies for additional services configured in the same context.

Verify the Service Overload Policies

To verify that the service overload policies were properly configured enter the following command in the Exec Mode:

```
[local]host_name# show service_type name service_name
```

This command lists the entire service configuration. Verify that the information displayed for the “Overload Policy” is accurate.

Repeat this configuration example to configure additional services in other contexts.

Verify the Congestion Control Configuration

To verify Congestion Control Configuration enter the following show command in the Exec Mode.

```
[local]host_name# show congestion-control configuration
```

The following output is a concise listing of all threshold and policy configurations showing multi-level Critical, Major and Minor threshold parameters:
Congestion-control: enabled

Congestion-control Critical threshold parameters
- system cpu utilization: 80%
- service control cpu utilization: 80%
- system memory utilization: 80%
- message queue utilization: 80%
- message queue wait time: 10 seconds
- port rx utilization: 80%
- port tx utilization: 80%
- license utilization: 100%
- max-session-per-service utilization: 100%
- tolerance limit: 10%

Congestion-control Major threshold parameters
- system cpu utilization: 0%
- service control cpu utilization: 0%
- system memory utilization: 0%
- message queue utilization: 0%
- message queue wait time: 0 seconds
- port rx utilization: 0%
- port tx utilization: 0%
- license utilization: 0%
- max-session-per-service utilization: 0%
- tolerance limit: 0%

Congestion-control Minor threshold parameters
- system cpu utilization: 0%
- service control cpu utilization: 0%
- system memory utilization: 0%
- message queue utilization: 0%
- message queue wait time: 0 seconds
- port rx utilization: 0%
- port tx utilization: 0%
- license utilization: 0%
- max-session-per-service utilization: 0%
- tolerance limit: 0%

Overload-disconnect: disabled

Overload-disconnect threshold parameters
- license utilization: 80%
- max-session-per-service utilization: 80%
- tolerance: 10%
- session disconnect percent: 5%
Configuring Congestion Control

iterations-per-stage: 8
Congestion-control Policy
  pdsn-service: none
  hsgw-service: none
  ha-service: none
  ggsn-service: none
  closedrp-service: none
  lns-service: none
  scf-service: reject
  pdif-service: none
  wsg-service: none
  pdg-service: none
  fng-service: none
  sgsn-service: none
  mme-service: drop
  henbgw-network-service: none
  asngw-service: none
  asnpc-service: none
  phsgw-service: none
  phspc-service: none
  mipv6ha-service: none
  lma-service: none
  saegw-service: none
  sgw-service: none
  pgw-service: none
  hnbgw-service: none
  pcc-policy-service: none
  pcc-quota-service: none
  pcc-af-service: none
  ipsg-service: none
  samog-service: none

The primary threshold to observe is license utilization. This threshold is defaulted to 80%. Overload controls on the system enables the Congestion-control Policy when the system has only 80% of the licenses used. The overload condition will not clear until the utilization drops below the tolerance limit setting. The tolerance limit is defaulted to 10%. If the system goes into overload due to license utilization (threshold at 80%), the overload condition will not clear until the license utilization reaches 70%.

The system may go into overload if threshold settings are set too low and congestion control is enabled. You will need to review all threshold values and become familiar with the settings.

Since the recommendation for license utilization overload threshold is 100%, you should enable a license threshold alarm at 80%. An alarm is then triggered when the license utilization hits 80%. When the congestion-control policy setting is set to drop, the system drops incoming packets containing new session requests.

Important: For additional information on configuring the alarm threshold, refer to the Threshold Configuration Guide.
Verify MME Congestion Action Profiles

To verify MME multilevel congestion action profiles, run the following Exec mode command:

```
[local]host_name# show lte-policy congestion-action-profile { name profile_name | summary }
```

Disconnecting Subscribers Based on Call or Inactivity Time

During periods of heavy system load, it may be necessary to disconnect subscribers in order to maintain an acceptable level of system performance. You can establish thresholds to select subscribers to disconnect based on the length of time that a call has been connected or inactive.

To enable overload disconnect for the currently selected subscriber, use the following configuration example:

```
configure

  context context_name

  subscriber name subscriber_name

  default overload-disconnect threshold inactivity-time dur_thresh

  default overload-disconnect threshold connect-time dur_thresh

  end
```

To disable the overload disconnect feature for this subscriber, use the following configuration example:

```
configure

  context context_name

  subscriber subscriber_name

  no overload-disconnect { [threshold inactivity-time] | [threshold connect-time] }

  end
```

Notes:

- `overload-disconnect` is not supported for the Call Session Control Function (CSCF) service.
Chapter 16
Routing

This chapter provides information on configuring an enhanced, or extended, service. The product administration guides provide examples and procedures for configuring basic services on the system. You should select the configuration example that best meets your service model, and configure the required elements for that model before using the procedures described below.

This chapter includes the following sections:

- Routing Policies
- Static Routing
- OSPF Routing
- OSPFv3 Routing
- Equal Cost Multiple Path (ECMP)
- BGP-4 Routing
- Bidirectional Forwarding Detection
- Viewing Routing Information
Routing Policies

This section describes how to configure the elements needed to define routing policies. Routing policies modify and redirect routes to and from the system to satisfy specific network deployment requirements.

Use the following building blocks to configure routing policies:

- **Route Access Lists** – The basic building block of a routing policy. Route access lists filter routes based on a range of IP addresses.
- **IP Prefix Lists** – A more advanced element of a routing policy. An IP Prefix list filters routes based on IP prefixes.
- **AS Path Access Lists** – A basic building block used for Border Gateway Protocol (BGP) routing. These lists filter Autonomous System (AS) paths.
- **Route Maps** – Route-maps provide detailed control over routes during route selection or route advertisement by a routing protocol, and in route redistribution between routing protocols. For this level of control you use IP Prefix Lists, Route Access Lists and AS Path Access Lists to specify IP addresses, address ranges, and Autonomous System paths.

Creating IP Prefix Lists

Use the following configuration example to create IP Prefix Lists:

```
config
c
context context_name

ip prefix-list name list_name { deny | permit } network_address/net_mask
```

Notes:

- Set the IP prefix list to deny, permit or match any prefix.
- IPv4 dotted-decimal and IPv6 colon-separated-hexadecimal addresses are supported.
- Save your configuration as described in the Verifying and Saving Your Configuration chapter.

Creating Route Access Lists

Use the following procedure to create a Route Access List:

```
config
c
context context_name

route-access-list { extended identifier } { deny | permit } [ ip address
ip_address ]

route-access-list named list_name { deny | permit } [ ip_address/mask | any ]
[ exact-match ]
```
**Creating AS Path Access Lists**

Use the following procedure to create an AS Path Access List:

```
config

context context_name

ip as-path access-list list_name [ { deny | permit } reg_expr ]
```

Notes:
- Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

**Creating Route Maps**

Use the following configuration example to create a Route Map:

```
config

context context_name

route-map map_name { deny | permit } seq_number
```

Notes:
- Use the `match` and `set` commands in Route Map Configuration mode to configure the route map. Refer to the *Command Line Interface Reference* for more information on these commands.
- Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

**Sample Configuration**

The example below shows a configuration that creates two route access lists, applies them to a route map, and uses that route map for a BGP router neighbor.

The example below shows a configuration that creates two route access lists, applies them to a route map, and uses that route map for a BGP router neighbor.
config
c
context ispl
    route-access-list named RACLin1a permit 88.151.1.0/30
    route-access-list named RACLin1a permit 88.151.1.4/30
    route-access-list named RACLany permit any
    route-map RMnet1 deny 100
        match ip address route-access-list RACLin1a
        #exit
    route-map RMnet1 deny 200
        match ip address route-access-list RACLlin1b
        #exit
    route-map RMnet1 permit 1000
        match ip address route-access-list RACLany
        #exit
router bgp 1
    neighbor 152.20.1.99 as-path 101
    neighbor 152.20.1.99 route-map RMnet1
Static Routing

The system supports static network route configuration on a per context basis. Define network routes by specifying the:

- IP address and mask for the route
- Name of the interface in the current context that the route must use
- Next hop IP address

Adding Static Routes to a Context

To add static routes to a context configuration, you must know the names of the interfaces that are configured in the current context. Use the `show ip interface` command to list the interfaces in the current context (Exec mode).

Information for all interfaces configured in the current context is displayed as shown in the following example.

```
[local] host_name# show ip interface 
Intf Name: Egress 1
Description:
IP State: Up (Bound to slot/port untagged ifIndex 402718721)
IP Address: 192.168.231.5
Subnet Mask: 255.255.255.0
Bcast Address: 192.168.231.255
MTU: 1500
Resoln Type: ARP ARP timeout: 3600 secs
L3 monitor LC-port switchover: Disabled
Number of Secondary Addresses: 0
Total interface count: 1
```

The first line of information for each interface lists the interface name for the current context as shown in the example output. In this example, there is one interface with the name `Egress 1`.

```
   config

   context context_name

   ip route ( ip_address [ ip_mask ] | ip_addr_mask_combo ) { next-hop
   next_hop_address | egress_name [ precedence precedence [ cost cost ] }
```

Notes:

- You can configure a maximum of 1,200 static routes per context. Save your configuration as described in the `Verifying and Saving Your Configuration` chapter.
Deleting Static Routes From a Context

Use the following configuration example to remove static routes from a context’s configuration:

```
config
  context context_name
    no ip route { ip_address ip_mask | ip_addr_mask_combo } next_hop_address
    egress_name [ precedence precedence ] [ cost cost ]
```

Notes:
- Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.
OSPF Routing

This section gives an overview of Open Shortest Path First (OSPF) routing and its implementation in the system. It also describes how to enable the base OSPF functionality and lists the commands that are available for more complex configurations.

You must purchase and install a license key before you can use this feature. Contact your Cisco account representative for more information on licenses.

**Important:** During system task recovery, it is possible for a dynamically-learned forwarding entry to incorrectly remain in the system forwarding table if that forwarding entry has been removed from the dynamic routing protocol during the recovery.

OSPF Version 2 Overview

OSPF is a link-state routing protocol that employs an interior gateway protocol (IGP) to route IP packets using the shortest path first based solely on the destination IP address in the IP packet header. OSPF routed IP packets are not encapsulated in any additional protocol headers as they transit the network.

An Autonomous System (AS), or Domain, is defined as a group of networks within a common routing infrastructure.

OSPF is a dynamic routing protocol that quickly detects topological changes in the AS (such as router interface failures) and calculates new loop-free routes after a period of convergence. This period of convergence is short and involves a minimum of routing traffic.

In a link-state routing protocol, each router maintains a database, referred to as the link-state database, that describes the Autonomous System's topology. Each participating router has an identical database. Each entry in this database is a particular router's local state (for example, the router's usable interfaces and reachable neighbors). The router distributes its local state throughout the AS by flooding.

All routers run the same algorithm in parallel. From the link-state database, each router constructs a tree of shortest paths with itself as root to each destination in the AS. Externally derived routing information appears on the tree as leaves. The cost of a route is described by a single dimensionless metric.

OSPF allows sets of networks to be grouped together. Such a grouping is called an area. The topology of this area is hidden from the rest of the AS, which enables a significant reduction in routing traffic. Also, routing within the area is determined only by the area’s own topology, lending the area protection from bad routing data. An area is a generalization of an IP subnetted network.

OSPF enables the flexible configuration of IP subnets so that each route distributed by OSPF has a destination and mask. Two different subnets of the same IP network number may have different sizes (that is, different masks). This is commonly referred to as variable-length subnetting. A packet is routed to the best (longest or most specific) match. Host routes are considered to be subnets whose masks are “all ones” (0xffffffff).

OSPF traffic can be authenticated or non-authenticated, or can use no authentication, simple/clear text passwords, or MD5-based passwords. This means that only trusted routers can participate in the AS routing. You can specify a variety of authentication schemes and, in fact, you can configure separate authentication schemes for each IP subnet.

Externally derived routing data (for example, routes learned from an exterior protocol such as BGP) is advertised throughout the AS. This externally derived data is kept separate from the OSPF link state data.

Each external route can also be tagged by the advertising router, enabling the passing of additional information between routers on the boundary of the AS.

OSPF uses a link-state algorithm to build and calculate the shortest path to all known destinations.
Basic OSPFv2 Configuration

This section describes how to implement basic OSPF routing.

Enabling OSPF Routing For a Specific Context

Use the following configuration example to enable OSPF Routing for a specific context:

```
config
  context context_name
    router ospf
  end
```

Notes:
- Save your configuration as described in the Verifying and Saving Your Configuration chapter.

Enabling OSPF Over a Specific Interface

After you enable OSPF, specify the networks on which it will run. Use the following command to enable OSPF:

```
network network_ip_address/network_mask area { area_id | area_ip_address }
```

**Important:** The default cost for OSPF on the system is 10. To change the cost, refer to the `ip ospf cost` command in the Ethernet Interface Configuration Mode Commands chapter of the Command Line Interface Reference.

Notes:
- Save your configuration as described in the Verifying and Saving Your Configuration chapter.

Redistributing Routes Into OSPF (Optional)

Redistributing routes into OSPF means any routes from another protocol that meet specified a specified criterion, such as route type, metric, or rule within a route-map, are redistributed using the OSPFv2 protocol to all OSPF areas. This is an optional configuration.

```
config
  context context_name
    router ospf
      redistribute { connected | static }
    end
```

Notes:
- Save your configuration as described in the Verifying and Saving Your Configuration chapter.
Confirming OSPF Configuration Parameters

To confirm the OSPF router configuration, use the following command and look for the section labeled `router ospf` in the screen output:

```
show config context ctxt_name [ verbose ]
```
OSPFv3 Routing

This section gives an overview of Open Shortest Path First Version 3 (OSPFv3) routing and its implementation in the system. It also describes how to enable the base OSPFv3 functionality and lists the commands that are available for more complex configurations.

OSPFv3 Overview

Much of OSPF version 3 is the same as OSPF version 2. OSPFv3 expands on OSPF version 2 to provide support for IPv6 routing prefixes and the larger size of IPv6 addresses. OSPFv3 dynamically learns and advertises (re redistributes) IPv6 routes within an OSPFv3 routing domain.

In OSPFv3, a routing process does not need to be explicitly created. Enabling OSPFv3 on an interface will cause a routing process and its associated configuration to be created.

Basic OSPFv3 Configuration

This section describes how to implement basic OSPF routing.

Enabling OSPFv3 Routing For a Specific Context

Use the following configuration example to enable OSPF Routing for a specific context:

```
config
  context context_name
    router ospfv3
  end
```

Notes:
- Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

Enabling OSPFv6 Over a Specific Interface

After you enable OSPFv3 specify the area in which it will run. Use the following command to enable OSPFv3:

```
area { area_id | area_ip_address } [ default-cost df1t-cost ] [ stub stub-area ] [ virtual-link vl-neighbor-ipv4address ]
```

*Important:* The default cost for OSPFv3 on the system is 10. To change the cost, refer to the *ipv6 ospf cost* command in the *Ethernet Interface Configuration Mode Commands* chapter of the *Command Line Interface Reference*.

Notes:
- Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.
Redistributing Routes Into OSPFv3 (Optional)

Redistributing routes into OSPFv3 means any routes from another protocol that meet specified a specified criterion, such as route type, metric, or rule within a route-map, are redistributed using the OSPFv3 protocol to all OSPF areas. This is an optional configuration.

```
config
  context context_name
    router ospf3
      redistribute { connected | static }
    end
```

Notes:
- Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.

Confirming OSPFv3 Configuration Parameters

To confirm the OSPF router configuration, use the following command and look for the section labeled `router ipv6 ospf` in the screen output:

```
show config context ctxt_name [ verbose ]
```

Equal Cost Multiple Path (ECMP)

The system supports ECMP for routing protocols. ECMP distributes traffic across multiple routes that have the same cost to lessen the burden on any one route.

The following command configures the maximum number of equal cost paths that can be submitted by a routing protocol:

```
config
  context context_name
    ip routing maximum-paths [ max_num ]
```

Notes:
- `max_num` is an integer from 1 through 10 (*releases prior to 18.2*) or 1 through 32 (*release 18.2+*).
- Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.
BGP-4 Routing

The Border Gateway Protocol 4 (BGP-4) routing protocol is supported through a BGP router process that is implemented at the context level.

The Border Gateway Protocol (BGP) is an inter-AS routing protocol. An Autonomous System (AS) is a set of routers under a single technical administration that use an interior gateway protocol and common metrics to route packets within the AS. The set of routers uses an exterior gateway protocol to route packets to other autonomous systems.

BGP runs over TCP. This eliminates the need for the BGP protocol to implement explicit update fragmentation, retransmission, acknowledgement, and sequencing information. Any authentication scheme used by TCP may be used in addition to BGP’s own authentication mechanisms.

BGP routers exchange network reachability information with other BGP routers. This information builds a picture of AS connectivity from which routes are filtered and AS-level policy decisions are enforced.

BGP-4 provides classless inter-domain routing. This includes support for advertising an IP prefix and eliminates the concept of network class within BGP. BGP-4 also allows the aggregation of routes, including the aggregation of AS paths.

Overview of BGP Support

Mobile devices communicate to the Internet through Home Agents (HAs). HAs assign IP addresses to the mobile node from a configured pool of addresses. These addresses are also advertised to Internet routers through an IP routing protocol to ensure dynamic routing. The BGP-4 protocol is used as a monitoring mechanism between an HA and Internet router with routing to support Interchassis Session Recovery (ICSR). (Refer to Interchassis Session Recovery for more information.)

The objective of BGP-4 protocol support is to satisfy routing requirements and monitor communications with Internet routers. BGP-4 may trigger an active to standby switchover to keep subscriber services from being interrupted.

The following BGP-4 features are supported:

- Exterior Border Gateway Protocol (EBGP) multi-hop
- Route Filtering for inbound and outbound routes
- Route redistribution and route-maps
- Support for BGP communities and extended communities in route maps
- Local preference for IPv4 and IPv6 (IBGP peers)

IP pool routes and loopback routes are advertised in the BGP domain in the following ways:

- Through BGP Configuration Mode redistribution commands, all or some of the connected routes are redistributed into the BGP domain. (IP pool and loopback routes are present in the IP routing table as connected routes.) The network routemap command provides the flexibility to change many BGP attributes.

- Through the BGP Configuration Mode network commands, connected routes are explicitly configured for advertisement into the BGP domain. The network routemap command provides the flexibility to change many BGP attributes. Refer to the Border Gateway Protocol Configuration Mode Commands chapter of the Command Line Interface Reference for details on these commands.

Important: If a BGP task restarts because of a processing card failure, a migration, a crash, or the removal of a processing card, all peering session and route information is lost.
Configuring BGP

This section describes how to configure and enable basic BGP routing support in the system.

```
config
  context context_name
    router bgp AS_number
      neighbor ip_address remote-as AS_num
```

Notes:

- A maximum of 64 BGP peers are supported per context.
- Save your configuration as described in the Verifying and Saving Your Configuration chapter.

Redistributing Routes Into BGP (Optional)

Redistributing routes into BGP simply means that any routes from another protocol that meet a specified criterion, such as a route type, or a rule within a route-map, are redistributed through the BGP protocol to all BGP areas. This is an optional configuration.

```
config
  context context_name
    router bgp as_number
      redistribute bgp { bgp | connected | static } [ metric metric_value ]
        [ metric-type { 1 | 2 } ] [ route-map route_map_name ]
```

Notes:

- The redistribution options are connected, ospf, rip, or static. Refer to the Border Gateway Protocol Configuration Mode Commands chapter of the Command Line Interface Reference for details on the redistribute command.
- A maximum of 64 route-maps are supported per context.
- Save your configuration as described in the Verifying and Saving Your Configuration chapter.
BGP Communities and Extended Communities

Route filtering based on a BGP community or extended community (route target) via CLI Route Map Configuration mode commands.

BGP Communities

Configuring a BGP Community

A BGP community is a group of destinations that share some common attribute. Each destination can belong to multiple communities. Autonomous system administrators define to which communities a destination belongs.

You configure a BGP community via a Context Configuration mode command.

```
config
  context context_name
    ip community-list { named named_list | standard identifier }
    { deny | permit } { internet | local-AS | no-advertise | no-export | value AS-community_number AS-community_number AS-community_number ...}
    { internet | local-AS | no-advertise | no-export | value AS-community_number AS-community_number AS-community_number ...}
    { internet | local-AS | no-advertise | no-export | value AS-community_number AS-community_number AS-community_number ...}
```

You can permit or deny the following BGP community destinations.

- **internet** – Advertise this route to the internet community, and any router that belongs to it.
- **local-AS** – Use in confederation scenarios to prevent sending packets outside the local autonomous system (AS).
- **no-advertise** – Do not advertise this route to any BGP peer, internal or external.
- **no-export** – Do not advertise to external BGP (eBGP) peers. Keep this route within an AS.
- **value AS-community_number** – Specifies a community string in AS:NN format, where AS = 2-byte AS-community hexadecimal number and NN = 2-byte hexadecimal number (1 to 11 characters).

You can enter multiple destinations and AS community numbers for each community. For additional information, see the Command Line Interface Reference.

Multiple community-list entries can be attached to a community-list by adding multiple permit or deny clauses for various community strings. Up to 64 community-lists can be configured in a context.
Setting the Community Attribute

You set the BGP community attribute via a `set community` command in a route map.

```plaintext
config

context context_name

route-map map_name { deny | permit } sequence_number

set community [additive]{ internet | local-AS | no-advertise | no-export | none | value AS-community_number AS-community_number AS-community_number ... }

{ internet | local-AS | no-advertise | no-export | none | value AS-community_number AS-community_number AS-community_number ... }

{ internet | local-AS | no-advertise | no-export | none | value AS-community_number AS-community_number AS-community_number ... }
```

The **additive** option allows you to enter multiple destinations and AS community numbers. For additional information, see the [Command Line Interface Reference](#).

Filtering via a BGP Community

To filter routes based on a BGP community, you configure a `match` clause in a route map. The command sequence follows below.

```plaintext
config

context context_name

route-map map_name { deny | permit } sequence_number

match community { named named_list | standard identifier }
```

BGP Extended Communities

Configuring a BGP Extended Community (Route Target)

A BGP extended community defines a route target. MPLS VPNs use a 64-bit Extended Community attribute called a Route Target (RT). An RT enables distribution of reachability information to the correct information table.

You configure a BGP extended community via a Context Configuration mode command.

```plaintext
config

context context_name

ip extcommunity-list { named named_list | standard identifier }

{ deny | permit } rt rt_number rt_number rt_number ...
```

`rt_number` specifies a Route Target as a string in AS:NN format, where AS = 2-byte AS-community hexadecimal number and NN = 2-byte hexadecimal number (1 to 11 characters). You can add multiple route numbers to an IP extcommunity list.
Multiple extended community-list entries can be attached to an extended community-list by adding multiple permit or deny clauses for various extended community strings. Up to 64 extended community-lists can be configured in a context.

Setting the Extended Community Attribute

You set the BGP extended community attribute via a `set extcommunity` command in a route map.

```
config
  context context_name
  route-map map_name { deny | permit } sequence_number
    set extcommunity rt rt_number rt_number rt_number ...
```

`rt_number` specifies a Route Target as a string in AS:NN format, where AS = 2-byte AS-community hexadecimal number and NN = 2-byte hexadecimal number (1 to 11 characters). You can add multiple route numbers to an IP extcommunity list.

Filtering via a BGP Extended Community

To filter routes based on a BGP extended community (route target), you configure a `match` clause in a route map. The command sequence follows below.

```
config
  context context_name
  route-map map_name { deny | permit }
    [no] match extcommunity { named named_list | standard identifier }
```

BGP Local Preference

The BGP local preference attribute is sent by BGP speaker only to IBGP peers. It is set in a route map via the following command sequence:

```
config
  context context_name
  route-map map_name { deny | permit }
    set local-preference pref_number
```

There is no `match` clause corresponding to local preference in the route-map because local-preference is directly used in the route selection algorithm.
ICSR and SRP Groups

BGP is employed with Interchassis Session Recovery (ICSR) configurations linked via Service Redundancy Protocol (SRP). By default an ICSR failover is triggered when all BGP peers within a context are down.

Optionally, you can configure SRP peer groups within a context. ICSR failover would then occur if all peers within a group fail. This option is useful in deployments in which a combination of IPv4 and IPv6 peers are spread across multiple paired VLANs, and IPv4 or IPv6 connectivity is lost by all members of a peer group.

For additional information refer to Interchassis Session Recovery in this guide and the description of the monitor bgp, monitor diameter and monitor authentication-probe commands in the Service Redundancy Protocol Configuration Mode Commands chapter of the Command Line Interface Reference.

Advertising BGP Routes from a Standby ICSR Chassis

An SRP Configuration mode command enables advertising BGP routes from an ICSR chassis in standby state. This command and its keywords allow an operator to take advantage of faster network convergence accrued from deploying BGP Prefix Independent Convergence (PIC) in the Optical Transport Network Generation Next (OTNGN).

BGP PIC is intended to improve network convergence which will safely allow for setting aggressive ICSR failure detection timers.

```
configure

context context_name

service-redundancy-protocol

advertise-routes-in-standby-state [ hold-off-time hold-off-time ]
[ reset-bfd-nbrs bfd-down-time ]

end
```

Notes:

- **hold-off-time hold-off-time** delays advertising the BGP routes until the timer expires. Specify *hold-off-time* in seconds as an integer from 1 to 300.
- After resetting BFD, **reset-bfd-nbrs bfd-down-time** keeps the BFD sessions down for the configured number of milliseconds to improve network convergence. Specify *bfd-down-time* as an integer from 50 to 120000.

Configurable BGP Route Advertisement Interval for ICSR

By default, the MinRtAdvInterval is set for each peer with a value of 5 seconds for an iBGP peer and 30 seconds for an eBGP peer. An operator can use the **neighbor identifier advertisement-interval** command to globally change the default interval.

The BGP advertisement-interval can also be separately set for each address family. If configured, this value over-rides the peer's default advertisement-interval for that address-family only. BGP will send route update-message for each AFI/SAFI based on the advertisement-interval configured for that AFI/SAFI. If no AFI/SAFI advertisement-interval is configured, the peer-based default advertisement-interval is used.

In ICSR configurations, this feature can be used to speed route advertisements and improve network convergence times.
The `timers bgp icsr-aggr-advertisement-interval` command is available in both the BGP Address-Family (VPNv4/VPNv6) Configuration and BGP Address-Family (VRF) Configuration modes.

```
configure
  context context_name
    router bgp as_number
      address-family { ipv4 | ipv6 | vpnv4 | vpnv6 }
        timers bgp icsr-aggr-advertisement-interval seconds
```

Notes:
- `seconds` – sets the number of seconds as an integer from 0 to 30. Default: 0.
Bidirectional Forwarding Detection

Bidirectional Forwarding Detection (BFD) is a network protocol used to detect faults between two forwarding engines connected by a link. BFD establishes a session between two endpoints over a particular link. If more than one link exists between two systems, multiple BFD sessions may be established to monitor each one of them. The session is established with a three-way handshake, and is torn down the same way. Authentication may be enabled on the session. A choice of simple password, MD5 or SHA1 authentication is available.

Overview of BFD Support

BFD does not have a discovery mechanism; sessions must be explicitly configured between endpoints. BFD may be used on many different underlying transport mechanisms and layers, and operates independently of all of these. Therefore, it needs to be encapsulated by whatever transport it uses.

Protocols that support some form of adjacency setup, such as OSPF or IS-IS, may also be used to bootstrap a BFD session. These protocols may then use BFD to receive faster notification of failing links than would normally be possible using the protocol's own keepalive mechanism.

In asynchronous mode, both endpoints periodically send Hello packets to each other. If a number of those packets are not received, the session is considered down.

When Echo is active, a stream of Echo packets is sent to the other endpoint which then forwards these back to the sender. Echo can be globally enabled via the `bfd-protocol` command, and/or individually enabled/disabled per interface. This function is used to test the forwarding path on the remote system.

The system supports BFD in asynchronous mode with optional Echo capability via static or BGP routing.

Configuring BFD

This section describes how to configure and enable basic BFD routing protocol support in the system.

There are several factors affecting the configuration of BFD protocol:

- Configuring a BFD Context
- Configuring IPv4 BFD for Static Routes
- Configuring IPv6 BFD for Static Routes
- Configuring BFD for Single Hop
- Configuring Multihop BFD
- Scaling of BFD
- Associating BGP Neighbors with the Context
- Associating OSPF Neighbors with the Context
- Associating BFD Neighbor Groups with the BFD Protocol
- Enabling BFD on OSPF Interfaces
- Monitoring BFD Connection for ICSR
Configuring a BFD Context

```config
cfg
  context context_name
    bfd-protocol
      [ bfd echo ]
  exit
```

Notes:
- Echo function can be optionally enabled for all interfaces in this context.
- 16 BFD sessions per context and 64 per chassis.

Configuring IPv4 BFD for Static Routes

Enable BFD on an interface.

```config
cfg
  context bfd_context_name
    interface if_name
      ip address ipv4_address ipv4_mask
      bfd interval interval_value min_rx rx_value multiplier multiplier_value
      [ bfd echo ]
  exit
```

Configure BFD static route.

```ip route static bfd if_name ipv4_gw_address``` 

Add static routes.

```ip route ipv4_address ipv4_mask``` 
```ip route ipv4_address ipv4_mask```
**Configuring IPv6 BFD for Static Routes**

Enable BFD on an Interface

```
config
  context bfd_context_name
  interface if_name
    ipv6 address ipv6_address ipv6_mask
    bfd interval interval_value min_rx rx_value multiplier multiplier_value
    [ bfd echo ]
  exit
```

Configure BFD static route.

```
ipv6 route static bfd if_name ipv6_gw_address
```

Add static routes.

```
ipv6 route ipv6_address ipv6_mask
ipv6 route ipv6_address ipv6_mask
```

**Configuring BFD for Single Hop**

Enable BFD on an interface.

```
config
  context bfd_context_name
  interface if_name
    ip address ipv4_address ipv4_mask
    ipv6 address ipv6_address ipv6_mask
    bfd interval interval_value min_rx rx_value multiplier multiplier_value
    [ bfd echo ]
  exit
```

Enable BFD on a BGP Neighbor. For additional information, see [Associating BGP Neighbors with the Context](#).

Enable BFD on an OSPF Neighbor. For additional information, see [Associating OSPF Neighbors with the Context](#).
Configuring Multihop BFD

Enable BFD on an interface.

```config
context bfd_context_name

interface if_name

ip address ipv4_address ipv4_mask
ipv6 address ipv6_address ipv6_mask

bfd interval interval_value min_rx rx_value multiplier multiplier_value
[ bfd echo ]

exit
```

Configure a Multihop BFD session.

```config
bfd-protocol

bfd multihop peer destination-address interval interval-value
multiplier multiplier-value
```

Enable BFD on a BGP Neighbor. For additional information, see Associating BGP Neighbors with the Context.

Scaling of BFD

Configure an active BFD session using one of the above methods and use same BFD neighbor while configuring the active interface. For additional information, see Associating BFD Neighbor Groups with the BFD Protocol.

```config
bfd-protocol

bfd nbr-group-name grp_name active-if-name if_name nexthop_address
```

Apply the same BFD results to one or more passive interfaces.

```config
bfd nbr-group-name grp_name passive-if-name if_name nexthop_address
```

```config
bfd nbr-group-name grp_name passive-if-name if_name nexthop_address
```
Associating BGP Neighbors with the Context

```
config
context context_name
  router bgp AS_number
    neighbor neighbor_ip-address remote-as rem_AS_number
    neighbor neighbor_ip-address ebgp-multihop max-hop max_hops
    neighbor neighbor_ip-address update-source update-src_ip-address
    neighbor neighbor_ip-address failover bfd [ multihop ]
```

Notes:
- Repeat the sequence to add neighbors.

Associating OSPF Neighbors with the Context

```
config
context context_name
  router ospf
    neighbor neighbor_ip-address
```

Notes:
- Repeat the sequence to add neighbors.

Associating BFD Neighbor Groups with the BFD Protocol

```
config
context context_name
  bfd-protocol
    bfd nbr-group-name grp_name active-if-name if_name nexthop_address
    bfd nbr-group-name grp_name passive-if-name if_name nexthop_address
```
Enabling BFD on OSPF Interfaces

All OSPF Interfaces

```configuration
config
  context context_name
  router ospf
    bfd-all-interfaces
```

Specific OSPF Interface

```configuration
config
  context context_name
    interface interface_name
      broadcast
      ip ospf bfd
```

Monitoring BFD Connection for ICSR

For ICSR configurations, the following command sequence initiates monitoring of the connection between the primary chassis and the BFD neighbor in the specified context. If the connection drops, the standby chassis becomes active.

```configuration
config
  context context_name
    service-redundancy-protocol
      monitor bfd context context_name { ipv4_address | ipv6_address }
      { chassis-to-chassis | chassis-to-router }
```

Notes:
- `ipv4_address | ipv6_address` defines the IP address of the BFD neighbor to be monitored, entered using IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation
- `chassis-to-chassis` enables BFD to run between primary and backup chassis on non-SRP links.
- `chassis-to-router` enables BFD to run between chassis and router.

Saving the Configuration

Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.
Chassis-to-Chassis BFD Monitoring for ICSR

An operator can configure BFD to more quickly advertise routes during an ICSR switchover. This solution complements the feature that allows the advertising of BGP routes from a Standby ICSR chassis. The overall goal is to support more aggressive failure detection and recovery in an ICSR configuration when implementing VoLTE.

You must configure the following features for chassis-to-chassis BFD monitoring in ICSR configurations:

- Enable Primary Chassis BFD Monitoring
- Set BFD to Ignore ICSR Dead Interval
- Configure ICSR Switchover Guard Timer
- Enable BFD Multihop Fall-over
- Enable Advertising BGP Routes from Standby ICSR Chassis

Enable Primary Chassis BFD Monitoring

You must enable monitoring of the connection between the primary chassis and specified BFD neighbors. If the connection drops, the standby chassis becomes active. For more information, see Monitoring BFD Connection for ICSR.

Set BFD to Ignore ICSR Dead Interval

The SRP Configuration mode `bfd-mon-ignore-dead-interval` command causes the standby ICSR chassis to ignore the dead interval and remain in the standby state until all the BFD chassis-to-chassis monitors fail.

Enable this feature in association with BFD chassis-to-chassis monitoring to support more aggressive ICSR failure detection times.

```bash
configure
context context_name

   service-redundancy-protocol variable

      bfd-mon-ignore-dead-interval

end
```

Configure ICSR Switchover Guard Timer

The SRP Configuration mode `guard timer` command configures the redundancy-guard-period and monitor-damping-period for SRP service monitoring.

Use these guard timers to ensure that local failures, such as card reboots and task restarts, do not result in ICSR events which can be disruptive.
configure

context context_name

service-redundancy-protocol variable

  guard-timer { aaa-switchover-timers { damping-period seconds |
        guard-period seconds } |
    diameter-switchover-timers { damping-period seconds |
        guard-period seconds } |
    srp-redundancy-timers { aaa { damping-period seconds |
        guard-period seconds } |
      diam { damping-period seconds | guard-period seconds } }

end

Notes:

- **aaa-switchover-timers** – sets timers that prevent back-to-back ICSR switchovers due to an AAA failure (post ICSR switchover) while the network is still converging.
  - **damping-period** – configures a delay time to trigger an ICSR switchover due to a monitoring failure within the guard-period.
  - **guard-period** – configures the local-failure-recovery network-convergence timer.
- **diameter-switchover-timers** – sets timers that prevent a back-to-back ICSR switchover due to a Diameter failure (post ICSR switchover) while the network is still converging.
  - **damping-period** – configures a delay time to trigger an ICSR switchover due to a monitoring failure within the guard-period.
  - **guard-period** – configures the local-failure-recovery network-convergence timer.
- **srp-redundancy-timers** – sets timers that prevent an ICSR switchover while the system is recovering from a local card-reboot/critical-task-restart failure.
  - **aaa** – local failure followed by AAA monitoring failure
  - **bgp** – local failure followed by BGP monitoring failure
  - **diam** – local failure followed by Diameter monitoring failure

Enable BFD Multihop Fall-over

A **fall-over bfd multihop mhsess_name** keyword in the Context Configuration mode ip route and ipv6 route commands enables fall-over BFD functionality for the specified multihop session. The **fall-over bfd** option uses BFD to monitor neighbor reachability and liveness. When enabled it will tear down the session if BFD signals a failure.

configure

context context_name

ip route { ip_address/ip_mask | ip_address ip_mask } { gateway_ip_address |
  next-hop next_hop_ip_address | point-to-point | tunnel } egress_intrfc_name
  [ cost cost ] [ fall-over bfd multihop mhsess_name ] [ precedence precedence ]
  [ vrf vrf_name [ cost value ] [ fall-over bfd multihop mhsess_name ]
  [ precedence precedence ] +

end
The `ip route` command now also allows you to add a static multihop BFD route.

```
ip route static multihop bfd mhbfd_sess_name local_endpt_ipaddr remote_endpt_ipaddr
```

**Important:** SNMP traps are generated when BFD sessions go up and down (BFDSessUp and BFDSessDown).

### ip route Command

```
configure

context context_name

    ip route { ip_address/ip_mask | ip_address ip_mask } { gateway_ip_address | next-hop next_hop_ip_address | point-to-point | tunnel } egress_intrfc_name
    [ cost cost ] [ fall-over bfd multihop mhsess_name ] [ precedence precedence ]
    [ vrf vrf_name [ cost value ] [ fall-over bfd multihop mhsess_name ]
    [ precedence precedence ] +

end
```

The `ip route` command now also allows you to add a static multihop BFD route.

```
ip route static multihop bfd mhbfd_sess_name local_endpt_ipaddr remote_endpt_ipaddr
```

### ip routev6 Command

```
configure

context context_name

    ipv6 route ipv6_address/prefix_length { interface name | next-hop
    ipv6_address interface name } [ cost cost ] [ fall-over bfd multihop mhsess_name ]
    [ precedence precedence ] [ vrf vrf_name [ cost value ] [ fall-over bfd multihop
    mhsess_name ] [ precedence precedence ]

end
```

The `ipv6 route` command now also allows you to add a static multihop BFD route.

```
ipv6 route static multihop bfd mhbfd_sess_name local_endpt_ipv6addr remote_endpt_ipv6addr
```
Adjust BFD Interval

Set the transmit interval (in milliseconds) between BFD packets to meet the convergence requirements of your network deployment.

```
configure

context context_name

interface interface_name broadcast

  bfd interval interval_num  min_rx milliseconds multiplier value

end
```

Notes:

- `milliseconds` is an integer from 50 through 10000. (Default 50)

Enable Advertising BGP Routes from Standby ICSR Chassis

For information on configuring the feature, see Advertising BGP Routes from a Standby ICSR Chassis.

Saving the Configuration

Save your configuration as described in the Verifying and Saving Your Configuration chapter.

BFD Support for Link Aggregation Member Links

Member-link based BFD detects individual link failures faster than LACP and reduces the overall session/traffic down period as a result of single member link failure.

Overview

A BFD Configuration mode CLI command configures BFD interactions with the linkagg task. Once a session is configured, BFD creates per member link BFD sessions and starts sending packets on each of the linkagg member links. If a member link BFD session fails, StarOS notifies failures to the linkagg task.
If you define a linkagg-peer using a slot number, you may configure a linkagg-peer for a redundant LC (Line Card) slot which must also specify a slot in its member-link configuration. Likewise, if you configure a linkagg-peer without a slot, you must delete it before configuring a peer with a slot specified.

**Important:** Only one IPv4 or IPv6 BFD session-based configuration is allowed per linkagg interface for compliance with RFC 7130.

### Configuring Support for BFD Linkagg Member-links

The `bfd linkagg-peer` command enables member-link BFD and configures the BFD link aggregation (linkagg) session values [RFC 7130].

```
configure
  context context_name
  bfd-protocol
    bfd linkagg-peer linkagg_group_id local-endpt-addr local-endpt_ipaddress remote-endpt-addr remote_endpt_ipaddress interval tx_interval min_rx rx_interval multiplier multiplier_value [ slot slot_number ]
    no bfd linkagg-peer linkagg_group_id [ slot slot_number ]
  end
```
Notes:

- `linkagg_group_id` specifies the LAG number as an integer from 1 through 255.
- `local-endpt-addr local-endpt_ipaddress` specifies the source address of the multihop BFD session in IPv4 or IPv6 notation.
- `remote-endpt-addr remote-endpt_ipaddress` specifies the remote address of the multihop BFD session in IPv4 or IPv6 notation.
- `interval tx_interval` specifies the transmit interval of control packets in milliseconds as an integer from 50 through 10000.
- `min_rx rx_interval` specifies the receive interval of control packets in milliseconds as an integer from 50 through 10000.
- `multiplier multiplier_value` specifies the value used to compute hold-down time as an integer from 3 through 50.
- `slot slot_number` for redundant active-standby link aggregation, this option specifies the card for which this configuration is intended.

Saving the Configuration

Save your configuration as described in the Verifying and Saving Your Configuration chapter.
Viewing Routing Information

To view routing information for the current context, run one of the following Exec mode commands:

- **show ip route**: Displays information for IPv4 routes in the current context.
- **show ipv6 route**: Displays information for ipv6 routes in the current context.
- **show ip static-route**: Displays information only for IPv4 static routes in the current context.
- **show ip ospf**: Displays IPv4 OSPF process summary information in the current context.
- **show ipv6 ospf**: Displays IPv6 OSPFv3 process summary information in the current context.
- **show ip bgp**: Displays IPv4 BGP information.

This example shows sample output of the command, **show ip route**.

```
[local]host_name# show ip route
"*" indicates the Best or Used route.

   Destination     Nexthop    Protocol Prec Cost Interface
*44.44.44.0/24   208.230.231.50 static   1   0   local1
*192.168.82.0/24 0.0.0.0    connected 0   0
*192.168.83.0/24 0.0.0.0    connected 0   0
208.230.231.0/24 0.0.0.0    ospf      110  10  local1
*208.230.231.0/24 0.0.0.0    connected 0   0  local1

Total route count: 5
```
Chapter 17
VLANs

This chapter provides information on configuring virtual local area networks (VLANs) in support of enhanced or extended services. The product administration guides provide examples and procedures for configuration of services on the system that may utilize VLANs. You should select the configuration example that best meets your service model before using the procedures described below.

This chapter includes the following sections:

- Overview
- Creating VLAN Tags
- Verifying the Port Configuration
- Configuring Subscriber VLAN Associations
- VLAN-Related CLI Commands

Important: VLAN – Layer 2 Traffic Management is a Cisco feature that requires a separate license. Contact your Cisco account representative for detailed information on specific licensing requirements. For information on installing and verifying licenses, refer to the Managing License Keys section of Software Management Operations.
Overview

Virtual LANs (VLANs) provide greater flexibility in the configuration and use of contexts and services. They are configured as “tags” on a per-port basis and allow more complex configurations to be implemented. The VLAN tag allows a single physical port to be bound to multiple logical interfaces that can be configured in different contexts. Therefore, each Ethernet port can be viewed as containing many logical ports when VLAN tags are employed.

Important: VLANs are supported in conjunction with subscriber traffic ports on Management I/O (MIO/UMIO) cards. The system supports the configuration limits for VLANs as described in Engineering Rules.

Overlapping IP Address Pool Support – GGSN

Overlapping IP Address pools provides allow operators to more flexibly support multiple corporate VPN customers with the same private IP address space without expensive investments in physically separate routers or virtual routers.

The system supports two types of overlapping pools – resource and overlap. Resource pools are designed for dynamic assignment only, and use a VPN tunnel (such as a GRE tunnel) to forward and receive the private IP addresses to and from the VPN. Overlapping type pools can be used for both dynamic and static addressing, and use VLANs and a next hop forwarding address to connect to the VPN customer.

To forward downstream traffic to the correct PDP context, the GGSN uses either the GRE tunnel ID or the VLAN ID to match the packet. When forwarding traffic upstream, the GGSN uses the tunnel and forwarding information in the IP pool configuration; overlapping pools must be configured in the APN in such instances.

When a PDP context is created, the IP address is assigned from the IP pool. In this case the forwarding rules are also configured into the GGSN. If the address is assigned statically, when the GGSN confirms the IP address from the pool configured in the APN, the forwarding rules are also applied.

The GGSN can scale to as many actual overlapping pools as there are VLAN interfaces per context, and there can be multiple contexts per GGSN. The limit is the number of IP pools. This scalability allows operators who wish to provide VPN services to customers using the customer's private IP address space, not to be concerned about escalating hardware costs or complex configurations.

RADIUS VLAN Support – Enhanced Charging Services

VPN customers often use private address space which can easily overlap with other customers. The subscriber addresses are supported with overlapping pools which can be configured in the same virtual routing context.

RADIUS Server and NAS IP addresses do not need to be in separate contexts, thereby simplifying APN and RADIUS configuration and network design. This feature allows the following scenarios to be defined in the same context:

- Overlapping RADIUS NAS-IP addresses for various RADIUS server groups representing different APNs.
- Overlapping RADIUS server IP addresses for various RADIUS servers groups.

Every overlapping NAS-IP address is given a unique next-hop address which is then bound to an interface that is bound to a unique VLAN, thereby allowing the configuration to exist within the same context.

The system forwards RADIUS access requests and accounting messages to the next hop defined for that NAS-IP; the connected routers forward the messages to the RADIUS server. The next hop address determines the interface and VLAN to use. Traffic from the server is identified as belonging to a certain NAS-IP by the port/VLAN combination.
The number of RADIUS NAS-IP addresses that can be configured is limited by the number of loopback addresses that can be configured.

**APN Support – PDN Gateway (P-GW)**

P-GW Access Point Name (APN) supports extensive parameter configuration flexibility for the APN. VLAN tagging may be selected by the APN, but are configured in the P-GW independently from the APN.

**Creating VLAN Tags**

Use the following example to create VLANs on a port and bind them to pre-existing interfaces. For information on creating interfaces, refer to *System Interfaces and Ports*.

```
config
  port ethernet slot/port
    no shutdown
    vlan vlan_tag_ID
    no shutdown
    bind interface interface_name context_name
end
```

Notes:

- *Optional*: Configure VLAN-subscriber associations. Refer to *Configuring Subscriber VLAN Associations* for more information.
- Repeat this procedure as needed to configure additional VLANs for the port.
- Refer to *VLAN-Related CLI Commands* and the *Command Line Interface Reference* for additional information.
- Save your configuration as described in the *Verifying and Saving Your Configuration* chapter.
Verifying the Port Configuration

Run the following command to verify the port configuration:

```
[local]host_name# show port info slot/port
```

An example of this command’s output when at least one VLAN has been configured for the port is shown below:

```
Port: 5/11
  Port Type : 10G Ethernet
  Role : Service Port
  Description : (None Set)
  Redundancy Mode : Port Mode
  Redundant With : 6/11
  Preferred Port : Non-Revertive
  Physical ifIndex : 85262336
  Administrative State : Enabled
  Configured Duplex : Auto
  Configured Speed : Auto
  Fault Unidirection Mode : 802_3ae clause 46
  Configured Flow Control : Enabled
  Interface MAC Address : 64-9E-F3-69-5B-EA
  SRP Virtual MAC Address : None
  Fixed MAC Address : 64-9E-F3-69-5B-CA
  Link State : Up
  Link Duplex : Full
  Link Speed : 10 Gb
  Flow Control : Enabled
  Link Aggregation Group : None
  Untagged:
    Logical ifIndex : 85262337
    Operational State : Up, Active
  Tagged VLAN: VID 10
    Logical ifIndex : 285278210
    VLAN Type : Standard
    VLAN Priority : 0
    Administrative State : Enabled
    Operational State : Up, Active
  Number of VLANs : 1
  SFP Module : Present (10G Base-SR)
```

Notes:

- Repeat this sequence as needed to verify additional ports.
- **Optional:** Configure VLAN-subscriber associations. Refer to Configuring Subscriber VLAN Associations for more information.
- Refer to VLAN-Related CLI Commands for additional information.
- Save your configuration as described in the Verifying and Saving Your Configuration chapter.
Configuring Subscriber VLAN Associations

Subscriber traffic can be routed to specific VLANs based on the configuration of their user profile. This functionality provides a mechanism for routing all traffic from a subscriber over the specified VLAN. All packets destined for the subscriber must also be sent using only IP addresses valid on the VLAN or they will be dropped.

RADIUS Attributes Used

The following RADIUS attributes can be configured within subscriber profiles on the RADIUS server to allow the association of a specific VLAN to the subscriber:

- **SN-Assigned-VLAN-ID**: In the Starent VSA dictionary
- **SN1-Assigned-VLAN-ID**: In the Starent VSA1 dictionary

**Important**: Since the instructions for configuring subscriber profiles differ between RADIUS server applications, this section only describes the individual attributes that can be added to the subscriber profile. Please refer to the documentation that shipped with your RADIUS server for instructions on configuring subscribers.

Configuring Local Subscriber Profiles

Use the configuration example below to configure VLAN associations within local subscriber profiles on the system.

**Important**: These instructions assume that you have already configured subscriber-type VLAN tags according to the instructions provided in Creating VLAN Tags.

```
config

    context context_name

    subscriber name user_name

        ip vlan vlan_id

    end
```

Verify the Subscriber Profile Configuration

Use the following command to view the configuration for a subscriber profile:

```
[local]host_name# show subscriber configuration username user_name
```

Notes:

- Repeat this command for each subscriber.
- Save your configuration as described in the Verifying and Saving Your Configuration chapter.
VLAN-Related CLI Commands

VLAN-related features and functions are supported across several CLI command modes. The following tables identify commands associated with configuration and monitoring of VLAN-related functions.

For detailed information regarding the use of the commands listed below, see the Command Line Interface Reference.

Table 36. VLAN-Related Configuration Commands

<table>
<thead>
<tr>
<th>CLI Mode</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
</table>
| AAA Server Group Configuration Mode | $radius\ attribute\ nas-ip-address\ address\ ip\ address\ nexthop-forwarding-address\ ip\ address\ vlan\ vlan_id$ | Sets the RADIUS client to provide the VLAN ID with the nexthop forwarding address to a system when running in single nexthop gateway mode.  
**Note:** To access the $vlan$ keyword, aaa-large configuration must be enabled via the Global Configuration mode. |
| ACS Charging Action Configuration Mode | $ip\ vlan\ vlan_id$                                                      | Configures the VLAN identifier to be associated with the subscriber traffic in the destination context. |
| Context Configuration Mode     | $ip\ pool\ pool_name\ nexthop\ forwarding\ address\ ip\ address\ overlap\ vlanid\ vlan_id$ | When a nexthop forwarding address is configured, the overlap vlanid keyword enables support for overlapping IP address pools and associates the pool with the specified VLAN ID. |
| Context Configuration Mode     | $ip\ routing\ overlap-pool$                                             | Advertises overlap-pool addresses in dynamic routing protocols when overlap pools are configured using VLAN IDs. When enabled, the overlap addresses are added as interface addresses and advertised. |
| Context Configuration Mode     | $radius\ attribute\ nas-ip-address\ address\ ip\ address\ nexthop-forwarding-address\ ip\ address\ vlan\ vlan_id$ | Specifies the VLAN ID to be associated with the next-hop IP address. |
| Ethernet Interface Configuration Mode | $[no]\ logical-port-statistics$                                        | Enables or disables the collection of logical port (VLAN and NPU) bulk statistics for the first 32 configured Ethernet or PVC interface types. |
| Ethernet Interface Configuration Mode | $vlan-map\ next-hop\ ipv4\ address$                                    | Sets a single next-hop IP address so that multiple VLANs can use a single next-hop gateway. The vlan-map is associated with a specific interface. |
| Ethernet Port Configuration Mode | $vlan\ vlan_id$                                                         | Enters VLAN Configuration mode.                                                                 |
| PVC Configuration Mode         | $[no]\ shutdown$                                                       | Enables or disables traffic over a specified VLAN. See below. |
### VLAN-Related CLI Commands

<table>
<thead>
<tr>
<th>CLI Mode</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscriber Configuration Mode</td>
<td><code>ip vlan vlan_id</code></td>
<td>Configures the subscriber VLAN ID that is used with the assigned address for the subscriber session to receive packets. If the IP pool from which the address is assigned is configured with a VLAN ID, this subscriber configured VLAN ID overrides it.</td>
</tr>
<tr>
<td>VLAN Configuration Mode</td>
<td><code>bind interface interface_name context_name</code></td>
<td>Binds a virtual interface and context to support VLAN service.</td>
</tr>
<tr>
<td>VLAN Configuration Mode</td>
<td><code>[no] ingress-mode</code></td>
<td>Enables or disables port ingress (incoming) mode.</td>
</tr>
<tr>
<td>VLAN Configuration Mode</td>
<td><code>priority value</code></td>
<td>Configures an 802.1p VLAN priority bit for ASN-GW service only.</td>
</tr>
<tr>
<td>VLAN Configuration Mode</td>
<td><code>[no] shutdown</code></td>
<td>Enables or disables traffic over the current VLAN.</td>
</tr>
<tr>
<td>VLAN Configuration Mode</td>
<td><code>vlan-map interface if_name context_name</code></td>
<td>Associates an IP interface having a VLAN ID with a context.</td>
</tr>
</tbody>
</table>

### Table 37. VLAN-Related Monitoring Commands

<table>
<thead>
<tr>
<th>CLI Mode</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exec Mode show commands</td>
<td><code>clear port slot/port vlan vlan_id</code></td>
<td>Clears NPU statistics for the port that has a previously configured VLAN ID.</td>
</tr>
<tr>
<td>Exec Mode show commands</td>
<td>`show logical-port utilization table vlan { 5-minute</td>
<td>hourly }`</td>
</tr>
<tr>
<td>Exec Mode show commands</td>
<td><code>show port info slot/port vlan vlan_id</code></td>
<td>Displays NPU counters for a previously configured VLAN ID.</td>
</tr>
</tbody>
</table>
Chapter 18
BGP MPLS VPNs

This chapter describes services that are supported by the ASR 5x00 for Border Gateway Protocol (BGP) Multi-Protocol Label Switching (MPLS) Virtual Private Networks (VPNs).

**Important:** MPLS is a licensed Cisco feature that requires a separate license. Contact your Cisco account representative for detailed information on specific licensing requirements. For information on installing and verifying licenses, refer to the *Managing License Keys* section of *Software Management Operations*.

It includes the following topics:

- Introduction
- MPLS-CE Connected to PE
- ASR 5x00 as a PE
- IPv6 Support for BGP MPLS VPNs
- VPN-Related CLI Commands
Introduction

Service providers require the ability to support a large number of corporate Access Point Names (APNs) which have a number of different addressing models and requirements. The ASR 5x00 uses BGP MPLS Layer 3 VPNs to segregate corporate customer APNs in a highly scalable manner. This solution conforms to RFC 4364 – BGP/MPLS IP Virtual Private Networks (VPNs).

The BGP/MPLS solution supports the following scenarios:
- MPLS-CE Connected to PE
- ASR 5x00 as a PE

The ASR 5x00 also supports VPNv6 as described in RFC 4659 – BGP-MPLS IP Virtual Private Network (VPN) Extension for IPv6 VPN. See IPv6 Support for BGP MPLS VPNs for details.

MPLS-CE Connected to PE

In this scenario the ASR 5x00 functions as an MPLS-CE (Customer Edge) network element connected to a Provider Edge (PE) Label Edge Router (LER), which in turn connects to the MPLS core (RFC 4364). See the figure below.

Figure 16. ASR 5x00 MPLS-CE to PE

The MPLS-CE functions like a PE router within its own Autonomous System (AS). It maintains Virtual Routing and Forwarding (VRF) routes and exchanges VPN route information with the PE via an MP-eBGP (Multi-Protocol-external BGP) session.

The PE is also configured with VRFs and exchanges VPN routes with other PEs in its AS via MP-iBGP (Multi-Protocol-internal BGP) connections and the MPLS-CE via an MP-eBGP connection.

The EBGP connection allows the PE to change next-hop IP addresses and labels in the routes learned from IBGP peers before advertising them to the MPLS-CE. The MPLS-CE in this case uses only MP-eBGP to advertise and learn routes. Label Distribution Protocol (LDP) and Resource Reservation Protocol (RSVP) are not required because of direct-connect EBGP peering. The MPLS-CE in this scenario pushes/pops a single label (learned over the MP-eBGP connection) to/from the PE.
ASR 5x00 as a PE

Overview

In this scenario, the ASR 5x00 functions as a PE router sitting at the edge of the MPLS core. See the figure below.

![ASR 5x00 as a PE](image)

The ASR 5x00 eliminates the need for an ASBR or PE as shown in the first two scenarios. In this scenario, two main requirements are introduced: IBGP functionality and MPLS label distribution protocols.

The ASR 5x00 can be configured to add two labels:

- an outer label learned from LDP or RSVP-TE (RSVP-Traffic Engineering)
- an inner label learned from MP-iBGP

This solution supports traffic engineering and QoS initiated via the ASR 5x00.

Sample Configuration

In this example, VRFs are configured on the ASR 5x00 PE and pools are associated with VRFs. The ASR 5x00 exchanges VPN routes with its IBGP peers (PE routers) and learns the MPLS paths to reach PEs via LDP. The ASR 5x00 forwards the packets to the next-hop with two labels – an inner label learned from PE and an outer label learned from the next hop IBGP neighbor.
Figure 18. Sample Configuration

mpls ip
    protocol ldp
    enable
    exit
exit

ip vrf vrf1
    mpls traffic-class copy
    exit
ip vrf vrf2
    mpls traffic-class value 5
    exit

router bgp 300
ip vrf vrf1
    route-target export 300 1
    route-target import 300 1
    route-distinguisher 300 1
    exit
ip vrf vrf2
    route-target export 300 2
    route-target import 300 2
    route-distinguisher 300 2
    exit
router-id 2.2.2.2
neighbor 192.168.107.20 remote-as 300
neighbor 192.168.107.20 update-source node1_loopback

address-family vpnv4
neighbor 192.168.107.20 activate
    neighbor 192.168.107.20 send-community both
    neighbor 192.168.107.20 next-hop-self
    exit

address-family ipv4 vrf vrf1
    redistribute connected
exit

address-family ipv4 vrf vrf2
  redistribute connected
exit

interface interface_to_internet
  ip address 192.168.109.65/24
  mpls ip
exit
router ospf
  network 192.168.109.0/24 area 0.0.0.0
exit
IPv6 Support for BGP MPLS VPNs

Overview

The ASR 5x00 supports VPNv6 as described in RFC 4659 – BGP-MPLS IP Virtual Private Network (VPN) Extension for IPv6 VPN.

An IPv6 VPN is connected over an IPv6 interface or sub-interface to the Service Provider (SP) backbone via a PE router. The site can be both IPv4 and IPv6 capable. Each VPNv6 has its own address space which means a given address denotes different systems in different VPNs. This is achieved via a VPNv6 address-family which prepends a Route Distinguisher (RD) to the IP address.

A VPNv6 address is a 24-byte quantity beginning with an 8-byte RD and ending with a 16-byte IPv6 address. When a site is IPv4 and IPv6 capable, the same RD can be used for the advertisement of both IPv4 and IPv6 addresses.

The system appends RD to IPv6 routes and exchanges the labeled IPv6-RD using the VPNv6 address-family. The Address Family Identifier (AFI) and Subsequent Address Family Identifier (SAFI) fields for VPNv6 routes will be set to 2 and 128 respectively.

The IPv6 VPN traffic will be transported to the BGP speaker via IPv4 tunneling. The BGP speaker advertises to its peer a Next Hop Network Address field containing a VPN-IPv6 address whose 8-octet RD is set to zero and whose 16-octet IPv6 address is encoded as an IPv4-mapped IPv6 address (RFC 4291) containing the IPv4 address of the advertising router. It is assumed that only EBGP peering will be used to exchange VPNv6 routes.

Support for VPN-IPv6 assumes the following:

- Dual Stack (IPv4/IPv6) routing
- IPv6 pools in VRFs
- BGP peering over a directly connected IPv4 interface

See the figure below.

Figure 19. IPv6-RD Support for VPNv6
Sample Configuration

This example assumes three VRFs. VRF 1 has only IPv4 routes, VRF 2 has both IPv4 and IPv6 routes, and VRF 3 has only IPv6 routes.

Configure VRFs.

```
ip vrf vrf1
exit

ip vrf vrf2
exit

ip vrf vrf3
exit
```

Enable MPLS BGP forwarding.

```
mls bgp forwarding
```

Configure pools.

```
ip pool vrf1-pool 51.52.53.0 255.255.255.0 private 0 vrf vrf1
exit

ip pool vrf2-pool 51.52.53.0 255.255.255.0 private 0 vrf vrf2
exit

ipv6 pool vrf2-v6pool prefix 2005:0101::/32 private 0 vrf vrf2
exit

ipv6 pool vrf3-v6pool prefix 2005:0101::/32 private 0 vrf vrf3
exit
```

Configure interfaces.

```
interface ce_interface_to_rtr
  ip address 192.168.110.90 255.255.255.0
exit

interface ce_v6_interface
  ip address 2009:0101:0101:0101::1/96
exit

interface ce_loopback loopback
```
ip address 52.1.2.3 255.255.255.255
exit
interface vrf1-loop loopback
  ip vrf forwarding vrf1
  ip address 1.52.53.54 255.255.255.255
exit
interface vrf2-loop loopback
  ip vrf forwarding vrf2
  ip address 2.52.53.54 255.255.255.255
exit
interface vrf2-v6loop loopback
  ip vrf forwarding vrf2
  ip address 2005:0202:0101::1/128
exit
interface vrf3-v6loop loopback
  ip vrf forwarding vrf3
  ip address 2005:0303:0101::1/128
exit

Configure BGP along with address families and redistribution rules.

router bgp 800
  router-id 1.1.1.1
  neighbor 192.168.110.20 remote-as 1003
  neighbor 192.168.110.20 activate
  address-family vpnv4
    neighbor 192.168.110.20 activate
    neighbor 192.168.110.20 send-community both
  exit
  address-family vpnv6
    neighbor 192.168.110.20 activate
    neighbor 192.168.110.20 send-community both
  exit
  ip vrf vrf1
    route-distinguisher 800 1
    route-target export 800 1
    route-target import 800 1
  exit
  address-family ipv4 vrf vrf1
    redistribute connected
    redistribute static
  exit
  ip vrf vrf2
    route-distinguisher 800 2
    route-target export 800 2
    route-target import 800 2
  exit
  address-family ipv4 vrf vrf2
    redistribute connected
    redistribute static
  exit
  address-family ipv6 vrf vrf2
    redistribute connected
redistribute static
exit
ip vrf vrf3
    route-distinguisher 800 3
    route-target export 800 3
    route-target import 800 3
exit
address-family ipv6 vrf vrf3
redistribute connected
redistribute static
exit

Configure APNs.

apn walmart51.com
    selection-mode sent-by-ms
    accounting-mode none
    aaa group walmart-group
    authentication pap 1 chap 2 allow-noauth
    ip context-name Gi_ce
    ip address pool name vrf1-pool
exit
apn amazon51.com
    selection-mode sent-by-ms
    accounting-mode none
    aaa group amazon-group
    authentication pap 1 chap 2 allow-noauth
    ip context-name Gi_ce
    ip address pool name vrf2-pool
    ipv6 address prefix-pool vrf2-v6pool
exit
apn apple51.com
    selection-mode sent-by-ms
    accounting-mode none
    aaa group apple-group
    authentication pap 1 chap 2 allow-noauth
    ip context-name Gi_ce
    ipv6 address prefix-pool vrf3-v6pool
exit
aaa-group amazon-group
    radius ip vrf vrf2
aaa group default
exit
gtpp group default
exit
ip igmp profile default
exit

Bind physical interfaces with the port.
VPN-Related CLI Commands

VPN-related features and functions are supported across several CLI command modes. The following tables identify commands associated with configuration and monitoring of VPN-related functions.

For detailed information regarding the use of the commands listed below, see the *Command Line Interface Reference*.

**Table 38. VPN-Related Configuration Commands**

<table>
<thead>
<tr>
<th>CLI Mode</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGP Address-Family (IPv4/IPv6) Configuration Mode</td>
<td>neighbor ip_address activate</td>
<td>Enables the exchange of routing information with a peer router.</td>
</tr>
<tr>
<td>BGP Address-Family (IPv4/IPv6) Configuration Mode</td>
<td>neighbor ip_address send community { both</td>
<td>extended</td>
</tr>
<tr>
<td>BGP Address-Family (IPv4/IPv6) Configuration Mode</td>
<td>redistribute connected</td>
<td>Redistributes routes into BGP from another protocol as BGP neighbors.</td>
</tr>
<tr>
<td>BGP Address-Family (VPNv4) Configuration Mode</td>
<td>neighbor ip_address activate</td>
<td>Enables the exchange of routing information with a peer router.</td>
</tr>
<tr>
<td>BGP Address-Family (VPNv4) Configuration Mode</td>
<td>neighbor ip_address send community { both</td>
<td>extended</td>
</tr>
<tr>
<td>BGP Address-Family (VRF) Configuration Mode</td>
<td>neighbor ip_address activate</td>
<td>Enables the exchange of routing information with a peer router.</td>
</tr>
<tr>
<td>BGP Address-Family (VRF) Configuration Mode</td>
<td>neighbor ip_address send community { both</td>
<td>extended</td>
</tr>
<tr>
<td>BGP Address-Family (VRF) Configuration Mode</td>
<td>redistribute connected</td>
<td>Redistributes routes into BGP from another protocol as BGP neighbors.</td>
</tr>
<tr>
<td>BGP Configuration Mode</td>
<td>address-family { ipv4 vrf vrf_name</td>
<td>vpnv4 }</td>
</tr>
<tr>
<td>BGP Configuration Mode</td>
<td>address-family { ipv6 vrf vrf_name</td>
<td>vpnv6 }</td>
</tr>
<tr>
<td>CLI Mode</td>
<td>Command</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>BGP Configuration Mode</td>
<td>ip vrf vrf_name</td>
<td>Adds a VRF to BGP and switches to the VRF Configuration mode to allow configuration of BGP attributes for the VRF.</td>
</tr>
<tr>
<td>BGP IP VRF Configuration Mode</td>
<td>route-distinguisher { as_value</td>
<td>Assigns a Route Distinguisher (RD) for the VRF. The RD value must be a unique value on the router for each VRF.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ip_address } rd_value</td>
</tr>
<tr>
<td>BGP IP VRF Configuration Mode</td>
<td>route-target { both</td>
<td>Adds a list of import and export route-target extended communities to the VRF.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>import</td>
</tr>
<tr>
<td>Context Configuration Mode</td>
<td>ip pool pool_name addr_range vrf</td>
<td>Configures a pool into the specified VRF. This parameter must be specified with the Next-Hop parameter. inlabel1 is the MPLS label that identifies inbound traffic destined for this pool. outlabel1 and outlabel2 specify the MPLS labels to be added to packets sent for subscribers from this pool.</td>
</tr>
<tr>
<td></td>
<td>vrf_name</td>
<td>mpls-label input</td>
</tr>
<tr>
<td>Context Configuration Mode</td>
<td>ip vrf vrf_name</td>
<td>Creates a VRF and assigns a VRF-ID. A VRF is created in the router.</td>
</tr>
<tr>
<td>Context Configuration Mode</td>
<td>ipv6 pool pool_name vrf vrf_name</td>
<td>Associates the pool with that VRF. Note: By default the configured ipv6 pool will be associated with the global routing domain.</td>
</tr>
<tr>
<td>Context Configuration Mode</td>
<td>mpls bgp forwarding</td>
<td>Globally enables MPLS Border Gateway Protocol (BGP) forwarding.</td>
</tr>
<tr>
<td>Context Configuration Mode</td>
<td>mpls exp value</td>
<td>Sets the default behavior as Best Effort using a zero value in the 3-bit MPLS EXP header. This value applies to all the VRFs in the context. The default behavior is to copy the DSCP value of mobile subscriber traffic to the EXP header, if there is no explicit configuration for DSCP to EXP (via the mpls map-dscp-to-exp dscp n exp m command). mpls exp disables the default behavior and sets the EXP value to the configured value.</td>
</tr>
<tr>
<td>Context Configuration Mode</td>
<td>mpls ip</td>
<td>Globally enables the MPLS forwarding of IPv4 packets along normally routed paths.</td>
</tr>
<tr>
<td>Context Configuration Mode</td>
<td>radius change-authorize-nas-ip</td>
<td>Configures COA traffic to use the specified MPLS labels. inlabel identifies inbound COA traffic. outlabel1 and outlabel2 specify the MPLS labels to be added to the COA response. outlabel1 is the inner output label; outlabel2 is the outer output label.</td>
</tr>
<tr>
<td></td>
<td>ip_address ip_address</td>
<td>encrypted</td>
</tr>
<tr>
<td>Ethernet Interface</td>
<td>mpls ip</td>
<td>Enables dynamic MPLS forwarding of IP packets on this interface.</td>
</tr>
<tr>
<td>Configuration Mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exec Mode</td>
<td>clear ip bgp peer</td>
<td>Clears BGP sessions.</td>
</tr>
<tr>
<td>Exec Mode</td>
<td>lsp-ping ip_prefix_FEC</td>
<td>Checks MPLS Label-Switched Path (LSP) connectivity for the specified forwarding equivalence class (FEC). It must be followed by an IPv4 or IPv6 FEC prefix.</td>
</tr>
<tr>
<td>CLI Mode</td>
<td>Command</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Exec Mode</td>
<td><strong>lsp-traceroute ip_prefix_FEC</strong></td>
<td>Discovers MPLS LSP routes that packets actually take when traveling to their destinations. It must be followed by an IPv4 or IPv6 FEC prefix.</td>
</tr>
<tr>
<td>IP VRF Context</td>
<td><strong>mpls map-dscp-to-exp dscp</strong> exp exp_bit_value</td>
<td>Maps the final differentiated services code point (DSCP) bit value in the IP packet header to the final Experimental (EXP) bit value in the MPLS header for incoming traffic.</td>
</tr>
<tr>
<td>IP VRF Context</td>
<td><strong>mpls map-exp-to-dscp exp</strong> exp_bit_value dscp dscp_bit_value</td>
<td>Maps the incoming EXP bit value in the MPLS header to the internal DSCP bit value in IP packet headers for outgoing traffic.</td>
</tr>
<tr>
<td>MPLS-IP Configuration</td>
<td><strong>protocol ldp</strong></td>
<td>Creates the MPLS protocol family configuration modes, or configures an existing protocol and enters the MPLS-LDP Configuration Mode in the current context. This command configures the protocol parameters for the MPLS protocol family.</td>
</tr>
<tr>
<td>MPLS-LDP Configuration</td>
<td>**advertise-labels { explicit-null</td>
<td>implicit-null }**</td>
</tr>
<tr>
<td>MPLS-LDP Configuration</td>
<td>**discovery { hello { hello-second</td>
<td>hold-interval seconds }</td>
</tr>
<tr>
<td>MPLS-LDP Configuration</td>
<td><strong>enable</strong></td>
<td>Enables Label Distribution Protocol (LDP).</td>
</tr>
<tr>
<td>MPLS-LDP Configuration</td>
<td><strong>router-id ip_address</strong></td>
<td>Configures the LDP Router ID.</td>
</tr>
<tr>
<td>MPLS-LDP Configuration</td>
<td>**session timers { hold-interval seconds</td>
<td>keepalive-interval seconds }**</td>
</tr>
</tbody>
</table>

Table 39. VPN-Related Monitoring Commands

<table>
<thead>
<tr>
<th>CLI Mode</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exec Mode</td>
<td><strong>show ip bgp neighbors</strong></td>
<td>Displays information regarding BGP neighbors.</td>
</tr>
<tr>
<td>Exec Mode</td>
<td>**show ip bgp vpnv4 { all</td>
<td>route-distinguisher</td>
</tr>
<tr>
<td>Exec Mode</td>
<td><strong>show ip bgp vpnv6</strong></td>
<td>Displays contents of VPNv6 routing table.</td>
</tr>
<tr>
<td>Exec Mode</td>
<td>**show ip bgp vpnv6 { all</td>
<td>route-distinguisher</td>
</tr>
<tr>
<td>Exec Mode</td>
<td><strong>show ip pool</strong></td>
<td>Displays pool details including the configured VRF.</td>
</tr>
</tbody>
</table>
### VPN-Related CLI Commands

<table>
<thead>
<tr>
<th>CLI Mode</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exec Mode show Commands</td>
<td><code>show mpls cross-connect</code></td>
<td>Displays MPLS cross-connect information. MPLS tunnel cross-connects between interfaces and Label-Switched Paths (LSPs) connect two distant interface circuits of the same type via MPLS tunnels that use LSPs as the conduit.</td>
</tr>
<tr>
<td>Exec Mode show Commands</td>
<td><code>show mpls ftn [vrf vrf_name]</code></td>
<td>Displays MPLS FEC-to-NHLFE (FTN) table information.</td>
</tr>
<tr>
<td>Exec Mode show Commands</td>
<td><code>show mpls ftn [vrf vrf_name]</code></td>
<td>Displays contents of the MPLS FTN table for a specified VRF.</td>
</tr>
<tr>
<td>Exec Mode show Commands</td>
<td><code>show mpls ilm</code></td>
<td>Displays MPLS Incoming Label Map (ILM) table information.</td>
</tr>
<tr>
<td>Exec Mode show Commands</td>
<td><code>show mpls ldp</code></td>
<td>Displays the MPLS LDP information.</td>
</tr>
<tr>
<td>Exec Mode show Commands</td>
<td><code>show mpls nexthop-label-forwarding-entry</code></td>
<td>Displays MPLS Next-Hop Label Forwarding Entry (NHLFE) table information.</td>
</tr>
</tbody>
</table>
This chapter provides information on configuring Content Service Steering (CSS). The product administration guides provide examples and procedures for configuration of basic services on the system. You should select the configuration example that best meets your service model, and configure the required elements for that model as described in the respective product administration guide, before using the procedures described below.

Important: Internal CSS is a generic feature, if an ECSv2 license is installed on your system, internal CSS can be enabled. A separate license is not required to enable internal CSS. Contact your local Cisco account representative for information on how to obtain a license.

This chapter contains the following topics:

- Overview
- Configuring Internal Content Service Steering
Overview

Content Server Selection (CSS) is a StarOS function that defines how traffic will be handled based on the “content” of the data presented by a mobile subscriber (or to a mobile subscriber). CSS is a broad term that includes features such as load balancing, NAT, HTTP redirection, and DNS redirection.

The content server (services) can be either external to the platform or integrated inside the platform.

CSS uses Access Control Lists (ACLs) to redirect subscriber traffic flows. ACLs control the flow of packets into and out of the system. ACLs consist of “rules” (ACL rules) or filters that control the action taken on packets matching the filter criteria.

ACLs are configurable on a per-context basis and applies to a subscriber through either a subscriber profile (or an APN profile in the destination context. For additional information, refer to the Access Control Lists chapter.
Configuring Internal Content Service Steering

To configure and activate a single CSS service for redirecting all of a subscriber’s IP traffic to an internal in-line service:

**Step 1** Define an IP ACL as described in Defining IP Access Lists for Internal CSS.

**Step 2** Optional: Apply an ACL to an individual subscriber as described in Applying an ACL to an Individual Subscriber (Optional).

**Step 3** Optional: Apply a single ACL to multiple subscribers as described in Applying an ACL to Multiple Subscribers (Optional).

**Step 4** Optional: Apply an ACL to multiple subscribers via APNs as described in Applying an ACL to Multiple Subscribers via APNs (Optional).

**Step 5** Save your configuration to flash memory, an external memory device, and/or a network location using the Exec mode command save configuration. For additional information on how to verify and save configuration files, refer to the System Administration Guide and the Command Line Interface Reference.

---

**Important:** Commands used in the configuration examples in this section provide base functionality to the extent that the most common or likely commands and/or keyword options are presented. In many cases, other optional commands and/or keyword options are available. Refer to the Command Line Interface Reference for complete information regarding all commands. Not all commands or keywords/variables may be supported or available. Availability varies on the platform type and installed license(s).

---

Defining IP Access Lists for Internal CSS

IP ACLs specify what type of subscriber traffic and which direction (uplink, downlink, or both) traffic is redirected. The IP ACL must be specified in the context in which subscriber authentication is performed.

**Caution:** To minimize the risk of data loss, do not make configuration changes to ACLs while the system is facilitating subscriber sessions.

Use the following configuration example to define an IP ACL for internal CSS; start in the Exec mode of the CLI:

```
configure

context context_name

ip access-list acl_name

redirect css service service_name keywords options

end
```
Notes:

- `service_name` must be an ACL service name.
- For information on the keywords and options available with the `redirect css service` command, see the ACL Configuration Mode Commands chapter in the Command Line Interface Reference.
- For IPv6 ACLs, the same configurations must be done in the IPv6 ACL Configuration Mode. See the IPv6 ACL Configuration Mode Commands chapter in the Command Line Interface Reference.

Applying an ACL to an Individual Subscriber (Optional)

For information on how to apply an ACL to an individual subscriber, refer to the Applying an ACL to an Individual Subscriber section of the Access Control Lists chapter.

Applying an ACL to Multiple Subscribers (Optional)

IP ACLs are applied to subscribers via attributes in their profiles. The subscriber profile can be configured locally on the system or remotely on a RADIUS server.

The system provides for the configuration of subscriber functions that serve as default values when specific attributes are not contained in the individual subscriber’s profile. When configured properly, the functions can be used to apply an ACL to:

- All subscribers facilitated within a specific context by applying the ACL to the profile of the subscriber named `default`.
- All subscribers facilitated by specific services by applying the ACL to a subscriber profile and then using the `default subscriber` command to configure the service to use that subscriber as the “default” profile.

Applying an ACL to the Subscriber Named default (Optional)

For information on how to apply an ACL to the default subscriber, refer to the Applying an ACL to the Subscriber Named default section in the Access Control Lists chapter.

Applying an ACL to Service-specified Default Subscribers (Optional)

For information on how to apply an ACL to the subscriber to be used as the “default” profile by various system services, refer to the Applying an ACL to Service-specified Default Subscribers section in the Access Control Lists chapter.

Applying an ACL to Multiple Subscribers via APNs (Optional)

IP ACLs are applied to subscribers via attributes in their profiles. The subscriber profile can be configured locally on the system or remotely on a RADIUS server.

To reduce configuration time, ACLs can alternatively be applied to APN templates. When configured, any subscriber packets facilitated by the APN template would then have the associated ACL applied.

For information on how to apply an ACL to multiple subscribers via APNs, refer to the Applying a Single ACL to Multiple Subscribers via APNs section in the Access Control Lists chapter.
Chapter 20
Session Recovery

With robust hardware failover and redundancy protection, any card-level hardware failures on the system can quickly be corrected. However, software failures can occur for numerous reasons, often without prior indication.

This chapter describes the Session Recovery feature that provides seamless failover and reconstruction of subscriber session information in the event of a hardware or software fault.

**Important:** Session Recovery is a licensed Cisco feature. A separate feature license may be required. Contact your Cisco account representative for detailed information on specific licensing requirements. For information on installing and verifying licenses, refer to the *Managing License Keys* section of *Software Management Operations*.

This chapter includes the following sections:

- How Session Recovery Works
- Additional ASR 5x00 Hardware Requirements
- Configuring the System to Support Session Recovery
- Recovery Control Task Statistics
How Session Recovery Works

This section provides an overview of how this feature is implemented and the recovery process.

The Session Recovery feature provides seamless failover and reconstruction of subscriber session information in the event of a hardware or software fault within the system preventing a fully connected user session from being disconnected.

Session recovery is performed by mirroring key software processes (for example, session manager and AAA manager) within the system. These mirrored processes remain in an idle state (standby-mode) wherein they perform no processing, until they may be needed in the event of a software failure (for example, a session manager task aborts).

The system spawns new instances of “standby mode” session and AAA managers for each active control processor (CP) being used. These mirrored processes require both memory and processing resources, which means that additional hardware may be required to enable this feature (see Additional Hardware Requirements).

Other key system-level software tasks, such as VPN manager, are performed on a physically separate packet processing card to ensure that a double software fault (for example, session manager and VPN manager fails at same time on same card) cannot occur. The packet processing card that hosts the VPN manager process is in active mode and reserved by the operating system for this sole use when session recovery is enabled.

There are two modes of session recovery:

- **Task recovery mode**: Wherein one or more session manager failures occur and are recovered without the need to use resources on a standby packet processing card. In this mode, recovery is performed by using the mirrored “standby-mode” session manager task(s) running on active packet processing cards. The “standby-mode” task is renamed, made active, and is then populated using information from other tasks such as AAA manager. In case of Task failure, limited subscribers will be affected and will suffer outage only until the task starts back up.

- **Full packet processing card recovery mode**: Used when a packet processing card hardware failure occurs, or when a planned packet processing card migration fails. In this mode, the standby packet processing card is made active and the “standby-mode” session manager and AAA manager tasks on the newly activated packet processing card perform session recovery.

Session/Call state information is saved in the peer AAA manager task because each AAA manager and session manager task is paired together. These pairs are started on physically different packet processing cards to ensure task recovery.

There are some situations wherein session recovery may not operate properly. These include:

- Additional software or hardware failures occur during the session recovery operation. For example, an AAA manager fails while the state information it contained was being used to populate the newly activated session manager task.

- A lack of hardware resources (packet processing card memory and control processors) to support session recovery.

---

**Important**: After a session recovery operation, some statistics, such as those collected and maintained on a per manager basis (AAA Manager, Session Manager, etc.) are in general not recovered, only accounting and billing related information is checkpointed and recovered.
Session Recovery is available for the following functions:

- Any session needing L2TP LAC support (excluding regenerated PPP on top of an HA or GGSN session)
- ASR 5000 only – Closed RP PDSN services supporting simple IP, Mobile IP, and Proxy Mobile IP
- CSCF sessions
- ASR 5000 only – eHRPD service (evolved High Rate Packet Data)
- ASR 5000 only – ePDG service (evolved Packet Data Gateway)
- ASR 5000 only – eWAG service (enhanced Wireless Access Gateway)
- GGSN services for IPv4 and PPP PDP contexts
- HA services supporting Mobile IP and/or Proxy Mobile IP session types with or without per-user Layer 3 tunnels
- ASR 5000 only – HNB-GW: HNB Session over IuH
- ASR 5000 only – HNB-GW: HNB-CN Session over IuPS and IuCS
- ASR 5000 only – HNB-GW: SeGW Session IPSec Tunnel
- ASR 5000 only – HSGW services for IPv4
- IPCF (Intelligent Policy Control Function)
- ASR 5000 only – IPSG-only systems (IP Services Gateway)
- LNS session types (L2TP Network Server)
- MME (Mobility Management Entity)
- ASR 5000 only – NEMO (Network Mobility)
- P-GW services for IPv4
- ASR 5000 only – PDG/TTG (Packet Data Gateway/Tunnel Termination Gateway)
- ASR 5000 only – PDIF (Packet Data Interworking Function)
- PDSN services supporting simple IP, Mobile IP, and Proxy Mobile IP
- S-GW (Serving Gateway)
- SaMOG (S2a Mobility over GTP) Gateway (CGW and MRME)
- ASR 5000 only – SAE-GW (System Architecture Evolution Gateway)
- SCM (Service Control Manager)
- ASR 5000 only – SGSN services (3G and 2.5G services) for IPv4 and PPP PDP contexts

Session recovery is **not supported** for the following functions:

- Destination-based accounting recovery
- GGSN network initiated connections
- GGSN session using more than 1 service instance
- MIP/L2TP with IPSec integration
- MIP session with multiple concurrent bindings
- Mobile IP sessions with L2TP
- Multiple MIP sessions
Important: Always refer to the Administration Guides for individual products for other possible session recovery and Interchassis Session Recovery (ICSR) support limitations.

When session recovery occurs, the system reconstructs the following subscriber information:

- Data and control state information required to maintain correct call behavior.
- A minimal set of subscriber data statistics; required to ensure that accounting information is maintained.
- A best-effort attempt to recover various timer values such as call duration, absolute time, and others.
- The idle time timer is reset to zero and the re-registration timer is reset to its maximum value for HA sessions to provide a more conservative approach to session recovery.

Important: Any partially connected calls (for example, a session where HA authentication was pending but has not yet been acknowledged by the AAA server) are not recovered when a failure occurs.

Additional ASR 5x00 Hardware Requirements

Because session recovery requires numerous hardware resources, such as memory, control processors, NPU processing capacity, some additional hardware may be required to ensure that enough resources are available to fully support this feature.

Important: A minimum of four packet processing cards (three active and one standby) per individual chassis is required to use this feature.

To allow for complete session recovery in the event of a hardware failure during a packet processing card migration, a minimum of three active packet processing cards and two standby packet processing cards should be deployed.

To assist you in your network design and capacity planning, consider the following factors:

- Subscriber capacity is decreased depending on the hardware configuration. A fully configured chassis would experience a smaller decrease in subscriber capacity versus a minimally configured chassis.
- The amount by which control transaction processing capacity is reduced.
- The reduction in subscriber data throughput.
- The recovery time for a failed software task.
- The recovery time for a failed packet processing card.

A packet processing card migration may temporarily impact session recovery as hardware resources (memory, processors, etc.) that may be needed are not available during the migration. To avoid this condition, a minimum of two standby packet processing cards should be configured.
Configuring the System to Support Session Recovery

The following procedures allow you to configure the session recovery feature for either an operational system that is currently in-service (able to accept incoming calls) or a system that is out-of-service (not part of your production network and, therefore, not processing any live subscriber/customer data).

**Important:** The session recovery feature, even when the feature use key is present, is disabled by default on the system.

### Enabling Session Recovery

As noted earlier, session recovery can be enabled on a system that is out-of-service (OOS) and does not yet have any contexts configured, or on an in-service system that is currently capable of processing calls. However, if the system is in-service, it must be restarted before the session recovery feature takes effect.

### Enabling Session Recovery on an Out-of-Service System

The following procedure is for a system that does not have any contexts configured.

To enable the session recovery feature on an out-of-service system, follow the procedure below. This procedure assumes that you begin at the Exec mode prompt.

**Step 1**  
At the Exec mode prompt, verify that the session recovery feature is enabled via the session and feature use licenses on the system by running the `show license info` command.

**Important:** If the current status of the Session Recovery feature is Disabled, you cannot enable this feature until a license key is installed in the system.

**Step 2**  
Use the following configuration example to enable session recovery.

```plaintext
configure

   require session recovery

end
```

**Step 3**  
Save your configuration as described in *Verifying and Saving Your Configuration.*

The system, when started, enables session recovery, creates all mirrored “standby-mode” tasks, and performs packet processing card reservations and other operations automatically.

**Step 4**  
After the system has been configured and placed in-service, you should verify the preparedness of the system to support this feature as described in *Viewing Session Recovery Status.*
Enabling Session Recovery on an In-Service System

When enabling session recovery on a system that already has a saved configuration, the session recovery commands are automatically placed before any service configuration commands in the configuration file.

To enable the session recovery feature on an in-service system, follow the procedure below. This procedure assumes that you begin at the Exec mode prompt.

**Step 1** At the Exec mode prompt, verify that the session recovery feature is enabled via the session and feature use licenses on the system by running the `show license info` command:

**Important**: If the current status of the Session Recovery feature is Disabled, you cannot enable this feature until a license key is installed in the system.

**Step 2** Use the following configuration example to enable session recovery.

```
configure
  require session recovery
end
```

**Important**: This feature does not take effect until after the system has been restarted.

**Step 3** Save your configuration as described in *Verifying and Saving Your Configuration.*

**Step 4** Perform a system restart by entering the `reload` command:

The following prompt appears:

```
Are you sure? [Yes|No]:
```

Confirm your desire to perform a system restart by entering *yes*.

The system, when restarted, enables session recovery and creates all mirrored “standby-mode” tasks, performs packet processing card reservations, and other operations automatically.

**Step 5** After the system has been restarted, you should verify the preparedness of the system to support this feature as described in *Viewing Session Recovery Status.*

**Important**: More advanced users may opt to simply insert the `require session recovery` command syntax into an existing configuration file using a text editor or other means, and then applying the configuration file manually. Exercise caution when doing this to ensure that this command is placed among the first few lines of any existing configuration file; it must appear before the creation of any non-local context.
Disabling the Session Recovery Feature

To disable the session recovery feature on a system, enter the `no require session recovery` command from the Global Configuration mode prompt.

**Important:** If this command is issued on an in-service system, then the system must be restarted by issuing the `reload` command.

Viewing Session Recovery Status

To determine if the system is capable of performing session recovery, when enabled, enter the `show session recovery status verbose` command from the Exec mode prompt.

The output of this command should be similar to the examples shown below.

```
[local]host_name# show session recovery status
Session Recovery Status:
  Overall Status : SESSMGR Not Ready For Recovery
  Last Status Update : 1 second ago

[local]host_name# show session recovery status
Session Recovery Status:
  Overall Status : Ready For Recovery
  Last Status Update : 8 seconds ago

[local]host_name# show session recovery status verbose
Session Recovery Status:
  Overall Status : Ready For Recovery
  Last Status Update : 2 seconds ago

<table>
<thead>
<tr>
<th>cpu state</th>
<th>----sessmgr----</th>
<th>----aaamgr----</th>
<th>demux</th>
<th>status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>active</td>
<td>standby</td>
<td>active</td>
<td>standby</td>
</tr>
<tr>
<td>1/1 Active</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1/2 Active</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1/3 Active</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2/1 Active</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2/2 Active</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2/3 Active</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3/0 Active</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3/2 Active</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4/1 Standby</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4/2 Standby</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4/3 Standby</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
```
### Viewing Recovered Session Information

To view session state information and any session recovery status, enter the following command:

```
show subscriber debug-info { callid id | msid id | username name }
```

The following example shows the output of this command both before and after a session recovery operation has been performed. The “Redundancy Status” fields in this example have been bold-faced for clarity.

```
username: user1  callid: 01callb1  msid: 0000100003
Card/Cpu: 4/2
Sessmgr Instance: 7
Primary callline:
Redundancy Status: Original Session

Checkpoints Attempts Success Last-Attempt Last-Success
Full: 69 68 29800ms 29800ms
Micro: 206 206 20100ms 20100ms

Current state: SMGR_STATE_CONNECTED
FSM Event trace:
State Event
SMGR_STATE_OPEN     SMGR_EVT_NEWCALL
SMGR_STATE_NEWCALL_ARRIVED SMGR_EVT_ANSWER_CALL
SMGR_STATE_NEWCALL_ANSWERED SMGR_EVT_LINE_CONNECTED
SMGR_STATE_LINE_CONNECTED SMGR_EVT_LINK_CONTROL_UP
SMGR_STATE_LINE_CONNECTED SMGR_EVT_AUTH_REQ
SMGR_STATE_LINE_CONNECTED SMGR_EVT_IPADDR_ALLOC_SUCCESS
SMGR_STATE_LINE_CONNECTED SMGR_EVT_AUTH_SUCCESS
SMGR_STATE_LINE_CONNECTED SMGR_EVT_UPDATE_SESS_CONFIG
SMGR_STATE_LINE_CONNECTED SMGR_EVT_LOWER_LAYER_UP

Data Reorder statistics
Total timer expiry: 0
Total flush (tmr expiry): 0
Total no buffers: 0
Total flush (no buffers): 0
Total flush (queue full): 0
Total flush (out of range): 0
Total flush (svc change): 0
Total out-of-seq arrived: 0
IPv4 Reassembly Statistics:
Success: 0
In Progress: 0
Failure (timeout): 0
Failure (no buffers): 0
Failure (other reasons): 0
Redirected Session Entries:
Allowed: 2000  Current: 0
Added: 0  Deleted: 0
Revoked for use by different subscriber: 0
Peer callline:
Redundancy Status: Original Session
```

```
Checkpoints Attempts Success Last-Attempt Last-Success
Full: 0 0 0ms 0ms
Micro: 0 0 0ms 0ms

Current state: SMGR_STATE_CONNECTED
FSM Event trace:
State Event
SMGR_STATE_LINE_CONNECTED SMGR_EVT_LOWER_LAYER_UP
SMGR_STATE_CONNECTED SMGR_EVT_AUTH_REQ
```
Notice that in the example above, where the session has been recovered/recreated, that state events (FSM Event State field) no longer exist. This field is re-populated as new state changes occur.
Recovery Control Task Statistics

Recovery Control Task (RCT) statistics show the following:

- Recovery action taken – Migration, Shutdown, Switchover
- Type of event – Planned or Unplanned
- From card to card – slot numbers
- Start time – YYYY-MM-DD+hh:mm:ss.sss
- Duration – seconds
- Card failure device (such as CPUn)
- Card failure reason
- Card is in usable state or not failed
- Recovery action status – Success or failure reason
- If recovery action failed, failure time stamp
- If recovery action failed, failure task facility name
- If recovery action failed, failure instance number

show rct stats Command

The Exec mode \texttt{show rct stats} command employs the following syntax:

\begin{verbatim}
show rct stats [verbose]
\end{verbatim}

Without the \texttt{verbose} keyword, a summary output is displayed as show in the example below:

\begin{verbatim}
RCT stats Summary
-------------------
Migrations = 0
Switchovers = 1, Average time - 25.855 sec
\end{verbatim}

With the verbose keyword the detailed statistics show in \texttt{Sample Output for show rct stats verbose} are provided.
Sample Output for show rct stats verbose

```
show rct stats verbose

RCT stats Details (Last 5 Actions)

Stats 1:
  Action       : Shutdown
  From         : 4
  To           : 5
  Start Time   : 2013-Aug-30+03:02:00.132
  Duration     : 002.804 sec
  Is Card Usable: Yes
  Failure Reason: CPU_CRITICAL_TASK_FAILURE
  Failure Device: CPU_0
  Recovery Status: Success
  Facility     : N.A
  Instance     : N.A

RCT stats Details (Last 5 Actions)

Stats 2:
  Action       : Shutdown
  From         : 12
  To           : 13
  Start Time   : 2013-Aug-30+03:02:10.100
  Duration     : 002.901 sec
  Is Card Usable: Yes
  Failure Reason: NPU_LC_CONNECT_TOP_FAIL
  Failure Device: PAC_LC_CONNECT_HARDWARE
  Recovery Status: Success
  Facility     : N.A
  Instance     : N.A

Stats 3:
  Action       : Migration
  From         : 7
  To           : 11
  Start Time   : 2013-Aug-30+03:03:40.120
  Duration     : 003.423 sec
  Is Card Usable: Yes
  Failure Reason: N.A.
  Failure Device: N.A
  Recovery Status: Success
  Facility     : N.A
  Instance     : N.A
```
### Stats 4:
- **Action**: Migration
- **From**: 7
- **To**: 11
- **Start Time**: 2013-Aug-30+03:03:41.256
- **Duration**: 005.222 sec
- **Is Card Usable**: Yes
- **Failure Reason**: N.A.
- **Failure Device**: N.A
- **Recovery Status**: TASK_MIGRATION_FAIL_PREMIGRATE
- **Facility**: vpnmgr
- **Instance**: 13

### Stats 5:
- **Action**: Migration
- **From**: 6
- **To**: 7
- **Start Time**: 2013-Aug-30+04:18:30.106
- **Duration**: 004.134 sec
- **Is Card Usable**: Yes
- **Failure Reason**: N.A.
- **Failure Device**: N.A
- **Recovery Status**: TASK_MIGRATION_FAIL_RENAME
- **Facility**: sessmgr
- **Instance**: 63

### RCT stats Summary

<table>
<thead>
<tr>
<th>Migrations</th>
<th>Average time</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4.260 sec</td>
</tr>
</tbody>
</table>

| Switchovers | 0            |

---

**Recovery Control Task Statistics**

---
Chapter 21
Interchassis Session Recovery

This chapter describes how to configure Interchassis Session Recovery (ICSR). The product Administration Guides provide examples and procedures for configuration of basic services on the system. You should select the configuration example that best meets your service model, and configure the required elements for that model as described in the respective product Administration Guide, before using the procedures described below.

Important: ICSR is a licensed Cisco feature that requires a separate license. Contact your Cisco account representative for detailed information on specific licensing requirements. For information on installing and verifying licenses, refer to the Managing License Keys section of Software Management Operations.

This chapter discusses the following:

- Overview
- ICSR Operation
- Configuring Interchassis Session Recovery (ICSR)
- Updating the Operating System
Overview

The ICSR feature provides the highest possible availability for continuous call processing without interrupting subscriber services. ICSR allows the operator to configure geographically distant gateways for redundancy purposes. In the event of a node or gateway failure, ICSR allows sessions to be transparently routed around the failure, thus maintaining the user experience. ICSR also preserves session information and state.

ICSR is implemented through the use of redundant chassis. The chassis are configured as primary and backup, with one being active and one standby. Both chassis are connected to the same AAA server. A checkpoint duration timer controls when subscriber data is sent from the active chassis to the standby chassis. If the active chassis handling the call traffic goes out of service, the standby chassis transitions to the active state and continues processing the call traffic without interrupting the subscriber session.

The chassis determine which is active through a proprietary TCP-based connection known as the Service Redundancy Protocol (SRP) link. The SRP link is used to exchange Hello messages between the primary and backup chassis and must be maintained for proper system operation.

ICSR licenses are currently supported for the following services:

- eHRPD – Evolved High Rate Packet Data
- ePDG – Evolved Packet Data Gateway
- GGSN – Gateway GPRS Support Node
- HA – Home Agent
- IPSG – IP Services Gateway
- MME – Mobility Management Entity
- P-GW – Packet Data Network Gateway
- PDSN – Packet Data Serving Node
- S-GW – Serving Gateway
- SAEGW – System Architecture Evolution Gateway

L2TP Access Concentrator (LAC) functionality for ICSR is supported by the following protocol and services:

- eGTP – enhanced GPRS Tunneling Protocol
- GGSN – Gateway GPRS Support Node
- P-GW – Packet Data Network Gateway
- SAEGW – System Architecture Evolution Gateway

L2TP Access Concentrator (LAC) functionality for ICSR is not supported by the following services:

- HA – Home Agent
- PMIP – Proxy Mobile IP

L2TP Network Server (LNS) functionality for ICSR is not supported by any services.

Important: For releases prior to 17.0, ICSR should not be configured on chassis supporting L2TP calls.
Overview

**Important:** ICSR support for LAC requires a separate LAC license, as well as an Inter-Chassis Session Recovery license.

**Important:** Contact your Cisco account representative to verify whether a specific service supports ICSR as an option.

### Interchassis Communication

Chassis configured to support ICSR communicate using periodic Hello messages. These messages are sent by each chassis to notify the peer of its current state. The Hello message contains information about the chassis such as its configuration and priority. A dead interval is used to set a time limit for a Hello message to be received from the chassis’ peer. If the standby chassis does not receive an Hello message from the active chassis within the dead interval, the standby chassis transitions to the active state. In situations where the SRP link goes out of service, a priority scheme is used to determine which chassis processes the session. The following priority scheme is used:

- route modifier
- chassis priority
- MIO/UMIO MAC address

### Checkpoint Messages

Checkpoint messages are sent from the active chassis to the standby chassis. These messages are sent at specific intervals and contain all the information needed to recreate the sessions on the standby chassis, if that chassis were to become active. Once a session exceeds the checkpoint duration, checkpoint data is collected on the session.

### SRP CLI Commands

**Exec Mode CLI Commands**

Exec mode `srp` CLI configuration commands can be used to enable, disable and initiate SRP functions. The table below lists and briefly describes these commands. For complete information see the *Exec Mode Commands (D-S)* chapter of the *Command Line Interface Reference*. 
### Table 40. srp CLI Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>srp initiate-audit manual-with-sync</code></td>
<td>Initiates a forced audit between ICSR chassis. This audit ensures that two ICSR peers are synchronized and identifies any discrepancies prior to scheduled or unscheduled switchover events.</td>
</tr>
<tr>
<td><code>srp initiate-switchover</code></td>
<td>Executes a forced switchover from active to inactive. When executed on the active chassis, this command switches the active chassis to the inactive state and the inactive chassis to an active state.</td>
</tr>
<tr>
<td><code>srp reset-auth-probe-fail</code></td>
<td>Resets the auth probe monitor failure information to 0.</td>
</tr>
<tr>
<td><code>srp reset-diameter-fail</code></td>
<td>Resets the Diameter monitor failure information to 0.</td>
</tr>
<tr>
<td><code>srp terminate-post-process</code></td>
<td>Forcibly terminates post-switchover processing.</td>
</tr>
<tr>
<td><code>srp validate-configuration</code></td>
<td>Validates the configuration for an active chassis.</td>
</tr>
<tr>
<td><code>srp validate-switchover</code></td>
<td>Validates that both active and standby chassis are ready for a planned SRP switchover.</td>
</tr>
</tbody>
</table>

### show Commands

Exec mode `show srp` commands display a variety of information related to SRP functions. The table below lists and briefly describes these commands. For complete information on these commands, see the *Exec Mode show Commands (Q-S)* chapter of the *Command Line Interface Reference*.

### Table 41. show srp Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show srp audit-statistics</code></td>
<td>Displays statistics of an external audit.</td>
</tr>
<tr>
<td><code>show srp call-loss statistics</code></td>
<td>Displays the history of calls lost during switchover.</td>
</tr>
<tr>
<td><code>show srp checkpoint statistics</code></td>
<td>Displays check pointing statistics on session redundancy data (session managers, current call recovery records, etc.).</td>
</tr>
<tr>
<td><code>show srp info</code></td>
<td>Displays Service Redundancy Protocol information (context, chassis state, peer, connection state, etc.).</td>
</tr>
<tr>
<td><code>show srp monitor</code></td>
<td>Displays SRP monitor information.</td>
</tr>
<tr>
<td><code>show srp statistics</code></td>
<td>Displays SRP statistics (hello messages sent, configuration validation, resource messages, switchovers, etc.).</td>
</tr>
</tbody>
</table>

For additional information about the output of `show srp` commands, see the *Statistics and Counters Reference*. 
AAA Monitor

AAA servers are monitored using the authentication probe mechanism. AAA servers are considered Up if the authentication-probe receives a valid response. AAA servers are considered Down when the max-retries count specified in the configuration of the AAA server has been reached. SRP initiates a switchover when none of the configured AAA servers responds to an authentication probe. AAA probing is only performed on the active chassis.

**Important:** A switchover event caused by an AAA monitoring failure is non-revertible.

If the newly active chassis fails to monitor the configured AAA servers, it remains as the active chassis until one of the following occurs:
- a manual switchover
- another non-AAA failure event causes the system to switchover
- a CLI command is used to clear the AAA failure flag and allow the chassis to switch to standby

BGP Interaction

The Service Redundancy Protocol implements revertible switchover behavior via a mechanism that adjusts the route modifier value for the advertised loopback/IP Pool routes. The initial value of the route modifier value is determined by the chassis’ configured role and is initialized to a value that is higher than a normal operational value. This ensures that in the event of an SRP link failure and an SRP task failure, the correct chassis is still preferred in the routing domain.

The Active and Standby chassis share current route modifier values. When BGP advertises the loopback and IP pool routes, it converts the route modifier into an autonomous systems (AS) path prepend count. The Active chassis always has a lower route modifier, and thus prepends less to the AS-path attribute. This causes the route to be preferred in the routing domain.

If communication on the SRP link is lost, and both chassis in the redundant pair are claiming to be Active, the previously Active chassis is still preferred since it is advertising a smaller AS-path into the BGP routing domain. The route modifier is incremented as switchover events occur. A threshold determines when the route modifier should be reset to its initial value to avoid rollover.

Requirements

ICSR configurations require the following:
- Two chassis configured for the same service types. The services must be bound on an SRP-activated loopback interface.
- Both chassis must have identical hardware.
- Three contexts:
  - **Redundancy** – to configure the primary and backup chassis redundancy.
  - **Source** – AAA configuration of the specified nas-ip-address must be the IP address of an interface bound to an HA, or any core network service configured within the same context.
  - **Destination** – to configure monitoring and routing to the PDN.
- AAA RADIUS server
- Border Gateway Protocol (BGP) – ICSR uses the route modifier to determine the chassis priority.
**Important:** ICSR is a licensed Cisco feature. Verify that each chassis has the appropriate license before using these procedures. To do this, log in to both chassis and execute a `show license information` command. Look for “Inter-Chassis Session Recovery”. If the chassis is not licensed, please contact your Cisco account representative.

The following figure shows an ICSR network.

### Figure 21. ASR 5500 ICSR Network

**ICSR Operation**

This section shows operational flows for ICSR.

The following figure shows an ICSR process flow due to a primary failure.
Figure 22. ICSR Process Flow (Primary Failure)

- Primary:
  - State = Active
  - Pass Hello messages.
  - Send session checkpoint message after call duration of 60 seconds
  - Fails and stops sending hello messages. State = Active
  - Hello Message State = Standby
  - Hello Message State = Standby
  - Hello Message State = Standby
  - Recovers and begins sending hello messages. State = Standby
  - Receives hello message with backup status of active and transitions to the standby state. State = Standby

- Backup:
  - State = Standby
  - Dead Interval (Default = 60 secs)
  - Detects that the primary has not sent a hello within the dead-interval and initiates switchover from the standby to the active state. State = Active
  - Begins advertising the srp-activated loopback and pool routes into the routing domain, and AAA services are enabled. Begins taking calls. State = Active
  - Hello Message State = Standby
  - Hello Message State = Active
The following figure shows an ICSR process flow due to a manual switchover.

**Figure 23. ICSR Process Flow (Manual Switchover)**
Chassis Initialization

When the chassis are simultaneously initialized, they send Hello messages to their configured peer. The peer sends a response, establishes communication between the chassis, and messages are sent that contain configuration information.

During initialization, if both chassis are misconfigured in the same mode - both active (primary) or both standby (backup), the chassis with the highest priority (lowest number set with the ICSR priority command) becomes active and the other chassis becomes the standby.

If the chassis priorities are the same, the system compares the two MAC addresses and the chassis with the higher MIO/UMIO MAC address becomes active. For example, if the chassis have MAC addresses of 00-02-43-03-1C-2B and 00-02-43-03-01-3B, the last 3 sets of octets (the first 3 sets are the vendor code) are compared. In this example, the 03-1C-2B and 03-01-3B are compared from left to right. The first pair of octets in both MAC addresses are the same, so the next pairs are compared. Since the 01 is lower than the 1C, the chassis with the MIO/UMIO MAC address of 00-02-43-03-1C-2B becomes active and the other chassis the standby.

Chassis Operation

This section describes how the chassis communicate, maintain subscriber sessions, and perform chassis switchover.

Chassis Communication

If one chassis in the active state and one in the standby state, they both send Hello messages at each hello interval. Subscriber sessions that exceed the checkpoint session duration are included in checkpoint messages that are sent to the standby chassis. The checkpoint message contains subscriber session information so if the active chassis goes out of service, the backup chassis becomes active and is able to continue processing the subscriber sessions. Additional checkpoint messages occur at various intervals whenever subscriber session information is updated on the standby chassis.

For additional information see the Service Redundancy Protocol Configuration Mode Commands chapter in the Command Line Interface Reference.

Chassis Switchover

If the active chassis goes out of service, the standby chassis continues to send Hello messages. If the standby chassis does not receive a response to the Hello messages within the dead interval, the standby chassis initiates a switchover. During the switchover, the standby chassis begins advertising its srp-activated loopback and pool routes into the routing domain. Once the chassis becomes active, it continues to process existing AAA services and subscriber sessions that had checkpoint information, and is also able to establish new subscriber sessions.

When the primary chassis is back in service, it sends Hello messages to the configured peer. The peer sends a response, establishes communication between the chassis, and sends Hello messages that contain configuration information. The primary chassis receives an Hello message that shows the backup chassis state as active and then transitions to standby. The Hello messages continue to be sent to each peer, and checkpoint information is now sent from the active chassis to the standby chassis at regular intervals.

When chassis switchover occurs, the session timers are recovered. The access gateway session recovery is recreated with the full lifetime to avoid potential loss of the session and the possibility that a renewal update was lost in the transitional checkpoint update process.
Configuring Interchassis Session Recovery (ICSR)

**Important:** The ICSR configuration must be the same on the primary and backup chassis. If each chassis has a different Service Redundancy Protocol (SRP) configuration, the session recovery feature does not function and sessions cannot be recovered when the active chassis goes out of service.

This section describes how to configure basic ICSR on each chassis. For information on commands that configure additional parameters and options, refer to the *Command Line Interface Reference*.

**Caution:** ICSR should not be configured for chassis supporting L2TP calls.

The procedures described below assume the following:

- The chassis have been installed and configured with core network services.
  
  For more configuration information and instructions on configuring services, refer to the respective product Administration Guide.

- In addition, the IP address pools must be srp activated.

- AAA server is installed, configured and accessible by both chassis.
  
  For more information on configuring the AAA server, refer to the *AAA Interface Administration and Reference*.

- BGP router installed and configured. See *Routing* for more information on configuring BGP services.

To configure the ICSR on a primary and/or backup chassis:

**Step 1** Configure the SRP context by applying the example configuration in *Configuring the Service Redundancy Protocol (SRP) Context*.

**Step 2** Modify the source context of the core network service by applying the example configuration in *Modifying the Source Context for ICSR*.

**Step 3** Modify the destination context of core network service by applying the example configuration in *Modifying the Destination Context for ICSR*.

**Step 4** Optional: Disable bulk statistics collection on the standby system by applying the example configuration in *Disabling Bulk Statistics Collection on a Standby System*.

**Step 5** Verify your primary and backup chassis configuration as described in *Verifying the Primary and Backup Chassis Configuration*.

**Step 6** Save your configuration as described in *Verifying and Saving Your Configuration*. 
Configuring the Service Redundancy Protocol (SRP) Context

To configure the system to work with ICSR:

Step 1  Create the chassis redundancy context and bind it to the IP address of the primary chassis by applying the example configuration in Creating and Binding the SRP Context.

Step 2  Configure the chassis redundancy context with priority, chassis mode, hello interval, dead-interval and peer IP address by applying the example configuration in Configuring SRP Context Parameters.

Step 3  Configure the SRP context with interface parameters (including interface name, IP address and port number) for interchassis communication by applying the example configuration in Configuring the SRP Context Interface Parameters.

Step 4  Verify your SRP context configuration as described in Verifying SRP Configuration.

Step 5  Save your configuration as described in Verifying and Saving Your Configuration.

Creating and Binding the SRP Context

Use the example below to create the SRP context and bind it to primary chassis IP address:

```
! Important: ICSR is configured using two systems. Be sure to create the redundancy context on both systems. CLI commands must be executed on both systems. Log onto both chassis before continuing. Always make configuration changes on the primary chassis first. Before starting this configuration, identify which chassis to configure as the primary and use that login session.

configure

    context  srp_ctxt_name [-noconfirm]

    service-redundancy-protocol

    bind address  ip_address

end
```

Notes:

- ICSR should be configured and maintained in a separate context.
- Be sure to bind the local IP address to the primary chassis. When configuring the backup chassis, be sure to bind the local IP address to the backup chassis.
Configuring SRP Context Parameters

**Important:** CLI commands must be executed on both chassis. Log onto both chassis before continuing. Always make configuration changes on the primary chassis first.

**Basic Parameters**

This configuration assigns a chassis mode and priority, and also configures the redundancy link between the primary and backup chassis:

```cli
configure
  context srp_ctxt_name
  service-redundancy-protocol
    chassis-mode { primary | backup }
    priority priority
    peer-ip-address ip_address
    hello-interval dur_sec
    dead-interval dead_dur_sec
end
```

Notes:

- ICSR should be configured and maintained in a separate context.
- When assigning the chassis mode on the backup chassis be sure to enter the `backup` keyword.
- The `checkpoint` command sets the amount of time the chassis waits before checkpointing an existing call session. Checkpoints can be set for IMS (VoLTE) and/or non-IMS sessions. The checkpoint is a snapshot of the current application state that can be used to restart its execution in case of failure. The default setting is 60 seconds.
- The `priority` determines which chassis becomes active in the event that both chassis are misconfigured with the same chassis mode; see *Chassis Initialization*. The higher priority chassis has the lower number. Be sure to assign different priorities to each chassis.
- Enter the IP chassis of the backup chassis as the `peer-ip-address` to the primary chassis. Assign the IP address of the primary chassis as the `peer-ip-address` to the backup chassis.
- The `dead-interval` must be at least three times greater than the `hello-interval`. For example, if the hello interval is 10, the dead interval should be at least 30. System performance is severely impacted if the hello interval and dead interval are not set properly. An optional `delay-interval` command allows you to delay the start dead-interval for an interval following the loading of configuration files.
SRP Redundancy, AAA and Diameter Guard Timers

Guard timers ensure that local failures, such as card reboots and task restarts, do not result in ICSR events which can be disruptive.

The **guard timer** command configures the redundancy-guard-period and monitor-damping-period for SRP service monitoring.

```
configure

context context_name

service-redundancy-protocol variable

  guard-timer { aaa-switchover-timers { damping-period seconds |
  guard-period seconds } | diameter-switchover-timers { damping-period seconds |
  guard-period seconds } | srp-redundancy-timers { aaa { damping-period seconds |
  guard-period seconds } | bgp { damping-period seconds | guard-period seconds } |
  diam { damping-period seconds | guard-period seconds } }

end
```

Notes:

- **aaa-switchover-timers** – sets timers that prevent back-to-back ICSR switchovers due to an AAA failure (post ICSR switchover) while the network is still converging.
  - **damping-period** – configures a delay time to trigger an ICSR switchover due to a monitoring failure within the guard-period.
  - **guard-period** – configures the local-failure-recovery network-convergence timer.

- **diameter-switchover-timers** – sets timers that prevent a back-to-back ICSR switchover due to a Diameter failure (post ICSR switchover) while the network is still converging.
  - **damping-period** – configures a delay time to trigger an ICSR switchover due to a monitoring failure within the guard-period.
  - **guard-period** – configures the local-failure-recovery network-convergence timer.

- **srp-redundancy-timers** – sets timers that prevent an ICSR switchover while the system is recovering from a local card-reboot/critical-task-restart failure.
  - **aaa** – local failure followed by AAA monitoring failure
  - **bgp** – local failure followed by BGP monitoring failure
  - **diam** – local failure followed by Diameter monitoring failure
DSCP Marking of SRP Messages

You can enable separate DSCP marking of SRP control and checkpoint messages. The `dscp-marking` command sets DSCP marking values for SRP control and checkpoint (session maintenance) messages.

```plaintext
configure

context context_name

service-redundancy-protocol

  dscp-marking { control | session } dscp_value
```

Notes:
- `dscp_value` can be:
  - af11 – Assured Forwarding Class 1 low drop PHB (Per Hop Behavior)
  - af12 – Assured Forwarding Class 1 medium drop PHB
  - af13 – Assured Forwarding Class 1 high drop PHB
  - af21 – Assured Forwarding Class 2 low drop PHB
  - af22 – Assured Forwarding Class 2 medium drop PHB
  - af23 – Assured Forwarding Class 2 high drop PHB
  - af31 – Assured Forwarding Class 3 low drop PHB
  - af32 – Assured Forwarding Class 3 medium drop PHB
  - af33 – Assured Forwarding Class 3 high drop PHB
  - af41 – Assured Forwarding Class 4 low drop PHB
  - af42 – Assured Forwarding Class 4 medium drop PHB
  - af43 – Assured Forwarding Class 4 high drop PHB
  - be – Best effort Per-Hop-Behaviour (default)
  - cs1 – Class selector 1 PHB
  - cs2 – Class selector 2 PHB
  - cs3 – Class selector 3 PHB
  - cs4 – Class selector 4 PHB
  - cs5 – Class selector 5 PHB
  - cs6 – Class selector 6 PHB
  - cs7 – Class selector 7 PHB
  - ef – Expedited Forwarding PHB, for low latency traffic
Optimizing Switchover Transitions

There are several SRP configuration options that reduce transition time from the active to standby gateways (primarily P-GW) in support of VoLTE traffic.

Important: These features require an updated ICSR license to support the enhancements. Contact your Cisco account representative for additional information.

Allow Non-VoLTE Traffic During ICSR Switchover

The ICSR framework reduces switchover disruption for VoLTE traffic by enabling VoLTE traffic on the newly active gateway prior to reconciling the billing information and enabling communication with the newly active gateway when accounting is not deemed critical.

This functionality extends to all other traffic, including data sessions and default bearer traffic for IMS/e911, The following ICSR functionality is provided for all non-VoLTE data traffic:

- When a switchover occurs, the newly active gateway forwards all traffic the moment the gateway becomes active.
- External communication with billing servers is deferred. See the traffic flow diagram below.
- When the newly active gateway receives all billing-related checkpointing information from the previously active gateway, it reconciles the billing data before communicating with external billing servers OCS (Online Charging System) or OFCS (Offline Charging System).
The `switchover allow-all-data-traffic` SRP Configuration mode CLI command allows all data traffic (VoLTE and non-VoLTE) during switchover transition. This command overwrites the `switchover allow-volte-data-traffic` command if enabled on a P-GW.

```
configure
context context_name
service-redundancy-protocol
switchover allow-all-data-traffic
```

**Important:** The `switchover allow-all-data-traffic` command must be run on both chassis to enable this feature.

The `switchover allow-volte-data-traffic` SRP Configuration mode CLI command allows VoLTE data traffic during ICSR switchover transition.
Interchassis Session Recovery

Configuring Interchassis Session Recovery (ICSR)

```plaintext
configure
  context context_name
  service-redundancy-protocol
    switchover allow volte-data-traffic [ maintain-accounting ]
```

Notes:

- When `maintain-accounting` is enabled, accounting accuracy is maintained for VoLTE calls. VoLTE data is allowed on the active gateway after VoLTE accounting statistics are flushed.

**Graceful Cleanup of ICSR After Audit of Failed Calls**

During an Audit on the gateways (P-GW/S-GW/GGSN/SAE-GW) after Session Recovery or an ICSR event, if any critical information, internally or externally related to a subscriber session seems inconsistent, ICSR will locally purge the associated session information.

Since external gateways (peer nodes) are unaware of the purging of this session, the UE session may be maintained at other nodes. This leads to hogging of resources external to the gateway and an unreachable UE for VoLTE calls.

When this feature is enabled, graceful cleanup for an ICSR audit of failed calls occurs. External signaling notifies peers of session termination before purging the session. The gateway will attempt to notify external peers of the removal of the session. External nodes to the local gateway include S-GW, P-GW, SGSN, MME, AAA, PCRF and IMSA.

Audit failure can occur because of missing or incomplete session information. Therefore, only the peers for which the information is available will be notified.

The `require graceful-clean-up-during-audit-failure` Global Configuration mode CLI command enables or disables the graceful cleanup feature.

```plaintext
configure
  require graceful-clean-up-during-audit-failure [ del-cause non-ims-apn
  { system-failure | none } ]
```

**Optimization of Switchover Control Outage Time**

The ICSR framework minimizes control outage time associated with the flushing of critical full checkpoint statistics, network convergence and internal auditing.

The amount of time consumed by the following activities affects control outage time during switchover:

- **Critical Flush** – During the Active to Pending-Standby transition, all sessmgrs flush any pending critical FCs (Full Checkpoints). During this time, the active chassis drops all control packets. If control signaling is allowed during this stage, a call may get disconnected based on the control message type and accounting information will be lost.

- **Network Convergence** – This encompasses the amount of time taken to update routes and send control/data to the newly active chassis. Control messages are dropped during the transition.

- **Accounting Flush** – During this flush stage data counts are synchronized between chassis. If control signaling is allowed during this flush, the call may get disconnected based on the control message type, and accounting information will be lost for calls that existed before switchover.

- **Audit** – During audit new calls are not allowed because synchronization of call resources may result in clearing of the calls.
The `switchover control-outage-optimization` CLI command allows new calls during the Accounting Flush, as soon as the Audit is completed. This SRP Configuration mode command enables the quicker restoration of control traffic (call-setup, modification, deletion) following an ICSR switchover.

```
configure
  context context_name
    service-redundancy-protocol
    switchover control-outage-optimization
end
```

### Configuring the SRP Context Interface Parameters

This procedure configures the communication interface with the IP address and port number within the SRP context. This interface supports interchassis communication.

**Important:** CLI commands must be executed on both chassis. Log onto both chassis before continuing. Always make configuration changes on the primary chassis first.

```
configure
  context vpn_ctxt_name [-noconfirm]
    interface srp_if_name
      ip-address { ip_address | ip_address/mask }
    exit
  exit
  port ethernet slot_num/port_num
    description des_string
    medium { auto | speed { 10 | 100 | 1000 } duplex { full | half } }
    no shutdown
    bind interface srp_if_name vpn_ctxt_name
end
```

### Verifying SRP Configuration

Verify that your SRP contexts were created and configured properly by running the `show srp info` command (Exec Mode) on each chassis.
Modifying the Source Context for ICSR

To modify the source context of core service:

**Step 1** Add the Border Gateway Protocol (BGP) router AS-path and configure the gateway IP address, neighbor IP address, remote IP address in the source context where the core network service is configured, by applying the example configuration in Configuring BGP Router and Gateway Address.

**Step 2** Configure the service redundancy context with the BGP neighbor context and IP address to monitor the BGP link activity by applying the example configuration in Configuring the SRP Context for BGP.

**Step 3** Verify your BGP context configuration by following the steps in Verifying BGP Configuration.

**Step 4** Save your configuration as described in Verifying and Saving Your Configuration.

Configuring BGP Router and Gateway Address

Use the following example to create the BGP context and network addresses.

```
configure

context source_ctxt_name

router bgp AS_num

network gw_ip_address

neighbor neighbor_ip_address remote-as AS_num

end
```

Notes:
- `source_ctxt_name` is the context where the core network service is configured.

Configuring the SRP Context for BGP

Use the following example to configure the BGP context and IP addresses in the SRP context.

```
configure

context srp_ctxt_name

service-redundancy-protocol

monitor bgp context source_ctxt_name neighbor_ip_address

end
```

`neighbor_ip_address` can be entered in IPv4 dotted-decimal or IPv6 colon-separated-hexadecimal notation. Multiple IP addresses can be added per context as IPv4 and/or IPv6 IP addresses.

An ICSR failover is triggered when all BGP peers within a context are down.
Optionally, you can configure SRP peer groups within a context. ICSR failover would then occur if all peers within a group fail. This option is useful in deployments in which a combination of IPv4 and IPv6 peers are spread across multiple paired VLANs, and IPv4 or IPv6 connectivity is lost by all members of a peer group.

A sample configuration for SRP peer groups within a context (“PGWin”) appears below.

```
monitor bgp context PGWin 10.1.1.16 group 1
monitor bgp context PGWin 10.1.1.17 group 1
monitor bgp context PGWin 69.2.215.0 group 2
monitor bgp context PGWin 69.2.215.1 group 2
monitor bgp context PGWin 2001:4333:201:1102:103:2a1:: group 3
monitor bgp context PGWin 2001:4333:201:1102:103:2a1:0:1 group 3
```

In the above sample configuration, ICSR failover would occur if both addresses in group 1, 2 or 3 lost connectivity.

For additional information refer to the description of the `monitor bgp`, `monitor diameter` and `monitor authentication-probe` commands in the Service Redundancy Protocol Configuration Mode Commands chapter of the Command Line Interface Reference.

**Verifying BGP Configuration**

Verify your BGP configuration by entering the `show srp monitor bgp` command (Exec Mode).

**Modifying the Destination Context for ICSR**

To modify the destination context of core service:

**Step 1**
Add the BGP router and configure the gateway IP address, neighbor IP address, remote IP address in the destination context where the core network service is configured, by applying the example configuration in Configuring BGP Router and Gateway Address in Destination Context.

**Step 2**
Configure the service redundancy context with BGP neighbor context and IP address to monitor the BGP link activity by applying the example configuration in Configuring SRP Context for BGP for Destination Context.

**Step 3**
Set the subscriber mode to `default` by following the steps in Setting Subscriber to Default Mode.

**Step 4**
Verify your BGP context configuration by following the steps in Verifying BGP Configuration in Destination Context.

**Step 5**
Save your configuration as described in Verifying and Saving Your Configuration.

**Configuring BGP Router and Gateway Address in Destination Context**

Use the following example to create the BGP context and network addresses.

```
configure

    context dest_ctxt_name
    router bgp AS_num
    network gw_ip_address
    neighbor neighbor_ip_address remote-as AS_num
```
Interchassis Session Recovery

Configuring Interchassis Session Recovery (ICSR)

Notes:
- AS_num is the autonomous systems path number for this BGP router.

Configuring SRP Context for BGP for Destination Context

Use the following example to configure the BGP context and IP addresses in the SRP context.

```plaintext
configure
context srp_ctxt_name
  service-redundancy-protocol
  monitor bgp context dest_ctxt_name neighbor_ip_address
end
```

Setting Subscriber to Default Mode

Use the following example to set the subscriber mode to default.

```plaintext
configure
context dest_ctxt_name
  subscriber default
end
```

Verifying BGP Configuration in Destination Context

Verify your BGP configuration by entering the `show srp monitor bgp` command (Exec Mode).

Disabling Bulk Statistics Collection on a Standby System

You can disable the collection of bulk statistics from a system when it is in the standby mode of operation.

**Important:** When this feature is enabled and a system transitions to standby state, any pending accumulated statistical data is transferred at the first opportunity. After that no additional statistics gathering takes place until the system comes out of standby state.

Use the following example to disable the bulk statistics collection on a standby system.

```plaintext
configure
  bulkstat mode
  no gather-on-standby
```
Verifying the Primary and Backup Chassis Configuration

This section describes how to compare the ICSR configuration on both chassis.

Step 1 Enter the \texttt{show configuration srp} command on both chassis (Exec mode).

Verify that both chassis have the same SRP configuration information. The output looks similar to following:

```
config
text source
   interface haservice loopback
      ip address 172.17.1.1 255.255.255.255 srp-activate
      #exit
   radius attribute nas-ip-address address 172.17.1.1
   radius server 192.168.83.2 encrypted key 01abd002c82b4a2c port 1812
   radius accounting server 192.168.83.2 encrypted key 01abd002c82b4a2c port 1813
   ha service ha-pdsn
   mn ha-spi spi-number 256 encrypted secret 6c93f7960b726b6f93f7960b726b6f
   hash-algorithm md5
   fa ha-spi remote-address 192.168.82.0/24 spi-number 256 encrypted secret
   1088bdd6817f64df
      bind address 172.17.1.1
      #exit
      #exit
context destination
   ip pool dynamic 172.18.0.0 255.255.0.0 public 0 srp-activate
      ip pool static 172.19.0.0 255.255.240.0 static srp-activate
      #exit
context srp
   service-redundancy-protocol
      #exit
      #exit
```

Configuring Subscriber State Management Audit Process

This audit is to ensures that two ICSR peers are in synch and identifies any discrepancies prior to any scheduled or unscheduled switchover events.

Step 1 Enter the SRP Context mode and enter the \texttt{service-redundancy-protocol} command.

Step 2 Enter the `audit daily-start-time` command. Specify the daily start time as an hour and minute. For example, a start time of 06 00 indicates that the audit will begin at 6:00 AM.

Step 3 Enter the `audit periodicity` command. Specify the interval in minutes for generating SRP audit statistics as an integer from 60 through 1440. For example, a periodicity of 90 indicates that SRP audit statistics will be generated every 90 minutes beginning at the specified start time. Default = 60.
A sample configuration sequence appears below.

```
config
context srp
  service-redundancy-protocol
    audit daily-start-time 06 00
    audit periodicity 90
end
```
Updating the Operating System

Updating the operating system (StarOS™) on ICSR chassis requires performing an Off-line update of each chassis while it is standby mode. Traffic disruption is minimal since an active chassis will be handling call sessions while the standby chassis is being updated.

The general upgrade sequence is as follows:

- Download the StarOS software image and copy/transfer it to both chassis.
- Save the currently running configurations on both chassis.
- Update the standby backup chassis first.
- Initiate an SRP switchover from the active primary chassis to make the standby backup chassis active.
- Update the standby primary chassis.
- Initiate an SRP switchover from the active backup chassis to make the standby primary chassis active.

The four-part flowchart below shows a more complete view of all the procedures required to complete the StarOS upgrade process.

⚠️ **Caution:** Enabling the Demux on MIO/UMIO feature changes resource allocations within the system. This directly impacts an upgrade or downgrade between StarOS versions in ICSR configurations. Contact Cisco TAC for procedural assistance prior to upgrading or downgrading your ICSR deployment.
Figure 25. ICSR Software Upgrade – Part 1

START Primary Chassis Active

Save Configuration

Copy Build onto Chassis

Copy Config Scripts onto Chassis (optional)

Fix Problems

No

Heath Check Passed?

Yes

START Backup Chassis Standby

Save Configuration

Copy Build onto Chassis

Copy Config Scripts onto Chassis (optional)

Fix Problems

No

SRP Check Passed?

Yes

No

BGP Check Passed?

Yes

Optional: Based on network deployment

Update Boot Record

Synchronize File Systems

Reload

A

B
Figure 26. ICSR Software Upgrade – Part 2

A  

B

Optional: Use TAC-prepared Config scripts.

Update Config File

Verify Version

Save Configuration

Synchronize File Systems

Fix Problems

Heath Check Passed?

Yes

SRP Check Passed?

Yes

Optional: Based on network deployment

BGP Check Passed?

Yes

Allow Time for Session Synchronization

Fix Problems

No

Fix Problems

No

Fix Problems

No

Initiate SRP Switchover

C  

D
Figure 27. ICSR Software Upgrade – Part 3

C

Primary Becomes Standby

Update Boot Record

Reload

Update Config File

Verify Version

Save Configuration

Synchronize File Systems

Heath Check Passed?

Yes

SRP Check Passed?

Yes

Optional: Use TAC-prepared Config scripts.

D

Backup Becomes Active

Optional: Based on network deployment

Fix Problems

AAA Monitor Okay?

No

Yes

F

335698
Figure 28. ICSR Software Upgrade – Part 4

- **E**
  - Optional: Based on network deployment
  - BGP Check Passed?
    - Yes: Allow Time for Session Synchronization
    - No: Fix Problems
  - Primary Becomes Active
  - Optional: Based on network deployment
  - AAA Monitor Okay?
    - No: Fix Problems
    - Yes: Make Test Calls
  - Software Upgrade COMPLETE

- **F**
  - Initiate SRP Switchover
  - Backup Becomes Standby
Both ICSR Chassis

Log into the CLI of the primary and backup and perform the tasks described below.

Downloading and Transferring the StarOS Build

Step 1  Verify that there is enough free space on the /flash device to accommodate the new operating system image file by entering the following Exec mode command:

[local]host_name# directory /flash

Step 2  Access to the Cisco support site and download facility is username and password controlled. Download the software image to a network location or physical device (USB stick) from which it can be uploaded to the /flash device.

Step 3  Transfer the new operating system image file to the /flash device on the MIO/UMIO using one of the following methods:

  Step a  Copy the file from a network location or local device plugged into the MIO/UMIO using the copy command

[local]host_name# copy from_url to_url [-noconfirm]

  Step b  Transfer the file to the /flash device using an FTP client with access to the system. The FTP client must be configured to transfer the file using binary mode.

  Step c  Transfer the file to the /flash device using an SFTP client with access to the system.

Step 4  Verify that the image file was successfully transferred to the /flash device by running the Exec mode the following command

[local]host_name# directory /flash

Step 5  Run the show version /flash/image_filename command to verify the build information. For example:

[local]host_name# show version /flash/image_filename.bin
Standby Backup Chassis

Log into the backup standby chassis and perform the tasks described below.

Performing Health Checks

Health checks are a series of Exec mode `show` commands to determine the readiness of the system to handle a software update.

**Step 1**  Run `show card table all |grep unknown`. No output should be displayed.

**Step 2**  Run `show card table |grep offline`. No output should be displayed.

**Step 3**  Run `show resources |grep Status`. The output should display “Within acceptable limits”.

**Step 4**  Run `show alarm outstanding`. Review the output for any issues that may preclude performing the software update.

Performing SRP Checks

Service Redundancy Protocol (SRP) checks verify that the mechanism for monitoring ICSR system status is operational.

**Step 1**  Run `show srp monitor all`.

**Step 2**  Review the output for any issues that may preclude performing the software update.

Performing BGP Checks

Border Gateway Protocol (BGP) checks are only required when BGP is used to support redundant interchassis communication. These checks are run per context and per service type.

**Step 1**  For each BGP-enabled context, run `show ip bgp summary`. Verify that the BGP peers are connected and IPv4 and IPv6 peers are up. Repeat for all BGP-enable contexts.

**Step 2**  Run `show service_name all |grep "Service Status:"`. The service should be “Started”. Repeat for all services running on the chassis.

Updating the Boot Record

You must add a new boot stack entry for the recently downloaded software image (.bin) file.

**Step 1**  Run the Exec mode `show boot` command to verify that there are less than 10 entries in the boot.sys file and that a higher priority entry is available (minimally there is no priority 1 entry in the boot stack).

**Step 2**  Create a new boot stack entry for the new file group, consisting of the new operating system image file and the currently used CLI configuration file by entering the following Global Configuration command:

```
[local]host_name(config)# boot system priority number image image_url
/flash/filename config cfg_url /flash/filename
```
Step 3  Assign the next highest priority to this entry, by using the <N-1> method, wherein you assign a priority number that is one number less than your current highest priority.

If priority 1 is in use, you must renumber the existing entries to ensure that at least that priority is available.

The maximum number of boot stack entries that can be contained in the boot.sys file is 10. If there are already 10 entries in the boot stack, you must delete at least one of these entries (typically, the lowest priority) and, if necessary, renumber some or all of the other entries before proceeding. Use the no boot system priority command to delete a boot stack entry.

For information on using the boot system priority command, refer to the Adding a New Boot Stack Entry section in this guide

Synchronizing File Systems

Synchronize the local file systems by entering the following Exec mode command:

```
[local]host_name# filesystem synchronize all
```

Reloading the Chassis

Reboot the chassis by entering the following command:

```
[local]host_name# reload [-noconfirm]
```

As the system reboots, it loads the new operating system software image and its corresponding CLI configuration file using the new boot stack entry configured earlier.

After the system reboots, establish a CLI session and enter the show version command to verify that the active software version is correct.

Optional for PDSN: If you are using the IP Pool Sharing Protocol during your upgrade, refer to Configuring IPSP Before the Software Upgrade in the PDSN Administration Guide.

Updating the Configuration File

Features in the new operating system may require changes to the configuration file. These changes can be done manually or facilitated by custom scripts prepared by Cisco TAC. Make whatever changes are necessary prior to saving the updated configuration file.

Verifying the Software Version

After the system has successfully booted, verify that the new StarOS version is running by executing the Exec mode show version command.

Saving the Configuration File

Use the Exec mode save configuration command to save the currently running configuration to the /flash device and to an off-chassis location (external memory device or network URL). The off-chassis copy assures that you will have a fallback, loadable configuration file should a problem be encountered.
Completing the Update Process

Repeat the following tasks to complete the upgrade process on the standby secondary chassis:

- Synchronizing File Systems
- Performing Health Checks
- Performing SRP Checks
- Performing BGP Checks

Waiting for Session Synchronization

Allow time for session synchronization to occur between the ICSR chassis before preceding to the next steps.

Step 1  Run the `show session recovery status verbose` command on both chassis. Proceed to the next steps only when no errors are seen in the output of this command.

Step 2  On the standby chassis, run `show srp checkpoint statistics | more`.

Step 3  On active chassis, run `show subs summary | grep Total`.

Step 4  Compare the number of subscribers on the active chassis and the number of Current pre-allocated calls: on the standby chassis. They should be similar (within 5%). Allow a few minutes for systems to complete synchronization.
Primary Chassis

Log into the active primary chassis and complete the tasks described below.

Initiating an SRP Switchover

An SRP switchover places the primary chassis in standby mode and makes the backup chassis active. The secondary chassis is now processing sessions with the upgraded software.

Step 1 On the primary chassis run the `srp initiate-switchover` command. All existing sessions will be migrated to the backup chassis and it begins servicing new session requests. Allow the switchover process to complete.

Step 2 On the primary chassis, run the `show srp info` command. Chassis State should indicate Standby when switchover is complete.

Step 3 On the backup chassis, confirm the switchover is complete by running the `show srp info` command. Chassis State should indicate Active when switchover is complete.

Checking AAA Monitor Status on the Newly Active Chassis

If your network deployment requires communication with AAA servers, log into the newly active chassis and perform an AAA monitor check. You will be checking for the existence of any SNMP traps that indicate the chassis cannot communicate with AAA servers (`starSRPAAAUnreachable`).

Step 1 Run the Exec mode command `show snmp trap history |grep starSRPAAAUnreachable`.

Step 2 There should be no output for this command, or no very recent SNMP trap notifications (based on the event timestamp).

Step 3 If the active chassis cannot communicate with one or more AAA servers, refer to Checking AAA Monitor Status for additional information on how to proceed.

Completing the Software Update

Log into the standby chassis and repeat the following tasks to complete the upgrade process on the standby primary chassis:

- Updating the Boot Record
- Reloading the Chassis
- Updating the Configuration File
- Verifying the Software Version
- Saving the Configuration File
- Synchronizing File Systems
- Performing Health Checks
- Performing SRP Checks
- Performing BGP Checks
- Waiting for Session Synchronization
Initiating an SRP Switchover

An SRP switchover places the primary chassis in active mode and makes the backup chassis active. The primary chassis is now processing sessions with the upgraded software.

Step 1  On the backup chassis run the `srp initiate-switchover` command. All existing sessions will be migrated to the primary chassis and it begins servicing new session requests. Allow the switchover process to complete.

Step 2  On the backup chassis, run the `show srp info` command. Chassis State should indicate Standby when switchover is complete.

Step 3  On the primary chassis, confirm the switchover is complete by running the `show srp info` command. Chassis State should indicate Active when switchover is complete.

Checking AAA Monitor Status

If your network deployment requires communication with AAA servers, check the status of communication with AAA servers as described in Checking AAA Monitor Status on the Newly Active Chassis.

Making Test Calls

Once the chassis state is verified and subscribers are migrated, perform new call testing to make sure calls are successful.

Fallback Procedure

To revert to the previous configuration and software build, perform the following steps as a user with administrative privileges.

Step 1  Run the Exec mode `show boot` command. The topmost lowest numbered entry of the displayed output should be the new configuration with the new software build. The second topmost entry should be the backup configuration.

Step 2  Remove the topmost boot entry n, and synchronize the configuration across the management cards.

    [local]host_name# config
    [local]host_name(config)# no boot system priority n
    [local]host_name(config)# end
    [local]host_name# filesystem synchronize all

Step 3  Reboot the system to load its previous configuration.

    [local]host_name# reload

Step 4  Perform health checks as described in Performing Health Checks.
Chapter 22
Support Data Collector

The Support Data Collector (SDC) is a system feature that allows scheduled collection of process state, counter, event and attribute data that may be useful when troubleshooting problems at an installation site.

This chapter includes the following sections:

- Overview
- Configuring SDR Collection
- Displaying the SDR Collection Configuration
- Collecting and Storing the SDR Information
- Managing Record Collection
- Using SDRs to Diagnose Problems
- SDR CLI Commands
Overview

The task of collecting the support data is performed by a background CLI task called the record collector. The administrator configures the SDC via the CLI with the commands to be executed on a periodic basis. The record collector always runs in the background and checks if there are records to be collected.

When it is time to collect support data, the scheduler executes the configured sequence of CLI commands and stores the results in a gunzipped (.gz) file on the hard-disk. This file is called an SDR (Support Data Record), and represents a snapshot of the overall state of the system at that time.

Technical Assistance Center (TAC) personnel and local administrators can review the SDRs on-line or by transferring them off the system. They may also wish to investigate the collector state information. The figure below shows system tasks that contain state and counter information. Arrows between tasks and processes represent messenger requests and indicate the predominant flow of data.

Figure 29. SDC Tasks and Processes
Configuring SDR Collection

The Support Data Record (SDR) is an ordered set of the CLI support commands’ display output that is stored in a stand-alone compressed file. Each CLI support command output is stored in its own record section. The record section is identified by a record section name and its ASCII command syntax. For example, the record section `show_version` would have a CLI command string of “show version”.

The order in which the record section commands appear in the configuration is significant. All of the support record section commands must be configured together as an ordered set. In other words, just specifying one command by itself will result in just that one command output constituting the contents of the entire SDR.

The user may configure a specific set of record sections for the SDR which may or may not include some or all of the default SDR record sections. This configuration is stored in the Global Configuration section of the configuration file. Refer to Configuration Commands (Global Configuration Mode) for more detail on the `support record section` command.

Displaying the SDR Collection Configuration

The `show configuration verbose` command displays the default support record sections, if the user has not specified any support record sections. If the user has configured support record sections, then the `show configuration` command displays user-configured support record sections. The support collection schedule configuration also appears in the `show configuration` output under the Global Configuration section.

Collecting and Storing the SDR Information

At the scheduled time, the Support Data Collector (SDC), if active, runs in the background to collect all the record section commands that have been specified. This information is concatenated as one contiguous output. The output is compressed and stored as a file on disk in the `/hd-raid/support/record/` directory.

The periodicity of the SDC is configured by the `support collection schedule` command under Global Configuration Mode. Once the SDR is stored, the SDC waits the sleep-duration interval specified via the `support collection` command before collecting another SDR.

> **Important:** The period between SDRs is equal to the configured sleep-duration interval + the time taken to collect the previous record.
Managing Record Collection

The SDRs are stored together in a self-relative set. This self-relative set is called a Support Record Collection. Each individual SDR is identified with a record-id. The record-id of the most recent SDR is always 0 (zero). The next older SDR is record-id 1, and so on, for the number of records in the stored collection. For example, if there are five SDRs, they are identified as SDR-0 through SDR-4.

Figure 30. Support Data Collection Hierarchy

When a new SDR is created, the numbers all increment by one and the newest SDR is given the value of 0. If the total number of records exceeds a configured maximum, then the oldest SDR is deleted.

Using the example above, when the maximum SDR count of 5 is reached, the SDRs continue to be SDR-0 through SDR-4, with the file timestamps indicating that the files are changing over time.
The time interval between collections may vary by several minutes in relation to the specified sleep-duration. This is because the interval specifies the idle time between scheduled collection runs. Since the actual overhead of the collecting process is not included in the scheduled intervals, the time differences between collections includes this non-deterministic amount of time.

**Important:** Using a shorter interval to compensate for this behavior is **not** recommended, since it will only add to the overhead incurred by the collection process and will ultimately impact the overall system performance. The sleep-duration (idle-time) between scheduled collections is an important component of the “self-throttling” mechanism that should not be circumvented by the user.

The Exec Mode `show support collection` command displays useful information about the Support Data Collector. The output includes information about when the collector last ran, how long it took to run, when it is scheduled to run again, as well as the number of SDRs currently stored, where they are stored, and how much storage space is being used. Refer to `show Commands (Exec Mode)` for more detail about this command.

### Using SDRs to Diagnose Problems

The user can compare the SDRs by examining two or more in sequence. These SDRs are dumped out in their CLI-formatted output display. Comparing the display outputs reveals trends and performance or configuration differences that indicate problem areas.

Once specific record sections have been identified as having problematic characteristics, only the CLI `show` commands associated with those sections need be monitored and compared to further isolate the problem areas. In addition, individual SDRs may be transferred via system-supported protocols to remote system, or the current collection may be transferred as a set for later analysis.
SDR CLI Commands

You may use the collected support data records to view support data chronologically. If the default list and sequence of sections is inadequate for system monitoring, you can configure your own set of record section commands that make up a particular support record.

**Important:** Refer to the SDR CLI Command Strings appendix for a listing of supported CLI strings (show commands) for record sections. The listing also identifies the CLI strings supported as default record sections. You can obtain the same listing by running the show support collection definitions command.

**Important:** You may enter up to 200 SDR CLI strings in a single record section command. If you attempt to add more than 200 CLI strings, an error message appears. You may also receive an error message if the system is unable to parse all of the requested CLI strings because they are too complicated to parse.

After configuring the SDR you then configure the sleep-duration interval between record collections and the number of historical records to be retained before being overwritten. By default, configuring this collection information makes the collector mechanism active (if not already active).

After one or more collection intervals have passed, the SDR data becomes available for analysis. The administrator can then use CLI commands to examine the SDR information to perform root cause analysis and trend analysis based on how the data has changed over time. The administrator may decide to transfer the SDRs off the system to be analyzed remotely, for example, by Cisco TAC.

For complete descriptions of the CLI commands discussed below, refer to the Command Line Interface Reference.

**Configuration Commands (Global Configuration Mode)**

`support record`

```
support record section section-name command "command-string" [ section section-name command "command-string" ] ... 

no support record [ all | section section-name ] 

default support record [ all | section section-name ] 
```

The `support record section` command configures a specific record section or set of record sections for a support information output command. The order in which record sections are saved is fixed, regardless of the sequence in which the CLI commands were entered.

For example:

```
[local]host_name(config)# support record section show_context command "show context"
```

If the `support record section` command is not explicitly configured by the user, a default set of record section commands are used. These default record section commands are displayed when you run the `show configuration verbose` command. If support record section commands are explicitly configured, they replace the default commands.
**Important:** Refer to the *SDR CLI Command Strings* appendix for a listing of supported CLI strings (show commands) for record sections. The listing also identifies the CLI strings included in default record sections.

The **no support record** command removes either a specific section of the record definition or all of the sections. If you specify the **default support record** command, the default record section definition of that specified record section is used. If neither the keyword **all** or **section** is specified, all the record section definitions are removed.

**support collection**

```
support collection [ sleep-duration [ hours h | minutes m ] ] [ max-records n ]
```

**no support collection**

**default support collection**

The **support collection** command modifies and/or enables the support collection process. If support collection has been previously disabled, this command enables the collection activity. If the support collection is currently enabled, this command may be used to modify the sleep-duration interval and/or the maximum number of SDRs that can be collected and stored.

The **sleep duration** keyword specifies the time interval between the collection of support data. It can be specified in hours or minutes with a default of one hour (60 minutes).

The **max-records** keyword specifies the number of SDRs to store as an integer from 1 to 65535. When this value is exceeded, the new SDR overwrites the oldest SDR. The default value is 168.

**Important:** SDR files will be stored in the `/hd-raid/support/records/` directory.

For example:

```
[local]host_name(config)# support collection sleep-duration minute 30 max-records 50
```

Use the **no support collection** command to explicitly disable the collection of the SDRs. If no record section commands are defined, the support data collector mechanism is also effectively disabled.

Use the **default support collection** command to enable the support data collector using the default record sections.

**Exec Mode Commands**

**show support record**

```
show support record record-id [ to record-id ] [ section section_name ]
```

The **show support record** command displays a collection of SDRs. The SDRs are displayed in order from lowest record-id to highest record-id.

Each SDR is identified by a time index called the record-id. For example, the most recent record is always record-id 0 (filename = sdr.0.gz). The next older record is record-id 1 (filename = sdr.1.gz), and so on.
When a new record is collected it is given a record-id of 0. The previously most recent record is renamed to record-id 1, and so on. The display includes the record-id along with the collection time-stamp.

The record-id variable identifies a single SDR. The to keyword specifies the endpoint record-id when displaying a range of SDRs.

The section keyword displays a particular section of the record.

delete support record

```
delete support record  record-id [ to record-id ]
```

The delete support records command removes an SDR with a specified record-id or all SDRs in the specified range of record-ids.

show support collection

```
show support collection [ definitions ]
```

The show support collection command displays information on SDC activity. It displays informations such as the start time of the last scheduled collection, the duration of the last scheduled collection, whether the collection is still in progress, etc. In addition this command lists the currently stored set of SDR record-ids, their respective timestamps, and size of each SDR.

```
[local]host_name# show support collection
  Record Collection Enabled : yes
  Last Collection Start Time : Monday October 21 06:29:05 PDT 2013
  Last Collection End Time : Monday October 21 06:29:09 PDT 2013
  Est. Collection Next Start : Monday October 21 07:29:13 PDT 2013 (40 minutes)

  Support Data Records at /var/tmp/support-records/
    ID   Name     Size  Date/Time
    167  sdr.167.gz  42863 Monday October 21 04:40:00 PDT 2013
    166  sdr.166.gz  170425 Monday October 21 05:40:08 PDT 2013
  total SDRs 2, total bytes 2132880, time span is last 1 day(s) 1 hour(s)
```

The optional definitions keyword displays the list of default support record section definitions. This is the list of all valid record section definitions. The display also indicates whether the record section is enabled or disabled by default.

```
[local]host_name# show support collection definitions
```

The output of this command reflects the sequence in which record sections will be output, regardless of the sequence in which they may have been entered by the user. Refer to the SDR CLI Command Strings appendix for additional information.
Appendix A
Engineering Rules

This appendix provides engineering guidelines for configuring the system to meet network deployment requirements.

This appendix consists of the following topics:

- CLI Session Rules
- ASR 5500 Interface and Port Rules
- Context Rules
- Subscriber Rules
- Service Rules
- Access Control List (ACL) Engineering Rules
CLI Session Rules

Multiple CLI session support is based on the amount of available memory. The Resource Manager reserves enough resources to support a minimum of six CLI sessions at all times. One of the six sessions is further reserved for use exclusively by a CLI session on an MIO/UMIO serial interface.

Additional CLI sessions beyond the pre-reserved limit are permitted if sufficient MIO/UMIO resources are available. If the Resource Manager is unable to reserve resources for a CLI session beyond those that are pre-reserved, users with administrator-privileges are prompted to create the new CLI session, even without reserved resources.

ASR 5500 Interface and Port Rules

The rules discussed in this section pertain to the Ethernet ports used for subscriber traffic on the MIO/UMIO card (ports 10 through 29).

- Give all logical interfaces a unique name to identify the interface from others in the same context. Logical interfaces in different contexts may have the same name.
- A single physical port can support multiple logical interfaces when you configure VLAN tags for that physical port. You can use VLAN tagging to bind a single physical port to multiple logical interfaces that reside in different contexts.
- Assign all logical interfaces a valid IP address and subnet.
  - Give each logical interface within a context a unique IP address(es). Logical interfaces in different contexts can have the same IP address(es).
  - If multi-homing is supported on the network, you can assign all logical interfaces a single primary IP address and up to 16 secondary IP addresses.
- You can configure a logical interface in only one context, but you can configure multiple interfaces (up to 512) in a single context.
- You can apply a maximum of 256 access control list (ACL) rules to a single logical interface.
- All ports are identified by their <slot#>/<port#>.
- Each physical port for subscriber traffic on an MIO/UMIO card may contain up to a maximum of 1,024 VLAN tags.
- A logical interface is limited to using a single VLAN on a single physical port, identified by its <card#/slot#/port#>.

Packet Data Network (PDN) Interface Rules

The following engineering rules apply to the interface to the packet data network (PDN):

- Configure the logical interfaces used to facilitate the PDN interface within the egress context.
- The default is to use a single interface within the egress context to facilitate the PDN interface.
- You can configure multiple interfaces in the egress context by using static routes or dynamic routing protocols.
- You may also configure next-hop default gateways.
Context Rules

- A maximum of 63 contexts may be configured per chassis. Enabling demux functions on an MIO card reduces the maximum number of contexts to 10.

- Interfaces per Context
  - Prior to Release 15.0: Up to 16 interfaces can be configured within a single context.
  - For Release 15.0 and higher: With the Demux MIO/UMIO feature enabled, up to 64 interfaces can be configured within a single context.
  - 512 Ethernet+PPP+tunnel interfaces
  - 32 ipv6ip tunnel interfaces
  - 511 GRE tunnels (2,048 GRE tunnels per chassis)
  - 256 loopback interfaces

- IP Addresses and IP Address Pools
  - Up to 2,000 IPv4 address pools can be configured within a single context.
  - Prior to Release 15.0: Up to 32 IPv6 pools can be configured within a single context.
  - For Release 15.0 and higher: Up to 256 IPv6 pools can be configured within a single context.
  - Up to a combined total of 5,000 IPv4 and IPv6 addresses can be configured per chassis.
  - Each context supports up to 32,000,000 static IP pool addresses. You can configure a maximum total of 96,000,000 static IP pool addresses per chassis. Each static IP pool can contain up to 500,000 addresses.
  - Each context supports up to 16,000,000 dynamic IP pool addresses. You can configure a maximum total of 32,000,000 dynamic IP pool addresses per chassis. Each dynamic IP pool can contain up to 500,000 addresses.

**Important:** The actual number of IP Pools supported per context and chassis depends on how many addresses are being used and how they are subnetted.

**Important:** Each address in the pool requires approximately 60 bytes of memory. The amount of memory required, however, depends on a number of factors such as the pool type, and hold-timer usage. Therefore, in order to conserve available memory, you may need to limit the number of pools depending on the number of addresses to be configured and the number of installed application cards.

- The maximum number of simultaneous subscriber sessions is controlled by the installed capacity license for the service(s) supported.
- The maximum number of static address resolution protocol (ARP) entries per context is 128.
- The maximum number of domains per context is 2,048.
- ASN-GW services configured within the same context cannot communicate with each other.

- Routes
  - Up to 1,200 static routes per context (48,000 per chassis).
  - 6,000 pool routes per context (6,000 per chassis)
  - 5,000 pool explicit host routes per context (6,000 per chassis)
- 64 route maps per context
- **BGP**
  - *Releases 12 and 14:* 16,000 BGP prefixes can be learned/advertised per context (64,000 per chassis)
  - *Releases 15 and 16:* 32,000 BGP prefixes can be learned/advertised per context (64,000 per chassis)
  - *Releases 17, 18 and higher:* 64,000 BGP prefixes can be learned/advertised per context (64,000 per chassis)
  - 64 EBGP peers can be configured per context (512 per chassis)
  - 16 IBGP peers per context
  - 512 BGP/AAA monitors per context in support of Interchassis Session Recovery (ICSR)
- **OSPF**
  - 200 OSPF neighbors per chassis
  - 10,000 OSPF routes per context (64,000 per chassis)
- **MPLS**
  - 16 label distribution protocol (LDP) sessions per context
  - 8,000 forwarding equivalence class (FEC) entries per context (48,000 per chassis)
  - Up to 8,000 incoming label map (ILM) entries per context (48,000 per chassis)
- **VRF**
  - *Prior to Release 15.0:* 250 virtual routing and forwarding (VRF) tables per context (1,024 or 2,048 [release 14.0+] VRFs per chassis)
  - *Release 15.0 and higher:* 300 virtual routing and forwarding (VRF) tables per context (2,048 VRFs per chassis) [256 VRFs per context with demux functions enabled on the MIO card]
  - APN limit is 2,048 per chassis; VRF limits and APN limits should be identical.
  - 64,000 IP routes
- **NEMO (Network Mobility)**
  - *Prior to Release 15.0:* 256K prefixes/framed routes per chassis and up to 8 dynamically learned prefixes per MR (Mobile Router)
  - *Release 15.0 and higher:* 512K prefixes/framed routes per chassis and up to 16 dynamically learned prefixes per MR (Mobile Router)
  - 128 AAA servers per context for a default AAA server group. The servers can be configured as accounting, authentication, charging servers, or any combination thereof.
  - You can configure up to 800 AAA server groups per context with following limitations:
    - 128 servers per AAA server group (accounting, authentication, charging server, or any combination thereof)
    - 1,600 servers per context in AAA Server group mode (accounting, authentication, charging server, or any combination thereof)
    - 800 NAS-IP address/NAS identifier (one primary and one secondary per server group) per context
  - Up to 12 charging gateway functions (CGFs) for GTPP accounting can be configured per context.
  - Up to 16 bidirectional forwarding detection (BFD) sessions per context (64 per chassis)
Important: Refer to *Engineering Rules* in your product administration guide for additional information on product-specific operating limits.

 Subscriber Rules
The following engineering rules apply to subscribers configured within the system:

- Configure a maximum of 2,048 local subscribers per context.
- You may configure attributes for each local subscriber.
- The system creates a default subscriber for each context when the context is made. Configure attributes for each default subscriber. If a AAA-based subscriber is missing attributes in the authentication reply message, the default subscriber attributes in the context where the subscriber was authenticated are used.

Important: Default is not used when local authentication (for local subscribers) is performed.

- Configure default subscriber templates on a per AAA realm (domain aliases configured within a context) basis.
- Configure default subscriber templates on a per PDSN, FA, ASN-GW, or HA service.
- For AAA authenticated subscribers, the selection of local subscriber template to use for setting attributes is in the following order:
  - If the username (NAI) matches any local domain name and the domain name has a local subscriber name configured, that local subscriber template is used.
  - If the first case fails, and if the serving service has a default username configured, that subscriber template is used.
  - If the first two cases fail, the default subscriber template in the AAA context is used.

 Service Rules
The following engineering rules apply to services configured within the system:

- Configure a maximum of 256 services (regardless of type) per system.

Caution: Large numbers of services greatly increase the complexity of management and may affect overall system performance. Therefore, you should not configure a large number of services unless your application absolutely requires it. Please contact your Cisco service representative for more information.

- The total number of entries per table and per chassis is limited to 256.
- Although you can use service names that are identical to those configured in different contexts on the same system, this is not a good practice. Services with the same name can lead to confusion and difficulty in troubleshooting problems, and make it difficult to understand the output of `show` commands.
Access Control List (ACL) Engineering Rules

The following rules apply to Access Control Lists:

- The maximum number of rules per ACL is 128.
- The maximum number of ACL rules applied per port is 128.
- The maximum number of ACL rules applied per context is 1,024.
- The maximum number of ACL rules per IPSec policy is 1.
- The maximum number of IPSec ACL rules per context is 1,024.
- The maximum number of IPSec ACL rules per crypto map is 8.
- The maximum number of ACLs you can configure per context is limited by the number of rules allowed within each ACL. If each ACL contained the maximum number of rules (128), the maximum number of ACLs per context is 8 (128 X 8 ACLs = 1,024 ACL rules per context).
- The maximum number of ACLs applied to an IP access group is 1, whether it is configured for a port or context. Since the maximum number of IP access groups you can apply to an interface or context is 16, the following calculations apply:
  - For each interface/port: 8 rules per ACL multiplied by 16 IP access groups = 128 (the ACL rules limit per port)
  - For each context: 64 rules per ACL multiplied by 16 IP access groups = 1,024 (the ACL rules limit per context)
Appendix B

StarOS Tasks

This appendix describes system and subsystem tasks running under StarOS on an ASR 5x00 and virtualized platforms. It includes the following sections:

- Overview
- Primary Task Subsystems
- Controllers and Managers
- Subsystem Tasks

**Important:** This appendix is not a comprehensive list of all StarOS tasks. It simply provides general descriptions of the primary tasks and subsystems within StarOS.
Overview

For redundancy, scalability and robust call processing, StarOS supports a series of tasks that perform specific functions. These tasks communicate with each other as needed to share control and data signals. As a result, processes can be distributed across multiple tasks thus reducing the overall work-load on any given task and improving system performance. This distributed design provides fault containment that greatly minimizes the impact to processes or sessions due to a failure.

The Exec mode `show task` command displays snapshots of running processes within StarOS. For detailed information about this command, see the *Command Line Interface Reference* and *Statistics and Counters Reference*.

The following sections describe the primary tasks that are implemented by StarOS:

- Primary Task Subsystems
- Controllers and Managers
Primary Task Subsystems

The individual tasks that run on the CPUs are divided into subsystems. Following is a list of the primary subsystems responsible for call session processing:

- **System Initiation Task (SIT):** This subsystem starts tasks and initializes the system. This includes starting a set of initial tasks at system startup time (static tasks), and starting individual tasks on demand at arbitrary times (dynamic tasks).

- **High Availability Task (HAT):** With the Recovery Control Task (RCT) subsystem, the HAT subsystem maintains the operational state of the system. HAT monitors the various software and hardware components of the system. If there are unusual activities, such as the unexpected termination of another task, the HAT subsystem takes a suitable course of action, such as triggering an event to the RCT subsystem to take corrective action or to report the status. The primary function of the HAT task is to minimize service impacts.

- **Recovery Control Task (RCT):** This subsystem executes a recovery action for any failure that occurs in the system. The RCT subsystem receives signals from the HAT subsystem (and in some cases from the NPU subsystem) and determines what recovery actions are needed.

  The RCT subsystem runs on the active management card and synchronizes the information it contains with the RCT subsystem on the standby management card.

- **Shared Configuration Task (SCT):** This subsystem provides a facility to set, retrieve, and receive notification of system configuration parameters. The SCT is mainly responsible for storing configuration data for the applications that run on the system.

  The SCT subsystem runs only on the active management card and synchronizes the information it contains with the SCT subsystem on the standby management card.

- **Resource Management (RM):** This subsystem assigns resources, such as CPU loading and memory, for every system task upon start-up. The RM subsystem monitors resource use to verify that allocations are as specified. RM also monitors all sessions and communicates with the Session Controller to enforce capacity licensing limits.

- **Virtual Private Network (VPN):** This subsystem manages the administrative and operational aspects of all VPN-related entities in the system. The functions performed by the VPN subsystem include:
  
  - Creating separate VPN contexts
  - Starting the IP services within a VPN context
  - Managing IP pools and subscriber IP addresses, and distributing the IP flow information within a VPN context.

  All IP operations within StarOS are done within specific VPN contexts. In general, packets are not forwarded across different VPN contexts. The only exception currently is the Session subsystem.

- **Network Processing Unit** (npuctrl/npumgr on ASR 5000; npusim on ASR 5500, and knpusim on VPC-DI and VPC-SI): This subsystem is responsible for the following:
  
  - Using the database to match address and port numbers to destination tasks for fast-path forwarding of dataframes
  - Receiving and transmitting user data frames to/from various physical interfaces
  - IP forwarding decisions (both unicast and multicast)
  - Per-interface packet filtering
  - Traffic management and traffic engineering
• Passing user data frames to/from packet processing CPUs
• Modifying, adding, or stripping datalink/network layer headers
• Recalculating checksums
• Maintaining statistics
• Managing external Ethernet interfaces

• **Card/Slot/Port (CSP):** Coordinates the events that occur when any card is inserted, locked, unlocked, removed, shutdown, or migrated. CSP also performs auto-discovery and configures ports on a newly-inserted interface card. It determines how interface cards map to packet processing cards. The CSP subsystem runs only on the active management card and synchronizes the information it contains with the SCT subsystem on the standby management card. It is started by the SIT subsystem and monitored by the HAT subsystem.

• **Session Manager (SM):** Performs high-touch processing of mobile subscribers’ packet-oriented data session flows. High-touch user data processing consists of the following:
  • Payload transformation
  • Filtering and scheduling
  • Statistics collection
  • Policing

### Controllers and Managers

Many of the primary subsystems are composed of controller tasks called Controllers, and subordinated tasks called Managers.

Controllers serve several purposes:

• Monitor the state of their Managers and allow communication between Managers within the same subsystem.
• Enable inter-subsystem communication since they can communicate with the controllers of other subsystems.
• Mask the distributed nature of the software from the user allowing for ease of management.

Managers manage resources and mappings between resources. In addition, some managers are directly responsible for call processing.

For information about the primary subsystems that are composed of critical, controller, and/or manager tasks, see Subsystem Tasks.
Subsystem Tasks

The following subsections list and briefly describe StarOS tasks for various subsystems:

- System Initiation Subsystem
- High Availability Subsystem
- Resource Manager Subsystem
- Virtual Private Networking Subsystem
- Network Processing Unit Subsystem
- Session Subsystem
- Platform Processes
- Management Processes

System Initiation Subsystem

Table 42. System Initiation Subsystem Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITMAIN</td>
<td>System Initiation Task – Main</td>
<td>Initiated at system start-up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reads and provides startup configuration to other SIT components.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Starts SITREAP sub-function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains CPU state information.</td>
</tr>
<tr>
<td>SITPARENT</td>
<td>SIT Parent Sub-function</td>
<td>Starts management cards in either active or standby mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Registers tasks with HAT task.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Notifies CSP task of CPU startup completion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brings up packet processing cards in standby mode.</td>
</tr>
<tr>
<td>SITREAP</td>
<td>SIT Reap Sub-function</td>
<td>Shuts down tasks as required.</td>
</tr>
</tbody>
</table>
## High Availability Subsystem

Table 43. High Availability Subsystem Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>hatcpu</td>
<td>High Availability Task CPU</td>
<td>Performs device initialization and control functions based on the CPUs hardware capabilities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reports the loss of any task on its CPU to hatsystem sub-function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Controls the LEDs on the packet processing cards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initializes and monitors the dedicated hardware on packet processing cards. (ASR 5x00 only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collects CPU monitoring information periodically and reports to the master hatcpu sub-function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reports the loss of any task on its CPU to the master hatcpu sub-function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performs device initialization and control functions because of the CPU’s hardware capabilities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reports the loss of any task on its CPU to hatsystem sub-function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Controls the LEDs on the management card. (ASR 5x00 only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initializes and monitors the dedicated hardware on the management card. (ASR 5x00 only)</td>
</tr>
<tr>
<td>hatsystem</td>
<td>High Availability Task System Controller</td>
<td>Controls all the HAT sub-function tasks in the system. It is initiated on system start-up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initializes system components (such as the Gigabit Ethernet switches and switch fabric).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monitors system components such as fans for state changes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triggers actions for redundancy in the event of fault detection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The HAT subsystem on the redundant management card mirrors the HAT subsystem on the active management card.</td>
</tr>
</tbody>
</table>
Resource Manager Subsystem

Table 44. Resource Manager (RM) Subsystem Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
</table>
| rmctrl | Resource Manager Controller | Started by the sitparent task on StarOS startup, and monitored by HAT for a failure.  
|        |                           | Initializes resources such as CPUs and memory.                           |
|        |                           | Requests updated card status from the CSP subsystem and updates the system card table. |
|        |                           | Communicates with all rmctrls to request their most recent set of resource data. |
| rmctrl | Resource Manager Managers  | Started by the sitparent task, and monitored by HATs for failures.        |
|        |                           | Initializes the local resource data and local resource scratch space.     |
|        |                           | Communicates with the SIT task on the local CPU to get its entire task table and the resources associated with each task. |
|        |                           | Gathers current resource utilization for each task.                       |
|        |                           | Sends the resource data to the rmctrl task.                               |

Virtual Private Networking Subsystem

Table 45. Virtual Private Networking (VPN) Subsystem Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>vpnctrl</td>
<td>VPN Controller</td>
<td>Created at system start-up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initiates the VPN Manager for each context.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Informs the Session Controller task when there are additions or changes to contexts. Only one Session Controller operates at any time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routes context specific operation information to the appropriate VPN Manager.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performs VPN Manager recovery and saves all VPN-related configuration information in SCT.</td>
</tr>
<tr>
<td>vpnmgr</td>
<td>VPN Manager</td>
<td>Started by the VPN Controller for each configured context (one is always present for the local context).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performs IP address pool and subscriber IP address management.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performs all context specific operations including but not limited to: UCM services, IP interfaces, the Address Resolution Protocol (ARP), IP address pool management, slow path forwarding, NPU flows, port Access Control Lists (ACLs), and logging.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides IP interface address information for each context to the Session Controller.</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Function</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>bgp</td>
<td>Border Gateway Protocol</td>
<td>Created by the VPN Manager for each context that has enabled the BGP routing protocol <em>(router bgp Context Configuration mode CLI command)</em>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Responsible for learning and redistributing routing information via the BGP protocol.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains the BGP peering connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applies any defined BGP routing policy.</td>
</tr>
<tr>
<td>ospf</td>
<td>Open Shortest Path First</td>
<td>Created by VPN Manager for each context that has enabled the OSPF routing protocol <em>(router ospf Context Configuration mode CLI command)</em>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Responsible for learning and redistributing routing information via the OSPF protocol.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains the OSPF neighboring relationship.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains the LSA database.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performs SPF calculations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applies any defined OSPF routing policy.</td>
</tr>
<tr>
<td>ospfv3</td>
<td>Open Shortest Path First</td>
<td>Created by VPN Manager for each context that has enabled the OSPFv3 routing protocol <em>(router ospfv3 Context Configuration mode CLI command)</em>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Responsible for learning and redistributing routing information via the OSPFv3 protocol.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains the OSPFv3 neighboring relationship.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains the LSA database.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performs OSPFv3 SPF calculations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applies any defined OSPFv3 routing policy.</td>
</tr>
<tr>
<td>rip</td>
<td>Routing Information Protocol</td>
<td>Created by VPN Manager for each context that has enabled the RIP routing protocol <em>(router rip Context Configuration mode CLI command)</em>.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Responsible for learning and redistributing routing information via the RIP protocol.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains the RIP database.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sends periodic RIP update messages.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applies any defined RIP routing policy.</td>
</tr>
<tr>
<td>zebos</td>
<td>L2 and L3 Switching</td>
<td>Created by VPN Manager for each context.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains the routing table (RIB and FIB) for the context.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performs static routing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interfaces to the kernel for routing &amp; interface updates.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Redistributes routing information to dynamic routing protocols.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calculates nexthop reachability.</td>
</tr>
</tbody>
</table>
## Network Processing Unit Subsystem

Table 46. Network Processing Unit (NPU) Subsystem Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>knpusim</td>
<td>Kernel-based NPU Simulator [VPC-DI, VPC-SI]</td>
<td>Created at StarOS start up. Provides port configuration services to the CSP task.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides interface binding and forwarding services to the VPN Manager.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides flow insertion and removal services to Session Manager and AAA Manager tasks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides recovery services to the NPU Controller.</td>
</tr>
<tr>
<td>npuctrl</td>
<td>NPU Controller</td>
<td>Created at StarOS start-up. Only one NPU Controller operates in the system at any time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monitors the state of NPU Managers in the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Registers to receive notifications when NPU Manager crashes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Controls recovery operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides a centralized location for CLI commands related to NPU Manager state.</td>
</tr>
<tr>
<td>npumgr</td>
<td>NPU Manager</td>
<td>Created for every packet processing card that is installed and started.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides port configuration services to the CSP task.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides interface binding and forwarding services to the VPN Manager.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides flow insertion and removal services to Session Manager and AAA Manager tasks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides recovery services to the NPU Controller.</td>
</tr>
<tr>
<td>npusim</td>
<td>NPU Simulator [ASR 5500]</td>
<td>Created for every DPC installed and started.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides port configuration services to the CSP task</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides interface binding and forwarding services to the VPN Manager.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides flow insertion and removal services to Session Manager and AAA Manager tasks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides recovery services to the NPU Controller.</td>
</tr>
</tbody>
</table>
## Session Subsystem

Table 47. Session Subsystem Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
</table>
| sessctrl | Session Controller | Created at StarOS start-up. Only one Session Controller instantiated in the system at any time.  
Acts as the primary point of contact for the Session Subsystem. Since it is aware of the other subsystems running within the system, the Session Controller acts as a proxy for the other components, or tasks, that make up the subsystem.  
Starts, configures, and coordinates the efforts of the Session Processing Subsystem sub-managers.  
Works with Resource Manager to start new Session Managers when all existing Session Managers exceed their capacity.  
Receives context information from VPN Managers.  
Distributes IP interface address information to other Session Processing Subsystem sub-managers.  
Manages Enhanced Charging Service (ECS), Content Filtering and URL Blacklisting services. |
| sessmgr  | Session Manager | Created by the Session Controller.  
Provides a subscriber processing system that supports multiple session types.  
Multiple Session Managers can run on a single CPU and/or can be distributed throughout any CPU present in the system.  
A single Session Manager can service sessions from multiple A11 Managers, and from multiple contexts.  
Processes protocols for A10/A11, GRE, R3, R4, R6, GTPU/GTPC, PPP, and Mobile IP.  
Manages Enhanced Charging Service, Content Filtering and URL Blacklisting services.  
Session Managers are paired with AAA Managers. |
| a11mgr   | A11 Manager | Created by the Session Controller for each context in which a PDSN service is configured.  
Receives the R-P sessions from the PCF and distributes them to different Session Manager tasks for load balancing.  
Maintains a list of current Session Manager tasks to aid in system recovery.  
The A11 Manager task is also known as the Signaling De-multiplexing task (SDT).  
With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active packet processing card. |
<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>aaamgr</td>
<td>Authorization, Authentication, and Accounting (AAA) Manager</td>
<td>Paired with Session Managers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performs all AAA protocol operations and functions for subscribers and administrative users within the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acts as a AAA client to AAA servers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manages GTP Prime (GTP’) messaging with charging gateway functions (CGFs).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiple AAA Managers can run on a single CPU and/or can be distributed throughout any CPU present in the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AAA operations for the CLI are done through a AAA Manager running on the active management card.</td>
</tr>
<tr>
<td>aaaproxy</td>
<td>Authorization, Authentication, and Accounting (AAA) Proxy Manager</td>
<td>Starts whenever the Global Configuration mode <code>gtpp single-source</code> command is configured.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When GTPP single-sourcing is enabled, aaaproxy generates requests to the accounting server using a single UDP source port number, instead of having each AAA Manager generate independent requests with unique UDP source port numbers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Runs on a demux card when session recovery is enabled. If session recovery is not enabled, the Global Configuration mode <code>require demux card</code> command starts aaaproxy on the designated demux card.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Writes CDRs to a file in its VRAM-disk. The enqueued CDRs are then periodically synchronized with a HDD for transfer.</td>
</tr>
<tr>
<td>acsctrl</td>
<td>Active Charging System (ACS) Controller</td>
<td>Active Charging service is defined at the global level and can be utilized through CSS commands from any VPN context. Enable via the Global Configuration mode <code>active-charging service</code> CLI command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The ACS controller runs on the primary packet processing card and is responsible for managing the ACS service.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reads and writes ACS configuration information into SCT.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The ACS Controller monitors the ACS Manager’s recovery process and performs cleanup when redundancy is enabled.</td>
</tr>
<tr>
<td>acsmgr</td>
<td>Active Charging System (ACS) Controller</td>
<td>Created by ACS Controller to perform IP session processing for a specific number of flows.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sends and receives data through Session Managers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Active/Standby acsmgr tasks are created when session recovery (SR) is enabled.</td>
</tr>
<tr>
<td>alcapmgr</td>
<td>Access Link Control Application Part Manager [ASR 5000 only]</td>
<td>Starts when an ALCAP service configuration is detected. There can be multiple instances of this task for load sharing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Runs the ALCAP protocol stack and handles the IuCS-over-ATM associations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains AAL2 node entity databases.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides nodal functions for IuCS-over-ATM interface on ALCAP protocol.</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Function</td>
</tr>
<tr>
<td>-----------</td>
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<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>cdrmod</td>
<td>Charging Detail Record Module</td>
<td>Responsible for receiving EDR/UDR records from different ACSMGR instances in the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Responsible for writing the received EDR/UDR records in files using the configured file naming conventions.</td>
</tr>
<tr>
<td>dgmbmgr</td>
<td>Diameter Gmb interface Application Manager</td>
<td>Provides Multimedia Broadcast/Multicast Service (MBMS) feature support for GGSN. It is instantiated when an MBMS policy CLI is configured in the GGSN Service configuration mode. dgmbmgr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains the MBMS UE and bearer contexts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handles the Gmb interface over a Diameter connection to a BMSC Server for MBMS bearer sessions. dgmbmgr recovers by polling all sessmgrs for MBMS session states and recreating the MBMS UE and MBMS bearer context information.</td>
</tr>
<tr>
<td>diamproxy</td>
<td>Diameter Proxy</td>
<td>Created by diactrl (which runs as part of vpnctrl) and the number of diamproxy tasks spawned is based on the configuration to use “multiple” or “single” proxies. In instances that a single proxy is configured, only one diamproxy task is spawned for the entire chassis and runs on demux packet processing cards. When multiple proxies are configured, one diamproxy task is run per packet processing card.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains Diameter base connections to all peers configured in the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Informs applications about any change in the connection status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acts as a pass-through to the messages from application to the Diameter server.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Just acts as a forwarding agent (does not maintain any queues).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A single Diameter proxy is used to service multiple Diameter applications.</td>
</tr>
<tr>
<td>egtpemgr</td>
<td>Enhanced GPRS Tunneling Protocol Egress Manager</td>
<td>Created by the Session Controller for each context in which an egtp-service of interface type sgw-egress or MME is configured.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handles certain EGTP messages from SGW, PGW.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains list of current EGTP sessions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains list of current Session Manager tasks which aids in session recovery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handles GTP Echo messaging.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active packet processing card.</td>
</tr>
<tr>
<td>egtpimgr</td>
<td>Enhanced GPRS Tunneling Protocol Ingress Manager</td>
<td>Created by Session Controller for each context in which an egtp-service of interface type sgw-ingress or pgw-ingress is configured.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receives EGTP sessions from MME/S4 SGSN/SGW and distributes them to different Session Manager tasks for load balancing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains list of current EGTP sessions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains list of current Session Manager tasks which aids in session recovery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handles GTP Echo messaging.</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Function</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>gtpcmgr</td>
<td>GPRS Tunneling Protocol Control (GTP-C) Message Manager</td>
<td>With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active packet processing card.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Created by the Session Controller for each context in which a GGSN service is configured.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receives the GTP sessions from the SGSN and distributes them to different Session Manager tasks for load balancing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains a list of current Session Manager tasks to aid in system recovery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verifies validity of GTPC messages.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains a list of current GTPC sessions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Handles GTPC Echo messaging to/from SGSN.</td>
</tr>
<tr>
<td>gtpumgr</td>
<td>GPRS Tunneling Protocol User (GTP-U Manager)</td>
<td>With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active packet processing card.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Created by the Session Controller for each context in which a GTPU service is configured. Supported for both GTPUv0 and GTPUv1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains a list of the GTPU-services available within the context and performs load-balancing (of only Error-Ind) for them.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supports GTPU Echo handling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provides Path Failure detection on no response for GTPU echo.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receives Error-Ind and demuxes it to a particular Session Manager.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Serves as the Default GTPU listener. GTPUMGR will process GTPU packets with invalid TEID.</td>
</tr>
<tr>
<td>hamgr</td>
<td>Home Agent (HA) Manager</td>
<td>With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active packet processing card.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Created by the Session Controller for each context in which an HA service is configured.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receives Mobile IP sessions from the Foreign Agents (FAs) and distributes them to different Session Manager tasks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains a list of current Session Manager tasks that aids in system recovery.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Functions as the DemuxMgr – handles all the PMIP signaling packets.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Functions as the Demuxmgr for MIPv6/MIPv4 HA.</td>
</tr>
<tr>
<td>imsimgr</td>
<td>International Mobile Subscriber Identity Manager for MME</td>
<td>Starts when an MME service configuration is detected. There is only one instance of this task:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selects which SessMgr to use for new subscriber sessions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains and reports MME-related demux statistics on events like Attach by IMSI, Attach by GUTI, etc.</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Function</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Can interact with the following tasks in the system:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Session Controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- MME Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Session Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With session recovery (SR) enabled, this demux manager is usually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>established on one of the CPUs on the first active packet processing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>card.</td>
</tr>
<tr>
<td>imsimgr</td>
<td>International Mobile Subscriber Identity Manager for SGSN</td>
<td>Started by the Session Controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selects SessMgr, when not done by linkmgr or sgtpcmgr tasks, for calls</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sessions based on IMSI/P-TMSI.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Load-balances across SessMgrs to select one to which a subscriber will</td>
</tr>
<tr>
<td></td>
<td></td>
<td>be assigned.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains records for all subscribers on the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains mapping between the IMSI/P-TMSI and SessMgrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With session recovery (SR) enabled, this demux manager is usually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>established on one of the CPUs on the first active demux packet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>processing card.</td>
</tr>
<tr>
<td>ipsgmgr</td>
<td>IP Services Gateway Manager</td>
<td>Created by the Session Controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In Server mode, acts as a RADIUS server, and supports Proxy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>functionality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In Snoop mode supports snooping RADIUS Accounting messages.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Load-balances across SessMgrs to select one to which a subscriber will</td>
</tr>
<tr>
<td></td>
<td></td>
<td>be assigned.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains records for all subscribers on the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains mapping between the IMSI/P-TMSI and SessMgrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With session recovery (SR) enabled, this demux manager is usually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>established on one of the CPUs on the first active demux packet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>processing card.</td>
</tr>
<tr>
<td>l2tpdemux</td>
<td>L2TP Demultiplexor Task</td>
<td>Created by the Session Controller when an LNS service is created. Only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>one L2TPDemux task is invoked for the entire system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>De-multiplexes and forwards new incoming tunnel create requests to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L2TPMgrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains information about current active tunnels in all L2TPMgrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Load-balances requests among L2TPMgrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With session recovery (SR) enabled, this demux manager is usually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>established on one of the CPUs on the first active packet processing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>card.</td>
</tr>
<tr>
<td>l2tpmgr</td>
<td>Layer 2 Tunneling Protocol Manager</td>
<td>Created by the Session Controller for each context in which a LAC or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LNS service is configured. Additional managers are created as needed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>depending on loading.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Responsible for all aspects of L2TP processing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains protocol state machines for all L2TP sessions and tunnels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triggers IPSec encryption for new L2TP tunnels as needed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Works with Session Managers to gracefully bring down tunnels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With session recovery (SR) enabled, this demux manager is usually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>established on one of the CPUs on the first active packet processing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>card.</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Function</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>linkmgr</td>
<td>SS7 Link Manager</td>
<td>Created by the Session Controller when the first SS7RD (routing domain) is activated. Multi-instanted for redundancy and scaling purposes. Provides SS7 and Gb connectivity to the platform. Routes per subscriber signalling across the SS7 (including Iu) and Gb interfaces to the SessMgr.</td>
</tr>
<tr>
<td>magmgr</td>
<td>Mobile Access Gateway (MAG) Manager</td>
<td>Created by the Session Controller when the first MAG service is created in a context. Sends and receives PMIP control messages (PBU/PBA). Adds an NPU flow to receive MIPv6 PBA packets. This flow is identical to the flow used in the HAMgr. Maintains the Binding Update List used to keep track of the mobile node’s bindings. Originates PBU-based on trigger received from the Session Manager during error conditions. Receives PBA and forwards it to Session Manager. Supports debugging facility – “magmgr” and “mobile-ipv6”.</td>
</tr>
<tr>
<td>mmgr</td>
<td>SGSN Master Manager</td>
<td>Created upon provisioning of SS7RDs/SCCP-NWs/etc. The Session Controller provides the initial system configuration which includes a detailed description of each distributed protocol layer, its resources sets, and a list of its service user protocol layers and service provider protocol layers. Runs as a single instance. Handles nodal SS7, Iu, and Gb functionality. Implements master linkmgr functionality for SS7 route status aggregation. Implements master linkmgr functionality for RNC and BSC status aggregation. With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active demux packet processing card.</td>
</tr>
<tr>
<td>mmedemux</td>
<td>Mobility Management Entity Demux Manager</td>
<td>Started as part of MME service creation procedure. There is only one mmedemux in the chassis. Distributes incoming S1-MME SCTP connections to mmemgr tasks in the system. Remains aware of all the active MME services in the system. With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active packet processing card.</td>
</tr>
<tr>
<td>mmemgr</td>
<td>Mobility Management Entity Manager</td>
<td>Starts when an MME service configuration is detected. There can be multiple instances of this task for load sharing. All mmemgrs will have all the Active MME Services configured and will be identical in configuration and capabilities. Runs the SCTP protocol stack. Handles the SCTP associations.</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Function</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| pcdemux  | Policy and Charging Control Bindmux Manager | Started as part of PCC service creation procedure. There is only one instance of BindMux MGR in the chassis.  
Handles multiplexing of the sessions across the available pccmgrs along with the session binding functions.  
Monitors load on pccmgrs.  
Distributes incoming IP-CAN connections across pccmgrs in the system.  
Performs session binding; binds IP-CAN/Gateway session with the AF-Session.  
Ensures all messaging for an IMSI across various interfaces is directed towards the selected pccmgr.  
Remains aware of all the active PCC services in the system.  
With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active packet processing card. |
| pccmgr   | Policy and Charging Control Bindmux Manager | pccmgr is part of a Session Manager instance.  
Handles all PCRF service sessions.  
Interfaces with PCC-Core while processing different events associated with individual subscriber sessions.  
Maintains subscriber information while applying business logic.  
Creates calline and corresponding APN session for each subscriber. |
| sgt_pcmgr| SGSN GPRS Tunneling Protocol Control message Manager | Created by the Session Controller for each VPN context in which an SGSN service is configured.  
Terminates Gn/Gp and GTP-U interfaces from peer GGSNs and SGSNs for SGSN Services.  
Terminates GTP-U interfaces from RNCs for IuPS Services.  
Controls standard ports for GTP-C and GTP-U.  
Processes and distributes GTP-traffic received from peers on these ports.  
Performs all node level procedures associated with Gn/Gp interface.  
With session recovery (SR) enabled, this demux manager is usually established on one of the CPUs on the first active demux packet processing card. |
**Task** | **Description** | **Function**
---|---|---
**srb** | Standard Routing Database | Eight srb tasks are created by the Session Controller when Content Filtering in the Enhanced Charging Service is enabled. A minimum of two packet processing cards are required to initiate these eight tasks.

Receives the static database from the session controller. Each srb task loads two database volumes (one primary and one secondary). The srb task also stores the static DB.

Rates and categorizes the URL based on the DB volumes and CSI (Category Set Index) stored on it.

Performs peer loading in case its peer fails. If both the srb task and its peer fail, the session controller performs the loading.

---

**Platform Processes**

**Table 48. Platform Process Tasks**

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>afctrl</td>
<td>ASR 5500 Fabric Controller</td>
<td>Responsible for the overall management of the system fabric. Manages the pool of Rendezvous Destinations and coordinates fabric recovery by the afmgr proclets after a fault. A single afctrl instance runs on the active MIO/UMIO only.</td>
</tr>
<tr>
<td>afmgr</td>
<td>ASR 5500 Fabric Manager</td>
<td>Responsible for the management of fabric resources on a particular card. There is one afmgr on every CPU that is responsible for one or more fabric access processors (FAPs) or fabric elements (FES). afmgr supports recovery but not migration.</td>
</tr>
<tr>
<td>afio</td>
<td>ASR 5500 Fabric I/O Driver</td>
<td>Responsible for the direct configuration of the fabric chipset. afio supports non-messenger interprocess communication (IPC) with the local afmgr and with other local afio instances.</td>
</tr>
<tr>
<td>connproxy</td>
<td>TCP/SCTP Connection proxy</td>
<td>Allows applications on any card to share the same TCP/SCTP connection to the same remote endpoint instead of opening a new connection for each application on the card.</td>
</tr>
<tr>
<td>cspctrl</td>
<td>Card-Slot-Port Controller</td>
<td>Manages physical chassis components.</td>
</tr>
</tbody>
</table>
| cssctrl | Content Server Selection (CSS) Controller | Maintains all global CSS properties which include a list of CSS servers that can be bound to a service in a context.

CSS defines how traffic will be handled based on the “content” of the data presented by or sent to a mobile subscriber. CSS encompasses features such as load balancing, NAT, HTTP redirection, DNS redirection.

The content server (services) can be either external to the platform or integrated within the platform. External CSS servers are configured via the Context Configuration mode `css server` command.

The CSS Controller does not create CSS Managers. CSS Managers are stopped and started by VPN Managers. A CSS Manager is automatically created for each context.
<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>cssmgr</td>
<td>Content Server Selection (CSS) Manager</td>
<td>Spawned by the VPN Manager within a StarOS context. Manages the keepalives to a CSS server within the specific VPN context. Fetches the CSS related information for a subscriber. If a CSS server goes down, the cssmgr task reprograms the NPUs to by-pass the service or redistribute the data among the rest of the servers in the service.</td>
</tr>
<tr>
<td>dcardctrl</td>
<td>Daughter Card Controller [ASR 5x00 only]</td>
<td>Spawns daughter card managers during system initialization and monitors daughter card managers during system steady state execution. It also spawns daughter card managers whenever a daughter card manager task fails.</td>
</tr>
<tr>
<td>dcardmgr</td>
<td>Daughter Card Manager [ASR 5x00 only]</td>
<td>Responsible for managing IPSec Security Associations for AH- and ESP-based sessions. Interfaces with the on-board hardware accelerated cryptographic chip which executes cryptographic algorithms associated with the given IPSec Security Associations.</td>
</tr>
<tr>
<td>dhmgr</td>
<td>Distributed Host Manager</td>
<td>Started automatically on each CPU by SITPARENT. Coordinates establishment of locally terminated TCP, SCTP, and UDP connections on behalf of multi-instanced tasks such as Diameter endpoints among sessmgr tasks.</td>
</tr>
<tr>
<td>drvctrl</td>
<td>Driver Controller</td>
<td>Centralizes access to many of the system device drivers. It also performs temperature and voltage monitoring.</td>
</tr>
<tr>
<td>hdctrl</td>
<td>Hard Drive Controller</td>
<td>Controls and manages the drive array spanning the management cards.</td>
</tr>
<tr>
<td>hwctrl</td>
<td>Hardware Controller</td>
<td>The hwctrl task has several timers that manage polling loops for hardware sensor readings, sensor threshold monitoring, and fan tray monitoring.</td>
</tr>
<tr>
<td>hwmgr</td>
<td>Hardware Manager</td>
<td>The hwmgr task runs on all cards in the chassis to read local accessible hardware sensors and report them back to the hwctrl.</td>
</tr>
<tr>
<td>inetd</td>
<td>InterNET Service Daemon</td>
<td>The subsystem responsible for starting most of the network services. Listens for requests from connecting clients, such as FTP, SFTP, and telnet. When a TCP packet or UDP packet arrives with a particular destination port number, inetd launches the appropriate server program to handle the connection.</td>
</tr>
<tr>
<td>ipsecctrl</td>
<td>IPSec Controller</td>
<td>Started by SIT on system startup regardless of configuration. Starts ipsecmgr tasks based on configuration and maintains its list for task recovery. Receives and maintains user configuration for IPSec. Manages the configured IPSec crypto maps and its assignment to ipsecmgrs. Interfaces with the vpnmgr task for required IPSec configuration parameters such as IP Access Lists, IP pools, interface addresses, and interface state notifications.</td>
</tr>
<tr>
<td>ipsecmgr</td>
<td>IPSec Manager</td>
<td>Created by the Session Controller, establishes and manages secure IKEv1, IKEv2 and IPSec data tunnels.</td>
</tr>
<tr>
<td>kvctrl</td>
<td>Key Value Controller</td>
<td>Central key value store (kvstore) function that runs on the management card. Its primary function is to support recovery and distribution functions.</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Function</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>lagmgr</td>
<td>Link Aggregation Group Manager [ASR 5x00 only]</td>
<td>Started by npucrtl on the demux card's primary CPU (ASR 5000) or MIO (ASR 5500) with a facility level between CSP and npumgr to receive configuration/status notification from npumgr and build global LAG database. Exchanges control packets (LACP and Marker) over configured physical ports with peers to reach agreement on an aggregation of links.</td>
</tr>
<tr>
<td>msgd</td>
<td>Messenger Daemon</td>
<td>Implements the Name Service and related functions for the internal message passing system.</td>
</tr>
<tr>
<td>msgproxy</td>
<td>Message Proxy</td>
<td>The Messenger Proxy process handles broadcast messages send from any single application (referred to as a client) to any facility which has one instance per thread (referred to as the Target Facility). One msgproxy task runs on each CPU complex on the SMC (ASR 5000), DPCs (ASR 5500) and SF Virtual Machine (VPC-DI). Processes incoming broadcast messages from the Client processes, such as sessctrl, distributes them to the correct Target Facility, such as sessmgr, creates the correct responses and sends them back to the correct Client.</td>
</tr>
<tr>
<td>nscontrol</td>
<td>Name Service Controller</td>
<td>As part of the Messenger process, provides a reliable channel for tasks to send control messages to the Messenger Daemon.</td>
</tr>
<tr>
<td>ntpd</td>
<td>Network Time Protocol (NTP) Daemon</td>
<td>Maintains the system time in synchronization with time servers using NTP. Enabled when one or more NTP servers have been configured via the NTP Configuration mode ntp server CLI command.</td>
</tr>
<tr>
<td>rct</td>
<td>Recovery Control Task</td>
<td>Monitors tasks/managers/facilities across the system and performs recovery in the event of a failure.</td>
</tr>
<tr>
<td>sct</td>
<td>Shared Configuration Task</td>
<td>Performs the redundant storage of configuration information and other state information in an in-memory database.</td>
</tr>
<tr>
<td>sft</td>
<td>Switch Fabric Task</td>
<td>Monitors the switch fabric and the gigabit Ethernet control plane.</td>
</tr>
<tr>
<td>sshd</td>
<td>Secure SHell Daemon</td>
<td>Supports secure login to the StarOS CLI. Enabled via the Context Configuration mode server sshd CLI command.</td>
</tr>
<tr>
<td>ucm</td>
<td>Utilities Configuration Manager</td>
<td>DHCPCD, DNS, FTPD, INETD, NTPD, PING, RLOGIN, SFTP, SFTP-SERVER, SNMPD, SSH, SSHD, TELNET, TELNETD, TFTP, TRACEROUTE</td>
</tr>
</tbody>
</table>
## Management Processes

Table 49. Management Process Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>bulkstat</td>
<td>Bulk Statistics Manager</td>
<td>Periodically polls and gathers bulk statistics and transfers this data to external management systems.</td>
</tr>
<tr>
<td>evlogd</td>
<td>Event Log Daemon</td>
<td>Handles event logging functions including the interface to external syslogd servers and the internal event logs.</td>
</tr>
<tr>
<td>orbs</td>
<td>ORBEM Service [ASR 5x00 only]</td>
<td>The orbs task is also known as the ORB Element Manager (ORBEM). An Element Management System (EMS) requests orbs to perform Element Management Functions on the system using secure IIOP. ORBS then interacts with concerned Controller Tasks to execute the function. The response/errors from the execution are interpreted, formulated into an EMF response, and handed off to EMS servers.</td>
</tr>
<tr>
<td>orbns</td>
<td>ORBEM Notification Service [ASR 5x00 only]</td>
<td>Notifies the EMS servers of event occurrences. Registers such EMS servers and subscribes them to associated event types. As the events occur, the concerned Controller Task notifies orbs (ORBEM), which then notifies the subscribing EMS servers.</td>
</tr>
<tr>
<td>sesstrc</td>
<td>Session Trace Collection Task</td>
<td>Implements the standards-based session trace functionality. Manages both CLI and signaling-based subscriber traces. It collects messages to be traced and generates trace files as needed. It uploads trace files to the Trace Collection Entity as needed.</td>
</tr>
<tr>
<td>snmp</td>
<td>Simple Network Management Protocol</td>
<td>Handles inboard SNMP operations if configured, and sends SNMP notifications (traps) if enabled.</td>
</tr>
<tr>
<td>threshold</td>
<td>Threshold Server</td>
<td>Handles monitoring of threshold crossing alerts, if configured. Polls the needed statistics/variables, maintains state, and generates log messages/SNMP notification of threshold crossings.</td>
</tr>
</tbody>
</table>
Appendix C
ICSR Checkpointing

This appendix lists and describes macro- and micro-checkpoints employed by the Interchassis Session Recovery framework. Checkpoints are exchanged between the active and standby ICSR chassis via the Service Redundancy Protocol (SRP).

The following topics are discussed:

- Overview of Checkpointing
- Macro-checkpoints
- Micro-checkpoints
Overview of Checkpointing

Interchassis Session Recovery (ICSR) provides a framework for sessmgr instance-level checkpointing within an ICSR framework. A checkpoint is a snapshot of the status of an application. Checkpointing can be used by sessmgr to push instance level information to the peer chassis.

Instance-level checkpointing sends messages to specific sessmgr instances. Each application, such as GGSN, PDSN, P-GW, S-GW or SGSN, is responsibility for encoding and decoding the checkpoint message. The ICSR framework provides the APIs for transport of the instance-level checkpoint information and associated statistics.

Macro-checkpoints contain full session information and micro-checkpoints contain only a few variables. Macro-checkpoints are sent initially from the active chassis to the standby chassis on power up and reload, and periodically thereafter. When a standby chassis receives macro-checkpoints, it clears any existing CRR (Call Recovery Record) or CLP (Call Line Pointer) related to that session, and creates a new CRR or CLP. Macro-checkpoints are also known as full checkpoints (FCs).

To conserve processing cycles and memory, dynamic and periodic updates from an active chassis to a standby chassis are done using micro-checkpoints.

The output of the Exec mode `show srp info` command displays a complete list of SRP checkpoints.
Macro-checkpoints

This section lists and briefly describes ICSR macro-checkpoints.

**GGSN_APN ID MAPPING**

This macro-checkpoint is sent from the active to the standby chassis to map APN names on the standby chassis.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs whenever a TCP connection is established between the sessmgrs and they move to READY_STATE.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **Related CLI command:** `show session subsystem facility sessmgr instance <instance no> debug-info` and `show srp micro-checkpoint statistics`

**INSTANCE LEVEL CHECKPOINT**

This macro-checkpoint is generated by ECS (Enhanced Charging System) to send new rules to the standby chassis. It is also used by ECS to delete or modify a rule on the standby chassis.

- **Time based:** Yes
- **Frequency:** 30 minutes
- **Event based:** Yes
- **Events:** Occurs:
  1. When a new rule is added or deleted on the active chassis.
  2. Every 30 minutes if the ECS is registered for periodic micro-checkpointing.
- **Accounting:** —
- **Delta/Cumulative:** —
- **Related CLI command:** `show session subsystem facility sessmgr instance <instance no> debug-info` and `show srp micro-checkpoint statistics`
SERVICE_ID MAPPING

This macro-checkpoint is sent from the active to the standby chassis to map Service IDs on the standby chassis.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs whenever a TCP connection is established between the sessmgrs and they move to READY_STATE.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **Related CLI command:** show session subsystem facility sessmgr instance <instance no> debug-info

VPNMGID MAPPING

This macro-checkpoint is sent from the active to the standby chassis to map VPNs on the standby chassis.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs whenever a TCP connection is established between the sessmgrs and they move to READY_STATE.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **Related CLI command:** show session subsystem facility sessmgr instance <instance no> debug-info
Micro-checkpoints

This section lists and briefly describes the characteristics of micro-checkpoints by application category. Micro-checkpoints are listed in alphabetical order under the following categories:

- Uncategorized
- DCCA Category
- ECS Category
- ePDG Category
- Firewall/ECS Category
- GGSN Category
- Gx Interface Category
- NAT Category
- PGW Category
- Rf Interface Category
- S6b Interface Category
- SaMOG Category

Uncategorized

SESS_UCHKPT_CMD_INVALIDATE_CRR

This micro-checkpoint is sent to the standby chassis to clear a deleted call. It carries the Call ID and other information that must be deleted on the standby chassis.

- Time based: No
- Frequency: N/A
- Event based: Yes
- Events: Occurs when a call is deleted on the active chassis.
- Accounting: No
- Delta/Cumulative: N/A
- CMD-ID: 1
- Related CLI command: None
**SESS_UCKKPT_CMD_UPDATE_CLPSTATS**

This micro-checkpoint sends VoLTE data statistics.

- **Time based:** Yes
- **Frequency:** —
- **Event based:** Yes
- **Events:** Occurs during ICSR background checkpointing. A chassis switchover triggers the sending of VoLTE data stats.
- **Accounting:** —
- **Delta/Cumulative:** —
- **CMD-ID:** 4
- **Related CLI command:** None

**SESS_UCHKPT_CMD_UPDATE_IDLESECS**

This micro-checkpoint sends remaining number of seconds before idle timeout.

- **Time based:** Yes
- **Frequency:** —
- **Event based:** No
- **Events:** Occurs during ICSR background checkpointing.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 2
- **Related CLI command:** None

**DCCA Category**

**SESS_UCHKPT_CMD_DCCA_SESS_INFO**

This micro-checkpoint sends Credit Control (CC) related information.

- **Time based:** Yes
- **Frequency:** 18 seconds for GR micro-checkpoint
- **Event based:** Yes
- **Events:** Sent along with the macro-checkpoint/CCA/Assume-positive-state-transitions.
- **Accounting:** Yes
- **Delta/Cumulative:** Cumulative
- **CMD-ID:** 19
- Related CLI command: None

ECS Category

SESS_UCHKPT_CMD_ACS_CALL_INFO

This micro-checkpoint sends critical ECS call level data.
- Time based: Yes
- Frequency: —
- Event based: Yes
- Events: Occurs whenever ECS call level information is created or modified.
- Accounting: No
- Delta/Cumulative: N/A
- CMD-ID: 179
- Related CLI command: None

SESS_UCHKPT_CMD_ACS_GX_LI_INFO

This micro-checkpoint sources lawful intercept (LI) related information maintained by ECS.
- Time based: Yes
- Frequency: —
- Event based: Yes
- Events: Occurs whenever LI information is created or modified.
- Accounting: No
- Delta/Cumulative: N/A
- CMD-ID: 75
- Related CLI command: None

SESS_UCHKPT_CMD_ACS_SESS_INFO

This micro-checkpoint sends ECS-level bearer-related data
- Time based: Yes
- Frequency: —
- Event based: Yes
- Events: Occurs whenever ECS bearer information is created or modified.
- Accounting: No
- Delta/Cumulative: N/A
- **CMD-ID**: 33
- **Related CLI command**: None

**SESS_UCHKPT_CMD_DEL_ACS_CALL_INFO**

This micro-checkpoint notifies that a Release Call event has occurred.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: Occurs whenever an ECS Release Call message is processed.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 188
- **Related CLI command**: —

**SESS_UCHKPT_CMD_DEL_ACS_SESS_INFO**

This micro-checkpoint notifies that a Release Bearer event has occurred.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: Occurs whenever an ECS Release Bearer message is processed.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 187
- **Related CLI command**: None

**SESS_UCHKPT_CMD_DYNAMIC_CHRG_CA_INFO**

This micro-checkpoint sends dynamic charging action information maintained by ECS.

- **Time based**: Yes
- **Frequency**: —
- **Event based**: Yes
- **Events**: Occurs whenever dynamic charging action information is created or modified.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 141
• Related CLI command: None

SESS_UCHKPT_CMD_DYNAMIC_CHRG_DEL_CA_INFO

This micro-checkpoint notifies that a dynamic charging action has been deleted.

• Time based: No
• Frequency: N/A
• Event based: Yes
• Events: Occurs whenever a dynamic charging action has been deleted.
• Accounting: No
• Delta/Cumulative: N/A
• CMD-ID: 183
• Related CLI command: None

SESS_UCHKPT_CMD_DYNAMIC_CHRG_DEL_QG_INFO

This micro-checkpoint notifies that a dynamic QoS group has been deleted.

• Time based: No
• Frequency: N/A
• Event based: Yes
• Events: Occurs whenever a dynamic QoS group has been deleted.
• Accounting: No
• Delta/Cumulative: N/A
• CMD-ID: 182
• Related CLI command: None

SESS_UCHKPT_CMD_DYNAMIC_CHRG_QG_INFO

This micro-checkpoint sends dynamic QoS group related information maintained by ECS.

• Time based: Yes
• Frequency: —
• Event based: Yes
• Events: Occurs whenever dynamic QoS group information is created or modified.
• Accounting: No
• Delta/Cumulative: N/A
• CMD-ID: 140
• Related CLI command: None
SESS_UCHKPT_CMD_DYNAMIC_RULE_DEL_INFO

This micro-checkpoint notifies that a dynamic rule has been deleted.

- **Time based**: No
- **Frequency**: —
- **Event based**: Yes
- **Events**: Occurs whenever a dynamic rule has been deleted.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 178
- **Related CLI command**: None

SESS_UCHKPT_CMD_DYNAMIC_RULE_INFO

This micro-checkpoint sources predefined and dynamic rule related information maintained by ECS.

- **Time based**: Yes
- **Frequency**: —
- **Event based**: Yes
- **Events**: Occurs whenever a dynamic rule is created or modified.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 43
- **Related CLI command**: None

ePDG Category

SESS_UCHKPT_CMD_DELETE_EPDG_BEARER

This micro-checkpoint synchronizes deleted ePDG bearers between the active and standby chassis.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: N/A
- **Accounting**: Yes
- **Delta/Cumulative**: Cumulative
- **CMD-ID**: 110
- **Related CLI command**: show srp micro-checkpoint statistics debug-info
SESS_UCHKPT_CMD_UPDATE_EPDG_BEARER

This micro-checkpoint synchronizes ePDG bearers between the active and standby chassis.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: No
- **Events**: N/A
- **Accounting**: Yes
- **Delta/Cumulative**: Cumulative
- **CMD-ID**: 110
- **Related CLI command**: show srp micro-checkpoint statistics debug-info

SESS_UCHKPT_CMD_UPDATE_EPDG_PEER_ADDR

This micro-checkpoint synchronizes ePDG peer addresses between the active and standby chassis.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: —
- **Accounting**: Yes
- **Delta/Cumulative**: Cumulative
- **CMD-ID**: 110
- **Related CLI command**: show srp micro-checkpoint statistics debug-info

SESS_UCHKPT_CMD_UPDATE_EPDG_REKEY

This micro-checkpoint synchronizes ePDG rekey statistics between the active and standby chassis.

- **Time based**: Yes
- **Frequency**: 30 seconds
- **Event based**: No
- **Events**: N/A
- **Accounting**: Yes
- **Delta/Cumulative**: Cumulative
- **CMD-ID**: 110
- **Related CLI command**: show srp micro-checkpoint statistics debug-info
SESS_UCHKPT_CMD_UPDATE_EPDPG_STATS

This micro-checkpoint synchronizes session statistics between the active and standby chassis.

- **Time based**: Yes
- **Frequency**: 30 seconds
- **Event based**: No
- **Events**: N/A
- **Accounting**: Yes
- **Delta/Cumulative**: Cumulative
- **CMD-ID**: 110
- **Related CLI command**: show srp micro-checkpoint statistics debug-info

Firewall/ECS Category

SESS_UCHKPT_CMD_SFW_DEL_RULE_INFO

This micro-checkpoint is sent when a ruledef is deleted for a bearer.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: Occurs whenever PCRF sends a command to disable the predefined stateful firewall access rules.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 186
- **Related CLI command**: None

SESS_UCHKPT_CMD_SFW_RULE_INFO

This micro-checkpoint notifies the addition of dynamically enabled stateful firewall (SFW) access rules.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: Occurs whenever PCRF sends a command to enable the predefined SFW access rules.
- **Accounting**: Yes
- **Delta/Cumulative**: Cumulative
- **CMD-ID**: 185
- **Related CLI command**: None
GGSN Category

**SESS_UCHKPT_CMD_GGSN_DELETE_SUB_SESS**

This micro-checkpoint sends an update when a secondary bearer is deleted.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs upon secondary bearer deletion
- **Accounting:** —
- **Delta/Cumulative:** —
- **CMD-ID:** 117
- **Related CLI command:** None

**SESS_UCHKPT_CMD_GGSN_UPDATE_RPR**

If RPR (Resilient Packet Ring) is configured in the GGSN service, an RPR timer is started during secondary bearer creation. This checkpoint is sent upon expiry of this timer.

- **Time based:** Yes
- **Frequency:** RPR timer
- **Event based:** Yes
- **Events:** Occurs when the secondary bearer creation RPR timer expires.
- **Accounting:** —
- **Delta/Cumulative:** —
- **CMD-ID:** 118
- **Related CLI command:** —

**SESS_UCHKPT_CMD_GGSN_UPDATE_SESSION**

This micro-checkpoint is sent in a Network or UE initiated update procedure except for updates that result in the following scenarios:

- Creation or deletion of the bearer
- TFT change or inter-RAT handovers
- Gn-Gp handoff

Parameters associated with this micro-checkpoint are shown below.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
• **Events:** Occurs for a network initiated or UE initiated update.
• **Accounting:** No
• **Delta/Cumulative:** N/A
• **CMD-ID:** 171
• **Related CLI command:** show srp checkpoint statistics active verbose, and show session subsystem facility sessmgr instance <instance_number> debug-info.

**SESS_UCHKPT_CMD_GGSN_UPDATE_STATS**

This micro-checkpoint periodically sends session statistics.

• **Time based:** Yes
• **Frequency:** Every five minutes
• **Event based:** No
• **Events:** N/A
• **Accounting:** Yes
• **Delta/Cumulative:** Cumulative
• **CMD-ID:** 116
• **Related CLI command:** None

**SESS_UCHKPT_CMD_UPDATE_COA_PARAMS**

This micro-checkpoint updates input and output ACL parameters.

• **Time based:** —
• **Frequency:** —
• **Event based:** Yes
• **Events:** COA (Change of Authorization) response
• **Accounting:** —
• **Delta/Cumulative:** —
• **CMD-ID:** 83
• **Related CLI command:** None
Gx Interface Category

SESS_UCHKPT_CMD_ACS_VOLUME_USAGE
This micro-checkpoint sends volume usage over Gx accounting buckets.

- **Time based:** Yes
- **Frequency:** 4 seconds for aamgr micro-checkpoint and 18 seconds for GR micro-checkpoint
- **Event based:** No
- **Events:** Send along with macro-checkpoint
- **Accounting:** Yes
- **Delta/Cumulative:** Cumulative
- **CMD-ID:** 79
- **Related CLI command:** —None

SESS_UCHKPT_CMD_UPDATE_SGX_INFO
This micro-checkpoint sends Gx session-related information.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Triggered on receiving CCA-I/U or RAR from PCRF.
- **Accounting:** Yes
- **Delta/Cumulative:** Cumulative
- **CMD-ID:** 137
- **Related CLI command:** None
NAT Category

SESS_UCHKPT_CMD_GR_UPDATE_NAT_REALM_PORT_INFO1

This micro-checkpoint is sent when a port chunk is allocated or deallocated for a subscriber sharing a NAT IP address with other subscribers. The port chunk is allocated or deallocated while data is being received for that subscriber.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Triggered when a new NAT port chunk is allocated or deleted.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 105
- **Related CLI command:** None

SESS_UCHKPT_CMD_GR_UPDATE_NAT_REALMS

This micro-checkpoint is sent when a NAT IP address is allocated to or deallocated from a subscriber.

For an on-demand case, it is triggered when the first packet matching a particular NAT realm is received and the NAT IP address is allocated to the subscriber.

If this is not an on-demand case, the NAT IP address is allocated during call setup and this micro-checkpoint is sent.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Triggered when a NAT IP address is allocated to or deallocated from a subscriber.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 45
- **Related CLI command:** None
SESS_UCHKPT_CMD_NAT_SIP_ALG_CALL_INFO
This micro-checkpoint is sent when a new SIP flow is created or deleted for a subscriber (while SIP data is being passed via the subscriber).

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Triggered when a new SIP flow is created or deleted.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 98
- **Related CLI command:** None

SESS_UCHKPT_CMD_NAT_SIP_ALG_CONTACT_PH_INFO
This micro-checkpoint is sent when a received SIP packet is analyzed and pinholes are created in the NAT firewall.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Triggered when a SIP packet creates pinholes in the NAT firewall.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 97
- **Related CLI command:** None

SESS_UCHKPT_CMD_UPDATE_DSK_FLOW_CHKPT_INFO
This micro-checkpoint is sent when a new NAT flow is created or deleted for a subscriber (while data is being passed via the subscriber).

This checkpoint is sent from a timer but it is not timer based. The timer is used to pace (10 micro-checkpoints) whenever the timer fires (granularity = 2 sec). This only occurs if there are new flows that need to be micro-checkpointed. Otherwise, no micro-micro-checkpoints are sent.

- **Time based:** No
- **Frequency:** See explanation above.
- **Event based:** Yes
- **Events:** Triggered when a new NAT flow is created or deleted.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- CMD-ID: 96
- Related CLI command: None

**SESS_UCHKPT_CMD_UPDATE_NAT_BYPASS_FLOW_INFO**

This micro-checkpoint is sent when NAT is enabled for a subscriber but bypass-nat (no NATing) is configured for this flow (based on a rule-match), and a new bypass flow is created.

This checkpoint is sent when the flow is both added and deleted.

- Time based: No
- Frequency: N/A
- Event based: Yes
- Events: Triggered when a new flow with bypass-nat enabled is created or deleted.
- Accounting: No
- Delta/Cumulative: N/A
- CMD-ID: 60
- Related CLI command: None

**P-GW Category**

**SESS_UCHKPT_CMD_PGW_DELETE_SUB_SESS**

Reserved for future use.

**SESS_UCHKPT_CMD_PGW_OVRCHRG_PRTCTN_INFO**

This micro-checkpoint indicates that the S-GW has set the Overcharging Protection bit in the MBR.

- Time based: No
- Frequency: N/A
- Event based: Yes
- Events: Triggered when the S-GW sets the Over Charging Protection Bit.
- Accounting: No
- Delta/Cumulative: N/A
- CMD-ID: 159
- Related CLI command: None
SESS_UCHKPT_CMD_PGW_SGWRESTORATION_INFO

This micro-checkpoint indicates the interval that a call will remain up when the S-GW is down.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Triggered when the S-GW goes into Restoration mode.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 158
- **Related CLI command:** None

SESS_UCHKPT_CMD_PGW_UBR_MBR_INFO

This micro-checkpoint is sent at the end of a UBR (Update Bearer Request) or MBR (Modify Bearer Request) except when the UBR / MBR procedure results in the following scenarios:

- TFT change
- Bearer update or modification for a collapsed call
- Pure P to collapsed or collapsed to Pure P change
- Inter-technology handoff, for example, WiFi to LTE

Parameters associated with this micro-checkpoint are shown below.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs as a result of a UBR or MBR procedure.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 193
- **Related CLI command:** show srp checkpoint statistics active verbose and show session subsystem facility sessmgr instance <instance_number> debug-info.

SESS_UCHKPT_CMD_PGW_UPDATE_APN_AMBR

Reserved for future use.

SESS_UCHKPT_CMD_PGW_UPDATE_INFO

Reserved for future use.
SESS_UCHKPT_CMD_PGW_UPDATE_LI_PARAM

This micro-checkpoint indicates the state of Lawful Intercept (LI) for this call.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Triggered when there is a change in the LI state for this call.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 151
- **Related CLI command:** None

SESS_UCHKPT_CMD_PGW_UPDATE_PDN_COMMON_PARAM

Reserved for future use.

SESS_UCHKPT_CMD_PGW_UPDATE_QOS

Reserved for future use.

SESS_UCHKPT_CMD_PGW_UPDATE_SGW_CHAN

Reserved for future use.

SESS_UCHKPT_CMD_PGW_UPDATE_STATS

This micro-checkpoint periodically sends session statistics.

- **Time based:** Yes
- **Frequency:** Every five minutes
- **Event based:** No
- **Events:** N/A
- **Accounting:** Yes
- **Delta/Cumulative:** Cumulative
- **CMD-ID:** 65
- **Related CLI command:** None
Rf Interface Category

SESS_UCHKPT_CMD_ACS_ACCOUNTING_TYPE_QCI_RF

This micro-checkpoint indicates a change in the SDF+QCI-based Rf accounting buckets.
- **Time based:** Yes
- **Frequency:** 4 seconds for aamgr checkpoint and 18 seconds for GR checkpoint
- **Event based:** No
- **Events:** N/A
- **Accounting:** Yes
- **Delta/Cumulative:** Cumulative
- **CMD-ID:** 126
- **Related CLI command:** None

SESS_UCHKPT_CMD_ACS_ACCOUNTING_TYPE_QCI_RF_WITH_FC

This micro-checkpoint indicates complete SDF+QCI-based Rf accounting buckets.
- **Time based:** Yes
- **Frequency:** 4 seconds for aamgr checkpoint and 18 seconds for GR checkpoint
- **Event based:** No
- **Events:** Sent along with macro-checkpoint.
- **Accounting:** Yes
- **Delta/Cumulative:** Cumulative
- **CMD-ID:** 164
- **Related CLI command:** None

SESS_UCHKPT_CMD_ACS_ACCOUNTING_TYPE_RATING_GROUP_RF

This micro-checkpoint indicates a change in the SDF-based Rf accounting buckets.
- **Time based:** Yes
- **Frequency:** 4 seconds for aamgr checkpoint and 18 seconds for GR checkpoint
- **Event based:** No
- **Events:** N/A
- **Accounting:** Yes
- **Delta/Cumulative:** Cumulative
- **CMD-ID:** 125
- **Related CLI command:** None
SESS_UCHKPT_CMD_ACS_ACCOUNTING_TYPE_RATING_GROUP_RF_WITH_FC

This micro-checkpoint indicates complete SDF-based Rf accounting buckets.

- **Time based:** Yes
- **Frequency:** 4 seconds for aamgr checkpoint and 18 seconds for GR checkpoint;
- **Event based:** No
- **Events:** Sent along with macro-checkpoint.
- **Accounting:** Yes
- **Delta/Cumulative:** Cumulative
- **CMD-ID:** 163
- **Related CLI command:** None

S6b Interface Category

SESS_UCHKPT_CMD_S6B_INFO

This micro-checkpoint sends the Restoration Priority Indicator when reauthorization occurs over the S6b interface.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs when an Sb6 reauthorization results in a change in value of the Restoration Priority Indicator.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 202
- **Related CLI command:** None
SaMOG Category

SESS_UCHKPT_CMD_CGW_DELETE_BEARER

Reserved for future use.

SESS_UCHKPT_CMD_CGW_DELETE_PDN

This micro-checkpoint indicates a PDN connection has been deleted.

- Time based: No
- Frequency: N/A
- Event based: Yes
- Events: Occurs whenever SaMOG sends a Delete-Session-Req or upon receiving a Delete-Bearer-Request.
- Accounting: No
- Delta/Cumulative: N/A
- CMD-ID: 169
- Related CLI command: show subscriber samog-only full

SESS_UCHKPT_CMD_CGW_UPDATE_BEARER_QOS

This micro-checkpoint indicates a QoS update for the bearer.

- Time based: No
- Frequency: N/A
- Event based: Yes
- Events: Occurs when a change in Bearer QoS is received from the P-GW due to a reauthorization (AAR Received from AAA Server) or Update-Bearer-Request.
- Accounting: No
- Delta/Cumulative: N/A
- CMD-ID: 167
- Related CLI command: show subscriber samog-only full
SESS_UCHKPT_CMD_CGW_UPDATE_PDN

This micro-checkpoint indicates a PDN update for a change in APN-AMBR.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs when a change in APN-AMBR is received from the P-GW due to a reauthorization (AAR Received from AAA Server) or Update-Bearer-Request.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 168
- **Related CLI command:** show subscriber samog-only full

SESS_UCHKPT_CMD_CGW_UPDATE_STATS

Reserved for future use.

SESS_UCHKPT_CMD_CGW_UPDATE_UE_PARAM

Reserved for future use.

SESS_UCHKPT_CMD_SAMOG_ACCT_INTERIM_INFO

This micro-checkpoint is sent for a SaMOG session on receipt of an Accounting Req (INTERIM-UPDATE) from the WLC.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs on receipt of an Accounting Req (INTERIM-UPDATE) from the WLC.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 177
- **Related CLI command:** show subscriber samog-only full
ICSR Checkpointing

Micro-checkpoints

SESS_UCHKPT_CMD_SAMOG_ACCT_START_INFO

This micro-checkpoint is sent for a SaMOG session on receipt of an Accounting Req (START) from the WLC (Wireless LAN Controller).

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: Occurs when a Account Req (START) request is received from the WLC.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 174
- **Related CLI command**: show subscriber samog-only full

SESS_UCHKPT_CMD_SAMOG_EOGRE_TUNNEL_INFO

This micro-checkpoint is sent for an Inter-RG handoff for EoGRE subscriber sessions. This checkpoint updates the VMAC Address and WLC EoGRE tunnel end-point address.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: Occurs whenever a DHCP-Discover message is received over a different EoGRE tunnel.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 201
- **Related CLI command**: show subscriber samog-only full

SESS_UCHKPT_CMD_SAMOG_GTPV1_UPDATE_PDN_INFO

This micro-checkpoint is sent for a SaMOG session upon receipt of an Update-PDP-Context-Req from the GGSN to update the PDN information.

- **Time based**: No
- **Frequency**: N/A
- **Event based**: Yes
- **Events**: Occurs after successful SaMOG processing of an Update-PDP-Context-Req from the GGSN.
- **Accounting**: No
- **Delta/Cumulative**: N/A
- **CMD-ID**: 191
Micro-checkpoints

- Related CLI command: show subscriber samog-only full

**SESS_UCHKPT_CMD_SAMOG_HANDOFF_AUTHEN_INFO**

This micro-checkpoint is sent for a SaMOG session that is Re-authenticating the subscriber while the subscriber session is in Handoff state.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs on completion of Re-Authentication for an existing SaMOG subscriber session currently in Handoff state.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 176
- Related CLI command: show subscriber samog-only full

**SESS_UCHKPT_CMD_SAMOG_HANDOFF_INIT_INFO**

This micro-checkpoint is sent for a SaMOG session on receipt of an Accounting Req (STOP) from the WLC (Wireless LAN Controller).

SaMOG will delay handoff as it expects an Accounting Req (START) from the subscriber.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs when a Account Req (STOP) request is received from the WLC.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- **CMD-ID:** 175
- Related CLI command: show subscriber samog-only full

**SESS_UCHKPT_CMD_SAMOG_LI_PROV_INFO**

This micro-checkpoint is sent for a SaMOG session that is on lawful intercept (LI) Active-Camp-on mode.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs after an LI trigger is received after SaMOG session has been created.
- **Accounting:** No
- **Delta/Cumulative:** N/A
ICSR Checkpointing

Micro-checkpoints

- CMD-ID: 189
- Related CLI command: show subscriber samog-only full

**SESS_UCHKPT_CMD_SAMOG_MIPV6_TIMER_INFO**

This micro-checkpoint updates the Binding Cache Life timer and MIPv6 binding status for a SaMOG session.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs whenever a PMIPv6 PBU is received with a lifetime of zero from the WLC.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- CMD-ID: 190
- Related CLI command: show subscriber samog-only full

**SESS_UCHKPT_CMD_SAMOG_MULTI_ROUND_AUTHEN_INFO**

This micro-checkpoint is sent for a SaMOG session when SaMOG is waiting on the UE after sending an Access-Challenge while Re-authenticating the subscriber session.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs after SaMOG sends an Access-Challenge for an existing SaMOG subscriber session during Re-authentication.
- **Accounting:** No
- **Delta/Cumulative:** N/A
- CMD-ID: 184
- Related CLI command: show subscriber samog-only full

**SESS_UCHKPT_CMD_SAMOG_REAUTHEN_INFO**

This micro-checkpoint is sent for a SaMOG session when subscriber Re-authentication is completed.

- **Time based:** No
- **Frequency:** N/A
- **Event based:** Yes
- **Events:** Occurs on completion of Re-Authentication for an existing SaMOG subscriber session.
- **Accounting:** No
- **Delta/Cumulative:** N/A
• CMD-ID: 172
• Related CLI command: show subscriber samog-only full

**SESS_UCHKPT_CMD_SAMOG_REAUTHOR_INFO**

This micro-checkpoint is sent for a SaMOG session when subscriber Re-authorization is completed.

• **Time based:** No
• **Frequency:** N/A
• **Event based:** Yes
• **Events:** Occurs on receiving and successfully processing AAR from the AAA Server to re-authorize the subscriber
• **Accounting:** No
• **Delta/Cumulative:** N/A
• **CMD-ID:** 173
• Related CLI command: show subscriber samog-only full
This appendix identifies the CLI command strings that can be entered for a record section via the `support record section` command in the Global Configuration Mode. The string must be entered within double quotation marks (" "") to be recognized. The table below also indicates default and non-default strings.

For detailed command string information, refer to the *Command Line Interface Reference* or the online Help for the command.

The table below also indicates default and non-default strings. It reflects the output sequence of the `show support collection definitions` command.

### Table 50. ASR 5500 SDR CLI Command Strings

<table>
<thead>
<tr>
<th>No.</th>
<th>Default SDR</th>
<th>Command String</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Enabled</td>
<td>“show version verbose”</td>
</tr>
<tr>
<td>1</td>
<td>Enabled</td>
<td>“show clock”</td>
</tr>
<tr>
<td>2</td>
<td>Enabled</td>
<td>“show clock universal”</td>
</tr>
<tr>
<td>3</td>
<td>Enabled</td>
<td>“show configuration”</td>
</tr>
<tr>
<td>4</td>
<td>Enabled</td>
<td>“show_profile”</td>
</tr>
<tr>
<td>5</td>
<td>Enabled</td>
<td>“show context”</td>
</tr>
<tr>
<td>6</td>
<td>Enabled</td>
<td>“show boot”</td>
</tr>
<tr>
<td>7</td>
<td>Enabled</td>
<td>“show boot initial-config”</td>
</tr>
<tr>
<td>8</td>
<td>Enabled</td>
<td>“show system uptime”</td>
</tr>
<tr>
<td>9</td>
<td>Disabled</td>
<td>“show license information”</td>
</tr>
<tr>
<td>10</td>
<td>Disabled</td>
<td>“show license history”</td>
</tr>
<tr>
<td>11</td>
<td>Disabled</td>
<td>“show hardware inventory”</td>
</tr>
<tr>
<td>12</td>
<td>Disabled</td>
<td>“show hardware version”</td>
</tr>
<tr>
<td>13</td>
<td>Disabled</td>
<td>“show card hardware”</td>
</tr>
<tr>
<td>14</td>
<td>Disabled</td>
<td>“show card dhaccel hardware counters”</td>
</tr>
<tr>
<td>15</td>
<td>Enabled</td>
<td>“show hd raid verbose”</td>
</tr>
<tr>
<td>16</td>
<td>Enabled</td>
<td>“debug hdctrl mdstat”</td>
</tr>
<tr>
<td>17</td>
<td>Enabled</td>
<td>“debug hdctrl history”</td>
</tr>
<tr>
<td>18</td>
<td>Disabled</td>
<td>“debug hdctrl Issas”</td>
</tr>
<tr>
<td>19</td>
<td>Disabled</td>
<td>“debug hdctrl mapping”</td>
</tr>
<tr>
<td>20</td>
<td>Enabled</td>
<td>“show hd iocnt all”</td>
</tr>
<tr>
<td>No.</td>
<td>Default SDR</td>
<td>Command String</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>21</td>
<td>Disabled</td>
<td>“show hd logs all”</td>
</tr>
<tr>
<td>22</td>
<td>Enabled</td>
<td>“show hd smart all”</td>
</tr>
<tr>
<td>23</td>
<td>Enabled</td>
<td>“debug hdctrl state”</td>
</tr>
<tr>
<td>24</td>
<td>Enabled</td>
<td>“debug hdctrl client list”</td>
</tr>
<tr>
<td>25</td>
<td>Disabled</td>
<td>“show card info”</td>
</tr>
<tr>
<td>26</td>
<td>Enabled</td>
<td>“show card diag”</td>
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<tr>
<td>27</td>
<td>Enabled</td>
<td>“show card table all”</td>
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<tr>
<td>28</td>
<td>Enabled</td>
<td>“show port table all”</td>
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<tr>
<td>29</td>
<td>Enabled</td>
<td>“show port info”</td>
</tr>
<tr>
<td>30</td>
<td>Enabled</td>
<td>“show port utilization table”</td>
</tr>
<tr>
<td>31</td>
<td>Enabled</td>
<td>“show data-path congestion”</td>
</tr>
<tr>
<td>32</td>
<td>Disabled</td>
<td>“show npu details”</td>
</tr>
<tr>
<td>33</td>
<td>Disabled</td>
<td>“show lagmgr details”</td>
</tr>
<tr>
<td>34</td>
<td>Enabled</td>
<td>“show fans”</td>
</tr>
<tr>
<td>35</td>
<td>Disabled</td>
<td>“show hardware version fans”</td>
</tr>
<tr>
<td>36</td>
<td>Enabled</td>
<td>“show power chassis”</td>
</tr>
<tr>
<td>37</td>
<td>Enabled</td>
<td>“show temperature”</td>
</tr>
<tr>
<td>38</td>
<td>Disabled</td>
<td>“show timing”</td>
</tr>
<tr>
<td>39</td>
<td>Disabled</td>
<td>“show alarm audible”</td>
</tr>
<tr>
<td>40</td>
<td>Disabled</td>
<td>“show alarm central-office”</td>
</tr>
<tr>
<td>41</td>
<td>Disabled</td>
<td>“show alarm outstanding”</td>
</tr>
<tr>
<td>42</td>
<td>Disabled</td>
<td>“show alarm statistics”</td>
</tr>
<tr>
<td>43</td>
<td>Enabled</td>
<td>“show cpu table”</td>
</tr>
<tr>
<td>44</td>
<td>Disabled</td>
<td>“show cpu info verbose”</td>
</tr>
<tr>
<td>45</td>
<td>Enabled</td>
<td>“show cpu errors verbose”</td>
</tr>
<tr>
<td>46</td>
<td>Enabled</td>
<td>“show cpu performance verbose”</td>
</tr>
<tr>
<td>47</td>
<td>Disabled</td>
<td>“show resources”</td>
</tr>
<tr>
<td>48</td>
<td>Disabled</td>
<td>“show task table”</td>
</tr>
<tr>
<td>49</td>
<td>Disabled</td>
<td>“show task memory”</td>
</tr>
<tr>
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- Enabled = Included in default record section
- Disabled = Not included in default record section