Contents

Restarting Control Center 5
Restarting Services on Policy Director (lb01 and lb02) 5
Recovering After a Power Outage 6
Recovery Control 6
  Cluster State Monitoring 7
  Controlled Startup 7
Switching Active and Standby Policy Directors 8
  Determining the Active Policy Director 8
  Switching Standby and Active Policy Directors 9
Backing Up and Restoring 9
Adding or Replacing Hardware 9
Export and Import Service Configurations 10

CHAPTER 2

Managing CPS Disks 13
Adding a New Disk 13
  Prerequisites 13
  ESX Server Configuration 13
  Target VM Configuration 14
    Update the collectd process to use the new file system to store KPIs 14
Mounting the Replication Set from Disk to tmpfs After Deployment 15
  Scenario 1 – Mounting All Members of the Replication Set to tmpfs 15
  Scenario 2 – Mounting Specific Members of the Replication Set to tmpfs 16
Manage Disks to Accommodate Increased Subscriber Load 16
  Clone Sessionmgr01 VM 17
  Disk Repartitioning of Sessionmgr01 VM 17
  Cloning and Disk Repartitioning of Sessionmgr02 VM 21

CHAPTER 3

Managing CPS Licenses 23
  Smart Software Licensing 23
  Classic Licensing 23
  Comparison between Licensing Models 24
  Smart Accounts/Virtual Accounts 25
    Request a Cisco Smart Account 26
    Cisco Smart Software Manager 26
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publishing Data</td>
<td>57</td>
</tr>
<tr>
<td>Control Center Access</td>
<td>57</td>
</tr>
<tr>
<td>Add a Control Center User</td>
<td>57</td>
</tr>
<tr>
<td>Update Control Center Mapping</td>
<td>58</td>
</tr>
<tr>
<td>Multiple Concurrent User Sessions</td>
<td>59</td>
</tr>
<tr>
<td>Configure Session Limit</td>
<td>60</td>
</tr>
<tr>
<td>Configure Session Timeout</td>
<td>60</td>
</tr>
<tr>
<td>Important Notes</td>
<td>61</td>
</tr>
<tr>
<td>Enabling Authentication and Authorization for CRD API</td>
<td>61</td>
</tr>
<tr>
<td>Unified API Security: Access Privileges</td>
<td>63</td>
</tr>
<tr>
<td>Enable Authentication for Unified API</td>
<td>64</td>
</tr>
<tr>
<td>WSDL and Schema Documentation</td>
<td>65</td>
</tr>
<tr>
<td>Enabling Unified API Access on HTTP Port 8080</td>
<td>65</td>
</tr>
<tr>
<td>TACACS+</td>
<td>68</td>
</tr>
<tr>
<td>Overview</td>
<td>68</td>
</tr>
<tr>
<td>TACACS+ Service Requirements</td>
<td>68</td>
</tr>
<tr>
<td>Caching of TACACS+ Users</td>
<td>69</td>
</tr>
<tr>
<td>Reading Log Files</td>
<td>70</td>
</tr>
<tr>
<td>CRD APIs</td>
<td>71</td>
</tr>
<tr>
<td>Limitations</td>
<td>71</td>
</tr>
<tr>
<td>Setup Requirements</td>
<td>71</td>
</tr>
<tr>
<td>Policy Server</td>
<td>71</td>
</tr>
<tr>
<td>Policy Builder</td>
<td>71</td>
</tr>
<tr>
<td>Architecture</td>
<td>76</td>
</tr>
<tr>
<td>MongoDB</td>
<td>76</td>
</tr>
<tr>
<td>Caching</td>
<td>76</td>
</tr>
<tr>
<td>API Endpoints and Examples</td>
<td>77</td>
</tr>
<tr>
<td>Query API</td>
<td>77</td>
</tr>
<tr>
<td>Create API</td>
<td>78</td>
</tr>
<tr>
<td>Update API</td>
<td>79</td>
</tr>
<tr>
<td>Delete API</td>
<td>79</td>
</tr>
<tr>
<td>Data Comparison API</td>
<td>80</td>
</tr>
<tr>
<td>Table Drop API</td>
<td>81</td>
</tr>
<tr>
<td>Export API</td>
<td>82</td>
</tr>
</tbody>
</table>
CHAPTER 7

Managing High Availability in CPS 133

Porting All-In-One Policy Builder Configuration to HA 133

Prerequisites 133

Porting the Policy Builder Configuration 133

HAProxy 136

HAProxy Service Operations 136

Diagnostics 136

Service Commands 136

HAProxy Statistics 136

Changing HAProxy Log Level 137

Expanding an HA Deployment 137

Typical Scenarios When Expansion is Necessary 138

Hardware Approach to Expanding 138

High Availability Consequences 138

Adding a New Blade 138

Component (VM Node) Approach to Expanding 139

Adding Additional Component 139

Enable SSL 139

CHAPTER 8

CPS Statistics 141

Bulk Statistics Overview 141

Grafana 142

CPS Statistics 142

Overview 142

CPS Statistic Types 144

Diameter Statistics 144

LDAP Statistics 144

System Statistics 144

Engine Statistics 145

MOG API Statistics 145

Error Statistics Definitions 145

Bulk Statistics Collection 146

Retention of CSV Files 147
Contents
Preface

- About this Guide, on page xiii
- Audience, on page xiii
- Additional Support, on page xiii
- Conventions (all documentation), on page xiv
- Obtaining Documentation and Submitting a Service Request, on page xv

About this Guide

This document describes operations, maintenance, and troubleshooting activities for the various VM servers in the Cisco Policy Suite (CPS). It assists system administrators and network engineers to operate and monitor the Policy Server.

Audience

This guide is best used by these readers:

- Network administrators
- Network engineers
- Network operators
- System administrators

This document assumes a general understanding of network architecture, configuration, and operations.

Additional Support

For further documentation and support:

- Contact your Cisco Systems, Inc. technical representative.
- Call the Cisco Systems, Inc. technical support number.
- Write to Cisco Systems, Inc. at support@cisco.com.

Conventions (all documentation)

This document uses the following conventions.

<table>
<thead>
<tr>
<th>Conventions</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bold</strong> font</td>
<td>Commands and keywords and user-entered text appear in <strong>bold</strong> font.</td>
</tr>
<tr>
<td>italic font</td>
<td>Document titles, new or emphasized terms, and arguments for which you supply values are in italic font.</td>
</tr>
<tr>
<td>[ ]</td>
<td>Elements in square brackets are optional.</td>
</tr>
<tr>
<td>{x</td>
<td>y</td>
</tr>
<tr>
<td>[ x</td>
<td>y</td>
</tr>
<tr>
<td>string</td>
<td>A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.</td>
</tr>
<tr>
<td>courier font</td>
<td>Terminal sessions and information the system displays appear in courier font.</td>
</tr>
<tr>
<td>&lt;&gt;</td>
<td>Nonprinting characters such as passwords are in angle brackets.</td>
</tr>
<tr>
<td>[ ]</td>
<td>Default responses to system prompts are in square brackets.</td>
</tr>
<tr>
<td>!, #</td>
<td>An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.</td>
</tr>
</tbody>
</table>

Note

Means reader take note. Notes contain helpful suggestions or references to material not covered in the manual.

Caution

Means reader be careful. In this situation, you might perform an action that could result in equipment damage or loss of data.
IMPORTANT SAFETY INSTRUCTIONS.

Means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.

SAVE THESE INSTRUCTIONS

Regulatory: Provided for additional information and to comply with regulatory and customer requirements.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see What’s New in Cisco Product Documentation.

To receive new and revised Cisco technical content directly to your desktop, you can subscribe to the . RSS feeds are a free service.
RESTRICTED RELEASE

Important

This is a Short Term Support (STS) release with availability and use restrictions. Contact your Cisco Account or Support representatives for more information.
CPS Basic Operations

• Starting and Stopping CPS, on page 1
• Restarting the Cisco Policy Server, on page 3
• Recovering After a Power Outage, on page 6
• Backing Up and Restoring, on page 9
• Adding or Replacing Hardware, on page 9
• Export and Import Service Configurations, on page 10

Starting and Stopping CPS

This section describes how to start and stop Cisco Policy Server nodes, VMs, and services.

Starting VMs Using VMware GUI

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Start a VMware vSphere session.</td>
</tr>
<tr>
<td>Step 2</td>
<td>Right-click the VM and select <strong>Power &gt; Power On</strong>. <strong>Important</strong> If the Policy Server (QNS) VM was previously powered off, it must be powered on only during Maintenance Window or low traffic time. If the VM is powered on during high traffic, then when the qns java process comes up and it immediately starts taking up load. As a result there can be timeouts and high CPU until around 60 seconds from the Policy Server (QNS) VM during the JVM hotspot warmup time. Once the JVM warmup phase is completed, the VM must be able to handle traffic smoothly.</td>
</tr>
<tr>
<td>Step 3</td>
<td>After the VM has started, log into the VM from Cluster Manager and verify that the processes are running.</td>
</tr>
</tbody>
</table>

Shutting Down the Cisco Policy Server Nodes

The following sections describe the commands to shut down the Cisco Policy Server nodes:

**Policy Director (LB) or Policy Server (QNS) Nodes**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>SSH to the lbx or qnsxx node from Cluster Manager:</td>
</tr>
</tbody>
</table>
ssh lbxx or ssh qnsxx

Step 2  Stop all CPS processes on the node:
        /usr/bin/monit stop all

Step 3  Check the status of all the processes. Verify that all processes are stopped before proceeding.
        /usr/bin/monit summary

Step 4  Stop the monit process:
        service monit stop

Step 5  Shut down lbxx/qnsxx:
        shutdown -h now

---

OAM (pcrfclient) Nodes

Step 1  SSH to the pcrfclientxx node from Cluster Manager:
        ssh pcrfclientxx

Step 2  Stop all CPS processes on the node:
        /usr/bin/monit stop all

Step 3  Check the status of all the processes. Verify that all processes are stopped before proceeding:
        /usr/bin/monit summary

Step 4  Stop the monit process:
        service monit stop

Step 5  Stop the licenses process:
        service lmgrd stop

Step 6  Shut down pcrfclientxx:
        shutdown -h now

---

sessionmgr Nodes

Step 1  SSH to the sessionmgrxx node from Cluster Manager:
        ssh sessionmgrxx

Step 2  Stop all CPS processes on the node:
        /usr/bin/monit stop all
Step 3  Check the status of all the processes. Verify that all processes are stopped before proceeding:

```
/usr/bin/monit summary
```

Step 4  Stop the monit process:

```
service monit stop
```

Step 5  For CPS nodes, such as sessionMgrs, there are mongo processes running that require special steps to stop. First, determine which processes are running by executing:

```
ls /etc/init.d/sessionmgr*
```

Step 6  Make sure the mongo replica set is in secondary:

```
/usr/bin/mongo --port $PORT --eval "rs.stepDown(10)"
```

where, PORT is the port number found in the previous step, such as 27717.

Step 7  Stop the MongoDB processes.

For example:

```
systemctl stop sessionmgr-27717
```

Step 8  Shut down sessionmgrxx:

```
shutdown -h now
```

## Restarting the Cisco Policy Server

CPS is composed of a cluster of nodes and services. This section describes how to restart the different services running on various CPS nodes.

### Restarting Database Services

Each database port and configuration is defined in the `/etc/broadhop/mongoConfig.cfg` file. The scripts that start/stop the database services can be found in the `/usr/bin` directory on the CPS nodes. To stop and start a database, log into each Session Manager VM and execute the commands as shown below. For example, to restart the sessionmgr 27717 database, execute:

```
systemctl stop sessionmgr-27717
systemctl start sessionmgr-27717
```

or:

```
systemctl restart sessionmgr-27717
```

### Note

It is important not to stop and start all of the databases in the same replica-set at the same time. As a best practice, stop and start databases one at a time to avoid service interruption.
Restarting Policy Server Services

If the Policy Server (QNS) VM was previously powered off, it must be powered on only during Maintenance Window or low traffic time. If the VM is powered on during high traffic, then when the qns java process comes up and it immediately starts taking up load. As a result there can be timeouts and high CPU until around 60 seconds from the Policy Server (QNS) VM during the JVM hotspot warmup time. Once the JVM warmup phase is completed, the VM must be able to handle traffic smoothly.

Restarting All Policy Server Services

To restart all Policy Server (QNS) services on all VMs, execute the following from the Cluster Manager:
/var/qps/bin/control/restartall.sh

Note
This script only restarts the Policy Server (QNS) services. It does not restart any other services.

Use summaryall.sh or statusall.sh to see details about these services.

Restarting All Policy Server Services on a Specific VM

To restart all Policy Server (QNS) services on a single CPS VM, execute the following from the Cluster Manager:
/var/qps/bin/control/restartqns.sh <hostname>

where <hostname> is the CPS node name of the VM (qns01, qns02, lb01, pcrfclient01, and so on).

Restarting Individual Policy Server Services on a Specific VM

Step 1
Log into the specific VM.

Step 2
To determine what Policy Server (QNS) services are currently running on the VM, execute:
monit summary

Output similar to the following appears:
The Monit daemon 5.5 uptime: 1d 17h 18m
Process 'qns-4' Running
Process 'qns-3' Running
Process 'qns-2' Running
Process 'qns-1' Running

Step 3
Execute the following commands to stop and start the individual Policy Server (QNS) process:
monit stop qns-<instance id>
monit start qns-<instance id>
**Restarting Services Managed by Monit**

The Monit service manages many of the services on each CPS VM.

To see a list of services managed by `monit` on a VM, log in to the specific VM and execute:

```
monit summary
```

To stop and start all services managed by `monit`, log in to the specific VM and execute the following commands:

```
monit stop all
monit start all
```

To stop and start a specific service managed by Monit, log in to the specific VM and execute the following commands:

```
monit stop <service_name>
monit start <service_name>
```

where `<service_name>` is the name as shown in the output of the `monit summary` command.

**Restarting Other Services**

**Restarting Subversion**

To restart Subversion (SVN) on OAM (pcrfclient) nodes, execute:

```
service httpd restart
```

**Restarting Policy Builder**

To restart Policy Builder on OAM (pcrfclient) nodes (pcrfclient01/pcrfclient02), execute:

```
monit stop qns-2
monit start qns-2
```

**Restarting Control Center**

To restart Control Center on OAM (pcrfclient) nodes (pcrfclient01/pcrfclient02), execute:

```
monit stop qns-1
monit start qns-1
```

**Restarting Services on Policy Director (lb01 and lb02)**

The following commands are used to restart the services on the Policy Director (lb) nodes only (lb01 and lb02).

---

**Step 1**
Login to lb01/lb02.

**Step 2**
To restart the service that controls the virtual IPs (lbvip01 and lbvip02 are virtual IP addresses shared between lb01 and lb02 for High Availability), execute the following command:
monit restart corosync

Step 3  To restart the service that balances and forwards IP traffic (port forwarding service) from lb01/lb02 to other CPS nodes, execute:

monit restart haproxy

---

Recovering After a Power Outage

If there is a controlled or uncontrolled power outage, the following power on procedures should be followed to bring the system up properly.

---

**Step 1**
Power ON the Cluster Manager.

**Step 2**
Power ON pcrfclient01.

**Step 3**
Power ON all Session Manager nodes (sessionmgr0x).

**Step 4**
Validate that the databases are all online by running:

diagnostics.sh --get_replica_status

**Note**
If a member is shown in an unknown state, it is likely that the member is not accessible from one of other members, mostly an arbiter. In that case, you must go to that member and check its connectivity with other members.

Also, you can login to mongo on that member and check its actual status.

**Step 5**
Power ON Policy Director node 2 (lb02).

**Step 6**
Power ON Policy Director node 1 (lb01).

**Step 7**
Power ON all Policy Server (QNS) nodes.

**Step 8**
Power ON pcrfclient02.

**Step 9**
On pcrfclient01, run the following commands to reinitialize the services:

monit stop all
monit start all

**Step 10**
Run diagnostics.sh to validate system is functioning properly.

---

Recovery Control

Due to the operational inter-dependencies within the CPS, it is necessary for some CPS services and components to become active before others.

CPS can monitor the state of the cluster through the various stages of startup. It also includes functionality to allow the system to gracefully recover from unexpected outages.
**Cluster State Monitoring**

CPS can monitor the state of the services and components of the cluster from the OAM (pcrfclient) VMs. By default, this functionality is disabled.

This functionality can be enabled by setting the cluster_state_monitor option to true in the CPS Deployment Template (Excel spreadsheet).

To update an existing deployment to support this functionality, modify this setting in your CPS Deployment Template and redeploy the csv files as described in the *CPS Installation Guide for VMWare*.

This monitoring system reports the state of the system as an integer value as described in the following table:

*Table 1: Cluster State Monitoring*

<table>
<thead>
<tr>
<th>Cluster State</th>
<th>Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>unknown state/pre-inspection state</td>
<td>The system will report ‘0’ until both conditions have been met under ‘1’: lbvip02 is UP AND databases are accessible. Various systems can be coming online while a ‘0’ state is being reported and does not automatically indicate an error. Even if the system cannot proceed to ‘1’ state, Policy Builder and Control Center UIs should be available in order to manage or troubleshoot the system.</td>
</tr>
<tr>
<td>1</td>
<td>lbvip02 is alive and all databases in /etc/broadhop/mongoConfig.cfg have an accessible primary</td>
<td>All backend databases must be available and the lbvip02 interface must be UP for the system to report this state.</td>
</tr>
<tr>
<td>2</td>
<td>lbvip02 port 61616 is accepting TCP connections</td>
<td>Backend Policy Server (QNS) processes access lbvip02 on this port. When this port is activated, it indicates that Policy Server (QNS) processes can proceed to start.</td>
</tr>
<tr>
<td>3</td>
<td>at least 50% of backend Policy Server (QNS) processes are alive</td>
<td>Once sufficient capacity is available from the backend processes, the Diameter protocol endpoint processes are allowed to start.</td>
</tr>
</tbody>
</table>

The current cluster state is reported in the following file on the OAM (pcrfclient):

/ var/run/broadhop.cluster_state

The `determine_cluster_state` command logs output of the cluster state monitoring process into / var/log/broadhop/determine_cluster_state.log.

**Controlled Startup**

In addition to the monitoring functionality, CPS can also use the cluster state to regulate the startup of some of the CPS services pending the appropriate state of the cluster.
By default this functionality is disabled. It can be enabled for the entire CPS cluster, or for troubleshooting purposes can be enabled or disabled on a per-VM basis.

Note
Cluster State Monitoring must be enabled for Controlled Startup to function.

Enable/Disable For All VMs in Cluster

The Controlled Startup functionality is enabled by the presence of the `/etc/broadhop/cluster_state` file.

To enable this feature on all CPS VMs in the cluster, execute the following commands on the Cluster Manager VM to create this file and to use the `syncconfig.sh` script to push those changes out to the other VMs.

```
touch /etc/broadhop/cluster_state
syncconfig.sh
```

To disable this feature on all VMs in the cluster, remove the `cluster_state` file on the Cluster Manager VM and sync the configuration:

```
rm /etc/broadhop/cluster_state
syncconfig.sh
```

Enable/Disable For Specific VM

To enable this feature on a specific VM, create a `/etc/broadhop/cluster_state` file on the VM:

```
touch /etc/broadhop/cluster_state
```

To disable this feature again on a specific VM, delete the `/etc/broadhop/cluster_state` file on the VM:

```
rm /etc/broadhop/cluster_state
```

Note
This is temporary measure and should only be used for diagnostic purposes. Local modifications to a VM can be overwritten under various circumstances, such as running `syncconfig.sh`.

Switching Active and Standby Policy Directors

In CPS, the active and standby strategy applies only to the Policy Directors (lb). The following are the two Policy Directors in the system:

- lb01
- lb02

Determining the Active Policy Director

Step 1
Log in to the pcrfclient01 VM.
Step 2  Run the following command to SSH to the active Policy Director (typically lb01):

```bash
ssh lb01vip01
```

Step 3  You can also confirm an active Policy Director by ensuring it has the virtual IP (VIP) associated with it by running the following command:

```bash
ifconfig -a
```
If you see the eth0:0 or eth1:0 interfaces present in the list and marked as “UP” then that is the active Policy Director.

For example:

```
eth0:0 Link encap:Ethernet HWaddr 00:0C:29:CD:7E:4C
  -- UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
```

The passive or standby load balancer will not have active VIPs shown in the `ifconfig -a` output (no eth0:0 and eth1:0).

---

### Switching Standby and Active Policy Directors

**Step 1**  Log in to the active Policy Director (lb) VM. See [Determining the Active Policy Director, on page 8](#) for details to determine which Policy Director is active.

**Step 2**  Restart the Heartbeat service using the following command:

```bash
monit restart corosync
```
This command will force the failover of the VIP from the active Policy Director to the standby Policy Director.

**Step 3**  To confirm the switchover, SSH to the other Policy Director VM and run the following command to determine if the VIP is now associated with this VM:

```bash
ifconfig -a
```
If you see the eth0:0 or eth1:0 interfaces in the list and marked as “UP” then that is the active Policy Director.

---

### Backing Up and Restoring

As a part of routine operations, it is important to make backups so that if there are any failures, the system can be restored. Do not store backups on system nodes.

For detailed information about backup and restore procedures, see the *CPS Backup and Restore Guide*.

### Adding or Replacing Hardware

Hardware replacement is usually performed by the hardware vendor with whom your company holds a support contract.
Export and Import Service Configurations

You can export and import service configurations for the migration and replication of data. You can use the export/import functions to back up both configuration and environmental data or system-specific information from the configuration for lab-to-production migration.

You can import the binary in the following two ways:

- Import the binary produced by export - All configuration exported will be removed (If environment is included, only environment will be removed. If environment is excluded, environment will not be removed). The file passed is created from the export API.
- Additive Import - Import the package created manually by adding configuration. The new configurations get added into the server without impacting the existing configurations. The import is allowed only if the CPS running version is greater than or equal to the imported package version specified in the configuration.

**Step 1**
In a browser, navigate to the export/import page, available at the following URLs:

**HA/GR:** https://<lbvip01>:7443/doc/import.html

**All-In-One (AIO):** http://<ip>:7070/doc/import.html

**Step 2**
Enter the API credentials.

**Step 3**
Select the file to be imported/exported.

The following table describes the export/import options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export</td>
<td></td>
</tr>
</tbody>
</table>
| All data| Exports service configuration with environment data, which acts as a complete backup of both service configurations and environmental data.
### Option Description

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclude environment</td>
<td>Exports without environment data, which allows exporting configuration from a lab and into another environment without destroying the new system's environment-specific data.</td>
</tr>
<tr>
<td>Only environment</td>
<td>Exports only environment data, which provides a way to back up the system-specific environmental information.</td>
</tr>
<tr>
<td>Export URL</td>
<td>Found in Policy Builder or viewed directly in Subversion.</td>
</tr>
<tr>
<td>Export File Prefix</td>
<td>Provide a name (prefix) for the export file. The exported filename automatically includes the date and time when the export was performed, for example: prefix_2016-01-12_11-03-56_3882276668.cps</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> The file extension .cps is used so that the file is not opened or modified by mistake by another application. The file should be used for export/import purposes only.</td>
</tr>
</tbody>
</table>

### Import

<table>
<thead>
<tr>
<th>Import</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import URL</td>
<td>URL is updated/created. We recommend importing to a new URL and use Policy Builder to verify/publish.</td>
</tr>
<tr>
<td>Commit Message</td>
<td>Message recorded with the import. Provide details that are useful to record.</td>
</tr>
</tbody>
</table>

After you select the file, the file's information is displayed.

**Step 4**

Select **Import** or **Export**.

CPS displays response messages that indicate the status of the export/import.
Export and Import Service Configurations
Managing CPS Disks

• Adding a New Disk, on page 13
• Mounting the Replication Set from Disk to tmpfs After Deployment, on page 15
• Manage Disks to Accommodate Increased Subscriber Load, on page 16

Adding a New Disk

This section describes the procedures needed to add a new disk to a VM.

Prerequisites

• All the VMs were created using the deployment process.
• This procedure assumes the datastore that will be used to have the virtual disk has sufficient space to add the virtual disk.
• This procedure assumes the datastore has been mounted to the VMware ESX server, regardless of the backend NAS device (SAN or iSCSI, etc).

ESX Server Configuration

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
</table>
| Step 1 | Login to the ESX server shell, and make sure the datastore has enough space:  
```
vmkfstools -c 4g /vmfs/volumes/datastore_name/VMNAME/xxxx.vmdk -d thin
```
| Step 2 | Execute `vim-cmd vmsvc/getallvms` to get the vmid of the VM where the disk needs to be added.  
```
Vmid Name File          Guest OS  Version Annotation
173  vminstaller-AIO [datastore5] vminstaller-AIO/vminstaller-AIO.vmx  centos64Guest vmx-08
```
| Step 3 | Assign the disk to the VM.  
The `xxxx` is the disk name, and 0 and 1 indicate the SCSI device number.  
In this example, this is the second disk:
Target VM Configuration

Step 1: Log in as root user on your Linux virtual machine.
Step 2: Open a terminal session.
Step 3: Execute the `df` command to examine the current disks that are mounted and accessible.
Step 4: Create an ext4 file system on the new disk:

```
mkfs -t ext4 /dev/sdb
```

*Note*: `/dev/sdb` is the second SCSI disk. It warns that you are performing this operation on an entire device, not a partition. That is correct, since you created a single virtual disk of the intended size. This is assuming you have specified the correct device. Make sure you have selected the right device; there is no undo.

Step 5: Execute the following command to verify the existence of the disk you created:

```
# fdisk -l
```

Step 6: Execute the following command to create a mount point for the new disk:

```
# mkdir /<NewDirectoryName>
```

Step 7: Execute the following command to display the current `/etc/fstab`:

```
# cat /etc/fstab
```

Step 8: Execute the following command to add the disk to `/etc/fstab` so that it is available across reboots:

```
/dev/sdb /<NewDirectoryName> ext4 defaults 1 3
```

Step 9: Reboot the VM.

```
shutdown -r now
```

Step 10: Execute the `df` command to check the file system is mounted and the new directory is available.

Update the collectd process to use the new file system to store KPIs

After the disk is added successfully, `collectd` can use the new disk to store the KPIs.

Step 1: SSH into pcrcfclient01/pcrcfclient02.
Step 2: Execute the following command to open the logback.xml file for editing:

```
vi /etc/collectd.d/logback.xml
```

Step 3: Update the file element `<file>` with the new directory that was added in the `/etc/fstab`.
Step 4: Execute the following command to restart `collectd`:

```
monit restart collectd
```
The content of logback.xml will be overwritten to the default path after a new upgrade. Make sure to update it after an upgrade.

Mounting the Replication Set from Disk to tmpfs After Deployment

You can mount all of the members of the Replication set to tmpfs, or you can mount specific members to tmpfs. These scenarios are described in the following sections.

Scenario 1 – Mounting All Members of the Replication Set to tmpfs

Step 1
Modify mongoConfig.cfg file using the vi editor on cluster manager. Change the DBPATH directory for the SPR Replication set that needs to be put on tmpfs.

Note
Make sure you change the path to /var/data/sessions.1, which is the tmpfs filesystem. Also, make sure to run diagnostics.sh before and after the activity.

The following example shows the contents of mongoConfig.cfg file before modification:

```
[SPR-SET1]
SETNAME=set06
OPLOG_SIZE=5120
ARBITER1=pcrfclient01a:27720
ARBITER_DATA_PATH=/var/data/sessions.6
MEMBER1=sessionmgr04a:27720
MEMBER2=sessionmgr03a:27720
MEMBER3=sessionmgr04b:27720
MEMBER4=sessionmgr03b:27720
DATA_PATH=/var/data/sessions.4
[SPR-SET1-END]
```

The following example shows the contents of mongoConfig.cfg file after modification:

```
[SPR-SET1]
SETNAME=set06
OPLOG_SIZE=5120
ARBITER1=pcrfclient01a:27720
ARBITER_DATA_PATH=/var/data/sessions.6
MEMBER1=sessionmgr04a:27720
MEMBER2=sessionmgr03a:27720
MEMBER3=sessionmgr04b:27720
MEMBER4=sessionmgr03b:27720
DATA_PATH=/var/data/sessions.1/set06
[SPR-SET1-END]
```

Step 2
Run build_set to generate new MongoDB startup scripts. It generates new mongod startup scripts for all the SPR Replication sets:

```
build_set.sh --spr --create-scripts
```

In this example, we are generating new MongoDB startup scripts for the SPR database. Use balance/session depending on your activity.
Step 3 In you need to generate new MongoDB scripts for specific setname, run the following command:

```
build_set.sh --spr --create-scripts --setname set06
```

Step 4 Verify that the new mongo script is generated. SSH to one of the session manager servers and run the following command. The DBPATH should match what you modified in Step 1, on page 15. For example:

```
grep /var/data sessionmgr-27720
```

You should see the following output:

```
DBPATH=/var/data/sessions.1/set06
```

Step 5 Copy the `mongoConfig.cfg` file to all nodes using the following command:

```
copytoall /etc/broadhop/mongoConfig.cfg /etc/broadhop/mongoConfig.cfg
```

Step 6 Run `build_etc.sh` to update puppet files, which retains the updated `mongoConfig.cfg` file after reboot.

Step 7 Stop and start the mongo databases one by one.

Step 8 Run `diagnostics.sh`.

Step 9 If this is an Active/Active GEOHA setup, scp the `mongoConfig.cfg` file to Site-B cluster manager, and do the following:

a) Copy the `mongoConfig.cfg` file from Cluster Manager to all nodes using the following command:

```
copytoall /etc/broadhop/mongoConfig.cfg /etc/broadhop/mongoConfig.cfg
```

b) Run `build_etc.sh` to update puppet files, which retains the updated `mongoConfig.cfg` file after reboot.

---

### Scenario 2 – Mounting Specific Members of the Replication Set to tmpfs

Step 1 Ssh to the respective session manager.

Step 2 Edit the mongoDB startup file using the vi editor. In this example we are modifying the SPR member.

```
[root@sessionmgr01 init.d]# vi /etc/init.d/sessionmgr-27720
```

Step 3 Change the DBPATH directory from `DBPATH=/var/data/sessions.4` to `DBPATH=/var/data/sessions.1/set06`.

Step 4 Save and exit the file (using !wq).

Step 5 Enter the following commands to stop and start the SPR DB member:

```
/usr/bin/systemctl stop sessionmgr-27720
/usr/bin/systemctl start sessionmgr-27720
```

Step 6 Wait for the recovery to finish.

---

### Manage Disks to Accommodate Increased Subscriber Load

If you need to prepare CPS for an increased number of subscribers (> 10 million), you can clone and repartition the sessionmgr disks as per your requirement.
**Clone Sessionmgr01 VM**

Downtime: No downtime

**Before you begin**

- Before disk repartition, clone sessionmgr01. This step is optional but to reduce the risk of losing the data during disk repartitioning, the customer can take the backup of sessionmgr01 VM. If the customer does not have enough space to take the backup this step can be ignored.

- Blade with enough space to hold cloned image of sessionmgr01.

---

**Step 1**
Login to vSphere Client on sessionmgr01 blade with administrator credentials.

**Step 2**
Right-click sessionmgr01 and select **Clone** > Choose appropriate inventory in which blade resides > Choose the blade with enough space to hold sessionmgr01 image > **Next** > **Next** > **Finish**.

**Step 3**
Cloning starts. Wait for it to finish the process.

---

**Disk Repartitioning of Sessionmgr01 VM**

Downtime: During this procedure Sessionmgr01 is shut down 2 times. Estimate approximately 30 minutes of downtime for sessionmgr01.

CPS continues to operate using the other sessionmgr02 while sessionmgr01 is stopped as part of procedure.

**Before you begin**

None

---

**Step 1**
Login to sessionmgr01 as a root user.

**Step 2**
The following commands may be executed to help identify which partition requires additional space.

```bash
synph# df -h/synph
synphfilesystem Size Used Avail Use% Mounted on/synph
synph/dev/mapper/vg_shiprock-lv_root 7.9G 1.5G 6.0G 20% //synph
synph/tmpfs 1.9G 0 1.9G 0% /dev/shm/synph
synph/dev/sda1 485M 32M 428M 7% /boot/synph
synph/dev/mapper/vg_shiprock-lv_home 2.0G 68M 1.9G 4% /home/synph
synph/dev/mapper/vg_shiprock-lv_var 85G 16G 65G 20% /var/synph
synph/tmpfs 2.3G 2.1G 172M 93% /var/data/sessions.1/synph
synph/synph
```

CPS Operations Guide, Release 18.3.0 (Restricted Release)
Step 3  
Execute the fdisk command to check the disk size.

```bash
# fdisk -l /dev/sda
```

Step 4  
Power down the Virtual Machine.

```bash
# shutdown -h now
```

**Note** If cloning is not possible because of space limitation on Blade, backup of sessionmgr01 VM can be taken by saving OVF of sessionmgr01 VM to local storage like Laptop, Desktop. (Both cloning and OVF backup are optional steps, but either one of them is highly recommended.)

Step 5  
Log in using the VMware vSphere Client as an administrator (e.g. root) to the ESXi host which has your Linux Virtual Machine on it.

Step 6  
Right-click on the Virtual Machine and select Edit Settings > Click Hard Disk 1 > Increase the Provisioned Size of the Hard Disk.

Step 7  
Power ON the Virtual Machine.

Step 8  
Login (ssh) to the Virtual Machine as root user.

Step 9  
Confirm that disk space has been added to the /dev/sda partition.
Step 10  Execute the following commands (Bold Characters indicates actual inputs from user (all of them are in lower case)).

```
# fdisk /dev/sda
```

The number of cylinders for this disk is set to 7832.
There is nothing wrong with that, but this is larger than 1024,
and could in certain setups cause problems with:
1) software that runs at boot time (e.g., old versions of LILO)
2) booting and partitioning software from other OSs
   (e.g., DOS FDISK, OS/2 FDISK)
Command (m for help): p
Disk /dev/sda: 64.4 GB, 64424509440 bytes
255 heads, 63 sectors/track, 7832 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes

```
Device Boot Start End Blocks Id System
/dev/sda1 * 1 13 104391 83 Linux
/dev/sda2 14 7179 57560895 8e Linux LVM
```

Command (m for help): d
Partition number (1-4): 2
Command (m for help): n
Command action
   e extended
   p primary partition (1-4)
p
Partition number (1-4): 2
First cylinder (14-7832, default 14): [press enter]
Using default value 14
Last cylinder +sizeM/+sizeK (14-7832,default 7832): [press enter]
Using default value 7832
Command (m for help): t
Partition number (1-4): 2
Hex code (type L to list codes): 8e
Changed system type of partition 2 to 8e (Linux LVM)
Command (m for help): w
The partition table has been altered!
Calling ioctl() to re-read partition table.
WARNING: Re-reading the partition table failed with error 16: Device or resource busy.
The kernel still uses the old table.
The new table will be used at the next reboot.
Syncing disks.

Step 11  Reboot the sessionmgr01 VM by executing the following command:

```
# reboot
```

This ensures that the new setting match up with the kernel.

Step 12  After reboot, execute following command:

```
# pvresize /dev/sda2
```

Physical volume "/dev/sda2" changed
1 physical volume(s) resized / 0 physical volume(s) not resized

Step 13  Confirm that the additional free space is added in sessionmgr VM.

```
# vgdisplay
--- Volume group ---
VG Name       vg_shiprock
System ID     lvm2
```
Step 14 Verify that the /var partition is mounted on /dev/mapper/vg_shiprock-lv_var.

```
# df -h
Filesystem Size Used Avail Use% Mounted on
/dev/mapper/vg_shiprock-lv_root 18G 2.5G 15G 15% /
/dev/mapper/vg_shiprock-lv_home 5.7G 140M 5.3G 3% /home
/dev/mapper/vg_shiprock-lv_var 85G 16G 65G 20% /var
/dev/sda1 99M 40M 55M 43% /boot
tmpfs 16G 0 16G 0% /dev/shm
tmpfs 8.0G 1.1G 7.0G 14% /data/sessions.1
```

Step 15 Extend /var partition to take up additional free space.

```
# lvextend -l +100%FREE /dev/mapper/vg_shiprock-lv_var
Extending logical volume lv_var to 120.00 GB
Logical volume lv_var successfully resized
```

Step 16 Check the newly added space in /dev/mapper/vg_shiprock-lv_var.

```
# lvdisplay
```

Step 17 Add space to VM file system.

```
# resize2fs /dev/mapper/vg_shiprock-lv_var
resize2fs 1.39 (29-May-2006)
Filesystem at /dev/mapper/vg_shiprock-lv_var is mounted on /var; on-line resizing required
Performing an on-line resize of /dev/mapper/vg_shiprock-lv_var to 6553600 (4k) blocks.
The filesystem on /dev/mapper/vg_shiprock-lv_var is now 6553600 blocks long.
```

Step 18 Check the increased size of /var partition.

```
# df -h
Filesystem Size Used Avail Use% Mounted on
/dev/mapper/vg_shiprock-lv_root 23G 2.1G 20G 10% /
/dev/mapper/vg_shiprock-lv_home 5.7G 140M 5.3G 3% /home
/dev/mapper/vg_shiprock-lv_var 130G 16G 95G 12% /var
/dev/sda1 99M 40M 55M 43% /boot
tmpfs 2.0G 0 2.0G 0% /dev/shm
```
Cloning and Disk Repartitioning of Sessionmgr02 VM

Repeat Clone Sessionmgr01 VM, on page 17 and Disk Repartitioning of Sessionmgr01 VM, on page 17 on sessionmgr02 for cloning and disk repartitioning of sessionmgr02 VM.
Managing CPS Licenses

• Smart Software Licensing, on page 23
• Classic Licensing, on page 23
• Comparison between Licensing Models, on page 24
• Smart Accounts/Virtual Accounts, on page 25
• License Conversion, on page 26
• Enable Smart Licensing for CPS, on page 27
• Product ID Tags, on page 29
• Smart Licensing CLI Commands, on page 29
• License Usage Threshold, on page 31

Smart Software Licensing

CPS 10.0.0 and its later releases support Smart Licensing. It is a cloud-based approach to licensing that simplifies the purchase, deployment, and management of Cisco software assets. Entitlements are purchased through your Cisco account via Cisco Commerce Workspace (CCW) and immediately deposited into your Virtual Account for usage. This eliminates the need to install license files on every device. Products that are smart enabled communicate directly to Cisco to report consumption. A single location is available to customers to manage Cisco software licenses—the Cisco Smart Software Manager (CSSM). License ownership and consumption are readily available to help make better purchase decision based on consumption or business need.

Classic Licensing

Classic Licensing is Cisco’s legacy licensing model based on Product Activation Keys (PAK) and Unique Device Identifiers (UDI). On most IOS devices, a determination of bandwidth needs is assessed prior to obtaining and installing a tar file on the platform to retrieve the UDI. A PAK is ordered and typically emailed to the customer. The combination of a UDI and PAK are used to receive a license file, which is installed in the boot directory to complete the installation of IOS on the platform. The License Registration Portal (LRP) is available to help migrate Classic Licenses to Smart Licenses. To access the LRP, and to obtain training and manage licenses, visit http://tools.cisco.com/SWIFT/LicensingUI/Home.
Comparison between Licensing Models

The following sections provide a comparison of the existing CPS SWIFT-based licensing model, the Cisco Smart Software Licensing model, and Cisco Smart Software Licensing as it is implemented in CPS 10.0.0 and later releases.

CPS SWIFT-Based Licensing

For CPS versions prior to 10.0.0, CPS licensing is SWIFT "lmgrd" based, and the license is tied to the MAC address of the device on which CPS is installed. The following list summarizes the CPS SWIFT-based licensing model:

- The License count that is purchased by the customer is defined in the license.lic file and is read into the CPS application using the lmgrd/cisco processes.
- License compliance is determined and tracked by CPS. CPS periodically compares the current session count with the licensed count at a predefined interval.
- CPS creates and logs license statuses: adhere, "RATE_LIMITED" and "VALID" statuses are logged with proper messages, and traps are generated accordingly.

Cisco Smart Software Licensing

The following list summarizes the Cisco Smart Software License model:

- Smart Licensing maintains and tracks license information including license quantity, license surplus, and shortage usages.
- There is no API for returning the number of licenses (entitlements) purchased by the customer.
- License compliance is determined and tracked by Cisco Smart Software License. Entitlement enforcement mode notifications will send out when it is changed upon the request.
- License (entitlement) expiration is tracked by Cisco Smart Software License. There is no API for returning the license expiration date.
- Smart Licensing does not support license version.
- Utility/Metering is not supported.
- An entitlement consumption request is allowed once every 24 hours maximum.
- Smart Licensing supports high availability. For Smart Agent clusters, one Smart Agent is active and the rest are standbys. This means that for a given cluster, only one Smart Agent is active, and it will register to the Smart Licensing portal at any time. (Smart License is a combination of Smart Agent and Smart Call Home, which is responsible for communicating to Cisco Smart Software Licensing.)

CPS Cisco Smart Software License Based Model

The following list summarizes the Cisco Smart Software License model for CPS 10.0.0 and greater:

- For a CPS high availability installation, only the active client (either perfclient01 or perfclient02) is registered to the Smart Licensing Portal at any given time, and it uses the same identify for the registration.
• CPS uses the Smart Licensing API to request the entitlement (license) consumption amount based on the pre-defined maximum licensed concurrent session amount.

• The predefined maximum licensed concurrent session amount is defined in the features.properties file for each CPS feature.

• One licensed entitlement count is equivalent to one CPS Policy concurrent session count.

• Smart Licensing Entitlement notifies CPS about the requested entitlement conformance (enforce mode) if the requested entitlement consumption is InCompliance or OutCompliance or Eval, meaning that the product instance is not registered to the Smart Licensing Portal and is running in evaluation mode. CPS populates license data into mongoDB: sharding/licensedfeats <SITEID> collection based on the received entitlement compliance status.

• The Smart Agent (SA) is embedded in CPS+SL (SA+SCH) integration. A CLI is supported.

• CPS Orchestration API-based installation is not supported.

• Dynamically switching the license manager from lmgrd to Smart Licensing or vise versa is supported. Switching the licensing manager requires a restart of CPS OAM (pcrfclient).

• CPS Smart Licensing integration follows the CPS In-Service Software Upgrade process.

In summary, CPS 10.0.0 and later releases support the same functionality as CPS SWIFT lmgrd-based licensing with the following exceptions:

• There is no API to return the license amount available for the virtual account. A new “complianceMode” attribute has been added to indicate the requested feature entitlement compliance status with the following value options:
  • InCompliance – The requested feature entitlement maximum licensed amount is in surplus status.
  • OutOfCompliance – The requested feature entitlement maximum licensed amount is in shortage status.
  • Eval – The product is not yet registered to Cisco Smart License Cloud.

• There is no API to return the license expiration date. The license expiration date value will set to “current date + 10 years future date” in CPS 10.0.0 and later releases.

• Smart Licensing does not support license version. Currently, the license version is set to “V1.0” in CPS.

Smart Accounts/Virtual Accounts

A Smart Account provides a single location for all Smart-enabled products and entitlements. It helps speed procurement, deployment, and maintenance of Cisco Software. When creating a Smart Account, you must have the authority to represent the requesting organization. After submitting, the request goes through a brief approval process.

A Virtual Account exists as a sub-account within the Smart Account. Virtual Accounts are a customer-defined structure based on organizational layout, business function, geography or any defined hierarchy. They are created and maintained by the Smart Account administrator.

See http://software.cisco.com to learn about, set up, or manage Smart Accounts.
Request a Cisco Smart Account

A Cisco Smart Account is an account where all products enabled for Smart Licensing are deposited. A Cisco Smart Account allows you to manage and activate your licenses to devices, monitor license use, and track Cisco license purchases. Through transparent access, you have a real-time view into your Smart Licensing products. IT administrators can manage licenses and account users within your organization's Smart Account through the Smart Software Manager.

Step 1
In a browser window, enter the following URL:
http://software.cisco.com

Step 2
Log in using your credentials, and then click Request Smart Account in the Administration area under Smart Account Management.
The Smart Account Request window is displayed.

Step 3
Under Create Account, select one of the following options:

- Yes, I have authority to represent my company and want to create the Smart Account – If you select this option, you agree to authorization to create and manage product and service entitlements, users, and roles on behalf of your organization.

- No, the person specified below will create the account – If you select this option, you must enter the email address of the person who will create the Smart Account.

Step 4
Under Account Information:

a) Click Edit beside Account Domain Identifier.
b) In the Edit Account Identifier dialog box, enter the domain, and click OK. By default, the domain is based on the email address of the person creating the account and must belong to the company that will own this account.
c) Enter the Account Name (typically, the company name).

Step 5
Click Continue.
The Smart Account request will be in pending status until it has been approved by the Account Domain Identifier. After approval, you will receive an email confirmation with instructions for completing the setup process.

Cisco Smart Software Manager

Cisco Smart Software Manager (CSSM) enables the management of software licenses and Smart Account from a single portal. The interface allows you to activate your product, manage entitlements, and renew and upgrade software. A functioning Smart Account is required to complete the registration process. To access the Cisco Smart Software Manager, see https://software.cisco.com/.

License Conversion

Using the License Registration Portal, you can convert classic licenses that are associated with Product Activation Keys (PAKs) to smart entitlements.
Step 1 To access the License Registration Portal:
   a) Login to the Cisco Software Central page at software.cisco.com.
   b) Under License, click Traditional Licensing.
      On the Welcome to the Product License Registration Portal window, you can choose to watch training videos, or you can go directly to the Product License Registration Portal.
   c) Select the Product License Registration Portal option.
      The Product License Registration page opens.

Step 2 Select the PAKs/Tokens tab to access your classic licenses.

Step 3 On the PAKs/Tokens tab, check the box next to the PAK/Token ID for which you want to convert licenses.

Step 4 From the Actions drop-down list, select Convert to Smart Entitlements.
In the Convert to Smart Entitlements dialog box, you can change to a different Virtual Account if needed.

Step 5 Check the box next to the PAK.

Step 6 Enter the Quantity to Convert, and click Submit.
You will receive a message when the conversion has completed successfully.

Step 7 Login to the Cisco Smart Software Manager (CCSM), and view the converted Smart Entitlements as follows:
   a) Select the Virtual Account, and click the License Conversion tab.
   b) Click the Event Log tab to see the confirmation message that the licenses were converted.

---

Enable Smart Licensing for CPS

You can enable smart licensing after upgrading CPS, or after a new CPS deployment.

*Note* These steps must be performed on the Cluster Manager VM.

---

Step 1 Log in to the Cluster Manager VM.

Step 2 Enter the following commands to create license_sl_data and license_sl_conf directories:

```
mkdir -p /etc/broadhop/license_sl_data
mkdir -p /etc/broadhop/license_sl_conf
```

Step 3 Create the following license configuration files in the /etc/broadhop/license_sl_conf directory on the Cluster Manager:
   a) Create a file named features.properties, and add the required PID and count. For example:

```
LicenseFeature=<PID>:<COUNT>
```

   b) Create a file named sl.properties with the following content from the CSSM account:

```
TRANSPORT_URL=https://tools.cisco.com/its/service/oddce/services/DDCEService
```
c) Create a file named `conf.properties` with the following content from the CSSM account. For example:

```properties
PRODUCT_SN=10999
PRODUCT_ID_TAG=CPS
SOFTWARE_ID_TAG=regid.2016-06.com.cisco.CPS10,1.0_e454cefa-5e10-4af4-81d8-3f76260485fb
USE_PROD_ROOT_CERT=true
RENEW_AUTH=false
TAC_PROFILE_NAME=CiscoTAC-1
HTTP_TRANSPORT_FLAG=true
HTTP_URL=https://tools.cisco.com/its/service/oddce/services/DDCEService
PRODUCT_NAME=Cisco Policy Suite
SOFTWARE_VERSION=10.0
SYSTEM_DESCRIPTION=Cisco Policy Suite for Mobile is a carrier-grade policy, charging, and subscriber data management solution.
PRODUCT_SERIES=Cisco Policy Suite Series
```

Step 4

Enter the following command to rebuild the `/etc/broadhop/license_sl_data` and `license_sl_conf` directory in the Cluster Manager VM:

```
/var/qps/install/current/scripts/build/build_etc.sh
```

Step 5

Enter the following commands to push the license to `pcrfclient01` and `pcrfclient02`:

```
ssh pcrfclient01
/etc/init.d/vm-init

ssh pcrfclient02
/etc/init.d/vm-init
```

Step 6

Enter the following commands to map the Smart License server hostname to the IP address and to synchronize the `/etc/hosts` files across the VMs:

```
echo "173.37.145.8 tools.cisco.com" >> /etc/hosts
/var/qps/bin/update/synchosts.sh
```

Step 7

Configure CPS to use Smart Licensing as follows:

a) Open the `qns.conf` file by entering the following command:

```
vim /etc/broadhop/qns.conf
```

b) Edit the `qns.conf` file, and add the following argument:

```
-Dcom.broadhop.license.approach=sl
```

c) Save and close the `qns.conf` file.

d) Enter the following commands to copy the modified `qns.conf` file from Cluster Manager to all of the VMs:

```
copytoall.sh /etc/broadhop/qns.conf /etc/broadhop/qns.conf
restartall.sh
```

Step 8

To view license related logs, see the following log file:

```
/var/log/broadhop/license.log
```

Step 9

Access the Cisco Smart Software Manager (CSSM) at the following location:

```
https://software.cisco.com/
```

Step 10

Select the appropriate virtual account, and then click **New Token** in the **General** tab.

Step 11

In the **Create Token** dialog box, enter the required information, accept the terms and responsibilities, and then click **Create Token**.
Step 12 Select the token text, and copy it to your clipboard.

Step 13 Enter the following command, pasting the token that you copied in place of `<token>`:

```
license smart register idtoken <token> [force]
```

---

**Product ID Tags**

Tags for the following PIDs have been created to enable the proper product IDs to be identified, reported, and enforced.

*Table 3: PID Tags*

<table>
<thead>
<tr>
<th>PID</th>
<th>Entitlement Tag</th>
<th>Entitlement name in CSSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLICY-VALUE</td>
<td>regid.2016-06.com.cisco.POLICY-VALUE, 1.0_7f667e53-11e1-40e2-9480-ff7eb064561c</td>
<td>CPS Value Plus Feature Pack</td>
</tr>
<tr>
<td>POLICY-ALL</td>
<td>regid.2016-06.com.cisco.POLICY-ALL, 1.0_65566461-0788-4c92-8ffa-f9a02e9843e8</td>
<td>CPS All Inclusive Feature Pack</td>
</tr>
<tr>
<td>POLICY-UPGRADE</td>
<td>regid.2016-06.com.cisco.POLICY-UPGRADE, 1.0_8fa236bc-e481-4673-aa4d-7da8f707647c</td>
<td>CPS Upgrade from Value Plus to All Inclusive Feature Pack</td>
</tr>
<tr>
<td>POLICY-ADD</td>
<td>regid.2016-06.com.cisco.PCRF-ADD, 1.0_676d51ca-4e14-40b3-81e7-1a600d726ce7</td>
<td>CPS PCRF Application License - Additional Applications</td>
</tr>
</tbody>
</table>

---

**Smart Licensing CLI Commands**

The following sections describe the commands that you can use to register, view information for, and manage Smart Licenses on your CPS systems.

---

*Note*

These commands must be run on the active pcrfclient.

---

**Register your Smart License**

You must issue the following command to register your Smart License:

```
license smart register idtoken <token> [force]
```

This command registers the device with Cisco using an ID token that you obtain from the CSSM. The agent will register this product with Cisco and receive back an identity certificate. This certificate is saved and automatically used for all future communications with Cisco. After registration it will send the current license usage information to Cisco. Every 180 days the agent will automatically renew the registration information with Cisco. The ID token is not saved on the device.

This only needs to be done once per device.
The force option will cause the device to attempt registration even if it thinks it is already registered.

**Show Smart License Information**

You can use the following commands to view information related to your Smart License:

- `show license status`
- `show license summary`
- `show license UDI`
- `show license usage`
- `show license all`
- `show license tech support`

**Manage your Smart License**

You can use the following commands to manage your Smart License:

- `license smart renew ID`  
  Dependency – Before using this command, Smart Licensing must be registered using the `license smart register idtoken` command.

  This command initiates a manual update of the license registration information with Cisco. Since the registration renewal is automatically done by the agent every 6 months, the customer will probably never need to use this command. It is available if for some reason the user needs to renew the registration information manually.

- `license smart renew auth`  
  Dependency – Before using this command, Smart Licensing must have been registered using the `license smart register idtoken` command.

  This command manually refreshes license authorization information with Cisco. Since the license authorization is renewed automatically by the agent every 30 days, the customer will probably never need to use this command. It is available if for some reason the user needs to renew the license authorization information manually.

- `license smart deregister`  
  Dependency – Before using this command, Smart Licensing must have been registered using the `license smart register idtoken` command.

  This command unregisters the device. The agent will try to contact the Cisco licensing cloud and unregister itself. All Smart Licensing entitlements and certificates on the platform will be removed. All certificates and registration information will be removed from the trusted store. This is true even if the agent is unable to communicate with Cisco to unregister. If the customer wants to use Smart Licensing again, they must run the `license smart register idtoken` command again.
License Usage Threshold

The Fault list configuration in Policy Builder allows configuring the thresholds at which License Usage Threshold Exceeded traps are sent out. The default recommended values are: Critical 95, Major 90, Minor 85 and Warning 80 which would result in traps being sent at 80, 85, 90 and 95 percent for License Usage Threshold Limits.

For example, if the license limit is 10000 sessions and there are 9600 active sessions, configuring the threshold at 95 and type as Critical would generate a Critical trap whose message is Session Count License Usage at 96%, exceeding threshold: 95%.

Configuration

Step 1  Open the Policy Builder GUI.
Step 2  Go to Reference Data tab and select Fault List from the left pane.
Step 3  Under Create Child, click Fault List to create a License Usage Threshold Fault as below.

Figure 1: License Usage Threshold Fault

Step 4  Choose a Name for the Fault List. Currently, only License Usage Threshold Percentage fault type is supported. The Alarm Severity can be configured to be one of Critical, Major, Minor or Warning.

The recommended values for License Usage Threshold Percentage are:

- Critical 95
- Major 90
- Minor 85
- Warning 80
The above PB configuration when saved and published would trigger an application trap of type MAJOR when the 90% threshold configuration is crossed. One example of a trap sent would be number of licenses exceeded.

**Validation Steps**

**Step 1** Configure a Threshold Limit as explained above in PB.

**Step 2** Generate active sessions exceeding the configured threshold limit.

**Step 3** Validate the Traps are received on the configured trap receiver for the defined limit and Severity.
CHAPTER 4

Managing CPS Interfaces and APIs

- CPS Interfaces and APIs, on page 33
- Multi-user Policy Builder, on page 55
- Control Center Access, on page 57
- Enabling Authentication and Authorization for CRD API, on page 61
- Unified API Security: Access Privileges, on page 63
- Enabling Unified API Access on HTTP Port 8080, on page 65
- TACACS+, on page 68
- CRD APIs, on page 71

CPS Interfaces and APIs

CPS includes southbound interfaces to various policy control enforcement functions (PCEFs) in the network, and northbound interfaces to OSS/BSS and subscriber applications, IMSs, and web applications.

Control Center GUI Interface

Purpose
Cisco Control Center enables you to do these tasks:
- Manage subscriber data, that is, find or create and edit information about your subscribers.
- View subscriber sessions.
- View system sessions.
- Populate custom reference data (CRD) tables.

URL and Port
HA: https://<lbvip01>:443
AIO: http://<ip>:8090

Protocol
HTTPS/HTTP
Accounts and Roles

There are two levels of administrative roles supported for Control Center: Full Privilege and View Only. The logins and passwords for these two roles are configurable in LDAP or in /etc/broadhop/authentication-password.xml.

- Full Privilege Admin Users: These users can view, edit, and delete information and can perform all tasks. Admin users have access to all screens in Control Center.

- View Only Admin Users: These users can view information in Control Center, but cannot edit or change information. View only administrators have access to a subset of screens in the interface.

CRD REST API

Purpose

The Custom Reference Data (CRD) REST API enables the query of, creation, deletion, and update of CRD table data without the need to access the Control Center GUI. The CRD APIs are available using an HTTP REST interface. The specific APIs are outlined in a later section in this guide.

URL and Port

HA: https://<lbvip01>:443/custrefdata
AIO: http://<ip>:8080/custrefdata

A validation URL is:
HA: https://<lbvip01>:8443/custrefdata
AIO: http://<ip>:8080/custrefdata

Protocol

HTTPS/HTTP

Accounts and Roles

Security and account management is accomplished by using the haproxy mechanism on the platform Policy Director (LB) by defining user lists, user groups, and specific users.

On Cluster Manager: /etc/puppet/modules/qps/templates/etc/haproxy/haproxy.cfg

Configure HAProxy

Update the HAProxy configuration to add authentication and authorization mechanism in the CRD API module.

1. Back up the /etc/haproxy/haproxy.cfg file.

2. Edit /etc/haproxy/haproxy.cfg on lb01/lb02 and add a userlist with at least one username and password as shown:

   userlist <userlist name>
   user <username1> password <encrypted password>

   For example:
Run the following command to generate an encrypted password:

```
/sbin/grub-crypt --sha-512
```

For example:
```
[root@host ~]# /sbin/grub-crypt --sha-512
Password:
Retype password:
<encrypted password output>
```

3. Add the following line in frontend https-api to enable Authentication and Authorization for CRD REST API and create a new backend server as crd_api_servers to intercept CRD REST API requests:

```
mode http
acl crd_api path_beg -i /custrefdata/
use_backend crd_api_servers if crd_api
backend crd_api_servers
  mode http
  balance roundrobin
  option httpclose
  option abortonclose
  server qns01_A qns01:8080 check inter 30s
  server qns02_A qns02:8080 check inter 30s
```

4. Update frontend https_all_servers by replacing api_servers with crd_api_servers for CRD API as follows:

```
acl crd_api path_beg -i /custrefdata/
use_backend crd_api_servers if crd_api
```

5. Edit /etc/haproxy/haproxy.cfg on lb01/lb02 as follows:

1. Add at least one group with user in userlist created in Step 2 as follows:
   
   ```
   group qns-ro users readonly
   group qns users apiuser
   ```

2. Add the following lines to the backend crd_api_servers:
   ```
   acl authoriseUsers http_auth_group(<cps-user-list>) <user-group>
   http-request auth realm CiscoApiAuth if !authoriseUsers
   ```

Map the group created in Step 5 with the acl as follows:

```
acl authoriseUsers http_auth_group(<cps-user-list>) <user-group>
```

6. Add the following in the backend crd_api_servers to set read-only permission (GET HTTP operation) for group of users:

   ```
   http-request deny if !METH_GET authoriseUsers
   ```

HAProxy Configuration Example
userlist cps_user_list
group qns-ro users readonly
group qns users apiuser
user readonly password
$6$xRtThhVpS0w410oO$pyEM6VYpVaUAxO0Pjb61Z5eZrmeAUUdCMF7D75B
XKbs4dhNcbXjgChVE0ckfLdp4T2CsUzzNkoqLRdn7RbAAU1
user apiuser password
$6$xRtThhVpS0w410oO$pyEM6VYpVaUAxO0Pjb61Z5eZrmeAUUdCMF7D75B
XKbs4dhNcbXjgChVE0ckfLdp4T2CsUzzNkoqLRdn7RbAAU1
frontend https-api
description API
bind lbvip01:8443 ssl crt /etc/ssl/certs/quantum.pem
mode http
acl crd_api path_beg -i /custrefdata/
use_backend crd_api_servers if crd_api

default_backend api_servers
reqadd X-Forwarded-Proto:\ https if { ssl_fc }
/frontend https_all_servers
description Unified API, CC, Grafana, CRD-API, PB-AP
bind lbvip01:443 ssl crt /etc/ssl/certs/quantum.pem no-sslv3 no-tlsv10
ciphers ECDH+AESGCM:DH+AESGCM:ECDH+AES256:DH+AES256:ECDH+AES128:DH+AES:RSA+AESGCM:RSA+AES:
noNULL:!eNULL:!LOW:!3DES:!MD5:!EXP:!PSK:!SRP:!DSS
mode http
acl crd_api path_beg -i /custrefdata/
use_backend crd_api_servers if crd_api
/backend crd_api_servers
mode http
balance roundrobin
option httpclose
option abortonclose
server qns01_A qns01:8080 check inter 30s
server qns02_A qns02:8080 check inter 30s
acl authoriseReadonlyUsers http_auth_group(cps_user_list) qns-ro
acl authoriseAdminUsers http_auth_group(cps_user_list) qns
http-request auth realm CiscoApiAuth if !authoriseReadonlyUsers
!authoriseAdminUsers
http-request deny if !METH_GET authoriseReadonlyUsers

Note
The haproxy.cfg file is generated by the Puppet tool. Any manual changes to the file in lb01/lb02 would be reverted if the puppet update or vm-inits scripts are run.

Grafana

Purpose
Grafana is a metrics dashboard and graph editor used to display graphical representations of system, application KPIs, bulkstats of various CPS components.
URL and Port

HA: https://<lbvip01>:9443/grafana
AIO: http://<ip>:443/grafana

Protocol

HTTPS/HTTP

Accounts and Roles

In CPS 7.5 and higher, at least one Grafana user account must be created to access the Grafana web interface.

In CPS 8.1 and higher, an administrative user account must be used to add, modify, or delete Grafana dashboards or perform other administrative actions.

Refer to the Graphite and Grafana chapter in this guide for details on adding or deleting these user accounts.

HAProxy

Purpose

Haproxy is a frontend IP traffic proxy process in lb01/lb02 that routes the IP traffic for other applications in CPS. The details of individual port that haproxy forwards is already described in other individual sections.

As per the Diameter configuration done, haproxy-diameter statistics will bind to one of the configurations and that URL will be displayed in about.sh output. For various options for Diameter configuration, refer to Diameter Related Configuration section in CPS Installation Guide for VMware.

More information about HAPerxy is provided in the HAPerxy, on page 136.

Documentation for HAPerxy is available at: http://www.haproxy.org/#docs

URL and Port

To view statistics, open a browser and navigate to the following URL:


Accounts and Roles

Not applicable.

JMX Interface

Purpose

Java Management Extension (JMX) interface can be used for managing and monitoring applications and system objects.

Resources to be managed / monitored are represented by objects called managed beans (mbeans). MBean represents a resource running in JVM and external applications can interact with mbeans through the use of
JMX connectors and protocol adapters for collecting statistics (pull); for getting/setting application configurations (push/pull); and notifying events like faults or state changes (push).

**CLI Access**

External applications can be configured to monitor application over JMX. In addition to this, there are scripts provided by application that connects to application over JMX and provide required statistics/information.

**Port**

pcrfclient01/pcrfclient02:
- Control Center: 9045
- Policy Builder: 9046

lb01/lb02:
- iomanager: 9045
- Diameter Endpoints: 9046, 9047, 9048...

qns01/qns02/qns... : 9045

Ports should be blocked using firewall to prevent access from outside the CPS system.

**Accounts and Roles**

Not applicable.

### Logstash

**Purpose**

Logstash is a process that consolidates the log events from CPS nodes into pcrfclient01/pcrfclient02 for logging and alarms. The logs are forwarded to CPS application to raise necessary alarms and the logs are stored at /var/log/logstash/logstash.log.
If logstash is not monitoring, then check the Policy Server (qns) process using `monit summary`.

```
[root@dc1-pcrfclient01 ~]# monit summary
The Monit daemon 5.17.1 uptime: 18h 41m

Process 'whisper' Running
Process 'sssd' Running
Process 'snmpd' Running
Program 'kpi_trapr' Status ok
Program 'db_trapr' Status failed
Program 'failover_trapr' Status ok
Program 'gps_process_trapr' Status ok
Program 'admin_login_trapr' Status ok
Program 'vm_trapr' Status ok
Program 'gps_message_trapr' Status ok
Program 'ldap_message_trapr' Status ok
Program 'logstash_process_status' Status ok
Process 'qns-2' Running
Process 'qns-1' Does not exist
Process 'corosync' Running
Program 'monitor_replica' Status ok
File 'monitor-qns-2' Accessible
File 'monitor-qns-1' Accessible
Process 'logstash' Not monitored
Program 'mon_db_for_lb_failover' Status ok
Program 'mon_db_for_callmodel' Status ok
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trapr' Status ok
Program 'gen_low_mem_trapr' Status ok
Process 'collectd' Running
Process 'carbon-cache' Running
Process 'carbon-aggregator' Running
Process 'auditrpms.sh' Running
System 'dcl-pcrfclient01' Running
```

On pcrfclient node, if Policy Server (qns) process is not running, 'logstash_process_status' program stops the logstash process so that the alarm is raised from another pcrfclient node.

**CLI Access**

There is no specific CLI interface for logstash.

**Protocol**

TCP and UDP

**Ports**

TCP: 5544, 5545, 7546, 6514

UDP: 6514

**Accounts and Roles**

Not applicable.
Purpose

In CPS 14.0.0 and higher releases, SSSD based authentication is supported, allowing users to authenticate against an external LDAP server and gain access to the CPS CLI. SSSD RPMs and default `sssd.conf` file is installed on each CPS VM when you perform a new installation or upgrade CPS.

For more information, refer to the `CPS Installation Guide for VMware`.

`/etc/monit.d/sssd` file has been added with the following content so that SSSD is monitored by monit:

```plaintext
check process sssd with pidfile /var/run/sssd.pid
start program = "/etc/init.d/sssd start" with timeout 30 seconds
stop program = "/etc/init.d/sssd stop" with timeout 30 seconds
```

Also `/etc/logrotate.d/sssd` file has been added to rotate the SSSD log files. Here is the default configuration:

```plaintext
"/var/log/sssd/*.log {
    daily
    missingok
    notifempty
    sharedscripts
    nodateext
    rotate 5
    size 100M
    compress
    delaycompress
    postrotate
        /bin/kill -HUP `cat /var/run/sssd.pid` 2>/dev/null 2> /dev/null || true
    endscript
}
"
```

Use the `monit summary` command to view the list of services managed by monit. Here is an example:

```
monit summary
The Monit daemon 5.17.1 uptime: 4d 2h 22m

Process 'whisper' Running
Process 'sssd' Running
Process 'snmptrapd' Running
Process 'snmpd' Running
Program 'vip_trap' Status ok
Program 'gr_site_status_trap' Status ok
Process 'redis' Running
Process 'gns-4' Running
Process 'gns-3' Running
Process 'gns-2' Running
Process 'gns-1' Running
File 'monitor-gns-4' Accessible
File 'monitor-gns-3' Accessible
File 'monitor-gns-2' Accessible
File 'monitor-gns-1' Accessible
Process 'memcached' Running
Process 'irqbalance' Running
Process 'haproxy-diameter' Running
Process 'haproxy' Running
Process 'cutter' Running
Process 'corosync' Running
```
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'lb01' Running

---

**Important**

Setting of other configuration files to support LDAP based authentication and the changes required in `sssd.conf` file as per the customer deployment is out of scope of this document. For more information, consult your Cisco Technical Representative.

---

**Restriction**

Grafana support LDAP authentication over httpd and does not use SSSD feature. Due to this, if LDAP server is down then grafana is not accessible for LDAP users.

---

**CLI Access**

No CLI is provided.

**Port**

Port number is not required.

---

**Configure Policy Builder**

**Step 1**

To provide admin access, enter username in the following file:

```
/var/www/svn/users-access-file
```

**Note**

This action should be performed on pcrcfclient and not on policy server (qns).

```
[groups]
admins = qns,qns-svn,sssd_pb_2
nonadmins = qns-ro
(/)
@admins = rw
@nonadmins = r
* = r
```

**Step 2**

Verify if you can export CRD data from the following link:

```
http://<aio_server>:7070/central/
```

---

**Configure Grafana**

**Step 1**

Bypass the first level authentication by updating the `/etc/httpd/conf.d/grafana-proxy.conf` file as follows:
LoadModule proxy_module modules/mod_proxy.so
LoadModule proxy_balancer_module modules/mod_proxy_balancer.so
LoadModule proxy_ftp_module modules/mod_proxy_ftp.so
LoadModule proxy_http_module modules/mod_proxy_http.so
LoadModule proxy_ajp_module modules/mod_proxy_ajp.so
LoadModule proxy_connect_module modules/mod_proxy_connect.so
# Set root to <ip address>/grafana
ProxyPass /grafana http://127.0.0.1:3000
ProxyPassReverse /grafana http://127.0.0.1:3000
# Set authentication for Grafana
# 1) Use httpd authentication as a front-end to Grafana
# 2) Remove header since Grafana is configured for anonymous
# authentication and will fail with a pass-thru header
#
# Notice: scope of authentication and header is limited to Grafana
# to avoid conflicts with other applications. Apache configuration
# in this file is global unless contained in the directive below.
<Location "/grafana">
    LoadModule headers_module modules/mod_headers.so
    Header set Access-Control-Allow-Origin "*"
    Header set Access-Control-Allow-Methods "GET, OPTIONS"
    Header set Access-Control-Allow-Headers "origin, authorization, accept"
    Header set Access-Control-Allow-Credentials true
    # Do not pass credentials to Grafana's anonymous authorization
    RequestHeader unset Authorization
    Satisfy Any
    #AuthName "Authentication Required"
    #AuthUserFile "/var/broadhop/.htpasswd"
    #Require valid-user
    #Order allow,deny
    # This is used for local calls to the API during puppet bring up
    Allow from 127.0.0.1
    #Satisfy Any
</Location>

Step 2  Restart httpd by running the following command:

/usr/bin/systemctl restart httpd

If port already in use error is displayed, execute the following steps:

a)  Run the following command to get process ID:

    ps -eaf | grep httpd

b)  Run the following command to kill the pid:

    kill -9 <pid>

Step 3  Update /etc/grafana/grafana.ini file to point to LDAP authentication instead of Basic Auth as follows:

    #################################### Basic Auth ##########################
    [auth.basic]
    # For CPS, trusted API requests come here and need local authentication
    ;enabled = true
    #################################### Auth LDAP ##########################
    [auth.ldap]
    enabled = true
    config_file = /etc/grafana/ldap.toml

Step 4  Modify /etc/grafana/ldap.toml file to provide LDAP details (for example, search basedn, bind dn, group search
base dn, member_of attribute) as follows:

    # Set to true to log user information returned from LDAP
    verbose_logging = true
# Ldap server host (specify multiple hosts space separated)
host = "ldap_l.cisco.com"
# Default port is 389 or 636 if use_ssl = true
port = 10648
# Set to true if ldap server supports TLS
use_ssl = true
# set to true if you want to skip ssl cert validation
ssl_skip_verify = true
# set to the path to your root CA certificate or leave unset to use system defaults
#root_ca_cert = "/etc/openldap/certs/ldap_local.cer"

# Search user bind dn
bind_dn = "uid=admin,ou=system"
# Search user bind password
bind_password = 'secret'

# User search filter, for example "(cn=%s)" or "(sAMAccountName=%s)" or "(uid=%s)"
search_filter = "(uid=%s)"

# An array of base dns to search through
search_base_dns = ["ou=users,dc=sprint,dc=com"]
#search_base_dns = ["ou=groups,dc=sprint,dc=com"]

# In POSIX LDAP schemas, without memberOf attribute a secondary query must be made for groups.
# This is done by enabling group_search_filter below. You must also set member_of= "cn"
# in [servers.attributes] below.
# Users with nested/recursive group membership and an LDAP server that supports
# LDAP_MATCHING_RULE_IN_CHAIN
# can set group_search_filter, group_search_filter_user_attribute, group_search_base_dns
# and member_of
# below in such a way that the user's recursive group membership is considered.
#
# Nested Groups + Active Directory (AD) Example:
#
# AD groups store the Distinguished Names (DNs) of members, so your filter must
# recursively search your groups for the authenticating user's DN. For example:
#
# group_search_filter = "(member:1.2.840.113556.1.4.1941:=%s)"
# group_search_filter_user_attribute = "distinguishedName"
# group_search_base_dns = ["ou=groups,dc=sprint,dc=com"]
#
# [servers.attributes]
# ... 
# member_of = "distinguishedName"

## Group search filter, to retrieve the groups of which the user is a member (only set if
## memberOf attribute is not available)
##group_search_filter = "(cn=%s)"
##group_search_filter = "(&(objectClass=*)(cn=%s))"
## Group search filter user attribute defines what user attribute gets substituted for %s
## in group_search_filter.
## Defaults to the value of username in [server.attributes]
## Valid options are any of your values in [servers.attributes]
## If you are using nested groups you probably want to set this and member_of in
## [servers.attributes] to "distinguishedName"
#group_search_filter_user_attribute = "cn"
## An array of the base DNS to search through for groups. Typically uses ou=groups
#group_search_base_dns = ["ou=groups,dc=sprint,dc=com"]
#group_search_base_dns = ["cn=Roles,ou=groups,dc=sprint,dc=com"]

# Specify names of the ldap attributes your ldap uses
[servers.attributes]
name = "cn"
surname = "sn"
username = "uid"
member_of = "cn"
email = "email"

# Map ldap groups to grafana org roles
[[servers.group_mappings]]
group_dn = "cn=Admin,ou=groups,dc=sprint,dc=com"
org_role = "Admin"
# The Grafana organization database id, optional, if left out the default org (id 1) will
# be used
# org_id = 1

[[servers.group_mappings]]
group_dn = "cn=User,ou=groups,dc=sprint,dc=com"
org_role = "Editor"

# If you want to match all (or no ldap groups) then you can use wildcard
#group_dn = "*"
#org_role = "Viewer"

Step 5       Restart Grafana server by running the following command:

  service grafana-server restart

Step 6       Log in to Grafana using LDAP user credentials.

---

**Mongo Database**

**Purpose**

MongoDB is used to manage session storage efficiently and address key requirements: Low latency reads/writes, high availability, multi-key access and so on.

CPS support different models of mongo database based on CPS deployment like AIO, HA or Geo-redundancy. Not all of the databases listed below may be used in your CPS deployment.

To rotate the mongoDB logs on the Session Manager VM, open the mongoDB file by executing the following command:

```bash
cat /etc/logrotate.d/mongodb
```

You will have output as similar to the following:

```json
{
daily
  rotate 5
copytruncate
create 640 root root
sharedscripts
postrotate
endscript
}
```

In the above script the mongoDB logs are rotated daily and it ensures that it keeps the latest 5 backups of these log files.

**HA**
The standard definition for supported replica-set defined in configuration file. This configuration file is self-explanatory which contains replica-set, set-name, hostname, port number, data file path and so on.

Location: /etc/broadhop/mongoConfig.cfg

**Table 4: HA Mongo Databases**

<table>
<thead>
<tr>
<th>Database Name</th>
<th>Port Number</th>
<th>Primary DB Host</th>
<th>Secondary DB Host</th>
<th>Arbiter</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>session_cache</td>
<td>27717</td>
<td>sessionmgr01</td>
<td>sessionmgr02</td>
<td>pcrfcli01</td>
<td>Session database</td>
</tr>
<tr>
<td>balance_mgmt</td>
<td>27718</td>
<td>sessionmgr01</td>
<td>sessionmgr02</td>
<td>pcrfcli01</td>
<td>Quota/Balance database</td>
</tr>
<tr>
<td>audit</td>
<td>27725</td>
<td>sessionmgr01</td>
<td>sessionmgr02</td>
<td>pcrfcli01</td>
<td>Reporting database</td>
</tr>
<tr>
<td>spr</td>
<td>27720</td>
<td>sessionmgr01</td>
<td>sessionmgr02</td>
<td>pcrfcli01</td>
<td>USuM database</td>
</tr>
<tr>
<td>cust_ref_data</td>
<td>27717</td>
<td>sessionmgr01</td>
<td>sessionmgr02</td>
<td>pcrfcli01</td>
<td>Custom Reference Data</td>
</tr>
</tbody>
</table>

Note: The port number configuration is based on what is configured in each of the respective Policy Builder plug-ins. Refer to the Plug-in Configuration chapter of the CPS Mobile Configuration Guide for correct port number and ports defined in mongo configuration file.

**AIO**

The All-in-One deployment mongo database runs on ports 27017 and 27729.

**Table 5: AIO Mongo Databases**

<table>
<thead>
<tr>
<th>Database Name</th>
<th>Port Number</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>27017</td>
<td>This port is used for all the databases.</td>
</tr>
</tbody>
</table>

**Important**

While choosing mongo ports for replica-sets, consider the following:

- Port is not in use by any other application. To check it, login to VM on which replica-set is to be created and execute the following command:

  ```bash
  netstat -lnp | grep <port_no>
  ```

  If no process is using same port then port can be chosen for replica-set for binding.

- Port number used should be greater than 1024 and not in ephemeral port range i.e, not in between following range:

  ```bash
  net.ipv4.ip_local_port_range = 32768 to 61000
  ```
**CLI Access**

Use the following commands to access the MongoDB CLI:

**HA:**
Login to `pcrcfclient01` or `pcrcfclient02` and run: `diagnostics.sh --get_replica_status`
This command will output information about the databases configured in the CPS cluster.

---

**Note**

If a member is shown in an unknown state, it is likely that the member is not accessible from one of other members, mostly an arbiter. In that case, you must go to that member and check its connectivity with other members.

Also, you can login to mongo on that member and check its actual status.

**AIO:**

```
mongo --port 27017
```

**Protocol**

Not applicable.

**Port**

Not applicable.

**Accounts and Roles**

Restrict MongoDB Access for Readonly Users: If firewall is enabled on system, then on all VMs for all readonly users, IP table rule will be created for outgoing connections to reject outgoing traffic to MongoDB replica sets.

For example, rule similar to the following is created.

```
REJECT tcp -- anywhere sessionmgr01 tcp dpt:27718 owner GID match qns-ro reject-with icmp-port-unreachable
```

With this, qns-ro user has restricted MongoDB access on sessionmgr01 on port 27718. Such rules are added for all readonly users who are part of qns-ro group for all replica sets.

---

**OSGi Console**

**Purpose**

CPS is based on Open Service Gateway initiative (OSGi) and OSGi console is a command-line shell which can be used for analyzing problems at OSGi layer of the application.

**CLI Access**

Use the following command to access the OSGi console:

```
telnet <ip> <port>
```
The following commands can be executed on the OSGi console:

- `ss`: List installed bundle status.
- `start <bundle-id>`: Start the bundle.
- `stop <bundle-id>`: Stop the bundle.
- `diag <bundle-id>`: Diagnose the bundle.

**Sharding Commands**

Use the following OSGi commands to add or remove shards:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>listshards</code></td>
<td>Lists all the shards.</td>
</tr>
<tr>
<td><code>removeshard &lt;shard id&gt;</code></td>
<td>Marks the shard for removal. If shard is non-backup, rebalance is required for shard to be removed fully. If shard is backup, it does not require rebalance of sessions and hence would be removed immediately.</td>
</tr>
<tr>
<td><code>rebalance &lt;rate limit&gt;</code></td>
<td>Rebalances the buckets and migrates session with rate limit. Rate limit is optional. If rate limit is passed, it is applied at rebalance.</td>
</tr>
<tr>
<td><code>rebalancebg &lt;rate limit&gt;</code></td>
<td>Rebalances the buckets and schedules background task to migrate sessions. Rate limit is optional. If rate limit is passed, it is applied at rebalance.</td>
</tr>
<tr>
<td><code>rebalancestatus</code></td>
<td>Displays the current rebalance status. Status can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• Rebalance is running (Remaining buckets: &lt;pending count&gt;)</td>
</tr>
<tr>
<td></td>
<td>• Rebalance is required</td>
</tr>
<tr>
<td></td>
<td>• Rebalanced</td>
</tr>
<tr>
<td><code>rebuildAllSkRings</code></td>
<td>In order for CPS to identify a stale session from the latest session, the secondary key mapping for each site stores the primary key in addition to the bucket ID and the site ID, that is, Secondary Key = &lt;Bucket Id&gt;; &lt;Site Id&gt;; &lt;Primary Key&gt;. To enable this feature, add the flag <code>-Dcache.config.version=1</code> in the <code>/etc/broadhop/qns.conf</code> file. Enabling this flag and running <code>rebuildAllSkRings</code> starts the data migration for the new version so that CPS can load the latest version of the session.</td>
</tr>
<tr>
<td><code>skRingRebuildStatus</code></td>
<td>Displays the status of the migration and the current cache version.</td>
</tr>
</tbody>
</table>
CPS Alarm Commands

Use the following OSGi command to get the information related to open application alarms in CPS:

Table 7: Alarm Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>listalarms</td>
<td>To list the open/active application alarms since last restart of policy server (QNS) process on pcrfclient01/02 VM.</td>
</tr>
</tbody>
</table>

Example:

```
 osgi> listalarms
Active Application Alarms
id=1000 sub_id=3001 event_host=lb02 status=down date=2017-11-22,10:47:34,051+0000 msg="3001:Host: site-host-gx Realm: site-gx-client.com is down"
```

Ports

pcrfclientXX:
- Control Center: 9091
- Policy Builder: 9092

lbXX:
- iomanager: 9091
- Diameter Endpoints: 9092, 9093, 9094 ...

qnsXX: 9091

Ports should be blocked using a firewall to prevent access from outside the CPS cluster.

Accounts and Roles

Not applicable.

Policy Builder GUI

Purpose

Policy Builder is the web-based client interface for the configuration of policies in Cisco Policy Suite.

URL and Port

HA: https://<lbvip01>:7443/pb
AIO: http://<ip>:7070/pb

Protocol
HTTPS/HTTP

Accounts and Roles
Initial accounts are created during the software installation. Refer to the CPS Operations Guide for commands to add users and change passwords.

REST API

Purpose
To allow initial investigation into a Proof of Concept API for managing a CPS System and Custom Reference Data related through an HTTPS accessible JSON API.

CLI Access
This is an HTTPS/Web interface and has no Command Line Interface.

URL and Port
API: http://<Cluster Manager IP>:8458

Accounts and Roles
Initial accounts are created during the software installation. Refer to the CPS Operations Guide for commands to add users and change passwords.

Rsyslog

Purpose
Enhanced log processing is provided using Rsyslog.

Rsyslog logs Operating System (OS) data locally (/var/log/messages etc.) using the /etc/rsyslog.conf and /etc/rsyslog.d/*.conf configuration files.

rsyslog outputs all WARN level logs on CPS VMs to /var/log/warn.log file.

On all nodes, Rsyslog forwards the OS system log data to lbvip02 via UDP over the port defined in the logback_syslog_daemon_port variable as set in the CPS deployment template (Excel spreadsheet). To download the most current CPS Deployment Template (/var/qps/install/current/scripts/deployer/templates/QPS_deployment_config_template.xlsm), refer to the CPS Installation Guide for VMware or CPS Release Notes for this release.

Additional information is available in the Logging chapter of the CPS Troubleshooting Guide. Refer also to http://www.rsyslog.com/doc/ for the Rsyslog documentation.
CLI Access
Not applicable.

Protocol
UDP

Port
6514

Accounts and Roles
Account and role management is not applicable.

Rsyslog Customization
CPS provides the ability to configure forwarding of consolidated syslogs from rsyslog-proxy on Policy Director VMs to remote syslog servers (refer to CPS Installation Guide for VMware). However, if additional customizations are made to rsyslog configuration to forward logs to external syslog servers in customer’s network for monitoring purposes, such forwarding must be performed via dedicated action queues in rsyslog. In the absence of dedicated action queues, when rsyslog is unable to deliver a message to the remote server, its main message queue can fill up which can lead to severe issues, such as, preventing SSH logging, which in turn can prevent SSH access to the VM.

Sample configuration for dedicated action queues is available in the Logging chapter of the CPS Troubleshooting Guide. Refer to rsyslog documentation on http://www.rsyslog.com/doc/v5-stable/concepts/queues.html for more details about action queues.

SVN Interface
Apache™ Subversion (SVN) is the versioning and revision control system used within CPS. It maintains all the CPS policy configurations and has repositories in which files can be created, updated and deleted. SVN maintains the file difference each time any change is made to a file on the server and for each change it generates a revision number.

In general, most interactions with SVN are performed via Policy Builder.

CLI Access
Use the following commands to access SVN:

Get all files from the server:

```
svn checkout --username <username> --password <password> <SVN Repository URL> <Local Path>
```

Example:

```
svn checkout --username broadhop --password broadhop
http://pcrfclien01/repos/configuration/root/configuration
```

If `<Local Path>` is not provided, files are checked out to the current directory.

Store/check-in the changed files to the server:

```
svn commit --username <username> --password <password> <Local Path> -m "modified config"
```
Example:
svn commit --username broadhop --password broadhop /root/configuration -m “modified config”

Update local copy to latest from SVN:
svn update <Local Path>

Example:
svn update /root/configuration/

Check current revision of files:
svn info <Local Path>

Example:
svn info /root/configuration/

Note
Use svn --help for a list of other commands.

Protocol
HTTP

Port
80

Accounts and Roles

CPS 7.0 and Higher Releases

Add User with Read Only Permission

From the pcrfclient01 VM, run adduser.sh to create a new user.
/var/qps/bin/support/adduser.sh

Note
This command can also be run from the Cluster Manager VM, but you must include the OAM (PCRFCLIENT) option:
/var/qps/bin/support/adduser.sh pcrfclient

Example:
[root@pcrfclient01 ~]# /var/qps/bin/support/adduser.sh
Enter username: <username>
Enter group for the user: <any group>
Enter password:
Re-enter password:
Add User with Read/Write Permission

By default, the `adduser.sh` script creates a new user with read-only permissions. For read-write permission, you must assign the user to the `qns-svn` group and then run the `vm-init` command.

From the `pcrfclient01` VM, run the `adduser.sh` script to create the new user.

Run the following command on both `pcrfclient01` and `pcrfclient02` VMs:

```
/etc/init.d/vm-init
```

You can now login and commit changes as the newly created user.

Change Password

From the `pcrfclient01` VM, run the `change_passwd.sh` script to change the password of a user.

```
/var/qps/bin/support/change_passwd.sh
```

Example:

```
[root@pcrfclient01 /]# /var/qps/bin/support/change_passwd.sh
Enter username whose password needs to be changed: user1
Enter new password:
Re-enter new password:
```

CPS Versions Earlier than 7.0

Perform all of the following commands on both the `pcrfclient01` and `pcrfclient02` VMs.

Add User

Use the `htpasswd` utility to add a new user

```
htpasswd -mb /var/www/svn/.htpasswd <username> <password>
```

Example:

```
htpasswd -mb /var/www/svn/.htpasswd user1 password
```

In some versions, the password file is `var/www/svn/password`

Provide Access

Update the user role file `/var/www/svn/users-access-file` and add the username under `admins` (for read/writer permissions) or `nonadmins` (for read-only permissions). For example:

```
[groups]
admins = broadhop
nonadmins = read-only, user1
[/]
@admins = rw
@nonadmins = r
```

Change Password

Use the `htpasswd` utility to change passwords.

```
htpasswd -mb /var/www/svn/.htpasswd <username> <password>
```

Example:
TACACS+ Interface

**Purpose**
CPS 7.0 and above has been designed to leverage the Terminal Access Controller Access Control System Plus (TACACS+) to facilitate centralized management of users. Leveraging TACACS+, the system is able to provide system-wide authentication, authorization, and accounting (AAA) for the CPS system.

Further the system allows users to gain different entitlements based on user role. These can be centrally managed based on the attribute-value pairs (AVP) returned on TACACS+ authorization queries.

**CLI Access**
No CLI is provided.

**Port**
CPS communicates to the AAA backend using IP address/port combinations configured by the operator.

**Account Management**
Configuration is managed by the Cluster Management VM which deploys the `/etc/tacplus.conf` and various PAM configuration files to the application VMs. For more account management information, refer to TACACS+ Service Requirements, on page 68.

For more information about TACACS+, refer to the following links:
- Portions of the solution reuse software from the open source pam_tacplus project hosted at: [https://github.com/jeroennijhof/pam_tacplus](https://github.com/jeroennijhof/pam_tacplus)

For information on CLI commands, refer to Accessing the CPS CLI, on page 54.

Unified API

**Purpose**
Unified APIs are used to reference customer data table values.

**URL and Port**
HA: `https://<lbvip01>:8443/ua/soap`
AIO: `http://<ip>:8080/ua/soap`

**Protocol**
HTTPS/HTTP
Accounts and Roles

Currently there is no authorization for this API

Accessing the CPS CLI

sudo supports a plugin architecture for security policies and input/output logging. The default security policy is sudoers, which is configured via the file /etc/sudoers, contains the rules that users must follow when using the sudo command.

sudo allows a system administrator to delegate authority to give certain users (or groups of users) the ability to run some (or all) commands as root or another user while providing an audit trail of the commands and their arguments.

For example: %adm ALL=(ALL) NOPASSWD: ALL

This means that any user in the administrator group on any host may run any command as any user without a password. The first ALL refers to hosts, the second to target users, and the last to allowed commands.

When an authenticated user has one of the above group permissions, they can access the CPS CLI and run predefined commands available to that user role. A list of commands available after authentication can be viewed using the sudo -l command (-l for list), or any user with root privileges can use sudo -l -U <qns-role> to see the available command for a specific Policy Server (qns) role.

The /etc/sudoers file contains user specifications that define the commands that users may execute. When sudo is invoked, these specifications are checked in order, and the last match is used. A user specification looks like this at its most basic:

User Host = (Runas) Command

Read this as "User may run Command as the Runas user on Host". Any or all of the above may be the special keyword ALL, which always matches. User and Runas may be usernames, group names prefixed with %, numeric UIDs prefixed with #, or numeric GIDs prefixed with %#. Host may be a hostname, IP address, or a whole network (for example, 192.0.2.0/24), but not 127.0.0.1.

Group Identifiers

 gid

The group identifier of the TACACS+ authenticated user on the VM nodes. This value should reflect the role assigned to a given user, based on the following values:

- group id=500 (qns)
  The group identifier used by Policy Server (qns) user in application.

- group id=501 (qns-su)
  This group identifier should be used for users that are entitled to attain superuser (or 'root') access on the CPS VM nodes.

- group id=504 (qns-admin)
  This group identifier should be used for users that are entitled to perform administrative maintenance on the CPS VM nodes.
To execute administrative scripts from qns-admin, prefix the command with `sudo`. For example

```
sudo stopall.sh
```

- **groupid=505 (qns-ro)**

  This group identifier should be used for users that are entitled to read-only access to the CPS VM nodes.

When an authenticated user has one of the above group permissions, they can access the CPS CLI and run predefined commands available to that user role. A list of commands available after authentication can be viewed using the `sudo -l` command (-l for list), or any user with root privileges can use `sudo -l -U <qns-role>` to see the available command for a specific Policy Server (qns) role.

For more information, refer to [https://www.sudo.ws/intro.html](https://www.sudo.ws/intro.html).

**home**

The user's home directory on the CPS VM nodes. To enable simpler management of these systems, the users should be configured with a pre-deployed shared home directory based on the role they are assigned with the gid.

- home=/home/qns-su should be used for users in the 'qns-su' group (gid=501)
- home=/home/qns-admin should be used for users in the 'qns-admin' group (gid=504)
- home=/home/qns-ro should be used for users in the 'qns-ro' group (gid=505)

---

**Multi-user Policy Builder**

Multiple users can be logged into Policy Builder at the same time.

In the event that two users attempt to make changes on same screen and one user saves their changes to the client repository, the other user may receive errors. In such cases the user must return to the login page, revert the configuration, and repeat their changes.

This section covers the following topics:

- [Create Users, on page 55](#)
- [Revert Configuration, on page 56](#)

---

**Create Users**

**Step 1**  
Log in to the Cluster Manager.

**Step 2**  
Add a user to CPS by executing:

```
adduser.sh
```

**Step 3**  
When prompted for the user’s group, set ‘qns-svn’ for read-write permissions or ‘qns-ro’ for read-only permissions.
• To check if a user already exists, login in as root and enter `su username`.
• To check a user’s ‘groups’, enter `groups username`.
• To change a user’s password, use the `change_passwd.sh` command.

Refer to CPS Commands, on page 183 for more information about these commands.

---

Revert Configuration

The user can revert the configuration if changes since the last publish/save to client repository are not wanted. This can also be necessary in the case of a ‘syn conflict’ error where both perfclient01 and perfclient02 are in use at the same time by different users and publish/save to client repository changes to the same file. The effect of reverting changes is that all changes since the publish/save to client repository will be undone.

---

Step 1

On the Policy Builder login screen, verify the user for which changes need to be reverted is correct. This can be done by clicking **Edit** and verifying that the Username and Password fields are correct.

*Figure 2: Verifying the User*

---

Step 2

Click **Revert**.

The following confirmation dialog opens.

*Figure 3: Revert Confirmation Message*

---

Step 3

Click **OK** to revert back to the earlier configuration. The following dialog confirms that the changes are reverted successfully.
Publishing Data

This section describes publishing Cisco Policy Builder data to the Cisco Policy Server. Publishing data occurs in the Cisco Policy Builder client interface, but affects the Cisco Policy Server. Refer to the CPS Mobile Configuration Guide for steps to publish data to the server.

Cisco Policy Builder manages data stored in two areas:

- The Client Repository stores data captured from the Policy Builder GUI in Subversion. This is a place where trial configurations can be developed and saved without affecting the operation of the Cisco Policy Builder server data.
  The default URL is http://pcrfclient01/repos/configuration.
- The Server Repository is where a copy of the client repository is created/updated and where the CPS picks up changes. This is done on Publish from Policy Builder.

  Note: Publishing will also do a Save to Client Repository to ensure the Policy Builder and Server configurations are not out of sync.

The default URL is http://pcrfclient01/repos/run.

Control Center Access

After the installation is complete, you need to configure the Control Center access. This is designed to give the customer a customized Control Center username.

Add a Control Center User

Step 1  Login to the Cluster Manager VM.
Step 2  Execute the following script to add a Control Center user.
/var/qps/bin/support/adduser.sh

  Note: To add a user with 'read/write' access to Control Center, their group should be 'qns'. To add a user with 'read' access to Control Center, their group should be 'qns-ro'.
Example:

```
/var/qps/bin/support/adduser.sh
Enter username: username
Enter group for the user: groupname
Enter password: password
Re-enter password: password
```

This example adds `username` to all the VMs in the cluster.

---

### Update Control Center Mapping

This section describes updating Control Center mapping of read-write/read-only to user groups (Default: qns and qns-ro respectively).

**Step 1**
Login to the Cluster Manager VM.

**Step 2**
Update `/etc/broadhop/authentication-provider.xml` to include the group mapping for the group you want to use.

**Note**
Make sure that this group exists on at least the Policy Server (QNS) VMs or adding users will fail due to no group available (there should be an entry in `/etc/group`).

In the following example, the 'test' group has been added as a read-write mapping for Control Center - updated line in bold:

```xml
<beans:beans xmlns="http://www.springframework.org/schema/security"
             xmlns:beans="http://www.springframework.org/schema/beans"
             xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xsi:schemaLocation="http://www.springframework.org/schema/beans
                                  classpath:/org/springframework/beans/factory/xml/spring-beans-3.0.xsd
                                  http://www.springframework.org/schema/security
                                  classpath:/org/springframework/security/config/spring-security-3.0.xsd">
    <beans:bean id="authenticationProvider"
                class="com.broadhop.ui.security.server.pam.PamAuthenticationProvider">
        <!-- change the key value to be the customer's role that maps to the cisco role. -->
        <beans:property name="roleMap">
            <beans:map>
                <beans:entry key="qns" value="ROLE_SUMADMIN"/>
                <beans:entry key="test" value="ROLE_SUMADMIN"/>
            </beans:map>
        </beans:property>
    </beans:bean>

    <authentication-manager>
        <authentication-provider ref="authenticationProvider"/>
    </authentication-manager>

</beans:beans>
```

**Step 3**
Run `syncconfig.sh` to put this file on all VMs.

**Step 4**
Restart the CPS system, so that the changes done above are reflected in the VMs:

`restartall.sh`
To add a new user to Control Center and specify the group you have specified in the configuration file above, refer to Add a Control Center User, on page 57.

## Multiple Concurrent User Sessions

CPS Control Center supports session limits per user. If the user exceeds the configured session limit, they are not allowed to log in. CPS also provides notifications to the user when other users are already logged in.

When a user logs in to Control Center, a Welcome message displays at the top of the screen. A session counter is shown next to the username. This represents the number of login sessions for this user. In the following example, this user is logged in only once (1).

*Figure 5: Welcome Message*

![Welcome Message](image)

The user can click the session counter (1) link to view details for the session(s), as shown below.

*Figure 6: Viewing Session Details*

![Viewing Session Details](image)

When another user is already logged in with the same username, a notification displays for the second user in the bottom right corner of the screen, as shown below.

*Figure 7: Login Notification for a Second User*

![Login Notification](image)

The first user also receives a notification, as shown, and the session counter is updated to 2.
Configure Session Limit

The session limit can be configured by the runtime argument, which can be configured in the qns.conf file.

-Dcc.user.session.limit=3 (default value is 5)

Configure Session Timeout

The default session timeout can be changed by editing the following file on the Policy Server (QNS) instance:

```
./opt/broadhop/qns-1/plugins/com.broadhop.ui_3.5.0.release/war/WEB-INF/web.xml
```

```
<!-- timeout after 15 mins of inactivity -->
<session-config>
 <session-timeout>15</session-timeout>
 </session-config>
```

The same timeout value must be entered on all Policy Server (QNS) instances.

When the number of sessions of the user exceeds the session limit, the user is not allowed to log in and receives the message “Max session limit per user exceed!”
Important Notes

If a user does not log out and then closes their browser, the session remains alive on the server until the session times out. When the session timeout occurs, the session is deleted from the memcached server. The default session timeout is 15 minutes. This is the idle time after which the session is automatically deleted.

When a Policy Server (QNS) instance is restarted, all user/session details are cleared.

When the memcached server is restarted without also restarting the Policy Server (QNS) instance, all http sessions on the Policy Server (QNS) instance are invalidated. In this case the user is asked to log in again and after that, the new session is created.

Enabling Authentication and Authorization for CRD API

Update the HAProxy configuration to enable authentication and authorization mechanism in the CRD API module.

There are two options to include a username and password in an API request:

1. Include the username and password directly in the request as shown:

   ```
   https://<username>:<password>@<lbvip02>:8443/custrefdata/_checksum
   ```

2. Add an authentication header to the request as shown:

   ```
   Authorization: Basic <base64 encoded value of username:password>
   ```

Step 1  Back up the `/etc/haproxy/haproxy.cfg` file before making modifications in the following steps.

Step 2  Edit `/etc/haproxy/haproxy.cfg` on lb01/lb02 and add a userlist with at least one username and password.

   Use the following syntax:

   ```
   userlist <userlist name>
   user <username1> password <encrypted password>
   ```

   For example:

   ```
   userlist cps_user_list
   user readonly password $6$xRtThhVpS0w41O6S8yEM6VYpVaUAx00Pj61ZSeZrmeAUUdCMF7iJ58bKb4dNChjcXOcGlVe0ckfLDp4T2CsUznKoqlRd4n7RcbAAU1
   user apiuser password $6$xRtThhVpS0w41O6S8yEM6VYpVaUAx00Pj61ZSeZrmeAUUdCMF7iJ58bKb4dNChjcXOcGlVe0ckfLDp4T2CsUznKoqlRd4n7RcbAAU1
   ```

   Run the following command to generate an encrypted password:

   ```
   /sbin/grub-crypt --sha-512
   ```

   For example:

   ```
   [root@host ~]# /sbin/grub-crypt --sha-512
   Password:
   Retype password:
   <encrypted password output>
   ```
Step 3 Add the following line in frontend `https-api` to enable Authentication and Authorization for CRD REST API and create a new backend server as `crd_api_servers` to intercept CRD REST API requests:

```plaintext
mode http
  acl crd_api path_beg -i /custrefdata/
  use_backend crd_api_servers if crd_api

backend crd_api_servers
  mode http
  balance roundrobin
  option httpclose
  option abortonclose
  server qns01_A qns01:8080 check inter 30s
  server qns02_A qns02:8080 check inter 30s
```

Step 4 Update frontend `https_all_servers` by replacing `api_servers` with `crd_api_servers` for CRD API as follows:

```plaintext
acl crd_api path_beg -i /custrefdata/
  use_backend crd_api_servers if crd_api
```

Step 5 To enable the authentication, edit `/etc/haproxy/haproxy.cfg` on `lb01/lb02` and add the following lines in the backend `crd_api_servers`:

```plaintext
acl validateAuth http_auth(<userlist_name>)
  http-request auth unless validateAuth
```

Map the userlist created in Step 2 with the acl as follows:

```plaintext
acl validateAuth http_auth(<userlist name>)
```

Step 6 To enable the authorization, add at least one group with the user in `userlist` created in Step 2 as follows:

```plaintext
group qns-ro users readonly
```

For example:

```plaintext
userlist cps_user_list
  group qns-ro users readonly
  user readonly password $6$xRtThhVpS0w410oS$pypyEM6VYpVaUAx0OPjb61Z5eZrmeAUUdCMF7D75BXXKbs4dhNChXjgChVE0ckfLDp4T2CsUzzNkoqLRdn7RbAAU1
  user apiuser password $6$xRtThhVpS0w410oS$pypyEM6VYpVaUAx0OPjb61Z5eZrmeAUUdCMF7D75BXXKbs4dhNChXjgChVE0ckfLDp4T2CsUzzNkoqLRdn7RbAAU1
```

Step 7 Add the following in the backend `crd_api_servers` to set read-only permission (GET HTTP operation) for group of users:

```plaintext
acl authoriseUsers http_auth_group(<user-list-name>) <group-name>
  http-request deny if !METH_GET authoriseUsers
```

Map the group created in Step 6 with the acl in the following line:

```plaintext
acl authorizeUsers http_auth_group(<userlist name>) <group-name>
```

Example:

HAProxy Configuration Example

```plaintext
userlist cps_user_list
  group qns-ro users readonly

  user readonly password $6$xRtThhVpS0w410oS$pypyEM6VYpVaUAx0OPjb61Z5eZrmeAUUdCMF7D75BXXKbs4dhNChXjgChVE0ckfLDp4T2CsUzzNkoqLRdn7RbAAU1
```
Unified API Security: Access Privileges

By default, the CPS Unified API does not require username and password authentication. To enable authentication, refer to Enable Authentication for Unified API, on page 64.

There are two options to include a username and password in an API request:

- Include the username and password directly in the request. For example:

  ```plaintext
  https://<username>;<password>@<lbvip02>:8443/ua/soap
  ```

- Add an authentication header to the request:

  ```plaintext
  Authorization: Basic <base64 encoded value of username:password>
  ```

  For example:

  ```plaintext
  ```

The haproxy.cfg file is generated by the Puppet tool. Any manual changes to the file in lb01/lb02 would be reverted if the pupdate or vm-initscripts are run.
Enable Authentication for Unified API

HAProxy is used to secure and balance calls to the CPS Unified API.

**Step 1**
Back up the `/etc/haproxy/haproxy.cfg` file before making modifications in the following steps.

**Step 2**
Edit `/etc/haproxy/haproxy.cfg` on lb01/lb02 and add a userlist with at least one username and password.

Use the following syntax:

```
userlist <userlist name>
user <username> password <encrypted password>
user <username> insecure-password <plain text password>
```

For example:

```
userlist L1
user apiuser password $6$eC8mFOWMcRnQo7FQ8C053tv5T2mPlmGAta0ukH87MpK9aLPtWqCEK
```

**Step 3**
Run the following command to generate an encrypted password:

```
/sbin/grub-crypt --sha-512
```

For example:

```
[root@host ~]# /sbin/grub-crypt --sha-512
Password:
Retype password:
<encrypted password output>
```

**Step 4**
Edit `/etc/haproxy/haproxy.cfg` on lb01/lb02 to configure HAProxy to require authentication. Add the following 4 lines to the haproxy.cfg file:

```
  acl validateAuth http_auth(<userlist_name>)
  acl unifiedAPI path_beg -i /ua/soap
  http-request allow if !unifiedAPI
  http-request auth unless validateAuth
```

The userlist created in Step 2 needs to be mapped with the acl in the following line:

```
  acl validateAuth http_auth(<userlist name>)
```

For example:

```
frontend https-api
  description Unified API
  bind lbvip01:8443 ssl crt /etc/ssl/certs/quantum.pem
  default_backend api_servers
  reqadd X-Forwarded-Proto: https if { ssl_fc }
  backend api_servers
  mode http
  balance roundrobin
  option httpclose
  option abortonclose
  option httpchk GET /ua/soap/keepalive
  server qns01_A qns01:8080 check inter 30s
  server qns02_A qns02:8080 check inter 30s
  server qns03_A qns03:8080 check inter 30s
  server qns04_A qns04:8080 check inter 30s
  acl validateAuth http_auth(L1)
  acl unifiedAPI path_beg -i /ua/soap
```
http-request allow if !unifiedAPI
http-request auth unless validateAuth

The configuration above applies authentication on context /ua/soap, which is the URL path of the Unified API.

Note: The haproxy.cfg file is generated by the Puppet tool. Any manual changes to the file in lb01/lb02 would be reverted if the puppet or vm-init scripts are run.

---

**WSDL and Schema Documentation**

In order to access the Unified API WSDL while using authentication change the following line:

```
 acl unifiedAPI path_beg -i /ua/soap
```

to

```
 acl unifiedAPI path_beg -i /ua/.
```

The default address for the WSDL is `https://<lbvip01>:8443/ua/wsdl/UnifiedApi.wsdl`

The Unified API contains full documentation in an html format that is compatible with all major browsers.

The default address is `https://<HA-server-IP>:8443/ua/wsdl/UnifiedApi.xsd`

Note: Run the `about.sh` command from the Cluster Manager to display the actual addresses as configured in your deployment.

---

**Enabling Unified API Access on HTTP Port 8080**

CPS 7.x onward uses HTTPS on port 8443 for Unified API access. To enable HTTP support (like pre-7.0) on port 8080, perform the following steps:

Note: Make sure to open port 8080 if firewall is used on the setup.

---

**Step 1**

Create the following directories (ignore File exists error), on Cluster Manager:

```
/bin/mkdir -p /var/qps/env_config/modules/custom/templates/etc/haproxy
/bin/mkdir -p /var/qps/env_config/modules/custom/templates/etc/monit.d
/bin/mkdir -p /var/qps/env_config/nodes
```

**Step 2**

Create the file

```
/var/qps/env_config/modules/custom/templates/etc/haproxy/haproxy-soaphttp.erb
```

with the following contents on Cluster Manager:

- Change XXXXX with the Unified API interface hostname or IP
- In this example, we are adding 10 Policy Servers (QNS). You can add/remove the number of Policy Servers (QNS) depending on your network requirements.
global
daemon

nbproc 1 # number of processing cores
stats socket /tmp/haproxy-soaphttp
defaults
timeout client 60000ms # maximum inactivity time on the client side
timeout server 180000ms # maximum inactivity time on the server side
timeout connect 60000ms # maximum time to wait for a connection attempt to a server to succeed

colls 127.0.0.1 local1 err

listen pcdf_proxy XXXX:8080 ---------- > where, XXXX, is Unified API interface hostname or IP
mode http
balance roundrobin
option httpclose
option abortonclose
option httpchk GET /ua/soap/KeepAlive
server qns01_A qns01:8080 check inter 30s
server qns02_A qns02:8080 check inter 30s
server qns03_A qns03:8080 check inter 30s
server qns04_A qns04:8080 check inter 30s
server qns05_A qns05:8080 check inter 30s
server qns06_A qns06:8080 check inter 30s
server qns07_A qns07:8080 check inter 30s
server qns08_A qns08:8080 check inter 30s
server qns09_A qns09:8080 check inter 30s
server qns10_A qns10:8080 check inter 30s

Step 3
Create the file /var/qps/env_config/modules/custom/templates/etc/monit.d/haproxy-soaphttp with the following contents on Cluster Manager:

check process haproxy-soaphttp with pidfile /var/run/haproxy-soaphttp.pid
start = "/usr/bin/systemctl start haproxy-soaphttp"
stopt = "/usr/bin/systemctl stop haproxy-soaphttp"

Step 4
Create or modify the /var/qps/env_config/nodes/lb.yaml file with the following contents on Cluster Manager:

If the file exists then just add custom::soap_http:

classes:
qps::roles::lb:
custom::soap_http:

Step 5
Create the file /var/qps/env_config/modules/custom/manifests/soap_http.pp with the following contents on Cluster Manager.

Change ethX with the Unified API IP interface like eth0/eth1/eth2.

class custom::soap_http{
  $haproxytype = "-soaphttp",
}

  service { "haproxy-soaphttp":
    enable => false,
    require => [Package [ "haproxy" ], File ["/etc/haproxy/haproxy-soaphttp.cfg"],
    File ["/etc/init.d/haproxy-soaphttp"], Exec ["sysctl_refresh"]],
  }
  file { "/etc/init.d/haproxy-soaphttp":
    owner => "root",
group => "root",
content => template("qps/etc/init.d/haproxy"),
require => Package [ "haproxy" ],
notify => Service["haproxy-soaphttp"],
}
Step 6  Validate the syntax of your newly created Puppet script on Cluster Manager:

```
/usr/bin/puppet parser validate /var/qps/env_config/modules/custom/manifests/soap_http.pp
```

Step 7  Rebuild your Environment Configuration on Cluster Manager:

```
/var/qps/install/current/scripts/build/build_env_config.sh
```

Step 8  Reinitialize your lb01/02 environments on Cluster Manager:

The following commands will take few minutes to complete.

```
ssh lb01 /etc/init.d/vm-init
nsh lb02 /etc/init.d/vm-init
```

Step 9  Validate SOAP request on http:

a) Verify the haproxy services are running on lb01 and lb02 by executing the commands on Cluster Manager:

```
ssh lb01 monit summary | grep haproxy-soaphttp
Process 'haproxy-soaphttp' Running
ssh lb01 service haproxy-soaphttp status
haproxy (pid 11061) is running...
```

```
ssh lb02 monit summary | grep haproxy-soaphttp
Process 'haproxy-soaphttp' Running
ssh lb02 service haproxy-soaphttp status
haproxy (pid 13458) is running...
```

b) Verify the following URLs are accessible:

Unified API WSDL: http://<IP address>:8080/ua/wsdl/UnifiedApi.wsdl
Unified API XSD: http://<IP address>:8080/ua/wsdl/UnifiedApi.xsd

where, `<IP address>` is the IP address set in Step 2, on page 65.
TACACS+

This section covers the following topics:

- Overview, on page 68
- TACACS+ Service Requirements, on page 68
- Caching of TACACS+ Users, on page 69

Overview

Cisco Policy Suite (CPS) is built around a distributed system that runs on a large number of virtualized nodes. Previous versions of the CPS software allowed operators to add custom accounts to each of these virtual machines (VM), but management of these disparate systems introduced a large amount of administrative overhead.

CPS has been designed to leverage the Terminal Access Controller Access Control System Plus (TACACS+) to facilitate centralized management of users. Leveraging TACACS+, the system is able to provide system-wide authentication, authorization, and accounting (AAA) for the CPS system.

Further the system allows users to gain different entitlements based on user role. These can be centrally managed based on the attribute-value pairs (AVP) returned on TACACS+ authorization queries.

TACACS+ Service Requirements

To provide sufficient information for the Linux-based operating system running on the VM nodes, there are several attribute-value pairs (AVP) that must be associated with the user on the ACS server used by the deployment. User records on Unix-like systems need to have a valid “passwd” record for the system to operate correctly. Several of these fields can be inferred during the time of user authentication, but the remaining fields must be provided by the ACS server.

A standard “passwd” entry on a Unix-like system takes the following form:

```
<username>:<password>:<uid>:<gid>:<gecos>:<home>:<shell>
```

When authenticating the user via TACACS+, the software can assume values for the username, password, and gecos fields, but the others must be provided by the ACS server. To facilitate this need, the system depends on the ACS server provided these AVP when responding to a TACACS+ Authorization query for a given username:

- uid
  
  A unique integer value greater than or equal to 501 that serves as the numeric user identifier for the TACACS+ authenticated user on the VM nodes. It is outside the scope of the CPS software to ensure uniqueness of these values.

- gid
  
  The group identifier of the TACACS+ authenticated user on the VM nodes. This value should reflect the role assigned to a given user, based on the following values:

```
  * gid=501 (qns-su)
```
This group identifier should be used for users that are entitled to attain superuser (or 'root') access on the CPS VM nodes.

• gid=504 (qns-admin)

This group identifier should be used for users that are entitled to perform administrative maintenance on the CPS VM nodes.

Note

For stopping/starting the Policy Server (QNS) process on node, the qns-admin user should use monit:

For example,

```
sudo monit stop qns-1
sudo monit start qns-1
```

• gid=505 (qns-ro)

This group identifier should be used for users that are entitled to read-only access to the CPS VM nodes.

• home

The user's home directory on the CPS VM nodes. To enable simpler management of these systems, the users should be configured with a pre-deployed shared home directory based on the role they are assigned with the gid.

• home=/home/qns-su should be used for users in the qns-su group (gid=501)

• home=/home/qns-admin should be used for users in the qns-admin group (gid=504)

• home=/home/qns-ro should be used for users in the qns-ro group (gid=505)

• shell

The system-level login shell of the user. This can be any of the installed shells on the CPS VM nodes, which can be determined by reviewing the contents of /etc/shells on one of the CPS VM nodes. Typically, this set of shells is available in a CPS deployment:

• /bin/sh

• /bin/bash

• /sbin/nologin

• /bin/dash

• /usr/bin/sudosh

The /usr/bin/sudosh shell can be used to audit user's activity on the system.

### Caching of TACACS+ Users

The user environment of the Linux-based VMs needs to be able to lookup a user’s passwd entry via different columns in that record at different times. The TACACS+ NSS module provided as part of the CPS solution
however is only able to query the Access Control Server (ACS) for this data using the username. For this reason the system relies upon the Name Service Cache Daemon (NSCD) to provide this facility locally after a user has been authorized to use a service of the ACS server.

More details on the operations of NSCD can be found by referring to online help for the software (nscd --help) or in its man page (nscd(8)). Within the CPS solution it provides a capability for the system to lookup a user's passwd entry via their uid as well as by their username.

To avoid cache coherence issues with the data provided by the ACS server the NSCD package has a mechanism for expiring cached information.

The default NSCD package configuration on the CPS VM nodes has the following characteristics:

- Valid responses from the ACS server are cached for 600 seconds (10 minutes)
- Invalid responses from the ACS server (user unknown) are cached for 20 seconds
- Cached valid responses are reloaded from the ACS server 5 times before the entry is completely removed from the running set -- approximately 3000 seconds (50 minutes)
- The cache are persisted locally so it survives restart of the NSCD process or the server

It is possible for an operator to explicitly expire the cache from the command line. To do so the administrator need to get the shell access to the target VM and execute the following command as a root user:

```
# nscl -i passwd
```

The above command will invalidate all entries in the passwd cache and force the VM to consult with the ACS server for future queries.

There may be some unexpected behaviors of the user environment for TACACS+ authenticated users connected to the system when their cache entries are removed from NSCD. This can be corrected by the user by logging out of the system and logging back into it or by issuing the following command, which forces the system to query the ACS server:

```
# id -a "$USER"
```

### Reading Log Files

Only qns-ro and qns-admin users are allowed to view log files at specific paths according to their role and maintenance requirement. Access to logs are allowed only using the following paths:

- `/var/log/`
- `/var/log/broadhop/scripts/`
- `/var/log/httpd`
- `/var/log/redis`
- `/var/log/broadhop`

Commands such as `cat`, `less`, `more`, and `find` cannot be executed using sudo in CPS 10.0.0 or higher releases.

To read any file, execute the following script using sudo:

```
$ sudo /var/qps/bin/support/logReader.py -r h -n 2 -f /var/log/puppet.log
```

where,
• `-r`: Corresponds to tail (t), tailf (tf), and head (h) respectively
• `-n`: Determines number of lines to be read. It works with the `-r` option. This is an optional parameter.
• `-f`: Determines the complete file path to be read.

**Note**
- Non-root users cannot view the sudo.sh logs.
- Support to read gunzipped files is also available.

**CRD APIs**

You use Custom Reference Data (CRD) APIs to query, create, delete, and update CRD table data without the need to utilize the Control Center interface. The CRD APIs are available via a REST interface.

**Limitations**

These APIs allow maintenance of the actual data rows in the table. They do not allow the creation of new tables or the addition of new columns. Table creation and changes to the table structure must be completed via the Policy Builder application.

Table names must be all in lowercase alphanumeric to utilize these APIs. Neither spaces nor special characters are allowed in the table name.

- Table names containing uppercase characters will return code 400 Bad Request.
- Spaces in the name are also not allowed and will be flagged as an error in Policy Builder.
- Special characters even when escaped or encoded in ASCII cause problems with the APIs and should not be used.

**Setup Requirements**

**Policy Server**

The feature `com.broadhop.custrefdata.service.feature` needs to be installed on the Policy Server.

In a High Availability (HA)/Distributed CPS deployment, this feature should be installed on the QNS0x nodes.

**Policy Builder**

The feature `com.broadhop.client.feature.custrefdata` needs to be installed in Policy Builder.

**Step 1**  Login into Policy Builder.
**Step 2**  Select Reference Data tab.
**Step 3**  From the left pane, select Systems.
Step 4

Select and expand your system name.

Step 5

Select **Plugin Configurations** (or a sub cluster or instance), a Custom Reference Data Configuration plugin configuration is defined.

The following parameters can be configured under **Custom Reference Data Configuration**:

**Table 8: Custom Reference Data Configuration**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Database IP Address</td>
<td>IP address of the primary sessionmgr database.</td>
</tr>
<tr>
<td>Secondary Database IP Address</td>
<td>Optional, this field is the IP address of a secondary, backup, or failover sessionmgr database.</td>
</tr>
<tr>
<td>Database Port</td>
<td>Port number of the sessionmgr. It should be the same for both the primary and secondary databases.</td>
</tr>
<tr>
<td>Db Read Preference</td>
<td>Read preference describes how sessionmgr clients route read operations to members of a replica set. You can select from the following drop-down list:</td>
</tr>
<tr>
<td></td>
<td>• Primary: Default mode. All operations read from the current replica set primary.</td>
</tr>
<tr>
<td></td>
<td>• PrimaryPreferred: In most situations, operations read from the primary but if it is unavailable, operations read from secondary members.</td>
</tr>
<tr>
<td></td>
<td>• Secondary: All operations read from the secondary members of the replica set.</td>
</tr>
<tr>
<td></td>
<td>• SecondaryPreferred: In most situations, operations read from secondary members but if no secondary members are available, operations read from the primary.</td>
</tr>
</tbody>
</table>

For more information, refer to [http://docs.mongodb.org/manual/core/read-preference/](http://docs.mongodb.org/manual/core/read-preference/).

| Connection Per Host       | Number of connections that are allowed per database host. Default value is 100.                                                                                                                             |

Step 6

In **Reference Data** tab > **Custom Reference Data Tables**, at least one Custom Reference Data Table must be defined.
The following parameters can be configured under Custom Reference Data Table:

### Table 9: Custom Reference Data Table Parameters

<table>
<thead>
<tr>
<th><strong>Parameter</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>This is the name of the table that will be stored in the database. It should start with alphanumeric characters, should be lowercase OR uppercase but not MixedCase, and should not start with numbers, no special characters are allowed, use “_” to separate words. For example, logical_apn = GOOD, logicalAPN = BAD, no_spaces. For more information, refer to Limitations, on page 71.</td>
</tr>
<tr>
<td>Display Name</td>
<td>This is the name of the table that will be displayed in Control Center.</td>
</tr>
<tr>
<td>Cache Results</td>
<td>This indicates whether the tables should be cached in memory. This should be checked for production. For more information, refer to Caching, on page 76.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Activation Condition</td>
<td>This is the Custom Reference Data Trigger which needs to be true before evaluating this table. This can be used to have multiple tables create the same data depending on conditions or to improve performance if tables don't need to be evaluated based on an initial condition(s).</td>
</tr>
<tr>
<td>Best Match</td>
<td>If checked, this allows '*' to be used in the values of the data and the best matching row is returned.</td>
</tr>
<tr>
<td>Evaluation Order</td>
<td>This indicates the order the tables within the search table group should be evaluated. Starting with 0 and increasing.</td>
</tr>
<tr>
<td>Columns</td>
<td>Columns correspond to the 'schema' for each column we're creating for this Custom Reference Data table.</td>
</tr>
<tr>
<td></td>
<td>• Name: The name of the column in the database.</td>
</tr>
<tr>
<td></td>
<td>• Display Name: A more readable display name.</td>
</tr>
<tr>
<td></td>
<td>• Use In Conditions: This represents whether this row will be available for conditions in Policies or Use Case Templates. There is a performance cost to having these checked, so we recommend to uncheck unless they are required. Default value is checked (true).</td>
</tr>
<tr>
<td></td>
<td>• Type: the type determines what values will be allowed when creating them in control center.</td>
</tr>
<tr>
<td></td>
<td>• Text: The value is allowed to be any characters. For example, example123!.</td>
</tr>
<tr>
<td></td>
<td>• Number: The value is allowed to be any whole number. For example, 1234.</td>
</tr>
<tr>
<td></td>
<td>• Decimal: The value is allowed to be any number (including decimals). For example, 1.234.</td>
</tr>
<tr>
<td></td>
<td>• True/False: The value needs to be 'true' or 'false'. For example, true.</td>
</tr>
<tr>
<td></td>
<td>• Date: The value is a date without a time component (May 17th, 2020).</td>
</tr>
<tr>
<td></td>
<td>• DateTime: The value is a date + time (May 17th, 2020 5:00pm).</td>
</tr>
<tr>
<td></td>
<td>• Key: This indicates that this column is all or part of the 'key' for the table that makes this row unique. By default, a key is required. Keys also are allowed set the Runtime Binding fields to populate this data from the current message/session. Typically, keys are bound to data from the current session (APN, RAT Type) and other values are derived from them. Keys can also be set to a value derived from another Custom Reference Data table.</td>
</tr>
<tr>
<td></td>
<td>• Required: This indicates whether this field will be marked required in Control Center. A key is always required.</td>
</tr>
</tbody>
</table>
### Parameter | Description
--- | ---
Valid Values | These are the valid values which will be allowed in Control Center (creates a list box).  
- List of Valid Values: A list of name/display name pairs which will be used to create the list. Valid values can also contain a 'name' which will be the actual value of the column and a display value which allows Control Center to display an easier to use name.  
- Valid Values pulled from another Table: This allows initializing the list based on another Custom Reference Data table. The 'name' value will be pulled from another table. There is no way to customize a 'display' name in this manner.

Validation | The validation set here will be checked by Control Center before allowing a row to be added.  
- Regular Expression: This is the Java regular expression that will be run on the proposed new cell value to validate it as described in [http://docs.oracle.com/javase/7/docs/api/java/util/regex/Pattern.html](http://docs.oracle.com/javase/7/docs/api/java/util/regex/Pattern.html).  
- Regular Expression Description: This is a message to the user indicating what the regular expression is trying to check.

Runtime Binding | Runtime binding is how key column data gets filled out ('bound') from data in the current session. There are multiple ways to bind this data and it is also possible to set an operator to define what should match (equals, less than, etc).  
- Bind to Subscriber AVP Code: This pulls the value from an AVP on the subscriber. It will also pull values from a session AVP or a Policy Derived AVP.  
- Bind to Session/Policy State Field: This pulls the value from a Policy State Data Retriever which knows how to retrieve a single value for a session  
- Bind to a Result Column from another Table: This allows the key to be filled out from a columns value from another table. This allows 'normalizing' the table structure and not having one giant table with a lot of duplicated values.  
- Bind to Diameter Request AVP code: This allows the key be filled out from an AVP on the Diameter request.  
- Matching Operator: This allows the row to be 'matched' in other ways than having the value be 'equals'. Default value is equals.  
  - eq: Equal  
  - ne: Not Equal  
  - gt: Greater than  
  - gte: Greater than or equal  
  - lt: Less than  
  - lte: Less than or equal
Architecture

MongoDB

The MongoDB database containing the CRD tables and the data is located in the MongoDB instance specified in the CRD plugin configuration.

The database is named cust_ref_data.

Two system collections exist in that database and do not actually contain CRD data:

- system.indexes — used by MongoDB. These are indices set on the database.
- crdversion — contains a document indicating the version of all the CRD tables you have defined. The version field increments by 1 every time you make a change or add data to any of your CRD tables.

A collection is created for each CRD table defined in Policy Builder.

- This collection contains a document for each row you define in the CRD table.
- Each document contains a field for each column you define in the CRD table.
- The field contains the value specified for the column for that row in the table.
- Additionally, there is a _id field which contains the internal key used by MongoDB and _version which is used by CPS to provide optimistic locking protection, essentially to avoid two threads overwriting the other's update, on the document.

An example is shown below:

Figure 11: CRD Table in Policy Builder

Caching

Setting the Cache Results to true (checked) is the default and recommended settings in most cases as it yields the best performance. Use of the cached copy also removes the dependency on the availability of the CRD database, so if there is an outage or performance issue, policy decisions utilizing the CRD data won’t be impacted.

The cached copy of the table is refreshed on CPS restart and whenever the API writes a change to the CRD table, otherwise the cached copy is used and the database is not accessed.
API Endpoints and Examples

The URL used to access the CRD API are different depending on the type of deployment (High Availability or All-in-One):

High Availability (HA): https://<lbvip01>:8443/custrefdata/<tablename>/_<operation>
All-In-One (AIO): http://<ip>:8080/custrefdata/<tablename>/_<operation>

The examples in the following sections refer to the HA URL.

Query API

Purpose
Returns all rows currently defined in the specified table.

HTTP Operation Type
GET

Example URL
https://<lbvip01>:8443/custrefdata/test/_query

Example URL with Filtering
https://<lbvip01>:8443/custrefdata/test/_query?key1=Platinum

Payload
None, although parameters can be specified on the URL for filtering.

Response
Success returns code 200 Ok; XML indicating rows defined is returned. If there are no records in the table, 200 Ok is returned with empty rows in it.

If the table does not exist, code 400 Bad Request is returned.

Example Response without Filtering

```xml
<rows>
  <row>
    <field code="field1" value="1004"/>
    <field code="field2" value="testee"/>
    <field code="key1" value="Platinum"/>
  </row>
  <row>
    <field code="field1" value="1004"/>
    <field code="field2" value="testee"/>
    <field code="key1" value="Platinum99"/>
  </row>
  <row>
    <field code="field1" value="field1example1"/>
    <field code="field2" value="field2example1"/>
    <field code="key1" value="key1example1"/>
  </row>
</rows>
```
Example Response with Filtering

The response returns keys with the tag “field code”. If you want to use the output of Query as input to one of the other APIs, the tag needs to be changed to “key code”. Currently using “field code” for a key returns code 404 Bad Request and a java.lang.NullPointerException.

Create API

Purpose
Create a new row in the specified table.

HTTP Operation Type
POST

Example Endpoint URL
https://<lbvip01>:8443/custrefdata/test/_create

Example Payload

```
<row>
  <key code="key1" value="Platinum"/>
  <field code="field1" value="1004"/>
  <field code="field2" value="testee"/>
</row>
```

Response
Success returns code 200 Ok; no data is returned. The key cannot already exist for another row; submission of a duplicate key returns code 400 Bad Request.

If creating a row fails, API returns 400 Bad Request.

Note
Create API does not support SVN CRD table operations and displays the following error message when Snv Crd Data checkbox is enabled in CRD table configuration:

Create operation is not allowed for subversion table
Update API

**Purpose**
Updates the row indicated by the key code in the table with the values specified for the field codes.

**HTTP Operation Type**
POST

**Example Endpoint URL**
https://<lbvip01>:8443/custrefdata/test/_update

**Example Payload**
```
<row>
  <key code="key1" value="Platinum"/>
  <field code="field1" value="1005"/>
  <field code="field2" value="tester"/>
</row>
```

**Response**
Success returns code 200 Ok; no data is returned. The key cannot be changed. Any attempt to change the key returns code 404 Not Found.

If updating a row fails, API returns 400 Bad Request.

---

**Note**
Update API does not support SVN CRD table operations and displays the following error message when Snv Crd Data checkbox is enabled in CRD table configuration:

*Update operation is not allowed for subversion table*

Delete API

**Purpose**
Removes the row indicated by the key code from the table.

**HTTP Operation Type**
POST

**Example Endpoint URL**
https://<lbvip01>:8443/custrefdata/test/_delete

**Example Payload**
```
<row>
  <key code="key1" value="Platinum"/>
</row>
```
Response

Success returns code 200 Ok; no data is returned. If the row to delete does not exist, code 404 Not Found is returned.

If deleting a row fails, API returns 400 Bad Request.

---

Note

Delete API does not support SVN CRD table operations and displays the following error message when Snv Crd Data checkbox is enabled in CRD table configuration:

Delete operation is not allowed for subversion table

---

Data Comparison API

Purpose

Determines whether the same CRD table data content is being used at different data centers.

The following three optional parameters can be provided to the API:

- **tableName**: Returns the checksum of a specified CRD table indicating if there is any change in the specified table. If the value returned is same on different servers, it means there is no change in the configuration and content of that table.

- **includeCrdversion**: Total database checksum contains combination of checksum of all CRD tables configured in Policy Builder. If this parameter is passed as true in API, then total database checksum includes the checksum of "crdversion" table. Default value is false.

- **orderSensitive**: Calculates checksum of the table by utilizing the order of the CRD table content. By default, it does not sort the row checksums of the table and returns order sensitive checksum of every CRD table. Default value is true.

custrefdata/_checksum

Database level Checksum API returns checksum details for all the CRD tables and the database. If the value returned is same on different servers, there will be no change in the configuration and content of any CRD table configured in Policy Builder.

**HTTP Operation Type**

GET

**Example Endpoint URL**

https://<lbvip01>:8443/custrefdata/_checksum

**Response**

```xml
<response>
  <checksum><all-tables-checksum></checksum>
  <tables>
    <table name="<table-1-name>" checksum="<checksum-of-table-1>">
    <table name="<table-2-name>" checksum="<checksum-of-table-2>">
```
Table specific Checksum API returns the checksum details for the specific CRD table. If the value returned is same on different servers, there will be no change in the configuration and content of that table.

HTTP Operation Type

GET

Example Endpoint URL

https://<lbvip01>:8443/custrefdata/_checksum?tableName=<user-provided-table-name>

Response

<Response>
  <Tables>
    <Table name="<user-provided-table-name>" checksum="<checksum-of-specified-table/>">
  </Tables>
</Response>

Table specific Checksum API does not support SVN CRD table operations and displays the following error message when Snv Crd Data checkbox is enabled in CRD table configuration:

Checksum operation is not allowed for subversion table

Table Drop API

Purpose

Drops custom reference table from MongoDB to avoid multiple stale tables in the system.

The Table Drop API is used in the following scenarios:

- If a CRD table does not exist in Policy Builder but exists in the database, the API can be used to delete the table from the database.

- If a CRD table exists in Policy Builder and database, the API cannot delete the table from the database. If this is attempted the API will return an error: “Not permitted to drop this table as it exists in Policy Builder”.

- If a CRD table does not exist in Policy Builder and database, the API will also return an error No table found:<tablename>.
/custrefdata/<table_name>/_drop

HTTP Operation Type
POST

Example Endpoint URL
https://<lbvip01>:8443/custrefdata/<table_name>/_drop

---

**Note**
Drop API does not support SVN CRD table operations and displays the following error message when Snv Crd Data checkbox is enabled in CRD table configuration:

*Drop operation is not allowed for subversion table*

---

**Export API**

**Purpose**
Exports single and multiple CRD table and its data.

/custrefdata/_export?tableName=<table_name>
Exports single CRD table and its data.
Returns an archived file containing csv file with information of specified CRD table `table_name`.

HTTP Operation Type
GET

Example Endpoint URL
https://<lbvip01>:8443/custrefdata/_export?tableName=<table_name>

/custrefdata/_export
Exports all CRD tables and its data.
Returns an archived file containing csv file with information for each CRD Table.

HTTP Operation Type
GET

Example Endpoint URL
https://<lbvip01>:8443/custrefdata/_export
Export API does not support Svn CRD tables and displays the following warning message in the Response Header "Export-Warning":

Datasource for tables [table1, table2,...] is subversion. Response will not contain data for these tables and skipped SVN CRD tables to be a part of archive.

Import API

Purpose
Imports CRD table and its data.
It takes an archived file as an input which contains one or more csv files containing CRD tables information.

HTTP Operation Type
POST

Example Endpoint URL
https://<lbvip01>:8443/custrefdata/_import
https://<lbvip01>:8443/custrefdata/_import?batchOperation=true
https://<lbvip01>:8443/custrefdata/_import?batchOperation=false&duplicateValidation=true

1. The "batchOperation" flag is used to insert CRD data in the batch. The default value is true and if you do not provide it in the request parameter the default value is taken.
2. The "duplicateValidation" flag is used to validate or invalidate duplicate data in the archive. The default value is true and if you do not provide it in the request parameter the default value is taken which means it will always validate your data as duplicate.
3. If "batchOperation" is true, the API will validate your data as duplicate data regardless of the value provided for "duplicateValidation".

Import API supports SVN CRD table operations in the following scenarios:

- If the archive contains only mongodb tables, success message is displayed in the response.
- If the archive contains only SVN tables, success and warning messages are displayed in the response.
- If the archive contains both mongodb and SVN tables, success and warning messages are displayed in the response.
Import Single File API

**Purpose**
Imports bulk CRD data by sending any supported file in the API request.
Supports only CSV and XLS file formats.

**HTTP Operation Type**
POST

**Example Endpoint URL**
https://<lbvip01>:8443/custrefdata/_importsinglefile

---

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Error responses are thrown in the following scenarios:</td>
</tr>
<tr>
<td>• When the attached file is of a different format other than CSV and XLS.</td>
</tr>
<tr>
<td>• When an empty file is attached.</td>
</tr>
<tr>
<td>• When the attached file has wrong headers.</td>
</tr>
<tr>
<td>• When the attached file does not have the same file as that of the Policy Builder table name.</td>
</tr>
<tr>
<td>• When the attached file has duplicate records.</td>
</tr>
<tr>
<td>• When no file is attached.</td>
</tr>
</tbody>
</table>

2. Ensure your .xls file does not contain any extra empty and colored header. If the .xls file contains any colored and empty header (header with color but no title), it is considered as a part of the Policy Builder table column. During import file operation, this type of header causes the API to send mismatch found between imported csv headers and policy builder table columns error in response. This is because the empty header is considered as a column from Policy Builder but the Policy Builder table does not contain this empty column.

3. Import Single File API does not support import of SVN CRD table data and displays the following error message:

   Single file import is not allowed for subversion table

---

Snapshot POST API

**Purpose**
Creates a snapshot of the CRD tables on the system. The created snapshot will contain CRD table data, policy configuration and checksum information for all CRD tables.
Snapshot GET API

Purpose
Enables you to get the list of all valid snapshots in the system.
The following information is available in the list of snapshots:
• Snapshot name
• Snapshot path
• Date and time of snapshot creation
• User comments provided on creation of the snapshot
• Checksum information of CRD tables
• Policy configuration SVN version number

/custrefdata/_snapshot

HTTP Operation Type
GET

Example Endpoint URL
https://<lbvip01>:8443/custrefdata/_snapshot
## Revert API

### Purpose
Enables you to revert the CRD data to a specific snapshot. If the specific snapshot name is not provided, the API will revert to the latest snapshot.

`/custrefdata/_revert?snapshotName=<snapshot_name>`

### HTTP Operation Type
POST

### Example Endpoint URL
https://<lbvip01>:8443/custrefdata/_revert?snapshotName=<snapshot_name>

### Optional Parameter
snapshotName

---

### Note
Revert API does not support reverting of CRD data for Svn CRD tables. For Svn CRD table, it clears the mongodb table and displays the following warning message:

**Datasource for tables [table_1, table_2...] is subversion. Data for these tables will be reverted using svn datasource not from database (mongodb)**
Tips for Usage

The Query API is a GET operation which is the default operation that occurs when entering a URL into a typical web browser.

The POST operations, Create, Update, and Delete, require the use of a REST client so that the payload and content type can be specified in addition to the URL. REST clients are available for most web browsers as plug-ins or as part of web service tools, such as SoapUI. The content type when using these clients should be specified as application/xml or the equivalent in the chosen tool.

View Logs

You can view the API logs in the OAM (pcrfclient) VM at the following location:

/var/log/broadhop/consolidated-qns.log
CHAPTER 5

Tracking CPS GUI and API Usage

• Track Usage, on page 89

Track Usage

Use the Audit History to track usage of the various GUIs and APIs.

If enabled, each request is submitted to the Audit History database for historical and security purposes. The user who made the request, the entire contents of the request and if it is subscriber-related (a network ID value), all network IDs are also stored in a searchable field.

Capped Collection

By default, the Audit History uses a 1 GB capped collection in MongoDB. The capped collection automatically removes documents when the size restriction threshold is hit. The oldest document is removed as each new document is added. For customers who want more than 1 GB of audit data, contact the assigned Cisco Advanced Services Engineer to get more information.

Configuration in Policy Builder is done in GB increments. It is possible to enter decimals, for example, 9.5 will set the capped collection to 9.5 GB.

PurgeAuditHistoryRequests

When using a capped collection, MongoDB places a restriction on the database and does not allow the deletion of data from the collection. Therefore, the entire collection must be dropped and re-created. This means that the PurgeAuditHistory queries have no impact on capped collections.

AuditRequests

As a consequence of the XSS defense changes to the API standard operation, any XML data sent in an AuditRequest must be properly escaped even if inside CDATA tags.

For example, &lt;ExampleRequest&gt;...&lt;/ExampleRequest&gt;

For more information on AuditType, refer to Cisco Policy Suite Unified API 2.3.0 Guide.
**Operation**

By default, Audit History is ON but it can be turned OFF.

- `ua.client.submit.audit=true` — property used by Policy Builder and set in `/etc/broadhop/pb/pb.conf`
- `Submit Requests to Audit Log` — Unified API plug-in configuration in Policy Builder.

**Initial Setup**

There are three parts to the Audit History:

- **Server** — database and Unified API
- **Policy Builder**
- **Audit Client** — bundle that the Policy Builder uses to send Audit requests

**Step 1**

Start the Policy Builder with the following property:

```
-Dua.client.submit.audit=false
```

(set in `/etc/broadhop/pb/pb.conf`)

**Step 2**

Add and configure the appropriate plug-in configurations for Audit History and Unified API.

**Step 3**

Publish the Policy Builder configuration.

**Step 4**

Start the CPS servers.

**Step 5**

Restart the Policy Builder with the following property:

```
-Dua.client.submit.audit=true
-Dua.client.server.url=https://lbvip02:8443/ua/soap
```

or

```
-Dua.client.server.url=http://lbvip02:8080/ua/soap
```

**Read Requests**

The Audit History does not log read requests by default.

- `GetRefDataBalance`
- `GetRefDataService`
- `GetSubscriber`
- `GetSubscriberCount`
- `QueryAuditHistory`
- `QueryBalance`
- `QuerySession`
The Unified API also has a Policy Builder configuration option to log read requests which is set to false by default.

### APIs

All APIs are automatically logged into the Audit Logging History database, except for QueryAuditHistory and KeepAlive. All Unified API requests have an added Audit element that should be populated to provide proper audit history.

### Querying

The query is very flexible - it uses regex automatically for the id and dataid, and only one of the following are required: id, dataid, or request. The dataid element typically will be the networkId (Credential) value of a subscriber.

---

**Note**

Disable Regex. The use of regular expressions for queries can be turned off in the Policy Builder configuration.

The id element is the person or application who made the API request. For example, if a CSR log into Control Center and queries a subscriber balance, the id will be that CSR's username.

The dataid element is typically the subscriber's username. For example, if a CSR log into Control Center and queries a subscriber, the id will be that of CSR's username, and the dataid will be the subscriber's credential (networkId value). For queries, the dataid value is checked for spaces and then tokenized and each word is used as a search parameter. For example, “networkId1 networkId2” is interpreted as two values to check.

The fromDate represents the date in the past from which to start the purge or query. If the date is null, the api starts at the oldest entry in the history.

The toDate represents the date in the past to which the purge or query of data includes. If the date is null, the api includes the most recent entry in the purge or query.

### Purging

By default, the Audit History database is capped at 1 GB. Mongo provides a mechanism to do this and then the oldest data is purged as new data is added to the repository. There is also a PurgeAuditHistory request which can purge data from the repository. It uses the same search parameters as the QueryAuditHistory and therefore is very flexible in how much or how little data is matched for the purge.

---

**Note**

Regex Queries! Be very careful when purging records from the Audit History database. If a value is given for dataid, the server uses regex to match on the dataid value and therefore will match many more records than expected. Use the QueryAuditHistory API to test the query.
Purge History

Each purge request is logged after the purge operation completes. This ensures that if the entire repo is destroyed, the purge action that destroyed the repo will be logged.

Control Center

The Control Center version 2.0 automatically logs all requests.

PurgeAuditHistoryRequest

This API purges the Audit History.

The query is very flexible - it uses regex automatically for the id and dataid, and only one of the following are required: id, dataid, or request. The dataid element typically will be the networkId (Credential) value of a subscriber.

The id element is the person or application who made the API request. For example, if a CSR logs into Control Center and queries a subscriber balance, the id will be that CSR's username.

The dataid element is typically the subscriber's username. For example, if a CSR logs into Control Center and queries a subscriber, the id will be that CSR's username, and the dataid will be the subscriber's credential (networkId value). For queries, the dataid value is checked for spaces and then tokenized and each word is used as a search parameter. For example, “networkId1 networkId2” is interpreted as two values to check.

The fromDate represents the date in the past from which to start the purge or query. If the date is null, the api starts at the oldest entry in the history.

The toDate represents the date in the past to which the purge or query of data includes. If the date is null, the api includes the most recent entry in the purge or query.

Note

Size-Capped Database

If the database is capped by size, then the purge request ignores the request key values and drops the entire database due to restrictions of the database software.

Schema

```xml
<PurgeAuditHistoryRequest>
  <key> AuditKeyType </key> [1]
</PurgeAuditHistoryRequest>
```

Example

```xml
<se:Envelope xmlns:se="http://schemas.xmlsoap.org/soap/envelope/">
  <se:Body>
    <PurgeAuditHistoryRequest xmlns="http://broadhop.com/unifiedapi/soap/types">
      <key>
        <id>username</id>
        <dataid>subscriber</dataid>
        <request>API Name</request>
        <fromDate>2011-01-01T00:00:00Z</fromDate>
        <toDate>2011-01-01T00:00:00Z</toDate>
      </key>
    </PurgeAuditHistoryRequest>
  </se:Body>
</se:Envelope>
```
To purge all CreateSubscriberRequest:

```xml
<se:Envelope xmlns:se="http://schemas.xmlsoap.org/soap/envelope/">
  <se:Body>
    <PurgeAuditHistoryRequest xmlns="http://broadhop.com/unifiedapi/soap/types">
      <key>
        <request>CreateSubscriberRequest</request>
      </key>
    </PurgeAuditHistoryRequest>
  </se:Body>
</se:Envelope>
```

To purge all CreateSubscriberRequest by CSR:

```xml
<se:Envelope xmlns:se="http://schemas.xmlsoap.org/soap/envelope/">
  <se:Body>
    <PurgeAuditHistoryRequest xmlns="http://broadhop.com/unifiedapi/soap/types">
      <key>
        <id>csrusername</id>
        <request>CreateSubscriberRequest</request>
      </key>
    </PurgeAuditHistoryRequest>
  </se:Body>
</se:Envelope>
```

To purge all actions by CSR for a given subscriber for a date range:

```xml
<se:Envelope xmlns:se="http://schemas.xmlsoap.org/soap/envelope/">
  <se:Body>
    <PurgeAuditHistoryRequest xmlns="http://broadhop.com/unifiedapi/soap/types">
      <key>
        <id>csrusername</id>
        <dataid>subscriber@gmail.com</dataid>
        <fromDate>2010-01-01T00:00:00Z</fromDate>
        <toDate>2012-11-01T00:00:00Z</toDate>
      </key>
    </PurgeAuditHistoryRequest>
  </se:Body>
</se:Envelope>
```

**QueryAuditHistoryRequest**

This API queries the Audit History.

The query is very flexible - it uses regex automatically for the id and dataid, and only one of the following are required: id, dataid, or request. The dataid element typically will be the networkId (Credential) value of a subscriber.

The id element is the person or application who made the API request. For example, if a CSR logs into Control Center and queries a subscriber balance, the id will be that CSR’s username.

The dataid element is typically the subscriber's username. For example, if a CSR logs into Control Center and queries a subscriber, the id will be that CSR's username, and the dataid will be the subscriber's credential (networkId value). For queries, the dataid value is checked for spaces and then tokenized and each word is used as a search parameter. For example, "networkId1 networkId2" is interpreted as two values to check.
The `fromDate` represents the date in the past from which to start the purge or query. If the date is null, the API starts at the oldest entry in the history.

The `toDate` represents the date in the past to which the purge or query of data includes. If the date is null, the API includes the most recent entry in the purge or query.

Schema:

```xml
<QueryAuditHistoryRequest>
  <key> AuditKeyType </key> [1]
</QueryAuditHistoryRequest>
```

Example:

```xml
<se:Envelope xmlns:se="http://schemas.xmlsoap.org/soap/envelope/">
  <se:Body>
    <QueryAuditHistoryRequest xmlns="http://broadhop.com/unifiedapi/soap/types">
      <key>
        <id>username</id>
        <dataid>subscriber</dataid>
        <request>API Name</request>
        <fromDate>2011-01-01T00:00:00Z</fromDate>
        <toDate>2011-01-01T00:00:00Z</toDate>
      </key>
    </QueryAuditHistoryRequest>
  </se:Body>
</se:Envelope>
```

To find all `CreateSubscriberRequest`:

```xml
<se:Envelope xmlns:se="http://schemas.xmlsoap.org/soap/envelope/">
  <se:Body>
    <QueryAuditHistoryRequest xmlns="http://broadhop.com/unifiedapi/soap/types">
      <key>
        <request>CreateSubscriberRequest</request>
      </key>
    </QueryAuditHistoryRequest>
  </se:Body>
</se:Envelope>
```

To find all `CreateSubscriberRequest` by CSR:

```xml
<se:Envelope xmlns:se="http://schemas.xmlsoap.org/soap/envelope/">
  <se:Body>
    <QueryAuditHistoryRequest xmlns="http://broadhop.com/unifiedapi/soap/types">
      <key>
        <id>csrusername</id>
        <dataid>subscriber@gmail.com</dataid>
      </key>
    </QueryAuditHistoryRequest>
  </se:Body>
</se:Envelope>
```

To find all actions by CSR for a given subscriber for a date range:

```xml
<se:Envelope xmlns:se="http://schemas.xmlsoap.org/soap/envelope/">
  <se:Body>
    <QueryAuditHistoryRequest xmlns="http://broadhop.com/unifiedapi/soap/types">
      <key>
        <id>csrusername</id>
        <dataid>subscriber@gmail.com</dataid>
        <fromDate>2010-01-01T00:00:00Z</fromDate>
      </key>
    </QueryAuditHistoryRequest>
  </se:Body>
</se:Envelope>
```
Policy Builder

The Policy Builder automatically logs all save operations (Publish and Save to Client) to the Audit History database and also to a log file.

- Policy Builder Publish submits an entry to the Audit Logging Server (goes to database).
- Policy Builder Save to Client Repository submits an entry to the Audit Logging Server (goes to database).
- Whenever a screen is saved locally (Save button) XML is generated and logged for that user in /var/log/broadhop/qns-pb.log.

Example login qns-pb.log from Local Save in Policy Builder:

2013-02-06 11:57:01,214 [UIThread [vt75cjikhk7v4oquyc9c7shp]] DEBUG c.b.c.r.BroadhopResourceSetAudit -
Audit: Local file change made by: broadhop. Updated File: file:/var/broadhop/pb/workspace/tmp-ITC2/checkout/ConfiguredExtensionPoint-43730cd7-b238-4b29-a828-d9b447e5a64f-33851.xmi

XML Representation of changed screen:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<policy:ConfiguredExtensionPoint xmlns:policy="http://broadhop.com/policy" id="43730cd7-b238-4b29-a828-d9b447e5a64f-33851">
  <extensionPoint href="virtual:URI#_vxG4swK1Ed-M48DL9vicxQ"/>
  <policies href="Policy-default-_sY__4L_REeGcdakzuzlAg.xmi#_sY__4L_REeGcdakzuzlAg"/>
</policy:ConfiguredExtensionPoint>
```

Controlling Local Save output:

In the logback.xml file that controls Policy Builder logging, add com.broadhop.client.resourceset.BroadhopResourceSetAudit as a category and set it to the desired level.

Reporting

For reporting purposes the following is the database structure in Mongo:

```json
{
  "_id": ObjectId("5097d75be4b0d5f7ab0d90fe"),
  "id_key": "username",
  "comment_key": "comment",
  "data_id_key": {
    "networkId11921":
  },
  "timestamp_key": ISODate("2012-11-05T15:12:27.673Z"),
  "request_key": "DeleteQuotaRequest",
}
The following table describes the various Reporting Keys.

**Table 10: Reporting Keys**

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>_id</td>
<td>The database unique identifier.</td>
</tr>
<tr>
<td>_id_key</td>
<td>the username of person who performed the action. In the above example the CSR who issued the debit request.</td>
</tr>
<tr>
<td>comment_key</td>
<td>Some description of the audit action.</td>
</tr>
<tr>
<td>data_id_key</td>
<td>The credential of the subscriber. It is a list and so, if the subscriber has multiple credentials, then they will all appear in this list. Please note that, it is derived from the request data and so, for a CreateSubscriber request, there may be multiple credentials sent in the request and each will be saved in the data_id_key list. In the DebitRequest case, only one credential is listed because the request only has the single networkId field.</td>
</tr>
<tr>
<td>timestamp_key</td>
<td>The time the request was logged. If the timestamp value is null in the request then the Audit module automatically populates this value.</td>
</tr>
<tr>
<td>request_key</td>
<td>The name of the request. This provides a way to search on type of API request.</td>
</tr>
<tr>
<td>data_key</td>
<td>The actual request XML.</td>
</tr>
</tbody>
</table>

**Audit Configuration**

**Step 1**   
Click the **Reference Data** tab, and then click **Systems > system name > Plugin Configurations**.
Step 2  Click Audit Configuration in the right pane to open the Audit Configuration dialog box.

Step 3  Under Audit Configuration there are different panes: General Configuration, Queue Submission Configuration, Database Configuration, and Shard Configuration. An example configuration is provided in the following figures:
The following parameters are used to size and manage the internal queue that aids in the processing of Audit messages. The application offloads message processing to a queue to speed up the response time from the API.
### Table 11: Audit Configuration Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Configuration</strong></td>
<td></td>
</tr>
<tr>
<td>Capped Collection</td>
<td>Select this check-box to activate capped collection function.</td>
</tr>
<tr>
<td>Capped Collection Size</td>
<td>By default, the Audit History uses a 1 GB capped collection in MongoDB. The capped collection automatically removes documents when the size restriction threshold is hit. Configuration in Policy Builder is done in GB increments. It is possible to enter decimals, for example, 9.5 will set the capped collection to 9.5 GB.</td>
</tr>
<tr>
<td>Log Read Requests</td>
<td>Select this check-box if you want read requests to be logged.</td>
</tr>
<tr>
<td>Include Read Requests in Query Results</td>
<td>Select this check-box only if you want to include read requests to be displayed in query results.</td>
</tr>
<tr>
<td>Disable Regex Search</td>
<td>If you select this check-box, the use of regular expressions for queries is turned off in the Policy Builder configuration.</td>
</tr>
<tr>
<td>Search Query Results Limit</td>
<td>This parameter limits the search results.</td>
</tr>
<tr>
<td><strong>Queue Submission Configuration</strong></td>
<td></td>
</tr>
<tr>
<td>Message Queue Size</td>
<td>Total number of messages the queue can hold at any given time.</td>
</tr>
<tr>
<td>Message Queue Sleep</td>
<td>The amount of time for the runnable to sleep between batch processing. The time is in milliseconds.</td>
</tr>
<tr>
<td>Message Queue Batch Size</td>
<td>The number of messages to process in a given wake cycle.</td>
</tr>
<tr>
<td>Message Queue Pool Size</td>
<td>The number of threads in the execution pool to handle message processing.</td>
</tr>
<tr>
<td><strong>Database Configuration</strong></td>
<td></td>
</tr>
<tr>
<td>Db Write Concern</td>
<td>Controls the write behavior of sessionMgr and for what errors exceptions are raised. Default option is OneInstanceSafe.</td>
</tr>
<tr>
<td>Db Read Preference</td>
<td>Read preference describes how sessionMgr clients route read operations to members of a replica set. The recommended option is typically Secondary Preferred.</td>
</tr>
<tr>
<td>Failover Slab Ms</td>
<td>This parameter is used to enter the amount of time to wait before starting failover database handling. The time is in milliseconds.</td>
</tr>
</tbody>
</table>
### Parameter Description

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| Max Replication Wait time Ms    | This option specifies a time limit, in milliseconds, for the write concern. This parameter is applicable only if you select TwoInstanceSafe in Db Write Concern.  
This parameter causes write operations to return with an error after the specified limit, even if the required write concern eventually succeeds. When these write operations return, MongoDB does not undo successful data modifications performed before the write concern exceeded the replication wait time limit. This time is in milliseconds. |

### Shard Configuration

<table>
<thead>
<tr>
<th>Primary Ip Address</th>
<th>The IP address of the sessionmgr node hosting the Audit database.</th>
</tr>
</thead>
</table>
| Secondary Ip Address            | The IP address of the sessionmgr node that provides fail over support for the primary database.  
This is the mirror of the database specified in the Primary IP Address field.  
Use this only for replication or replica pairs architecture.  
This field is present but deprecated to maintain backward compatibility. |
| Port                            | Enter the Port number of the Audit database as defined in /etc/broadhop/mongoConfig.cfg.  
The default value in Policy Builder is 27017.  
For All-In-One deployments, the default Audit database port number is configured as 27017 (no update is needed to this field).  
For HA or GR deployments, the default Audit database port is 27725. You must update this field to match the Audit database port (27725) or as defined in /etc/broadhop/mongoConfig.cfg. |

According to your network requirements, configure the parameters in Audit Configuration and save the configuration.

---

**Pre-configured auditd**

In the `/usr/share/doc/audit-version/` directory, the audit package provides a set of pre-configured rules files.

The Linux Audit system provides a way to track security-relevant information on your system. Based on pre-configured rules, Audit generates log entries to record as much information about the events that are happening on your system as possible.

In the `/usr/share/doc/audit-version/` directory, the audit package provides a set of pre-configured rules files.

To use these pre-configured rule files, create a backup of your original `/etc/audit/audit.rules` file and copy the configuration file of your choice over the `/etc/audit/audit.rules` file:

```
cp /etc/audit/audit.rules /etc/audit/audit.rules_backup

```
For more information on auditd process, refer to the link.
Prometheus and Grafana

- Introduction, on page 103
- Enable Prometheus, on page 103
- Add Datasource in Grafana for Prometheus, on page 105
- Grafana, on page 106
- Configure Grafana Users using CLI, on page 106
- Connect to Grafana, on page 107
- Grafana Administrative User, on page 108
- Configure Grafana for First Use, on page 114
- Manual Dashboard Configuration using Grafana, on page 116
- Configure Useful Dashboard Panels, on page 121
- Copy Dashboards and Users to percfclent02, on page 123
- Configure Garbage Collector KPIs, on page 124
- Export and Import Dashboards, on page 127
- Export Graph Data to CSV, on page 128
- Session Consumption Report, on page 130

Introduction

Prometheus is an application which is a part of monitoring solution in CPS. It is used to actively gather statistics from the running virtual machines and application services.

Prometheus application resides on both percfclent VMs. It scrapes statistics from collectd exporter after every configured interval and stores in /var/data/Prometheus directory on percfclent VMs.

To learn more about Prometheus, refer to: https://prometheus.io/docs/introduction/overview/.

Enable Prometheus

This following sections provides information on how to enable Prometheus on CPS system.

- By default, Prometheus is disabled on system. You need to configure Prometheus to start its operation.
- You can configure Prometheus using CSV based configurations or API based configurations.
• By default, statistics granularity is set to 10 seconds. To change it, you need to configure statistics granularity. Support is present for both CSV/API based installations.

• After enabling Prometheus, you must add Prometheus data source in Grafana.

• When Prometheus is enabled on the system, existing dashboards created with graphite will not work. You must use Prometheus queries to create new dashboard on the system.

CSV Based Installation Configuration Parameters

Table 12: CSV Based Installation Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>enable_prometheus</td>
<td>This parameter is used to enable/disable Prometheus in CPS.</td>
</tr>
<tr>
<td></td>
<td>Default: disabled</td>
</tr>
<tr>
<td></td>
<td>Possible Values: enabled, disabled</td>
</tr>
<tr>
<td>stats_granularity</td>
<td>This parameter is used to configure statistics granularity in seconds.</td>
</tr>
<tr>
<td></td>
<td>Default: 10 seconds</td>
</tr>
<tr>
<td></td>
<td>Possible Values: Positive Number</td>
</tr>
</tbody>
</table>

For example, in case of CSV based installations, you can configure Configuration.csv with the following parameters to enable Prometheus on Cluster Manager:

cat /var/qps/config/deploy/csv/Configuration.csv | tail -5
db_authentication_admin_passwd,72261348A44594381D2E84ADD1E6D9A,
db_authentication_passwd_encryption,true,
db_authentication_readonly_passwd,72261348A44594381D2E84ADD1E6D9A,
enable_prometheus,enabled,
stats_granularity,1,

After configuring the parameters, run the following commands to import the new configuration to VMs:

/var/qps/install/current/scripts/import/import_deploy.sh
/var/qps/install/current/scripts/upgrade/reinit.sh

API Based Installation Parameters

Table 13: API Based Installation Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>enablePrometheus</td>
<td>This parameter is used to enable/disable Prometheus in CPS.</td>
</tr>
<tr>
<td></td>
<td>Default: disabled</td>
</tr>
<tr>
<td></td>
<td>Possible Values: enabled, disabled</td>
</tr>
<tr>
<td>statsGranularity</td>
<td>This parameter is used to configure statistics granularity in seconds.</td>
</tr>
<tr>
<td></td>
<td>Default: 10 seconds</td>
</tr>
<tr>
<td></td>
<td>Possible Values: Positive Number</td>
</tr>
</tbody>
</table>
In case of API based installations, you need to use `api/system/config/config` PATCH API from Cluster Manager.

For example:

```
cat prom.yaml
enablePrometheus: "enabled"
statsGranularity: "1"
curl -i -X PATCH http://installer:8458/api/system/config/config -H "Content-Type: application/yaml" --data-binary @prom.yaml
HTTP/1.1 200 OK
Date: Fri, 20 Apr 2018 08:38:20 GMT
Content-Length: 0
```

## Add Datasource in Grafana for Prometheus

1. **Step 1**  
   Login to Grafana with admin credentials.

2. **Step 2**  
   Click on the Grafana logo to open the sidebar menu.

   ![Sidebar Menu](image)

3. **Step 3**  
   Click on **Data Sources** in the sidebar.

4. **Step 4**  
   Click on **Add data source**.

   ![Add data source](image)

5. **Step 5**  
   From **Type** drop-down list, select **Prometheus**.

6. **Step 6**  
   Set the appropriate Prometheus server URL (for example, `http://localhost:9090`).

7. **Step 7**  
   Click **Add** to save the new data source.

8. **Step 8**  
   Create graph with Prometheus as a data source.
For example, a sample graph which gives 1 min load average of VMs.

*Figure 19: Sample Graph*

---

**Grafana**

Grafana is a third-party metrics dashboard and graph editor.

Grafana provides a graphical or text-based representation of statistics and counters collected in the Prometheus database. To use Prometheus in Grafana, refer to [http://docs.grafana.org/features/datasources/prometheus/](http://docs.grafana.org/features/datasources/prometheus/).

**Additional Grafana Documentation**

This chapter provides information about the CPS implementation of Grafana. For more information about Grafana, or access the general Grafana documentation, refer to: [http://docs.grafana.org](http://docs.grafana.org).

**Configure Grafana Users using CLI**

In CPS 7.0.5 and higher releases, users must be authenticated to access Grafana. No default users are provided. In order to access Grafana, you must add at least one user as described in the following sections.

The steps mentioned in the sections describe how to add and delete users who are allowed view-only access of Grafana. In order to create or modify dashboards, refer to Grafana Administrative User, on page 108.

After adding or deleting a Grafana user, manually copy the `/var/broadhop/.htpasswd` file from the perfclient01 VM to the perfclient02 VM.

Also, run `/var/qps/bin/support/grafana_sync.sh` to synchronize the information between two OAM (perfclient) VMs.

There is no method to change the password for a Grafana user; you can only add and delete users. The `change_passwd.sh` script cannot be used to change the password for Grafana users.

Log on to the perfclient01 VM to perform any of the following operations.

**Add First User**

**Step 1**

Run the following command on the perfclient01 VM to create first user and encrypt the password:

```
/usr/bin/htpasswd -cs /var/broadhop/.htpasswd user1
```
Add Another User

Step 1
Run the following command on the perfclient01 VM to create another user:
/usr/bin/htpasswd -s /var/broadhop/.htpasswd user2

Step 2
When prompted for a password, enter and re-enter the password.
This step creates a password file and forces SHA encryption of the password.

Delete a User

Run the following command on the perfclient01 VM:
/usr/bin/htpasswd -D /var/broadhop/.htpasswd user2

Connect to Grafana

Use the following URL to access Grafana.

- HA: https://<lbvip01>:9443/grafana
- All in One: http://<ip>:80/grafana

When prompted, enter the username and password of a user you created in Configure Grafana Users using CLI, on page 106.
**Grafana Administrative User**

**Log in as Grafana Admin User**

To create or modify dashboards in Grafana, you must log in as the Grafana administrative user.

---

**Step 1**  
Click the Grafana logo in the upper left corner of your screen.

*Figure 21: Grafana Logo*

**Step 2**  
Click **Sign In**.

**Step 3**  
Enter the administrative username and password: **admin/admin**
Change Grafana Admin User Credentials

Step 1  Log in as the administrative user (admin/admin).
Step 2  Click the Grafana logo, then click Grafana admin.
Step 3  Click Global Users.
Step 4  Click Edit.

Figure 22: Changing Grafana Admin User Credentials

Add a Grafana User

Note  The steps mentioned here can be performed only by administrative user.

Step 1  Click the Grafana logo in the upper left corner of your screen.
Step 2  Click Sign in. Enter the administrative username and password.
Step 3  Click Grafana admin from the left side to open the System info pane on the right side.
Step 4  Click Global Users to open a pane. By default, the List tab appears displaying the list of users currently configured in Grafana.

Figure 23: List Tab

Step 5  Click Create user at the top to open Create a new user pane.
Step 6 Enter the required parameters in Name, Email, Username and Password fields.

Step 7 Click Create to create the grafana user.

Step 8 You will see the newly added user in the List tab. By default, the new user will have only Viewer rights.

Step 9 Click Edit to open Edit User pane. Only administrative user can update/modify the user properties.
Change the Role of Grafana User

You can also change the rights of the user from the main page.

Note

The steps mentioned here can be performed only by administrative user.

Click Main Org. drop-down list to select Users. This will open Organization users pane, where you can change the role of a user from Role drop-down list.

The user can have Admin/Viewer/Editor/Read Only Editor roles.

- **Admin**: An admin user can view, update and create dashboards. Also the admin can edit and add data sources and organization users.

- **Viewer**: A viewer can only view dashboards, not save or create them.
Add an Organization

Grafana supports multiple organizations in order to support a wide variety of deployment models, including using a single Grafana instance to provide service to multiple potentially untrusted Organizations.

In many cases, Grafana will be deployed with a single Organization. Each Organization can have one or more Data Sources. All Dashboards are owned by a particular Organization.

---

**Note**

The steps mentioned here can be performed only by **administrative** user.

---

**Step 1**

Click **Main Org.** drop-down list to select **New Organization**.

---

**Figure 26: New Organization**

---

**Step 2**

This will open a new pane **Add Organization**. Enter organization name in **Org. name** field. For example, test.

**Step 3**

After adding the name, click **Create** to open **Organization** pane.
Figure 27: Organization

In this pane, you can modify the organization name and other organization information. After modifying the information, click **Update** to update the information.

---

**Move Grafana User to another Organization**

---

**Note**
The steps mentioned here can be performed only by **administrative** user.

---

**Step 1**
Click **Grafana admin** from the main page to **System Info** page.

**Step 2**
Click **Global Users** from the left pane to open **Users** pane on the right.

**Step 3**
Click **Edit** against the user for whom you want to make the changes.

**Step 4**
Under **Organizations** section, you can add the user to some other organizations.
**Configure Grafana for First Use**

After an initial installation or after upgrading an existing CPS deployment which used Grafana, you must perform the steps in the following sections to validate the existing data sources.

**Migrate Existing Grafana Dashboards**

During an upgrade of CPS (and Grafana), saved dashboard templates remain intact.

After upgrading an existing CPS deployment, you must manually migrate any existing Grafana dashboards.

**Step 1** Sign in as the Grafana Administrative User. For more information, refer to Grafana Administrative User, on page 108.

**Step 2** Click Home at the top of the Grafana window and then click Import as shown below:

---

**Figure 28: Move User to another Organization**

In Add organization field, you need to enter the name of the new organization.

You can also change the role of the user from the Role drop-down list.

After adding the required information, click Add to add the user into a new organization.

In the above example, you can see that the user is added to the new organization. If you want to remove the user from previous organization, click the red cross at the end.
Step 3

In the Migrate dashboards section, verify that **Elasticsearch Def** (Elasticsearch Default via API) is listed, then click **Import**.

*Figure 30: Import File*
All existing dashboards are imported and should now be available.

**Manual Dashboard Configuration using Grafana**

Grafana enables you to create custom dashboards which provide graphical representations of data by fetching information from the Prometheus database. Each dashboard is made up of panels spread across the screen in rows.

**Note**

CPS includes a series of preconfigured dashboard templates. To use these dashboards, refer to Updating Imported Templates.

**Create a New Dashboard Manually**

**Step 1**
Sign-in as a Grafana Administrative user. For more information, see Grafana Administrative User, on page 108.

**Step 2**
Click **Home** at the top of the Grafana window and select **New** as shown below:

*Figure 31: Home*

A blank dashboard is created.
Step 3  
At the top of the screen, click the gear icon, then click Settings.

Step 4  
Provide a name for the dashboard and configure any other Dashboard settings. When you have finished, click the X icon in the upper right corner to close the setting screen.
Step 5  
To add a graph to this dashboard, hover over the green box on the left side of the dashboard, then point to Add Panel, then click Graph.

Configure Data Points for the Panel

Step 1  
Click the panel title, as shown below, then select Edit.
Step 2  Select the necessary metrics by clicking on the select metric option provided in the query window. A drop-down list appears from which you can choose the required metrics.

Select metrics by clicking select metric repeatedly until the lowest level of the hierarchy.

Note    Clicking the ‘*’ option in the drop-down list selects all the available metrics.

Step 3  Click the ‘+’ tab to add aggregation functions for the selected metrics. The monitoring graph is displayed as shown below.
**Figure 39: Aggregation Functions**

![Aggregation Functions Image]

**Step 4** The x-axis and y-axis values can be configured in the **Axes & Grid** tab.

*Figure 40: Axes and Grid*

**Step 5** Click the disk icon (Save dashboard) at the top of the screen, as shown in the following image.

**Note** The changes to this dashboard are lost if you do not click the **Save** icon.
Graphical representation of application-messages such as - CCR, CCA, Gx, Gy, LDAP, Rx messages and so on, can be configured in the dashboard panel by using the queries shown in the below figure.

Configure Useful Dashboard Panels

The following section describes the configuration of several useful dashboard panels that can be used while processing Application Messages. Configure the dashboard panel as shown in the screens below.

**Total Error:**

This dashboard panel lists the errors found during the processing of Application Messages. To configure Total Error dashboard panel, create a panel with name 'Total Error' and configure its query as shown:
Figure 43: Total Error Dashboard

This dashboard panel displays the total delay in processing various Application Messages. To configure Total Delay dashboard panel, create a panel with name Total Delay and configure its query as shown:

Figure 44: Total Delay Dashboard

Total Delay:

This dashboard panel displays the total delay in processing various Application Messages. To configure Total Delay dashboard panel, create a panel with name Total Delay and configure its query as shown:

Figure 44: Total Delay Dashboard

Total TPS:

This panel displays the total TPS of CPS system. Total TPS count includes all Gx, Gy, Rx, Sy, LDAP and so on. The panel can be configured as shown below:
Some of the preconfigured templates (such as Diameter statistics panels) have matrices configured which are specific to a particular set of Diameter realms. These panels need to be reconfigured to match customer specific Diameter realms.

For example, the Gx P-GW panel in the Diameter Statistics dashboard does not fetch the stats and displays the message “No Datapoints”. The probable reasons could be:

- Matrices used in query uses matrices specific to particular Diameter realm which is different on customer setup.
- No application call of such type has ever landed on CPS Policy Directors (LBs) (no Diameter call from the P-GW has ever landed on Policy Director after the Grafana setup).

As a best practice, the internal Grafana database should be kept in sync between pcrfclient01 and pcrfclient02. This sync operation should be performed after any dashboard or Grafana user is migrated, updated, added or removed.

Under normal operating conditions, all Grafana operations occur from pcrfclient01. In the event of a pcrfclient01 failure, pcrfclient02 is used as backup, so keeping the database in sync provides a seamless user experience during a failover.

The following steps copy all configured Grafana dashboards, Grafana data sources, and Grafana users configured on pcrfclient01 to pcrfclient02.

Log in to the pcrfclient01 VM and run the following command:

```
/var/qps/bin/support/grafana_sync.sh
```
As a precaution, the existing database on pcrfclient02 is saved as a backup in the /var/lib/grafana directory.

Configure Garbage Collector KPIs

The following sections describe the steps to configure Garbage Collector (GC) KPIs in Grafana:

- Backend changes: Changes in the collectd configuration so that GC related KPIs will be collected by collectd and stored in graphite database.
- Frontend changes: Changes in Grafana GUI for configuring metrics for GC graph.

Backend Changes

Check if the following changes are already present in the jmxplugin.conf file. If already configured, then skip this section and move to configuring the Grafana dashboard.

---

**Step 1** Edit /etc/puppet/modules/qps/templates/collectd_worker/collectd.d/jmxplugin.conf on the Cluster Manager VM as described in the following steps.

**Step 2** Verify that the JMX plugin is enabled. The following lines must be present in the jmxplugin.conf file.

- JVMARG has path for jmx jar
- JVMARG
  -Djava.class.path=/usr/share/collectd/java/collectd-api.jar/usr/share/collectd/java/generic-jmx.jar
- And GenericJMX plugin is loaded
- LoadPlugin org.collectd.java.GenericJMX

**Step 3** Add an Mbean entry for garbage collector mbean in GenericJMX plugin so that statistics from this mbean will be collected.

```xml
# Garbage collector information
<MBean "garbage_collector">
  <ObjectName "java.lang:type=GarbageCollector,*">
    <InstancePrefix "gc-">
    <InstanceFrom "name">
      <Value>
        Type "invocations"
        #InstancePrefix ""
        #InstanceFrom ""
        Table false
        Attribute "CollectionCount"
      </Value>
    </InstanceFrom>
  </ObjectName>
  <Value>
    Type "total_time_in_ms"
    InstancePrefix "collection_time"
    #InstanceFrom ""
    Table false
    Attribute "CollectionTime"
  </Value>
</MBean>
```

**Step 4** For every “Connection” block in jmxplugin.conf file add the entry for garbage collector mbean.
For example:

```
<Connection>
    InstancePrefix "node1."
    ServiceURL "service:jmx:rmi:///jndi/rmi://localhost:9053/jmxrmi"
    Collect "garbage_collector"
    Collect "java-memory"
    Collect "thread"
    Collect "classes"
    Collect "qns-counters"
    Collect "qns-actions"
    Collect "qns-messages"
</Connection>
```

Step 5  Save the changes to the jmxplugin.conf file then synchronize the changes to all CPS VMs as follows:

a) Go to the /var/qps/install/current/scripts/build/ directory on the Cluster Manager and execute the following script:

```
./build_puppet.sh
```

b) Go to the /var/qps/install/current/scripts/upgrade/ directory on the Cluster Manager and execute the following command:

```
./reinit.sh
```

c) Restart the collectd service on all VMs by running the following command on each VM in the CPS cluster:

```
monit restart collectd
```

Frontend Changes

The frontend changes must be done in the Grafana GUI.

Step 1  Create a new Grafana dashboard. For more information, see Manual Dashboard Configuration using Grafana, on page 116.

Step 2  In the Metrics tab of the new dashboard, configure queries for GC related KPIs.

The query needs to be configured in the following format:

```
cisco.quantum.qps.<hostname>.node*. gc*.total_time_in_ms-collection_time
```

```
cisco.quantum.qps.<hostname>.node*.gc*.invocations
```

where, `<hostname>` is regular expression for the name of hosts from which KPI needs to be reported.

If this is a CPS All in One (AIO) deployment, the hostname is “lab”.

If this is a High Availability (HA) CPS deployment, KPIs need to be reported from all Policy Server (QNS) VMs.

Assuming the Policy Server (QNS) VMs have “qns” in their hostname, then a regular expression would be *qns*. This would report data for all VMs that have a hostname containing “qns” (qns01 qns02 and so on).

- AIO Setup
• HA Setup

An example statistics graph is shown below.

Step 3  Save the dashboard by clicking on Save icon.
Export and Import Dashboards

Existing dashboard templates can be exported and imported between environments. This is useful for sharing Grafana dashboards with others.

Export Dashboard

This topic describes how to export a dashboard configuration to a file.

**Step 1** Sign-in as a Grafana Administrative User.

**Step 2** Open the dashboard to be exported.

**Step 3** Click the gear icon at the top of the page, and then select **Export** to save the dashboard configuration on your local system.

*Figure 49: Export*

**Step 4** If prompted, select the location on your local system to save the dashboard template, and click **OK**.

Import Dashboard

This topic describes how to import a dashboard from a file.

**Step 1** Sign-in as a Grafana Administrative User.

**Step 2** Click **Home** at the top of the Grafana window, and then click **Import** as shown below.
Step 3  Click Choose File.

Step 4  Select the file on your local system to save the dashboard template and click Open.

Step 5  After the dashboard is loaded, click the disk icon (Save dashboard) at the top of the screen to save the dashboard.

Note  Your changes to this dashboard are lost if you do not save the dashboard.

The data to be imported in the dashboard should be in the correct format. Grafana does not throw any error if incorrectly formatted data is loaded.

Export Graph Data to CSV

This topic describes how to export the data in a graph panel to a CSV file.

Step 1  Click the title of the graph as shown below to open the graph controls.
Step 2  Click the rows button to open another menu.

Step 3  Click Export CSV.

A grafana_data_export.csv file is downloaded by your browser.
Session Consumption Report

Introduction

This feature generates the session consumption report and stores the data into a separate log. The total number of sessions limited by the license, the total number of active sessions, and total transactions per second are documented at regular time intervals into the log. The core license number is derived from the license file that has the total number of sessions limited by the license. The active session count and the transaction count has been taken from Grafana using the graphite query. A single entity of the feature mainly prints the current time stamp with the statistics values.

Data Collection

The session and TPS count is collected from the graphite API with a JSON response. The JSON response is then parsed to get the counter, which is then logged into the consolidated log. The sample URL and the JSON response are given below:

```bash
> curl "http://localhost:8008/render?target=cisco.quantum.qps.pcrfclient01.set_session_count_total.records&from=-20second&until=-0hour&format=json"
> [{"target": "cisco.quantum.qps.localhost.set_session_count_total.records", "datapoints": [[3735.42, 1455148210], [3748.0, 1455148220]]}]
> curl "http://localhost:8008/render?target=sumSeries(cisco.quantum.*.*.node*.messages.e2e*.success)&from=-20second&until=-0hour&format=json"
> [{"target": "sumSeries(cisco.quantum.*.*.node*.messages.e2e*.success)", "datapoints": [[2345.34324, 1455148210], [2453.23445453, 1455148220]]}
```

Logging

Data logging is done using the logback mechanism. The consolidated data that is generated is stored in a separate log file named `consolidated-sessions.log` inside the `/var/log/broadhop` directory along with other logs. The data entries are appended to the log every 90 seconds. The logs generated are detailed and have the counter name and the current value with the time stamp.

Performance

The codebase pulls the JSON response from the Graphite API. The overhead by the codebase adds an average of 350 ms of time.

Log Rotation

A log rotation policy is applied on the logs generated for the session Consumption Report. The file size limitation for each log file is 100 MB. The limitation on number of log files is 5. The logs get rotated after reaching the limitations. One file contains a little more than two years of data, so five such files can contain 10 years of data until the first file get replaced.
Sample Report

2016-02-15 20:30:01 - TPS_COUNT: 6440.497603  SESSION_COUNT: 200033.0
LICENSE_COUNT: 1000000

2016-02-15 20:31:31 - TPS_COUNT: 6428.235699999999  SESSION_COUNT: 201814.0
LICENSE_COUNT: 1000000

2016-02-15 20:33:01 - TPS_COUNT: 5838.386624000001  SESSION_COUNT: 204818.0
LICENSE_COUNT: 1000000

2016-02-15 20:34:31 - TPS_COUNT: 6266.777699999999  SESSION_COUNT: 208719.0
LICENSE_COUNT: 1000000

2016-02-15 20:36:01 - TPS_COUNT: 6001.863687  SESSION_COUNT: 211663.0
LICENSE_COUNT: 1000000

2016-02-15 20:37:31 - TPS_COUNT: 6528.9450540000025  SESSION_COUNT: 213976.0
LICENSE_COUNT: 1000000

2016-02-15 20:39:01 - TPS_COUNT: 6384.073428  SESSION_COUNT: 218851.0
LICENSE_COUNT: 1000000

2016-02-15 20:40:31 - TPS_COUNT: 6376.373494000002  SESSION_COUNT: 220515.0
LICENSE_COUNT: 1000000

2016-02-15 20:42:01 - TPS_COUNT: 6419.310694000001  SESSION_COUNT: 221663.0
LICENSE_COUNT: 1000000

LICENSE_COUNT: 1000000

2016-02-15 20:45:01 - TPS_COUNT: 6200.357029999999  SESSION_COUNT: 223786.0
LICENSE_COUNT: 1000000

2016-02-15 20:46:31 - TPS_COUNT: 6299.090987  SESSION_COUNT: 223973.0
LICENSE_COUNT: 1000000

2016-02-15 20:48:02 - TPS_COUNT: 6294.876452  SESSION_COUNT: 225845.0
LICENSE_COUNT: 1000000

2016-02-15 20:49:31 - TPS_COUNT: 6523.586347999997  SESSION_COUNT: 228450.0
LICENSE_COUNT: 1000000

2016-02-15 20:51:01 - TPS_COUNT: 5842.6139970000001  SESSION_COUNT: 229334.0
LICENSE_COUNT: 1000000

2016-02-15 20:52:31 - TPS_COUNT: 6354.272679999999  SESSION_COUNT: 234070.0
LICENSE_COUNT: 1000000

2016-02-15 20:54:01 - TPS_COUNT: 6582.6139700000001  SESSION_COUNT: 236139.0
LICENSE_COUNT: 1000000

2016-02-15 21:00:03 - TPS_COUNT: 6217.872034999999  SESSION_COUNT: 236139.0
LICENSE_COUNT: 1000000
Managing High Availability in CPS

• Porting All-In-One Policy Builder Configuration to HA, on page 133
• HAProxy, on page 136
• Expanding an HA Deployment, on page 137
• Enable SSL, on page 139

Porting All-In-One Policy Builder Configuration to HA

This section describes how to port the Policy Builder configuration from an All-In-One (AIO) environment to a High Availability (HA) environment.

Prerequisites

• All the VMs were created using the deployment process.

• This procedure assumes the datastore that will be used to have the virtual disk has sufficient space to add the virtual disk.

• This procedure assumes the datastore has been mounted to the VMware ESX server, regardless of the backend NAS device (SAN or iSCSI, etc).

Porting the Policy Builder Configuration

Policy Builder configuration can be utilized between environments, however, the configuration for Systems and Policy Enforcement Points is environment-specific and should not be moved from one environment to another.

The following instructions will not overwrite the configuration specific to the environment. Please note that as the Systems tab and Policy Enforcement Points data is not moved, the HA system should have these things configured and running properly (as stated above).

The following steps describe the process to port a configuration from an AIO environment to an HA environment.

Step 1
If the HA environment is currently in use, ensure that SVN backups are up to date.
Step 2

Find the URL that Policy Builder is using to load the configuration that you want to use. You can find this by clicking Edit on the initial page in Policy Builder.

The URL is listed in the URL field. For the purpose of these instructions, the following URL will be used for exporting the configuration from the AIO environment and importing the configuration to the HA environment:
http://pcrfclient01/repos/configuration

Figure 54: Repository configuration

Step 3

On the AIO, export the Policy Builder configuration by entering the following commands:

```
    cd /var/tmp
    svn export http://pcrfclient01/repos/configuration aio_configuration
```

This creates a directory `/var/tmp/aio_configuration`.

Step 4

Remove the system configuration by entering the following commands:

```
    cd aio_configuration
    rm -f System* *Configuration* DiameterStack* VoucherSettings* Cluster* Instance*
```

Step 5

Move the `/var/tmp/aio_configuration` directory to `/var/tmp` on your Cluster Manager (using scp, zip and so on).

Step 6

SSH into the percfclient01.

The following steps assume you will replace the existing default Policy Builder configuration located at http://pcrfclient01/repos/configuration on your HA environment. If you would like to access your old configuration, copy it to a new location. For example:
Step 7
Check out the old configuration:
```
svn co http://pcrfclient01/repos/configuration /var/tmp/ha_configuration
```

Step 8
Remove the non-system configuration:
```
svn rm ls | egrep -v '(System|Configuration|DiameterStack|VoucherSettings|Cluster|Instance)'
```

Step 9
Copy in the AIO configuration files:
```
/bin/cp -f /var/tmp/aio_configuration/* .
svn add *
```

Step 10
Commit the configuration:
```
svn ci . -m 'commit configuration moved from AIO'
```

Step 11
If you are already logged into Policy Builder, reload the Policy Builder URL in your browser to access the new configuration.

Step 12
Check for errors in Policy Builder. This often indicates a software mismatch.
Errors are shown with an (x) next to the navigation icons in the left pane of Policy Builder. For example:

*Figure 55: Error in Policy Builder*

Step 13
Publish the configuration. Refer to the *CPS Mobile Configuration Guide* for detailed steps.
HAProy is an opensource load balancer used in High Availability (HA) and Geographic Redundancy (GR) CPS deployments. It is used by the CPS Policy Directors (lbs) to forward IP traffic from lb01/lb02 to other CPS nodes. HAProy runs on the active Policy Director VM.

Documentation for HAProy is available at http://www.haproxy.org/#docs.

**HAProy Service Operations**

**Diagnostics**

For a general diagnostics check of the HAProy service, run the following command from any VM in the cluster (except sessionmgr):

```
 diagnostics.sh --ha_proxy
```

**QPS Diagnostics Multi-Node Environment**

Ping Check for qns01...[PASS]
Ping Check for qns02...[PASS]
Ping Check for qns03...[PASS]
Ping Check for qns04...[PASS]
Ping Check for lb01...[PASS]
Ping Check for lb02...[PASS]
Ping Check for sessionmgr01...[PASS]
Ping Check for sessionmgr02...[PASS]
Ping Check for sessionmgr03...[PASS]
Ping Check for sessionmgr04...[PASS]
Ping Check for pcrfclient01...[PASS]
Ping Check for pcrfclient02...[PASS]
HA Multi-Node Environment
Checking HAProy status...[PASS]

**Service Commands**

The following commands must be issued from the lb01 or lb02 VM.

To check the status of the HAProy services, run the following command:

```
monit status haproxy
```

[root@host-lb01 ~]# service haproxy status
haproxy (pid 10005) is running...

To stop the HAProy service, run the following command:

```
monit stop haproxy
```

To restart the HAProy service, run the following command:

```
monit restart haproxy
```

**HAProy Statistics**

To view statistics, open a browser and navigate to the following URL:
Changing HAProxy Log Level

To change HAProxy log level in your CPS deployment, you must make changes to the HAProxy configuration files on the Cluster Manager and then push the changes out to the Policy Director (lb) VMs.

Once deployed, the HAProxy configuration files are stored locally on the Policy Director VMs at /etc/haproxy/haproxy.cfg.erb and /etc/haproxy/haproxy-diameter.erb.

**Note**
Whenever you upgrade with latest ISO, the log level will be set to default level (err).

---

**Step 1** Log in to the Cluster Manager.

**Step 2** Create a backup of the HAProxy configuration file before continuing:

```bash
cp /var/qps/install/current/puppet/modules/qps/templates/etc/haproxy/haproxy.cfg.erb /var/qps/install/current/puppet/modules/qps/templates/etc/haproxy/haproxy.cfg.erb-bak-<date>
```

**Step 3** Edit the HAProxy files as needed.

By default, the logging level is set as error (err) in

```bash
/var/qps/install/current/puppet/modules/qps/templates/etc/haproxy/haproxy-diameter.erb:
log 127.0.0.1 local1 err
```

By default, the logging level in

```bash
/var/qps/install/current/puppet/modules/qps/templates/etc/haproxy/haproxy.cfg.erb:
log 127.0.0.1 local3 emerg alert crit err warning
```

The log level can be adjusted to any of the following log levels as needed:

`emerg alert crit err warning notice info debug`

**Step 4** Run `build_all.sh` to rebuild the CPS VM packages.

**Step 5** Run `reinit.sh` to trigger all VMs to download the latest software and configuration from the Cluster Manager.

---

Expanding an HA Deployment

For future installations and network upgrades, this section proposes what hardware and components you should consider as you grow your network. The CPS solution is a robust and scalable software-based solution that can be expanded by adding additional hardware and software components. The following sections explain typical scenarios of when to expand the hardware and software to effect such growth.
Typical Scenarios When Expansion is Necessary

Your network may grow for the following reasons:

• The subscriber base has grown or will grow beyond the initial installation specifications.
  In this case, the number of active or non-active subscribers becomes larger than the initial deployment. This can cause one or more components to reach capacity. New components must be added to accommodate the growth.

• The services or subscriber scenarios have changed, or new services have been introduced, and the transactions per second on a component no longer meet requirements.
  When a new service or scenario occurs, often there is a change in the overall Transactions Per Second (TPS), or in the TPS on a specific component. When this occurs, new components are necessary to handle the new load.

• The operator notices that there are factors outside of the initial design that are causing either the overall system or a specific component to have a high resource load.
  This may cause one or multiple components to reach its capacity for TPS. When this occurs, new components are necessary to handle the new factors.

Hardware Approach to Expanding

Adding a new component may require adding additional hardware. However, the addition of more hardware depends on the physical resources already available, plus what is needed for the new component.

If the number of subscribers exceeds 10 million, then the customer needs to Clone and Repartition sessionmgr Disks. See Manage Disksto Accommodate Increased Subscriber Load, on page 16.

High Availability Consequences

When adding more hardware, the design must take into consideration the high availability (HA) needs of the system. The HA design for a single-site system is N+1 at the hardware and application level. As a result, adding a new blade incrementally increases the HA capacity of the system.

For example, in a basic installation there are 2 Cisco Policy Server blades handling the traffic. The solution is designed so that if one of the blades fails, the other blade can handle the entire capacity of the system. When adding a third blade for capacity expansion, there are now 2 blades to handle the system load if one of the blades fails. This allows for a more linear scaling approach because each additional blade can be accountable for being able to use its full capacity.

Note When adding new blades to a cluster, the blades in the cluster must be co-located to achieve the proper throughput between other components.

Adding a New Blade

Step 1 Install ESX server to the blade.
Open the CPS Deployment Template spreadsheet. This spreadsheet should have been created and maintained during the initial deployment.

In the Additional Hosts sheet, add an entry for the new ESX server with IP, Host name and Alias.

Save the CSV file and transfer it to the following directory on the Cluster Manager: /var/qps/config/deploy/csv.

Run /var/qps/install/current/scripts/import/import_deploy.sh to convert the csv to json.

---

The most common components to be expanded are on the Cisco Policy Servers. As your system begins to scale up, you will need to add more CPS nodes and more SessionMgrs. Expansion for other components can follow the same pattern as described here. The next sections discuss the configurations needed for those specific components to be active in the system.

Modify the CPS Deployment Template spreadsheet (this spreadsheet should have been created and maintained during the initial deployment).

In the Hosts sheet, add the new VM node with the parameters. See the CPS Installation Guide for VMware for details about each column.

Save the CSV file and transfer it to the following directory on the Cluster Manager: /var/qps/config/deploy/csv.

Run /var/qps/install/current/scripts/import/import_deploy.sh to convert the csv to json.

Deploy the new VM using /var/qps/install/current/scripts/deployer/deploy.sh xxx, where xxx is the alias of the new VM to be deployed.

Refer to the CPS Installation Guide for VMware for more details about using deploy.sh.

CPS uses encryption on all appropriate communication channels in HA deployments. No additional configuration is required.

Default SSL certificates are provided with CPS but we recommend that you replace these with your own SSL certificates. Refer to Replace SSL Certificates in the CPS Installation Guide for VMware for more information.
Enable SSL
CPS Statistics

- Bulk Statistics Overview, on page 141
- CPS Statistics, on page 142
- Bulk Statistics Collection, on page 146
- CPS KPI Monitoring, on page 148
- Example CPS Statistics, on page 171

Bulk Statistics Overview

Bulk Statistics are the statistics that are gathered over a given time period and written to a set of files. These statistics can be used by external analytic processes and/or network management systems. The architecture of CPS bulk statistic collection is shown below.

*Figure 56: CPS Bulk Statistic Collection Architecture*

The collection utility collectd is used for collecting and storing statistics from each VM. Detailed collectd documentation can be found on [http://collectd.org/](http://collectd.org/).

Collectd within CPS is deployed with nodes relaying data using the collectd network plug-in ([https://collectd.org/wiki/index.php/Plugin:Network](https://collectd.org/wiki/index.php/Plugin:Network)) to the centralized collection nodes on the perfcient01 and perfcient02 virtual machines. The centralized collector writes the collected data to output CSV files.
pcrfclient01 and pcrfclient02 collect bulk statistics independently. As a result, it is normal to have slight differences between the two files. For example, pcrfclient01 generates a file at time t and pcrfclient02 generates a file at time t +/- the clock drift between the two machines.

As a best practice, always use the bulk statistics collected from pcrfclient01. pcrfclient02 can be used as a backup if pcrfclient01 fails.

If pcrfclient01 becomes unavailable, statistics is still gathered on pcrfclient02. Statistics data is not synchronized between pcrfclient01 and pcrfclient02, so a gap exists in the collected statistics while pcrfclient01 is down.

Statistics value in csv files is displayed in E notation format depending on value and data source type. For example, for Gauge type of data source, statistics value is converted to E notation if value is greater than 10^7.

Grafana

CPS Statistics

The list of statistics available in CPS is consolidated in an Excel spreadsheet. After CPS is installed, this spreadsheet can be found in the following location on the Cluster Manager VM:

/var/qps/install/current/scripts/documents/QPS_statistics.xlsx

Overview

The following diagram represents the various statistic gathering points for incoming and outgoing messages.

Figure 57: Various Statistic Gathering Points for Incoming and Outgoing Messages
Table 14: Measurement Legend

<table>
<thead>
<tr>
<th>Legend</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Inbound queue counts and times*</td>
</tr>
<tr>
<td>B</td>
<td>Policy action counts and times</td>
</tr>
<tr>
<td>C</td>
<td>Interface specific counts and times</td>
</tr>
<tr>
<td>D</td>
<td>Policy message counts and times</td>
</tr>
<tr>
<td>E</td>
<td>Outbound queue counts and times*</td>
</tr>
<tr>
<td>F</td>
<td>Round trip counts and times*</td>
</tr>
</tbody>
</table>

where, * – statistics only apply to Diameter messages

A brief description of each statistic gathering points is given below:

- Upon receipt of a message on the Policy Director (lb) node, the message is registered as received and forwarded to a middle tier processing node.

- This middle tier processing node tracks the inbound message counts and time spent within the inbound processing queue. If a message is discarded due to SLA violation, then counters are incremented at this point. This occurs at point A within the diagram.

- Upon arrival within the policy engine all messages are counted and timers are started to measure the duration of processing.

- Any internal or external actions are tracked at this point and the round trip time is measured from the policy engine invocation of the action and success or failure of the action. This occurs at point B within the diagram.

- For external actions (for example, LDAP), interface specific statistics may be captured. This occurs at point C in the diagram and is gathered from the Policy Director nodes.

- Upon completion of the message in the policy engine, the total elapsed time is measured and whether success or failure occurred in processing.

  **Note**  
  A message is considered a success even if the policy returns an error (such as 5002). These application errors are tracked at point D within the diagram.

- Outbound messages are tracked from the policy engine to the Policy Directors at point E within the diagram.

- Upon receipt of outbound messages, the Policy Directors tracks either end to end completion time for inbound requests OR starts a timer and counts outbound requests. This occurs at point F within the diagram.
CPS Statistic Types

This section describes various forms of statistics generated by CPS.

Diameter Statistics

In Diameter statistics, Monitoring Areas are defined on the basis of Queues maintained in it. Diameter statistics can also be defined based on whether the statistic is related to a counter or gauge or derived or absolute.

- Counter: Counter type represents a non-negative integer which monotonically increases until it reaches a maximum value of $2^{32}-1$ (4294967295 decimal), when it resets and starts increasing again from zero.

  Counters have no defined “initial” value, and thus, a single value of a Counter has (in general) no information content. You must take a delta of multiple readings to understand anything.

- Gauge: Gauge type represents a non-negative integer, which can increase or decrease, but can never exceed a maximum value, nor fall below a minimum value. The maximum value cannot be greater than $2^{32}-1$ (4294967295 decimal), and the minimum value cannot be smaller than 0.

- Derived: It is intended to store the derivative of the line going from the last to the current value of the data source. Such data sources are very common with events that can be counted. Internally, derive works exactly like COUNTER but without overflow checks. So if your counter does not reset at 32 or 64 bit you might want to use DERIVE and combine it with a MIN value of 0.

- Absolute: It is intended for counters which get reset upon reading. In effect, the type is very similar to GAUGE except that the value is an (unsigned) integer and is divided by the time since the last reading. This is used for fast counters which tend to overflow. So instead of reading them normally you reset them after every read to make sure you have a maximum time available before the next overflow. Another usage is for things you count like number of messages since the last update.

LDAP Statistics

CPS tracks LDAP statistics for general LDAP actions, LDAP query counters, LDAP connection counters, as well as message counters.

Categories:

- Action
- Messages

System Statistics

System statistics are defined based on six categories:

- CPU
- File System Usage
- Disk Performance
- Interface
- CPU Load
- Memory
Engine Statistics

Engine statistics are defined based on three categories:

- Session Count
- Session Operation
- Internal messages

MOG API Statistics

API statistics are defined based on five categories: Bearer Count, Tenant Onboarding Count, Subscriber Onboarding Count, Authentication Count and Callback Response Statistics.

Default and Dedicated Bearer Counters
Counter for the number of default and dedicated bearers related to API requests.

Default and Dedicated Bearer Statistics
Provides the statistics for default and dedicated bearers related to API requests.

Tenant Onboarding Counters
Counter for the number of tenant onboarding related to API requests.

Tenant Onboarding Statistics
Provides the statistics for tenant onboarding related to API requests.

Subscriber Onboarding Counters
Counter for the number of subscriber onboarding related to API requests.

Subscriber Onboarding Statistics
Provide the statistics for subscriber onboarding related to API requests.

Error Statistics Definitions

About error statistics, here are the definitions of each error suffix:

Table 15: Error Statistics Definitions

<table>
<thead>
<tr>
<th>Error Statistics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>node1.messages*.error</td>
<td>Failure processing a message</td>
</tr>
<tr>
<td>e2e*_qns_stat.error</td>
<td>Count of occurrence for given Diameter result code</td>
</tr>
<tr>
<td>pe-submit-error</td>
<td>Error submitting to policy engine</td>
</tr>
<tr>
<td>_bypass</td>
<td>Message not sent to policy engine due to successful response (2001)</td>
</tr>
</tbody>
</table>
### Error Statistics

<table>
<thead>
<tr>
<th>Error Statistics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>_drop</td>
<td>Message dropped due to SLA violation</td>
</tr>
<tr>
<td>rate-limit</td>
<td>Message dropped due to rate limiting violation</td>
</tr>
</tbody>
</table>

The Diamter E2E statistics with the suffix “error” always have a value of 0 (zero) unless they have “_late” in the statistic name.

---

### Bulk Statistics Collection

By default, CPS outputs a bulk statistics CSV file to the `/var/broadhop/stats/` directory on the pcrfclient01 and pcrfclient02 VMs in five minute intervals.

The default naming standard is `bulk-hostname-YYYY-MM-DD-HH-MI.csv`

These CSV files include all statistics collected from all VMs during the 5 minute interval.

---

#### Note

If a statistic is generated by the system multiple times within the 5 minute interval, only the last measured statistic is collected in the CSV file.

---

The following list is a sample of the file names created in the `/var/broadhop/stats/` directory on the pcrfclient01 VM.

```
[root@pcrfclient01 stats]# pwd
/var/broadhop/stats
[root@pcrfclient01 stats]# ls
bulk-pcrfclient01-201510131350.csv
bulk-pcrfclient01-201510131355.csv
bulk-pcrfclient01-201510131400.csv
bulk-pcrfclient01-201510131405.csv
bulk-pcrfclient01-201510131410.csv
bulk-pcrfclient01-201510131415.csv
bulk-pcrfclient01-201510131420.csv
bulk-pcrfclient01-201510131425.csv
bulk-pcrfclient01-201510131430.csv
bulk-pcrfclient01-201510131435.csv
bulk-pcrfclient01-201510131440.csv
bulk-pcrfclient01-201510131445.csv
bulk-pcrfclient01-201510131450.csv
bulk-pcrfclient01-201510131455.csv
bulk-pcrfclient01-201510131500.csv
bulk-pcrfclient01-201510131505.csv
bulk-pcrfclient01-201510131510.csv
bulk-pcrfclient01-201510131515.csv
bulk-pcrfclient01-201510131520.csv
bulk-pcrfclient01-201510131525.csv
bulk-pcrfclient01-201510131530.csv
bulk-pcrfclient01-201510131535.csv
bulk-pcrfclient01-201510131540.csv
bulk-pcrfclient01-201510131545.csv
bulk-pcrfclient01-201510131550.csv
bulk-pcrfclient01-201510131555.csv
```
Retention of CSV Files

CPS retains each bulk statistic CSV file on the pcrlc01/02 VM for 2 days, after which the file is automatically removed. If you need to preserve these CSV files, you must back up or move them to an alternate system.

Configuring Logback.xml


Collectd is configured in the following files:

- `/etc/collectd.conf`
- `/etc/collectd.d/jmxplugin.conf`
- `/etc/collectd.d/exec.conf`

Restarting the Collectd Service

After making any configuration changes to logback.xml, restart the collectd service:

`monit restart collectd`

Adding Realm Names to Diameter Statistics

By default, the Diameter statistics that are generated do not include the realm names. To include realms in the statistics collected, add the following line in the qns.conf file (comma separated auth-appl-id):

`-Ddiameter.appid.realm.stats=Auth-Appl-Id-1,Auth-Appl-Id-2,... Auth-Appl-Id-n`

where each Auth-Appl-Id refers to the specific protocol's Auth-Application-Id for which realms are needed in the statistics.

For example, to add Gx, Gy, Rx and Sy realms to the statistic names, use the following Auth-Appl-Ids:

`-Ddiameter.appid.realm.stats=16777238,16777235,16777236,9`

where

- Gx Auth-Application-ID = 16777238
- Rx Auth-Application-ID = 16777236
- Gy Auth-Application-ID = 4
• Sy Auth-Application-ID = 7

Adding a realm will increase the number of statistics generated/collection. Add realms only when necessary.

As an example, statistic names with and without the realms are shown below for reference for the following statistic:

e2e_<domain>_realm_[alias_<message id>

Counter name with Realm (with qns.conf file modification):
C,lb02,node2.messages.e2e_PHONE_sy-ac.cisco.com_AC_Syp_AAR_2001.qns_stat.success,528
C,lb02.node2.messages.e2e_PHONE_sy-bm.cisco.com_BM_Syp_AAR_2001.qns_stat.success,1221

Counter name without Realm (without qns.conf file modification):
C,lb01.node2.messages.e2e_PHONE_AC_Syp_AAR_2001.qns_stat.success,1495
C,lb01.node2.messages.e2e_PHONE_BM_Syp_AAR_2001.qns_stat.success,4

Each statistic field has a fixed maximum length of 63 characters. Based on the current syntax, the length of the realm should not exceed 16 characters, otherwise it will lead to truncation of the counter name.

CPS KPI Monitoring

This section provides a list of Key Performance Indicators (KPIs), useful for tracking the overall health of CPS.

The complete list of CPS statistics is available in a spreadsheet format in the following location on the Cluster Manager VM:
/var/qps/install/current/scripts/documents/QPS_statistics.xlsx

The KPIs highlighted in the following sections are also included on the Stats Recommended to Monitor tab in the QPS_statistics.xlsx spreadsheet.

System Health Monitoring KPIs

The following table lists the KPIs and thresholds to track the overall performance of the CPS deployment, including information about the underlying hardware.
Table 16: System Health Monitoring KPIs

<table>
<thead>
<tr>
<th>Name/Description</th>
<th>Statistics/Formula</th>
<th>Warning Threshold</th>
<th>Major Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Utilization</td>
<td>100 - cpu.&lt;cpuid&gt;.idle</td>
<td>&gt; 60% utilization over 60 second period</td>
<td>&gt; 80% utilization over 60 second period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(assuming idle is less than 40%)</td>
<td>(assuming idle is less than 20%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU Steal</td>
<td>cpu.&lt;cpuid&gt;.steal</td>
<td>-</td>
<td>&gt; 2% over 60 second period</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU I/O Wait</td>
<td>cpu.&lt;cpuid&gt;.wait</td>
<td>&gt; 30 for more than 5 min</td>
<td>&gt; 50 for more than 10 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory utilization</td>
<td>memory.free – memory.used</td>
<td>&gt; 70% utilization over 60 second period</td>
<td>&gt; 80% utilization over 60 second period</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk Utilization</td>
<td>df.&lt;fs&gt;.df_complex.free - df.&lt;fs&gt;.df_complex.used</td>
<td>&gt; 80% utilization</td>
<td>&gt; 90% utilization</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CPU is a critical system resource. When the demand increases and CPU utilization exceeds 80% utilization, the efficiency of the CPU is reduced. When CPU utilization exceeds 80%, the application processing time will increase, message response will increase, and drops and timeouts will be seen.

If multiple VMs on the same hypervisor and same hardware have concurrent CPU demands, the hypervisor will “steal” CPU from one VM to satisfy another VM CPU needs. If the CPU Steal statistic is non-zero, there is not enough CPU allocated for the VMs.

This monitors CPU I/O wait time. High CPU wait times may indicate CPUs waiting on disk access.

Memory is a system resource, which needs to be less than 80%. The swap threshold has been reduced for CPS, and swapping should occur when the system resources are exhausted and memory utilization hits 99%.

Disk storage is a critical system resource, and when file system utilization exceeds 90% utilization the system can become less efficient. When the file system utilization hits 100%, then application can stop functioning.
<table>
<thead>
<tr>
<th>Name/Description</th>
<th>Statistics/Formula</th>
<th>Warning Threshold</th>
<th>Major Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Store utilization</td>
<td>var-data-sessions_1-free - var-data-sessions_1-used</td>
<td>&gt; 70% utilization</td>
<td>&gt; More than 80% utilization</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Queue</td>
<td>node1.messages.in_q*.avg</td>
<td>-</td>
<td>More than 1 ms over 60 seconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Database lock</td>
<td>*lock.percent</td>
<td>&gt; 15% lock</td>
<td>&gt; 20% lock</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter 3xxx errors</td>
<td>messages.e2e_* _3xxx.success</td>
<td>&gt; 0.5% of <em>.node</em>.messages.e2e_*2001.success Over 30 minute period</td>
<td>&gt; 1% of <em>.node</em>.messages.e2e_*2001.success Over 30 minute period</td>
</tr>
<tr>
<td></td>
<td>(and exclude the late statistics)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>as a percentage of <em>.node</em>.messages.e2e_*2001.success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter 5xxx errors</td>
<td>messages.e2e_* _5xxx.success</td>
<td>&gt; 0.5% of <em>.node</em>.messages.e2e_*2001.success Over 5 minute period</td>
<td>&gt; 1% of <em>.node</em>.messages.e2e_*2001.success Over 5 minute period</td>
</tr>
<tr>
<td></td>
<td>(and exclude the late statistics)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>as a percentage of <em>.node</em>.messages.e2e_*2001.success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name/Description</td>
<td>Statistics/Formula</td>
<td>Warning Threshold</td>
<td>Major Threshold</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Diameter Message Response Time</td>
<td>-</td>
<td>&gt; 100 ms for more than 30 minutes&lt;br&gt;or&lt;br&gt;= 0 for more than 5 minutes</td>
<td>&gt; 300 ms for more than 15 minutes&lt;br&gt;or&lt;br&gt;= 0 for more than 10 minutes</td>
</tr>
<tr>
<td>Active Session Count</td>
<td>set_session_count_total. records</td>
<td>&gt;80% of the lessor of the dimensioned or licensed capacity for more than 1 hour &lt;br&gt;or&lt;br&gt;= 0 for more than 5 minutes</td>
<td>&gt;80% of the lessor of the dimensioned or licensed capacity for more than 10 minutes&lt;br&gt;or&lt;br&gt;= 0 for more than 10 minutes</td>
</tr>
<tr>
<td>Policy Execution Count (Internal TPS)</td>
<td>-</td>
<td>&gt; 80% of the lessor of the dimensioned TPS capacity for more than 1 hour &lt;br&gt;or&lt;br&gt;= 0 for more than 5 minutes</td>
<td>&gt; 80% of the lessor of the dimensioned TPS capacity for more than 10 minutes&lt;br&gt;or&lt;br&gt;= 0 for more than 10 minutes</td>
</tr>
<tr>
<td>Policy Errors</td>
<td>-</td>
<td>&gt; 0</td>
<td>&gt; 20 within 5 minutes</td>
</tr>
<tr>
<td>Dedicated Bearer Errors</td>
<td>node1.counters.&lt;domain&gt;.<em>[realm</em>] Gx_bearer_setup_qci_&lt;qci&gt;<em>fail</em>&lt;failure-code&gt;<em>qns_count &lt;br&gt;as a percentage of node1.counters. &lt;domain&gt;.</em>[realm_] Gx_bearer_setup_qci_&lt;qci&gt;_qns_count</td>
<td>&gt; .1</td>
<td>&gt; .5</td>
</tr>
</tbody>
</table>
### Session Monitoring KPIs

The following KPIs enable you to monitor CPS session operation volumes, error counts and other useful statistics.

As each deployment is unique, no recommended ranges are provided. Cisco recommends monitoring these KPIs for a period of time (1-3 months) to establish a baseline. Deviations can then be monitored from the baseline values.

#### Table 17: Session Monitoring KPIs

<table>
<thead>
<tr>
<th>Category</th>
<th>Name/Description</th>
<th>Statistics/Formula</th>
<th>Availability/Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Operation</td>
<td>Errored session creation count</td>
<td>node1.actions.CreateEntry.qns_stat.error</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td>Successful session creation count</td>
<td>node1.actions.CreateEntry.qns_stat.success</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td>Total milliseconds of successful</td>
<td>node1.actions.CreateEntry.qns_stat.total_time_in_ms</td>
<td>Policy Server (qns)</td>
</tr>
</tbody>
</table>

**Table 17: Session Monitoring KPIs**
<table>
<thead>
<tr>
<th>Category</th>
<th>Name/Description</th>
<th>Statistics/Formula</th>
<th>Availability/Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Operation</td>
<td>Errored session deletion count</td>
<td>node1.actions.DeleteEntry. qns_stat.error</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Session Operation</td>
<td>Successful session deletion count</td>
<td>node1.actions.DeleteEntry. qns_stat.success</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Session Operation</td>
<td>Total milliseconds of successful session deletions</td>
<td>node1.actions.DeleteEntry. qns_stat.total_time_in_ms</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Session Operation</td>
<td>Errored session retrieval count</td>
<td>node1.actions.GetSessionAction. qns_stat.error</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Session Operation</td>
<td>Successful session retrieval count</td>
<td>node1.actions.GetSessionAction. qns_stat.success</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Session Operation</td>
<td>Total milliseconds of successful session retrievals</td>
<td>node1.actions.GetSessionAction. qns_stat.total_time_in_ms</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Session Operation</td>
<td>Errored session update count</td>
<td>node1.actions.UpdateEntry. qns_stat.error</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Session Operation</td>
<td>Successful session update count</td>
<td>node1.actions.UpdateEntry. qns_stat.success</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Session Operation</td>
<td>Total milliseconds of successful session updates</td>
<td>node1.actions.UpdateEntry. qns_stat.total_time_in_ms</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Internal Messages</td>
<td>Errored timer messages</td>
<td>node1.messages.TimerExpired. qns_stat.error</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Internal Messages</td>
<td>Successful timer messages</td>
<td>node1.messages.TimerExpired. qns_stat.success</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Category</td>
<td>Name/Description</td>
<td>Statistics/Formula</td>
<td>Availability/Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Session</td>
<td>Gauge count of lock percentage</td>
<td><code>&lt;set_name&gt;</code>. lock.percent</td>
<td>sessionmgr</td>
</tr>
<tr>
<td>Session</td>
<td>Gauge count of delete operations</td>
<td><code>&lt;set_name&gt;</code>. op_delete.gauge</td>
<td>sessionmgr</td>
</tr>
<tr>
<td>Session</td>
<td>Gauge count of insert operations</td>
<td><code>&lt;set_name&gt;</code>. op_insert.gauge</td>
<td>sessionmgr</td>
</tr>
<tr>
<td>Session</td>
<td>Gauge count of update operations</td>
<td><code>&lt;set_name&gt;</code>. op_update.gauge</td>
<td>sessionmgr</td>
</tr>
<tr>
<td>Secondary Key Operations</td>
<td>Per ring count of failed lookup for primary key using the secondary key in cache ring</td>
<td>`node1.counters.skcache_ring &lt;1</td>
<td>2&gt;_cache_miss. qns_count`</td>
</tr>
<tr>
<td>Session Type Count</td>
<td>Count of session types (GX_TGPP/RX_TGPP/SY_PRIME/SD_V11 … etc) in active session DB partition per admin set</td>
<td><code>&lt;set_id&gt;</code>.set_&lt;set number of admin db&gt;<em>session_type</em>&lt;session_type&gt;.<em>session_type</em>.records</td>
<td>sessionmgr</td>
</tr>
<tr>
<td>Session Count</td>
<td>Count of sessions in all active session DB partitions</td>
<td><code>set_session_count_.total.records</code></td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td>Threshold: &gt; 80% of dimensioned or licensed capacity for more than 1 hour, or = 0 (zero) for more than 5 minutes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Diameter Monitoring KPIs**

The following CPS KPIs are useful for monitoring Diameter message traffic.

**Note**

As each deployment is unique, no recommended ranges are provided. Cisco recommends monitoring these KPIs for a period of time (1-3 months) to establish a baseline. Deviations can then be monitored from the baseline values.
### Table 18: Diameter Monitoring KPIs

<table>
<thead>
<tr>
<th>Application Monitor Area</th>
<th>Category</th>
<th>Statistic</th>
<th>Description</th>
<th>Availability/Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>[realm</em>] Gx_CCR-I_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>[realm</em>] Gx_CCR-I_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>[realm</em>] Gx_CCR-I_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>[realm</em>] Gx_CCR-I_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>[realm</em>] Gx_CCR-I_5xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Gx_CCR-I.qns_count</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>AppId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Gx_CCR-U_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Gx_CCR-U_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Gx_CCR-U_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Gx_CCR-U_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Gx_CCR-U_5xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Gx_CCR-U. qns_count</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>AppId/Category</td>
<td>Monitoring Area</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/Node</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
<td>-----------</td>
<td>-------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Gx/F Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Gx_CCR-U_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
<td></td>
</tr>
<tr>
<td>Gx/F Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Gx_CCR-U_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
<td></td>
</tr>
<tr>
<td>Gx/F Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Gx_CCR-U_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
<td></td>
</tr>
<tr>
<td>Gx/F Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Gx_CCR-U_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
<td></td>
</tr>
<tr>
<td>Gx/F Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Gx_CCR-U_5xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
<td></td>
</tr>
<tr>
<td>Gx/A Diameter Input Queue</td>
<td>node1.counters. [realm_] Gx_CCR-U. qns_count</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
<td></td>
</tr>
<tr>
<td>AppId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>&lt;realm</em>&gt;_.Gx_CCR-T_2001.qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>&lt;realm</em>&gt;_.Gx_CCR-T_2001.qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>&lt;realm</em>&gt;_.Gx_CCR-T_3xxx.qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>&lt;realm</em>&gt;_.Gx_CCR-T_4xxx.qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;<em>&lt;realm</em>&gt;_.Gx_CCR-T_5xxx.qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters.[realm_].Gx_CCR-T.qns_count</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>AppId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
<td>-----------</td>
<td>-------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;_ [realm_] Gx_RAR_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;_ [realm_] Gx_RAR_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;_ [realm_] Gx_RAR_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;_ [realm_] Gx_RAR_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;_ [realm_] Gx_RAR_5xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Gx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.e2e_&lt;domain&gt;_ [realm_] Gx_RAR_timeout. qns_stat.success</td>
<td>Success timeout count for RAR message</td>
<td>Policy Director</td>
</tr>
<tr>
<td>ApplId/Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
<td>-----------</td>
<td>-------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Gx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Gx_RAA.qns_count</td>
<td>Count of all messages sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Gx/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages. in_q_Gx_RAA. qns_stat.error</td>
<td>Count of messages failed to be sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Gx/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages. in_q_Gx_RAA. qns_stat.success</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Gx/E</td>
<td>Diameter Output Queue</td>
<td>node1.counters. [realm_] Gx_RAR.qns_count</td>
<td>Count of messages successful sent to the Policy Director (LB)</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>[realm</em>] Rx_AAR_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>[realm</em>] Rx_AAR_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>[realm</em>] Rx_AAR_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>ApplId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.&lt;domain&gt;.<em>realm</em>.Rx_AAR_4xxx.qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.&lt;domain&gt;.<em>realm</em>.Rx_AAR_5xxx.qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.&lt;domain&gt;.<em>realm</em>.Rx_AAR_timeout.qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters.<em>realm</em>.Rx_RAA.qns_count</td>
<td>Count of messages successful sent to the Policy Director (LB)</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters.<em>realm</em>.Rx_AAR_drop.qns_count</td>
<td>Count of messages dropped due to exceeding SLA</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/E</td>
<td>Diameter Output Queue</td>
<td>node1.counters.<em>realm</em>.Rx_AAA_2001.qns_count</td>
<td>Count of AAA messages with result-code = 2001 sent successfully to the Policy Director (LB)</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>AppId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------</td>
<td>----------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_ASR_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_ASR_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_ASR_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_ASR_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_ASR_5xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_ASR_retry. qns_count</td>
<td>Retry count for ASR message</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>AppId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------</td>
<td>------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_ASA_bypass. qns_count</td>
<td>Count of messages that do not require processing by the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_ASA. qns_count</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_ASA_drop. qns_count</td>
<td>Count of messages dropped due to exceeding SLA</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_RAR_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_RAR_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Rx_RAR_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td><strong>AppId/ Monitoring Area</strong></td>
<td><strong>Category</strong></td>
<td><strong>Statistic</strong></td>
<td><strong>Description</strong></td>
<td><strong>Availability/ Node</strong></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Rx_RAR_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Rx_RAR_5xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_RAA_bypass. qns_count</td>
<td>Count of messages that do not require processing by the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_RAA.qns_count</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_RAA_drop. qns_count</td>
<td>Count of messages dropped due to exceeding SLA</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Rx_STR_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Rx_STR_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>AppId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Rx_STR_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Rx_STR_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Rx_STR_5xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_STR.qns_count</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_STR_drop. qns_count</td>
<td>Count of messages dropped due to exceeding SLA</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages. in_q_Rx_STR. qns_stat.success</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages. in_q_Rx_STR. qns_stat. total_time_in_ms</td>
<td>Total milliseconds of messages successfully sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>ApplId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Rx/D</td>
<td>Engine Message</td>
<td>node1.messages. diameter_Rx_STR. qns_stat.success</td>
<td>Success message count</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/D</td>
<td>Engine Message</td>
<td>node1.messages. diameter_Rx_STR. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Rx/E</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Rx_STA_2001. qns_count</td>
<td>Count of STA messages with result-code = 2001 sent successfully to the Policy Director (LB)</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>.[realm</em>] Sy_SLR_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>.[realm</em>] Sy_SLR_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>.[realm</em>] Sy_SLR_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>.[realm</em>] Sy_SLR_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>AppId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
<td>-----------</td>
<td>-------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;<em>&lt;realm</em>&gt; Sy_SLR_5xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Sy_SLR_bypass. qns_count</td>
<td>Count of messages that do not require processing by the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Sy_SLR.qns_count</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters. [realm_] Sy_SLR_drop.qns_count</td>
<td>Count of messages dropped due to exceeding SLA</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages. in_q_Sy_SLA. qns_stat.success</td>
<td>Count of messages successfully sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages. in_q_Sy_SLA. qns_stat. total_time_in_ms</td>
<td>Total milliseconds of messages successfully sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/D</td>
<td>Engine Message</td>
<td>node1.messages. diameter_Sy_SLA. qns_stat.success</td>
<td>Success message count</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/D</td>
<td>Engine Message</td>
<td>node1.messages. diameter_Sy_SLA. qns_stat. total_time_in_ms</td>
<td>Total milliseconds of successful messages</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>AppId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Sy/B</td>
<td>Diameter Action</td>
<td>node1.actions. send.diameter_ Sy_SLR.qns_stat.success</td>
<td>Success actions count</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/B</td>
<td>Diameter Action</td>
<td>node1.actions. send.diameter_ Sy_SLR.qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful actions</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Sy_SNR_2001. qns_stat.success</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Sy_SNR_2001. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages with return code matching 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Sy_SNR_3xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages. e2e_&lt;domain&gt;_ [realm_] Sy_SNR_4xxx. qns_stat.success</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>ApplId/ Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/ Node</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------</td>
<td>------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e2e_&lt;domain&gt;_.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[realm_]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sy_SNR_5xxx.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>qns_stat.success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters.</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[realm_]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sy_SNR.qns_count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters.</td>
<td>Count of messages dropped due to exceeding SLA</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[realm_]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sy_SNR_drop.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>qns_count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages.</td>
<td>Count of messages successfully sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in_q_Sy_SNR.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>qns_stat.success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages.</td>
<td>Total milliseconds of messages successfully sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in_q_Sy_SNR.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>qns_stat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>total_time_in_ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.</td>
<td>Success message count for return code 2001</td>
<td>Policy Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e2e_&lt;domain&gt;_.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[realm_]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>qns_stat.success</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>total_time_in_ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AppId/Monitoring Area</td>
<td>Category</td>
<td>Statistic</td>
<td>Description</td>
<td>Availability/Node</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.</td>
<td>Success count of messages with return code matching 3XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>e2e_&lt;domain&gt;<em>&lt;realm</em>&gt;Sy_STR_3xxx.qns_stat.success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.</td>
<td>Success count of messages with return code matching 4XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>e2e_&lt;domain&gt;<em>&lt;realm</em>&gt;Sy_STR_4xxx.qns_stat.success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>node[x].messages.</td>
<td>Success count of messages with return code matching 5XXX</td>
<td>Policy Director</td>
</tr>
<tr>
<td>Sy/F</td>
<td>Diameter Round Trip</td>
<td>e2e_&lt;domain&gt;<em>&lt;realm</em>&gt;Sy_STR_5xxx.qns_stat.success</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters.</td>
<td>Count of message that do not require processing by the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>[realm_]Sy_STA_bypass.qns_count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters.</td>
<td>Count of messages successful sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>[realm_]Sy_STA.qns_count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.counters.</td>
<td>Count of messages dropped due to exceeding SLA</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>[realm_]Sy_STA_drop.qns_count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages.in_q_Sy_STA.qns_stat.success</td>
<td>Count of messages successfully sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
</tbody>
</table>
## Example CPS Statistics

### Sample CSV Files

The following list is a sample of the file names created in the /var/broadhop/stats directory on the pcrfclient01 VM.

```
[root@pcrfclient01 stats]# pwd
/var/broadhop/stats
[root@pcrfclient01 stats]# ls
bulk-pcrfclient01-201510131350.csv
bulk-pcrfclient01-201510131355.csv
bulk-pcrfclient01-201510131400.csv
bulk-pcrfclient01-201510131405.csv
bulk-pcrfclient01-201510131410.csv
```

<table>
<thead>
<tr>
<th>AppId/ Monitoring Area</th>
<th>Category</th>
<th>Statistic</th>
<th>Description</th>
<th>Availability/ Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sy/A</td>
<td>Diameter Input Queue</td>
<td>node1.messages. in_q_Sy_STA. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of messages successfully sent to the policy engine</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/D</td>
<td>Engine Message</td>
<td>node1.messages. diameter_Sy_STA. qns_stat.success</td>
<td>Success message count</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/D</td>
<td>Engine Message</td>
<td>node1.messages. diameter_Sy_STA. qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful messages</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/B</td>
<td>Diameter Action</td>
<td>node1.actions.send. diameter_Sy_STR. qns_stat.success</td>
<td>Success actions count</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/B</td>
<td>Diameter Action</td>
<td>node1.actions.send. diameter_Sy_STR.qns_stat.total_time_in_ms</td>
<td>Total milliseconds of successful actions</td>
<td>Policy Server (qns)</td>
</tr>
<tr>
<td>Sy/E</td>
<td>Diameter Output Queue</td>
<td>node1.counters. [realm_] Sy_STR.qns_count</td>
<td>Count of messages successfully sent to the Policy Director (LB)</td>
<td>Policy Server (qns)</td>
</tr>
</tbody>
</table>
bulk-pcrfclient01-201510131415.csv
bulk-pcrfclient01-201510131420.csv
bulk-pcrfclient01-201510131425.csv
bulk-pcrfclient01-201510131430.csv
bulk-pcrfclient01-201510131435.csv
bulk-pcrfclient01-201510131440.csv
bulk-pcrfclient01-201510131445.csv
bulk-pcrfclient01-201510131500.csv
bulk-pcrfclient01-201510131505.csv
bulk-pcrfclient01-201510131510.csv
bulk-pcrfclient01-201510131515.csv
bulk-pcrfclient01-201510131520.csv
bulk-pcrfclient01-201510131525.csv
bulk-pcrfclient01-201510131530.csv
bulk-pcrfclient01-201510131535.csv
bulk-pcrfclient01-201510131540.csv
bulk-pcrfclient01-201510131545.csv
bulk-pcrfclient01-201510131600.csv
bulk-pcrfclient01-201510131605.csv
bulk-pcrfclient01-201510131610.csv
bulk-pcrfclient01-201510131615.csv
bulk-pcrfclient01-201510131620.csv
bulk-pcrfclient01-201510131625.csv
bulk-pcrfclient01-201510131630.csv

Sample Output

C,<VM_name>,node1.actions.send.diameter_Gx_CCA-I.qns_stat.success,19
where, the <VM_Name> indicates which VM the statistics has been collected on.

A sample bulk statistics .csv file is shown below:

C,qns01,node1.actions.SaveSubscriberActionImpl.qns_stat.error,0
C,qns01,node1.actions.SaveSubscriberActionImpl.qns_stat.success,6
C,qns01,node1.actions.send.diameter_Gx_CCA-1.qns_stat.error,0
C,qns01,node1.actions.send.diameter_Gx_CCA-1.qns_stat.success,19
C,qns01,node1.actions.send.diameter_Gx_CCA-T.qns_stat.error,0
C,qns01,node1.actions.send.diameter_Gx_CCA-T.qns_stat.success,9
D,qns01,node1.messages.in_q_Gx_CCR-I.qns_stat.total_time_in_ms,14
D,qns01,node1.messages.in_q_Gx_CCR-T.qns_stat.total_time_in_ms,2
D,qns01,node1.messages.in_q_Gx_CCR-U.qns_stat.total_time_in_ms,1
D,qns01,node1.messages.in_q_Gx_RAA.qns_stat.total_time_in_ms,0
D,qns01,node1.messages.in_q_Sh_SNA.qns_stat.total_time_in_ms,2
D,qns01,node1.messages.in_q_ShCUDA.qns_stat.total_time_in_ms,0
D,qns01,node1.messages.TimerExpired.qns_stat.total_time_in_ms,7244
D,qns01,node1.spr.createSubscriber.qns_stat.total_time_in_ms,29
D,qns01,node1.spr.deleteSubscriber.qns_stat.total_time_in_ms,40
D,qns01,node1.spr.updateSubscriber.qns_stat.total_time_in_ms,21
G,lb02,node1.ldap.SITELDAP.qns_qap_connection.MaximumAvailableConnections,10.0
G,lb02,node1.ldap.SITELDAP.qns_qap_connection.NumAvailableConnections,0.0
G,lb02,node1.thread.gauge.daemon_thread_count,80.0
G,lb02,node1.thread.gauge.live_thread_count,184.0
Working with CPS Utilities

- Policy Tracing and Execution Analyzer, on page 173
- Network Cutter Utility, on page 177
- Policy Builder Configuration Reporter, on page 177
- CRD Generator Conversion Tool, on page 178
- Policy Builder Configuration Converter Conversion Tool, on page 181

Policy Tracing and Execution Analyzer

Cisco Policy Server comes with a set of utilities to actively monitor and trace policy execution. These utilities interact with the core policy server and the mongo database to trigger and store traces for specific conditions.

Architecture

The policy tracing and execution analyzer is 3-tier architecture:

- Tier 1 — command line utilities to manage the policy trace generation and extract policy traces.
- Tier 2 — policy server creation of policy traces using triggers defined in Tier 1.
- Tier 3 — storage of the policy traces in a MongoDB.

Administering Policy Traces

All commands are located on the Control Center virtual machine within /var/qps/bin/control directory. There are two main scripts which can be used for tracing: trace_ids.sh and trace.sh.

- The trace_ids.sh script maintains all rules for activating and deactivating traces within the system.
- The trace.sh script allows for the real time or historical retrieval of traces.

Before running trace_ids.sh and trace.sh, confirm which database you are using for traces. For more information, refer to Policy Trace Database, on page 176. If no database has been configured, then by default the scripts connects to primary database member of SPR-SET1.
Managing Trace Rules using trace_ids.sh

Running `trace_ids.sh` with the `-h` argument produces a help text describing the capabilities of the script.

```
/var/qps/bin/control/trace_ids.sh -h
```

Usage:
```
/var/qps/bin/control/trace_ids.sh -i <specific id> -d sessionmgr01:27719/policy_trace
/var/qps/bin/control/trace_ids.sh -r <specific id> -d sessionmgr01:27719/policy_trace
/var/qps/bin/control/trace_ids.sh -x -d sessionmgr01:27719/policy_trace
/var/qps/bin/control/trace_ids.sh -l -d sessionmgr01:27719/policy_trace
```

By default, if the `-d` option is not provided then the script connects to the primary database member of SPR-SET1. If you are not using the SPR database, you need to find out which database you are using. To find out which database you are using, refer to Policy Trace Database, on page 176. Make sure to update the commands mentioned in Step 1, on page 174 to Step 4, on page 174 accordingly.

This script starts a selective trace and outputs it to standard out.

---

**Note**

Adding a specific audit ID for tracing requires running the command with the `-i` argument and passing in a specific ID. The policy server matches the incoming session with the ID provided and compares this against the following network session attributes:

- Credential ID
- Framed IPv6 Prefix
- IMSI
- MAC Address
- MSISDN
- User ID

If an exact match is found then the transaction is traced. Spaces and special characters are not supported in the audit ids.

- Removing a specific audit ID from active tracing requires specifying the `-r` argument with id to remove.
• Removing all ids requires sending in the \(-x\) argument and this will remove all ids from the database.
• Listing all ids requires sending in the \(-l\) argument.

Usage:

Usage with SPR-SET as database:

```bash
./trace_ids.sh -l
MongoDB shell version: 2.6.3
connecting to: sessionmgr01:27720/policy_trace
112345
MongoDB shell version: 2.6.3
connecting to: sessionmgr01:27720/policy_trace
null
```

Usage with \(-d\) option:

```bash
./trace_ids.sh -l -d sessionmgr01:27717/policy_trace
MongoDB shell version: 2.6.3
connecting to: sessionmgr01:27717/policy_trace
874838
MongoDB shell version: 2.6.3
connecting to: sessionmgr01:27717/policy_trace
null
```

Situations where traces are generated automatically

The following criteria cause the system to generate a trace regardless of whether the id is present in the trace database or not:

• If there is an AVP with the code: `audit_id`, `audit-id`, `auditid`. In this case, the traces are stored in the database with the value of the AVP.

• If there is a subscriber attribute (USuM AVP) with a code of `audit-policy` and a value of “true”. In this case, the traces are stored using the credentials stored for the subscriber.

• If an error is triggered internally.

Note

An error is defined as an internal processing error (e.g. database failure or other failure) and is not a failure message code.

Managing Trace Results using `trace.sh`

Running `trace.sh` with \(-h\) arguments produce a help text describing the capabilities of the script:

```
/var/qps/bin/control/trace.sh -h
```

Usage:

```
/var/qps/bin/control/trace.sh -i <specific id> -d sessionmgr01:27719/policy_trace
/var/qps/bin/control/trace.sh -x <specific id> -d sessionmgr01:27719/policy_trace
/var/qps/bin/control/trace.sh -a -d sessionmgr01:27719/policy_trace
/var/qps/bin/control/trace.sh -e -d sessionmgr01:27719/policy_trace
```
By default, if `-d` option is not provided then the script connects to primary database member of SPR-SET1. If you are not using the SPR database, you need to find out the which database you are using. To find out which database you are using, refer to Policy Trace Database, on page 176. Make sure to update the commands mentioned in Step 1, on page 176 to Step 4, on page 176 accordingly.

This script starts a selective trace and outputs it to standard out.

---

**Step 1** Specific audit ID tracing:

```
/var/qps/bin/control/trace.sh -i <specific id>
```

Specifying the `-i` argument for a specific ID causes a real time policy trace to be generated while the script is running. Users can redirect this to a specific output file using standard Linux commands.

**Step 2** Dump all traces for specific audit ID:

```
/var/qps/bin/control/trace.sh -x <specific id>
```

Specifying the `-x` argument with a specific ID, dumps all historical traces for a given ID. Users can redirect this to a specific output file using standard Linux commands.

**Step 3** Trace all:

```
/var/qps/bin/control/trace.sh -a
```

Specifying the `-a` argument causes all traces to output in real time policy trace while the script is running. Users can redirect this to a specific output file using standard Linux commands.

**Step 4** Trace all errors:

```
/var/qps/bin/control/trace.sh -e
```

Specifying the `-e` argument causes all traces triggered by an error to output in real time policy trace while the script is running. Users can redirect this to a specific output file using standard Linux commands.

---

**Policy Trace Database**

The default location of the policy trace database is the administrative database and can be optionally specified in the trace database fields. These fields are defined at the cluster level in the system configurations.

**Note** Make sure to run all trace utility scripts from `/var/qps/bin/control` directory only.

---

**Configure Traces Database in Policy Builder**

**Step 1** Log in to the Policy Builder.

**Step 2** From left pane, open up the *name of your system* and select the required cluster.
Step 3  From right pane, select the check box for **Trace Database**.

The following table provides the parameter descriptions under **Trace Database** check box:

**Table 19: Trace Database Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Database IP Address</td>
<td>The IP address of the sessionmgr node that holds trace information which allows for debugging of specific sessions and subscribers based on unique primary keys.</td>
</tr>
<tr>
<td>Secondary Database IP Address</td>
<td>The IP address of the database that provides fail over support for the primary database. This is the mirror of the database specified in the Primary IP Address field. Use this only for replication or replica pairs architecture. This field is present but deprecated to maintain downward compatibility.</td>
</tr>
<tr>
<td>Database Port</td>
<td>Port number of the database for Session data. Default value is 27717.</td>
</tr>
</tbody>
</table>

---

**Network Cutter Utility**

CPS supports a new network cutter utility, which keeps monitoring Policy Server (QNS) VMs failures. When any of the Policy Server VMs are down, utility cuts those unnecessary connections to avoid sending traffic to Policy Server VMs that are down, and this also results in avoiding timeouts.

This utility is started by `monit` on Policy Director (lb) VMs and keeps monitoring policy server VMs failures.


You can verify the status of network cutter utility on lb01/02 VMs using `monit summary` and `network-cutter status` command:

```
monit summary | grep cutter
Process 'cutter' Running

service network-cutter status
network-cutter (pid 3735) is running
```

You can verify if network cutter utility has been started using `ps -ef | grep cutter` command:

```
ps -ef | grep cutter
root 6496  1 0 Feb18 ? 00:16:22 /usr/java/default/bin/java -jar /var/broadhop/images/network-cutter.jar
```

**Policy Builder Configuration Reporter**

The Configuration-Reporter utility processes CPS Policy Builder configuration and report any missing cross-reference files and stale files. An option has also been provided to remove the stale files and missing cross-references in the XMI files from the configuration data in the utility.
This utility can be used before or after installation to check if customers have all the configuration files needed.

This reporting utility addresses the following concerns:

- Reports if there are any missing PB configuration files (.xmi files) and a summary of what those files are.
- Reports if there are any stale files and a summary of the same. Stale files are Service Option files whose corresponding Use Case Template files are missing.
- It also shows the missing configuration files on a per-file basis, showing the files that are referencing the missing files.
- Additionally, the customer can see all the different configuration objects and their quantity to see the variety of configurations they are using.
- Using -r option, utility creates a new archive file with cleaned XMI files (removes the stale files and missing cross-references from XMI files from the original configuration data).

To run the utility, perform the following steps:

1. Mount ISO on Cluster Manager if you unmounted the ISO after completing the CPS installation or upgrade.
2. Extract the release train into the temp directory:
   ```
   cd /tmp
   tar -zxvf /mnt/iso/app/install/release-train-xxx.tar.gz
   ```
   where, `release-train-xxx.tar.gz` is the release train version.
3. Go into Configuration-Reporter directory which is present inside utility directory of extracted utility.
   ```
   cd release-train-xxx/Utility/Configuration-Reporter
   ```
4. Execute jar using the following command:
   ```
   java -jar configuration-reporter.jar <pb-configuration-xmi-files-in-archive-form> [-r]
   ```
   where,
   - `<pb-configuration-xmi-files-in-archive-form>` is the name of the configuration file.
   - `[-r]` is an optional parameter and if specified will remove all the references of missing files from XMI files and stale files in the archive file and outputs the corrected archive as `filename_cleaned.zip|cps` (output file will have same extension as input file) on the same path where command runs.

**CRD Generator Conversion Tool**

CPS provides a CRD conversion tool which converts existing Balance and Quota templates PB configuration data to CRD Data. You can provide XMI files to the tool in the following ways:

- Use Import/Export tool to export CPS configuration as an archive file (.cps extension archive) and provide the same to the tool.
The conversion tool is used to convert all Balance and Quota template configuration data to CRD data. This helps to reduce the number of XMI files in the system and improves the performance.

Prerequisites:
The feature com.broadhop.balance.crdbalance.feature must be enabled so that CRD tables for Balance and Quota Template details are displayed in Policy Builder (as readonly) and Control Center. These CRD tables need to be present for importing the Balance and Quota CRD data which will be converted using the tool and Balance and Quota Templates XMI files present in Policy Builder.

To enable com.broadhop.balance.crdbalance.feature, add the feature in /var/qps/current_config/etc/broadhop/pb/features and /var/qps/current_config/etc/broadhop/pcrf/features files. For more information, refer to Customize Features in the Deployment section in CPS Installation Guide for VMware.

To run the utility, perform the following steps:

1. Mount ISO on Cluster Manager.
2. Extract release train into temp directory:
   
   ```
   tar -zxvf /mnt/iso/app/install/xxx.tar.gz /tmp/
   ```
3. Go to CRD_generator_Utility directory which is inside the utility directory of the extracted release train:
   
   ```
   cd /tmp/release-train-xxx/Utility/CRD_generator_Utility
   ```
4. Execute jar using the following command:
   
   ```
   java –jar com.broadhop.customreferencedata.generator-<svn-revision-number>-full.jar [-a <archive-file> | -d <directory>]
   ```

The following table describes the various command line options:

<table>
<thead>
<tr>
<th>Command Line Options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-a</td>
<td>Option for passing zip archive file which contains XMI files.</td>
</tr>
<tr>
<td>-d</td>
<td>Option for passing directory path where XMI files are present.</td>
</tr>
<tr>
<td>-e</td>
<td>Generates .exportCrdInfo file with specified exportCRDversion. Valid Values 1 and 2 are described as follows:</td>
</tr>
<tr>
<td></td>
<td>1. 1: Data-type validations will happen only during import of generated archive into CPS.</td>
</tr>
<tr>
<td></td>
<td>2. 2: All validations will happen during import of generated archive into CPS and is the default value.</td>
</tr>
<tr>
<td>Command Line Options</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>-h</td>
<td>Prints help.</td>
</tr>
<tr>
<td>-o</td>
<td>Object type for which CRD conversion needs to be performed. Default value is AccountBalanceTemplate.</td>
</tr>
</tbody>
</table>
| -r                   | Removes duplicate CRD data. Valid Values 0 and 1 are described as follows:  
  1. 0: De-duplication is disabled by default which means duplicate data will be part of generated CRD data files.  
  2. 1: Keeps the first record is retained and skips the rest. De-duplication is enabled which means duplicate data will be not be part of generated CRD data. |
| -v                   | Validates CRD data against the schema (required field constraint validation). Default value is true which means validation of schema is enabled and CRD data record with missing required field value will not be part of generated CRD data files. |
| -xls                 | Generates XLS format files for CRD data. Default option is CSV format CRD data files. |

The tool generates a “.crd” extension archive file containing "exportCrdInfo" file and CRD tables data in CSV/XLS format which can be used by Import/Import All CRD functionality in CPS to import the CRD data into the system.

5. To view or edit the csv files, perform the following optional steps:

1. View-only using Excel: In Excel, you can only view the csv files present in generated “.crd” archive where non-ASCII characters are present in it. In order to view non-ASCII characters which might be present in CRD Data, perform the following steps:
   1. Open a blank Excel file.
   2. Go to Menu option **Data > From Text File** and import the CRD table CSV file in which non-ASCII is present.
   3. A “Text Import Wizard” is displayed. Perform the following steps:
      1. Select Unicode (UTF-8) in File origin drop-down.
      2. Check **Comma** as delimiters.
      3. Do not perform any changes and click **Finish**.
      4. Click **Ok**.
   4. All non-ASCII characters are displayed correctly.
It is not recommended to edit generated CRD Table csv files containing non-ASCII characters in excel view.

2. View and edit using other editors (vi editor): You can view and edit csv files present in “.crd” archive file using editors such as vi editor even if the CRD data contains non-ASCII characters.

6. The generated “.crd” extension archive file needs to be imported as CRD Data into CPS which can be performed using the following options:
   • Use "_import" CRD API to import CRD data in CSV format.
   • Use "Import All" option in Control Center to import CRD data in CSV format.
   • Use "Import" option in Control Center to import CRD data in XLS format. This option enables you to import single XLS CRD data at a time.

Policy Builder Configuration Converter Conversion Tool

CPS provides a conversion tool to convert the balance references in the existing service configuration to CRD data string value to adopt the CRD table driven configuration solution. The tool can perform the following:

• Convert Account Balance template references present in existing Customer's PB Service configuration to CRD Data "Dynamic Reference Data Key" string value.
• An "-r" option is provided to clean up the following converted referenced data:
  • References to Account Balance template in Service Options, Use Case Templates and Use Case Options is removed in the output archive file configuration data.
  • Account Balance template and all Quota templates present in the original PB configuration data will not be part of output archive file.

This conversion tool is used to convert balance references in existing configuration data and clean Balance and Quota templates as part of result archive file. This helps in reducing the number of XMI files in configuration data.

To run the utility, perform the following steps:
1. Mount ISO on Cluster Manager.
2. Extract release train into temp directory:

   ```
tar -zxvf /mnt/iso/app/install/xxx.tar.gz /tmp/
   ```

3. Go to PB-Configuration-Converter.Utility directory which is inside the utility directory of the extracted release train:

   ```
   ```

4. Execute jar using the following command:
1. You have the option to provide the XMI files input as an archive file or directory path in which all Policy Builder created XMI files are present. Select any one of the following mandatory options to run the command:
   - `-a`: Option for passing Archive file (.zip or .cps extension archive file).
   - `-d`: Option for passing directory path containing XMI files to process.

2. You can use "-r" option to perform cleanup operation for reducing the XMI files as follows:
   - Removes Account Balance template references from Service Option XMIs once the update of “Dynamic Reference Data Key” is performed.
   - Removes Account Balance template references from Use Case Template and Use Case Option XMIs.
   - Removes Account Balance template, One Time Quota template, Recurring Quota template and Rollover Quota template XMI files from PB configuration data in resulting archive file.

The tool generates an archive file named as "<input-file-name>_updated.<input-file-extension>" if it is an archive file input or "<input-directory-name>_updated.zip" if it is a directory file input. It contains all the XMI files in the input file along with updated Service Option XMIs with a new field “dynamicRefDataKey” if there are references to Account Balance template object type.

---

**Note**

The output archive file might not contain “.exportInfo” and “.exportRepositoryInfo” files as the tool only works on conversion of Service configuration balance reference data present in user input and copies all other input files in the output archive.
If you want to save the output of any command on any of the CPS VMs, then the output should be redirected to a file.

- `about.sh`, on page 184
- `adduser.sh`, on page 184
- `auditrpms.sh`, on page 185
- `build_all.sh`, on page 185
- `build/etc.sh`, on page 187
- `build/set.sh`, on page 187
- `capture_env.sh`, on page 188
- `change_passwd.sh`, on page 188
- `cleanup_license.sh`, on page 189
- `component_alarm_reports.py`, on page 189
- `copytoall.sh`, on page 190
- `diagnostics.sh`, on page 191
- `dump_utility.py`, on page 194
- `list_installed_features.sh`, on page 197
- `reinit.sh`, on page 199
- `restartall.sh`, on page 200
- `restartqns.sh`, on page 200
- `runonall.sh`, on page 201
- `service`, on page 201
- `session_cache_ops.sh`, on page 202
- `set_priority.sh`, on page 205
- `startall.sh`, on page 207
- `startqns.sh`, on page 207
- `statusall.sh`, on page 208
- `stopall.sh`, on page 210
- `stopqns.sh`, on page 210
- `summaryall.sh`, on page 211
- `sync_times.sh`, on page 224
- `syncconfig.sh`, on page 224
about.sh

This command displays core, patch, and feature software version information and URLs to the various interfaces and APIs for the deployment.

Syntax

/var/qps/bin/diag/about.sh [-h]

Executable on VMs

• Cluster Manager
• pcrfclient01/02

adduser.sh

This utility adds a new user to the specified nodes that are part of the CPS deployment. These accounts will be provisioned without shell access and, as such, they're only useful for authenticating against the various web-based GUIs used to administrate CPS.

The hosts that get provisioned with these new accounts can be selected using the 'node-regex' option. The default regular expression used by the script is:

node-regex ::= ^(pcrfclient|qns|lb[0-9]+|sessionmgr)

Syntax

/var/qps/bin/support/adduser.sh [-h] [node-regex]

When prompted for the user’s group, set ‘qns-svn’ for read-write permissions or ‘qns-ro’ for read-only permissions.

To add a user with 'read/write' access to Control Center, their group should be 'qns'.

• To check if a user already exists, login as root and enter ‘su <username>’.
• To check a user’s ‘groups’, enter ‘groups <username>’.

Executable on VMs

All

Example

[root@host /]# /var/qps/bin/support/adduser.sh
Enter username: username
Enter group for the user: groupname
Enter password: password
Re-enter password: password
The above example adds username to all the VMs in the cluster.

**auditrpms.sh**

This script runs in background on all VMs except Cluster Manager. This script/daemon should be always running and is monitored via monit. No intervention from end user is required. Corresponding logs are generated at individual nodes in `/var/log/broadhop/audit/audit_rpms.log`.

---

**Note**

All successful attempts i.e. installation or removal are tracked in this file. In case package is upgraded there would be two entries seen in log file, one for removal of old package and one for installation of new package.

**Executable on VMs**

On all VMs except Cluster Manager

**Example**

```
[root@host ~]# monsum | grep auditrpms
Process 'auditrpms.sh' Running
```

**build_all.sh**

This command is executed from Cluster Manager to rebuild CPS package.

**Syntax**

- `/var/qps/install/current/scripts/build_all.sh`
- `/var/qps/install/current/scripts/build/build_all.sh`

**Executable on VMs**

Cluster Manager

**Example**

```
[root@host /]# /var/qps/install/current/scripts/build_all.sh
Building /etc/broadhop...
Copying to /var/qps/images/etc.tar.gz...
Creating MD5 Checksum...
Copying /etc/puppet to /var/qps/images/puppet.tar.gz...
Creating MD5 Checksum...
Copying Policy Builder configuration (/var/qps/current_config/pb_config) to /var/qps/images/svn.tar.gz...
Creating MD5 Checksum...
Updating tar from: /var/qps/env_config/ to /var/www/html/images/
Creating MD5 Checksum...
Building /var/qps/bin...
Copying /var/qps/bin to /var/qps/images/scripts_bin.tar.gz...
Creating MD5 Checksum...
```
Building images...
Building image: /var/qps/images/controlcenter.tar.gz
Installing from:
   file:///var/qps/.tmp/release
Installing features:
   com.broadhop.controlcenter.feature.feature.group
   com.broadhop.faultmanagement.service.feature.feature.group
   com.broadhop.infrastructure.feature.feature.group
   com.broadhop.server.runtime.product
   com.broadhop.snmp.feature.feature.group
Creating MD5 Checksum... /var/qps/images/controlcenter.tar.gz.md5chksum
Building image: /var/qps/images/diameter_endpoint.tar.gz
Installing from:
   file:///var/qps/.tmp/release
Installing features:
   com.broadhop.diameter2.service.feature.feature.group
   com.broadhop.server.runtime.product
   com.broadhop.snmp.feature.feature.group
Creating MD5 Checksum... /var/qps/images/diameter_endpoint.tar.gz.md5chksum
Building image: /var/qps/images/iomanager01.tar.gz
Installing from:
   file:///var/qps/.tmp/release
Installing features:
   com.broadhop.iomanager.feature.feature.group
   com.broadhop.notifications.service.feature.feature.group
   com.broadhop.server.runtime.product
   com.broadhop.snmp.feature.feature.group
Creating MD5 Checksum... /var/qps/images/iomanager01.tar.gz.md5chksum
Building image: /var/qps/images/iomanager02.tar.gz
Installing from:
   file:///var/qps/.tmp/release
Installing features:
   com.broadhop.iomanager.feature.feature.group
   com.broadhop.notifications.service.feature.feature.group
   com.broadhop.server.runtime.product
   com.broadhop.snmp.feature.feature.group
Creating MD5 Checksum... /var/qps/images/iomanager02.tar.gz.md5chksum
Building image: /var/qps/images/pb.tar.gz
Installing from:
   file:///var/qps/.tmp/release
Installing features:
   com.broadhop.client.feature.audit.feature.group
   com.broadhop.client.feature.balance.feature.group
   com.broadhop.client.feature.custrefdata.feature.group
   com.broadhop.client.feature.diameter2.feature.group
   com.broadhop.client.feature.notifications.feature.group
   com.broadhop.client.feature.spr.feature.group
   com.broadhop.client.feature.unifiedapi.feature.group
   com.broadhop.client.feature.vouchers.feature.group
   com.broadhop.client.feature.ws.feature.group
   com.broadhop.client.product
Creating MD5 Checksum... /var/qps/images/pb.tar.gz.md5chksum
Building image: /var/qps/images/pcrf.tar.gz
Installing from:
   file:///var/qps/.tmp/release
Installing features:
   com.broadhop.audit.service.feature.feature.group
   com.broadhop.balance.service.feature.feature.group
   com.broadhop.balance.spr.feature.feature.group
   com.broadhop.custrefdata.service.feature.feature.group
   com.broadhop.diameter2.local.feature.feature.group
   com.broadhop.externaldatocache.memcache.feature.feature.group
   com.broadhop.notifications.local.feature.feature.group
   com.broadhop.policy.feature.feature.group
build_etc.sh

This command is executed from Cluster Manager to rebuild etc.tar.gz in /etc/broadhop/ directory.

Syntax
/var/qps/install/current/scripts/build/build_etc.sh

Executable on VMs
Cluster Manager

Example
[root@host /]# /var/qps/install/current/scripts/build/build_etc.sh
Building /etc/broadhop...
Copying to /var/qps/images/etc.tar.gz...
Creating MD5 Checksum...

build_set.sh

This command is used to rebuild replica sets. This command is normally only run the first time the environment starts, but can be used if CPS databases must be rebuilt.

Syntax
/var/qps/bin/support/mongo/build_set.sh [--help]

Executable on VMs
All

Example
To create replica-sets for SPR:
[root@host /]# /var/qps/bin/support/mongo/build_set.sh --spr --create
Starting Replica-Set Creation
capture_env.sh

This command collects most of the debug logs to debug an issue.

Syntax
/var/qps/bin/support/env/capture_env.sh

Executable on VMs
pcrfclient01/02

Output
This command provides the following information to collect logs:
- -h|--help: Show usage
- -q|--qns: For capturing qns logs (default is to skip qns logs)
- -t|--trap: For capturing trap logs (default is to skip trap logs)
- -m|--mongo: For capturing mongo logs (default is to skip mongo logs)
- -v|--var-log: For capturing /var/log/messages (default is to skip the log)
- -a|--age: Should be followed by maximum age of log based on last modification time (defaults to 1 day)
- -n|--host: Should be followed by common separated list of hostnames for capturing logs (defaults to all hosts)

Example
[root@host /]# /var/qps/bin/support/env/capture_env.sh
Creating archive of QPS environment information...
---------------------------
Capturing /etc/broadhop...
Capturing logs...
Capturing Policy Builder data...
Capturing installed software versions...

change_passwd.sh

Change the Control Center user’s (Linux user) password on Cluster Manager VM or OAM (pcrfclient) VM.

Syntax
/var/qps/bin/support/change_passwd.sh [-h]
Executable on VMs

All

Example

Enter username whose password needs to be changed:
Enter new password:
Re-enter new password:

Done.
Disconnecting from pcrfclient01... done.

cleanup_license.sh

Cleans up the records related to license in the licensesfeats collection in the sharding database. This command must be run as root user when license file is updated on the OAM (pcrfclient) machine.

Syntax

/var/qps/bin/support/mongo/cleanup_license.sh [-h]

Executable on VMs

• Cluster Manager
• pcrfclient01/02

component_alarm_reports.py

This command is used to store or retrieve the open/active component alarms in CPS.

• For clear alarms, it removes the alarms matching the clear alarm.
• For active alarms, it clears old alarms if any and adds the latest alarm.

Syntax

component_alarm_reports.py -h

CPS Update/Report Component Alarm(s) to/from Mongo DB
optional arguments:
-h, --help show this help message and exit
--action {update,report} Update an alarm. report : Report active alarms
--eventhost EVENTHOST, -e EVENTHOST Event Host Name
--date DATE, -d DATE Date of event
--name NAME, -n NAME Name of alarm
--facility FACILITY, -f FACILITY
Facility of alarm
--severity SEVERITY, -s SEVERITY
Severity of alarm
--info INFO, -i INFO Info of alarm

Attention
The --action update parameter is for Cisco Internal Use Only.

Path:
On Cluster Manager: /var/qps/install/current/scripts/modules/component_alarm_reports.py
On pcrfclient and policy director VMs:
/var/qps/bin/install/current/scripts/modules/component_alarm_reports.py

Executable on VMs
Cluster Manager, Policy Director and OAM (pcrfclient) nodes

Examples
To retrieve the active alarms:

copytoall.sh

Prior to 7.0.5 release, in order to propagate the changes done in Cluster Manager, user used to execute
reinit.sh which in turn triggers each CPS VM to download and install the updated VM images from the
Cluster Manager and it time consuming process.

In CPS 7.0.5 and higher releases, if minor changes are made to any file in Cluster Manager, instead of executing
reinit.sh script, use this command to synchronize the modified files from Cluster Manager to all other VMs.

Syntax

copytoall.sh

Executable on VMs
Cluster Manager

Note
In case executing copytoall.sh command from qns-admin, prefix sudo before the command.

Example
1. If the user updated /etc/broadhop/logback.xml file in Cluster Manager.
2. Build etc directory on each cluster by executing `build_all.sh` from Cluster Manager to rebuild CPS package script.

   ```
   /var/qps/install/current/scripts/build_all.sh
   ```

3. Execute the following command to copy the file:

   ```
   SSHUSER_PREFERROOT=true copytoall.sh /etc/broadhop/logback.xml /etc/broadhop/logback.xml
diagnostics.sh
   ```

**diagnostics.sh**

Runs a set of diagnostics and displays the current state of the system. If any components are not running, red failure messages are displayed.

**Note**

RADIUS-based policy control is no longer supported in CPS 14.0.0 and later releases as 3GPP Gx Diameter interface has become the industry-standard policy control interface.

**Syntax**

```
/var/qps/bin/diag/diagnostics.sh -h
```

Usage: `/var/qps/bin/diag/diagnostics.sh [options]`

This script runs checks (i.e. diagnostics) against the various access, monitoring, and configuration points of a running CPS system.

In HA/GR environments, the script always does a ping check for all VMs prior to any other checks and adds any that fail the ping test to the IGNORED_HOSTS variable. This helps reduce the possibility for script function errors.

**Note**: See `/var/qps/bin/diag/diagnostics.ini` to disable certain checks for the HA/GR environment persistently. The use of a flag will override the diagnostics.ini value.

Examples:

```
/var/qps/bin/diag/diagnostics.sh -q
/var/qps/bin/diag/diagnostics.sh --basic_ports --clock_skew -v
--ignored_hosts='portal01,portal02'
```

**Options:**

```--basic_ports : Run basic port checks
   For AIO: 80, 11211, 27017, 27749, 7070, 8080, 8090, 8182, 9091, 9092
   For HA/GR: 80, 11211, 7070, 8080, 8081, 8182, 9091, 9092, and Mongo DB ports based on /etc/broadhop/mongoConfig.cfg
--clock_skew : Check clock skew between lb01 and all vms (Multi-Node Environment only)
--diskspace : Check diskspace
--get_active_alarms : Get the active alarms in the CPS
--get_replica_status : Get the status of the replica-sets present in environment.
(Multi-Node Environment only)
--get_sharding_status : Get the status of the sharding information present in environment.
(Multi-Node Environment only)
--get_shard_health : Get the status of the sharded database information present in environment. (Multi-Node Environment only)
--get_peer_status: Get the diameter peers present in the environment.
--get_sharded_replica_status : Get the status of the shards present in environment.
(Multi-Node Environment only)
--ha_proxy : Connect to HAProxy to check operation and performance statistics, and ports
   (Multi-Node Environment only)
   http://lbvip01:5540/haproxy?stats
   http://lbvip01:5540//haproxy-diam?stats
--help -h : Help - displays this help
--hostnames : Check hostnames are valid (no underscores, resolvable, in
   /etc/broadhop/servers) (AIO only)`
```
--ignored_hosts : Ignore the comma separated list of hosts. For example
--ignored_hosts='portal01,portal02'
    Default is 'portal01,portal02,portal01b,portal02b' (Multi-Node Environment only)
--ping_check : Check ping status for all VM
--qns_diagnostics : Retrieve diagnostics from CPS java processes
--qns_login : Check qns user passwordless login
--quiet -q : Quiet output - display only failed diagnostics
--radius : Run radius specific checks
--redis : Run redis specific checks
--svn : Check svn sync status between pcrfclient01 & pcrfclient02 (Multi-Node Environment only)
--tacacs : Check Tacacs server reachability
--swapspace : Check swap space
--verbose -v : Verbose output - display *all* diagnostics (by default, some are grouped for readability)
--virtual_ips : Ensure Virtual IP Addresses are operational (Multi-Node Environment only)
--vm_allocation : Ensure VM Memory and CPUs have been allocated according to recommendations

The test for swap memory usage must have the following criteria:

• The test passes if the swap space used is less than 200 MB.

• The script issues a warning if the swap space used is between 200 MB and 1000 MB.

• The status fails if the swap memory used exceeds 1000 MB.

**Executable on VMs**

Cluster Manager and OAM (pcrfclient) nodes

**Example**

```
[root@pcrfclient01 ~]# diagnostics.sh
QNS Diagnostics
Checking basic ports (80, 7070, 27017-27720, 27749, 8080, 9091)...[PASS]
Checking qns passwordless logins on all boxes...[PASS]
Validating hostnames...[PASS]
Checking swap space for all VMs...[PASS]
Checking for clock skew...[PASS]
Retrieving QNS diagnostics from qns01:9045...[PASS]
Retrieving QNS diagnostics from qns02:9045...[PASS]
Checking HAproxy status...[PASS]
Checking VM CPU and memory allocation for all VMs...[PASS]
Checking Virtual IPs are up...[PASS]
[root@pcrfclient01 ~]#
```

**List of Active Alarms**

To get the list of active alarms, execute the `diagnostics.sh --get_active_alarms` command. Here is a sample output:

```
#diagnostics.sh --get_active_alarms

CPS Diagnostics HA Multi-Node Environment
----------------------------------------------
Active Application Alarm Status
----------------------------------------------
id=1000 sub_id=3001 event_host=lb02 status=down date=2017-11-22,
10:47:34,651+0000  msg="3001:Host: site-host-gx Realm: site-gx-client.com is down"
```
id=1000 sub_id=3001 event_host=lb02 status=down date=2017-11-22, 10:47:34,048+0000 msg="3001:Host: site-host-sd Realm: site-sd-client.com is down"

id=1000 sub_id=3001 event_host=lb01 status=down date=2017-11-22, 10:45:17,927+0000 msg="3001:Host: site-server Realm: site-server.com is down"

id=1000 sub_id=3001 event_host=lb02 status=down date=2017-11-22, 10:47:34,091+0000 msg="3001:Host: site-host-rx Realm: site-rx-client.com is down"

id=1000 sub_id=3002 event_host=lb02 status=down date=2017-11-22, 10:47:34,111+0000 msg="3002:Realm: site-server.com:applicationId: 7:all peers are down"

Active Component Alarm Status
---------------------------------------------------------------------------------

```
Event_host=lb02 name=processdown severity=critical facility=operatingsystem
date=2017-11-22 10:13:49,310329511 +00:00 info=corosync process is down
```

- Due to the limitation of architecture of the CPS SNMP implementation, if the SNMP deamon or policy server (QNS) process on pcrf client VM restarts, there can be gap between active alarms displayed by the `diagnostics.sh` and active alarms in NMS.

- The date printed for application alarm status is when the alarm was seen at pcrf client VM. The time for the alarm at NMS is the time before the alarm is received from Policy Director (LB) VM. So there can be a difference in the dates for the same alarm reported in `diagnostics.sh` and in NMS.

The following table list the type of SNMP alarms:

### Table 20: IDs - Type of SNMP Alarms

<table>
<thead>
<tr>
<th>Alarm ID</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>Application Alarm</td>
</tr>
<tr>
<td>7100</td>
<td>Database Alarm</td>
</tr>
<tr>
<td>7200</td>
<td>Failover Alarm</td>
</tr>
<tr>
<td>7300</td>
<td>Process Alarm</td>
</tr>
<tr>
<td>7400</td>
<td>VM Alarm</td>
</tr>
<tr>
<td>7700</td>
<td>GR Alarm</td>
</tr>
</tbody>
</table>

For more information on SNMP alarms, refer to *CPS SNMP, Alarms and Clearing Procedures Guide*.

**Sample Output of `--get_sharding_status`**

```
<table>
<thead>
<tr>
<th>Shard Id Count</th>
<th>Mongo DB</th>
<th>State</th>
<th>Backup DB</th>
<th>Removed</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>sessionmgr01:27717/session_cache</td>
<td>online</td>
<td>false</td>
<td>false</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>sessionmgr01:27717/session_cache_2</td>
<td>online</td>
<td>false</td>
<td>false</td>
<td>0</td>
</tr>
</tbody>
</table>
```
### dump_utility.py

This collection utility is used to collect standard information from the CPS system in case of issues (system, application, database). This utility collects such information from VM, depending on type of information and VMs selected in the input.

This utility can be executed from anywhere from the terminal. Logs are printed on terminal and written to a log file: `/var/tmp/dumputility-<date_time_when_executed>.log`.

---

**Important**

Warning messages related to the files that does not exist in the system will not be displayed on the terminal but will be logged only to the log file (/var/tmp/dumputility-<date_time_when_executed>.log).

---

**Caution**

Running the dump utility can be CPU intensive.

---

**Important**

The dump utility should be run from the Cluster Manager wherever possible.

The following types of information can be collected:

- **Common Information:** This information is common for all type of issues. Information is collected from perfclient01 VM. If perfclient01 is down, information is collected from perfclient02 VM. If both VMs are down, information is collected from Cluster Manager VM. The following information can be fetched:
  - `about.sh` output
  - `diagnostics.sh` output
  - `list_installed_features.sh` output
  - Facter output
  - Consolidated logs
  - Bulkstats files
• SVN dump from PB config

**System Information:** This information is useful in troubleshooting system related issues. The following information can be fetched:

  • `sysctl -a` output
  • Information about processes running
  • Firewall configuration
  • `Netstat statistics`
  • Complete `lsf` output
  • Total number of open files
  • `ifconfig` output
  • Routing table information
  • Disk usage
  • `Monit status`
  • `Monit summary`
  • System logs
  • `Sar logs`
  • `Dmesg logs`
  • Secure logs
  • `Yum logs`
  • Whisper logs
  • Puppet logs

**Application Information:** This information is useful in troubleshooting application-related issues. The following information can be fetched:

  • Contents of `/etc/broadhop directory`
  • `/var/log/broadhop logs`
  • `monit status`
  • `monit summary`

**Database Information:** This information is useful in troubleshooting database related issues. The following information can be fetched:

  • MongoDB logs
  • Mongostat output
  • `rs.status()` output
• rs.conf() output
• /var/qps/bin/support/mongo/session_cache_ops.sh -count output
• top_qps.sh output for 10 seconds
• mongotop output for 3 seconds

• **OAM (PCRFCLIENT) Specific Data:** The following information can be fetched from OAM (pcrfclient) VMs:
  • carbon logs
  • httpd logs
  • pcs resource show output

• **Policy Director (lb) Specific Data:** The following information can be fetched from policy director (load balancer) VMs:
  • SNMP trap logs
  • HAproxy logs
  • pcs resource show output

• **Policy Server (QNS) Specific Data:** The following information can be fetched from policy server (QNS) VMs:
  • Thread level CPU/memory usage of java process
  • jstack output of java process
  • Policy Server (QNS) logs
  • Policy Server service logs

**Syntax**

dump_utility.py

The following options are supported:

• `-v,--vm-type`: Specifies type of VM or single VM name from which information has to be fetched. Multiple VMs are separated by colon. For example, --vm-type qns:sessionmgr01.

• `-i,--info-type`: Specifies type of information to be collected. Possible values are application, db, system, vm_specific. Multiple values are separated by colon. For example, --info-type application:system.

• `-o,--output-file-name`: Name of the tar file to store fetched information.

• `-h,--help`: Displays help.

**Executable on VMs**

• Cluster Manager
Example

- To fetch system information from Policy Director (lb) VMs:
  
  ```
  dump_utility.py --info-type system --vm-type lb
  ```

- To fetch application and VM specific information from qns01:
  
  ```
  dump_utility.py --info-type application:vm_specific --vm-type qns01
  ```
  OR
  
  ```
  dump_utility.py --info-type application:vm_specific --vm-type sav-qns01
  ```
  where, `sav-qns01` is hostname of qns01 VM.

- To fetch database specific information from all replica sets:
  
  ```
  dump_utility.py --info-type db --vm-type pcrfclient:sessionmgr
  ```

Sample output:

```bash
dump_utility.py --info-type application --vm-type sav-qns01
Logs are also getting stored in /var/tmp/dumputility-07-06-2016-04-07-47.log
**********************************************
Collecting information, please wait...
**********************************************
Fetching common information like about.sh/list_installed_features/diagnostics etc from pcrfclient01
This step takes time, please wait...
Fetching command outputs from pcrfclient01
Fetching files hosts file from pcrfclient01
Fetching files consolidated logs from pcrfclient01
Fetching files Bulkstats file from pcrfclient01
Fetching command outputs from qns01
Fetching files Broadhop dir from qns01
Fetching files Broadhop logs from qns01
**********************************************
Information is collected at : /var/tmp/07-06-2016-04-07-47.tar.gz
**********************************************
Disconnecting from pcrfclient01... done.
```

For non-root users, certain CPS scripts (about.sh, diagnostics.sh and so on) expects sudo password. For such scripts, output is displayed on terminal and is saved in the file. Also for some data which can only be accessed by root user, permission denied related warning is displayed.

---

**list_installed_features.sh**

Displays the features and versions of the features that are installed on each VM in the environment.

**Syntax**

```
/var/qps/bin/diag/list_installed_features.sh
```
Executable on VMs

Example

```
[root@host /]# /var/qps/bin/diag/list_installed_features.sh
Features installed on lb01:9045
  com.broadhop.infrastructure.feature=7.0.2.r072627
  com.broadhop.iomanager.feature=7.0.2.r072627
  com.broadhop.server.runtime.product=7.0.2.r072627
  com.broadhop.snmp.feature=7.0.2.r072627
Features installed on lb02:9045
  com.broadhop.infrastructure.feature=7.0.2.r072627
  com.broadhop.iomanager.feature=7.0.2.r072627
  com.broadhop.server.runtime.product=7.0.2.r072627
  com.broadhop.snmp.feature=7.0.2.r072627
Features installed on qns01:9045
  com.broadhop.balance.service.feature=3.4.2.r071203
  com.broadhop.balance.spr.feature=3.4.2.r071203
  com.broadhop.custrefdata.service.feature=2.4.2.r072158
  com.broadhop.diameter2.local.feature=3.4.2.r072694
  com.broadhop.externaldatacache.memcache.feature=7.0.2.r072627
  com.broadhop.infrastructure.feature=7.0.2.r072627
  com.broadhop.server.runtime.product=7.0.2.r072627
  com.broadhop.snmp.feature=7.0.2.r072627
  com.broadhop.policy.feature=7.0.2.r072627
  com.broadhop.unifiedapi.interface.feature=2.3.2.r072695
  com.broadhop.unifiedapi.ws.service.feature=2.3.2.r072695
  com.broadhop.vouchers.service.feature=3.4.2.r071203
  com.broadhop.ws.service.feature=1.5.2.r071537
Features installed on qns02:9045
  com.broadhop.balance.service.feature=3.4.2.r071203
  com.broadhop.balance.spr.feature=3.4.2.r071203
  com.broadhop.custrefdata.service.feature=2.4.2.r072158
  com.broadhop.diameter2.local.feature=3.4.2.r072694
  com.broadhop.externaldatacache.memcache.feature=7.0.2.r072627
  com.broadhop.infrastructure.feature=7.0.2.r072627
  com.broadhop.server.runtime.product=7.0.2.r072627
  com.broadhop.snmp.feature=7.0.2.r072627
  com.broadhop.policy.feature=7.0.2.r072627
  com.broadhop.unifiedapi.interface.feature=2.3.2.r072695
  com.broadhop.unifiedapi.ws.service.feature=2.3.2.r072695
  com.broadhop.vouchers.service.feature=3.4.2.r071203
  com.broadhop.ws.service.feature=1.5.2.r071537
Features installed on qns03:9045
  com.broadhop.balance.service.feature=3.4.2.r071203
  com.broadhop.balance.spr.feature=3.4.2.r071203
  com.broadhop.custrefdata.service.feature=2.4.2.r072158
  com.broadhop.diameter2.local.feature=3.4.2.r072694
  com.broadhop.externaldatacache.memcache.feature=7.0.2.r072627
  com.broadhop.infrastructure.feature=7.0.2.r072627
  com.broadhop.server.runtime.product=7.0.2.r072627
  com.broadhop.snmp.feature=7.0.2.r072627
  com.broadhop.policy.feature=7.0.2.r072627
  com.broadhop.unifiedapi.interface.feature=2.3.2.r072695
  com.broadhop.unifiedapi.ws.service.feature=2.3.2.r072695
  com.broadhop.vouchers.service.feature=3.4.2.r071203
  com.broadhop.ws.service.feature=1.5.2.r071537
```
This command is executed from Cluster Manager. It SSHs to all the CPS VMs and triggers the 
/etc/init.d/vm-init.sh script on each VM to download all the Puppet scripts, CPS softwares, /etc/hosts files and updates the VM with the new software from Cluster Manager to the VM.

Refer to vm-init.sh, on page 230, to trigger this process for a single VM as opposed to all VMs.
**Syntax**

/var/qps/install/current/scripts/upgrade/reinit.sh

**Executable on VMs**

Cluster Manager

**Example**

[root@host /]# /var/qps/install/current/scripts/upgrade/reinit.sh
Running pupdate on lab
Updating /etc/hosts file from installer VM...
Updating /etc/facter/facts.d/bxb1-lb01...
Updating /etc/puppet from installer VM...

---

**restartall.sh**

This command is executed from Cluster Manager. It stops and restarts all of the Policy Server (QNS) services on all VMs in the CPS cluster. This command is also executed when new software is installed on VMs.

Refer to restartqns.sh, on page 200 to restart Policy Server (QNS) services on a specific VM as opposed to all VMs.

**Syntax**

/var/qps/bin/control/restartall.sh

**Executable on VMs**

Cluster Manager

---

**Note**

When executing restartall.sh command from qns-admin, prefix sudo before the command.

**Example**

/var/qps/bin/control/restartall.sh
Currently active LB: lb01

This process will restart all QPS software on the nodes in this order:

lb02 pcrfclient02 qns01 qns02 pcrfclient01 lb01

---

**restartqns.sh**

This command stops and restarts all Policy Server (QNS) services on the target VM.

**Syntax**

/var/qps/bin/control/restartqns.sh hostname
**Executable on VMs**
Cluster Manager

When executing `restartqns.sh` command from qns-admin, prefix `sudo` before the command.

**Example**

```
/var/qps/bin/control/restartqns.sh qns01
/var/qps/bin/control/restartqns.sh pcrfclient01
```

**runonall.sh**

Executes a command, as provided as an argument, on all of the VMs listed in the servers file. These commands must be run as the CPS user on the remote VMs, or they will fail to execute properly.

**Syntax**

```
/var/qps/bin/control/runonall.sh <executable command>
```

**Executable on VMs**

All

**Note**

In case executing `runonall.sh` command from qns-admin, prefix `sudo` before the command.

**Example**

```
/var/qps/bin/control/runonall.sh ntpdate -u
```

**service**

This command is used to control individual services on each VM.

**Syntax**

```
service < option > | --status-all | [ service_name [ command | --full-restart ] ]
```

**Caution**

Do not use this command for any services managed by the monit service. Use the monit summary command to view the list of services managed by monit. The list of services managed by monit is different on each CPS VM.
session_cache_ops.sh

This command provides information about, and performs operations on the session database.

Syntax

```
/var/qps/bin/support/mongo/session_cache_ops.sh <Argument1> <Argument2>
<Argument1>: --count or --remove
--count
--remove
--statistics-count
--add-shard
--add-ringset
--db-shrink
<Argument2>: site1 or site2 or site3 ... siten
```

This argument for GR only, in GR setup user need to pass the site number {site1 or site2 ...} as second argument.

Options

--count

This option prints the count of sessions present in all available session_cache* databases.

The session count is the number of allocated entries in the database for unique subscriber sessions on the network. Each allocated entry may have related nested sub-sessions with other session types such as Sy/Rx.

- A session count is incremented when a Gx CCR-I arrives and an entry (Mongo data structure called a document) is allocated.
- If there are other types of sessions related to that unique subscriber during the life of the Gx session (or Sy/Rx) these are nested within the "document".
- If these "other" types of sessions are terminated, they are removed from the document and those counter types are decremented immediately.
- When the Gx CCR-T arrives it is decremented immediately from the Gx Type count.
- Up to 30 seconds later the unique session entry/document is removed, and the Session Total count is decremented.

The other session types should not be used in validating the number of total sessions as this varies greatly between call models and time. These are simply specific totals drawn from each entry.

It is typical for the session_total_count will be slightly more than the Gx_TYPE count due to the 30 second delay. The reason for this delay is that the entry (document) needs to wait for any other related (nested) sessions to close.

On occasion there may be small variance of data between what the perfcient01 and perfcient02 report, although they are querying the same database. These are, however, comparable.

The counters processing order is that the total session count is performed first and the detailed session (types) are done second. Slight discrepancies/variance in the numbers may occur.

Example
# session_cache_ops.sh --count
Session cache operation script
Tue Dec 22 02:26:49 MST 2015

Session Replica-set SESSION-SET1

Session Database : Session Count

session_cache : 14
session_cache_2 : 15
session_cache_3 : 12
session_cache_4 : 10

No of Sessions in SET1 : 51
Total Number of Sessions : 51

--remove

This option removes sessions from all available session_cache* databases.

Warning

You will be prompted to confirm this action after running this command. If you proceed, this will remove existing sessions in the replica-set.

Example

# session_cache_ops.sh --remove
Session cache operation script
Tue Dec 22 02:29:42 MST 2015

Session Replica-set SESSION-SET1

WARNING: Continuing will remove existing sessions in replica-set : SESSION-SET1
CAUTION: This result into loss of session data
Are you sure you want to continue (y/yes or n/no)? : y

Removing sessions from session_cache db
connecting to: sessionmgr04:27717/session_cache
WriteResult({ "nRemoved" : 1 })

Remove sessions operation completed on session_cache db.
Removing sessions from session_cache_2 db
connecting to: sessionmgr04:27717/session_cache_2
WriteResult({ "nRemoved" : 0 })

Remove sessions operation completed on session_cache_2 db.
Removing sessions from session_cache_3 db
connecting to: sessionmgr04:27717/session_cache_3
WriteResult({ "nRemoved" : 0 })

Remove sessions operation completed on session_cache_3 db.
Removing sessions from session_cache_4 db
connecting to: sessionmgr04:27717/session_cache_4
WriteResult({ "nRemoved" : 0 })

Remove sessions operation completed on session_cache_4 db.

--statistics-count

This option prints statistics count of the sessions (types if the session Gx, Rx, and so on) in all available session_cache* databases.

Example
# session_cache_ops.sh --statistics-count
Session cache operation script
Tue Dec 22 02:28:38 MST 2015
-------------------------------
Sessions statistic counter on General
-------------------------------

Session Type : Session Count
-------------------------------
ADMIN-SET1
  EDR : 5
  GX_SCE : 10
-------------------------------

--add-shard

Adds session shards to the session database, either normal shards or hot standby shards.

Example

# session_cache_ops.sh --add-shard
Session cache operation script
Tue Dec 22 02:22:24 MST 2015
Session Sharding
-------------------------------
Select type of session shard Default [*]
  Hot Standby [ ]
Sessionmgr pairs : sessionmgr01:sessionmgr02:27717
Session shards per pair : 4
Creating Session sharding [ Done ]

-------------------------------
Note :
- Press 'y' to select the shard type
- If sharding needed for multiple sessionmgr vms with port please provide sessionmgr vm with port separated by ' : ', and pair separated by ','
(Ex: sessionmgr01:sessionmgr02:27717,sessionmgr03:sessionmgr04:27717)

--add-ringset

This option adds a new set to the ring.

Example

# session_cache_ops.sh --add-ringset
Session cache operation script
Session cache operation script: addRingSet
The progress of this script can be monitored in the following log:
/var/log/broadhop/scripts/session_cache_ops_08062016_182315.log
Note:
Please provide sessionmgr vm separated by ':' and pair separated by ','

(Ex HA: sessionmgr01-lab:sessionmgr02-lab)
(Ex GB: sessionmgr01-site1:sessionmgr02-site1,sessionmgr01-site2:sessionmgr02-site2)
Enter cache servers: sessionmgr01,sessionmgr02
Verifying Qnsses processes is running
Adding set sessionmgr01,sessionmgr02 to ring
Executing OSGI Command> setSkRingSet 1 4 sessionmgr01:11211,
Executing OSGI Command> setSkRingSet 1 4 sessionmgr02:11211,
Executing OSGI Command> rebuildSkRing 1
Ringset added successfully

--db-shrink

This option is used after clean of all sessions from CPS mongo database. It performs a synchronization operation by removing session cache database files and copying data files from primary member. This reduces the database size and compact database files and/or reclaim disk space. Currently, this operation does not support specific to replica-set.

Note
This option must be performed in maintenance window (if required in production) and when there is no session data.

Example

# session_cache_ops.sh --db-shrink
Session cache operation script
Fri May 13 06:17:42 EDT 2016
---------------------------------------------------------
Session DB Shrink Replica-set
---------------------------------------------------------
CAUTION: This option must performed in maintenance window and no session data
Are you sure you want to continue (y/yes or n/no)? : yes
Verify log /var/log/broadhop/scripts/session_cache_ops_13052016_061742.log

DB Shrink operation completed successfully for set - SESSION-SET1
DB File count before Shrink: 36
DB File count after Shrink: 16
DB Size before Shrink: 4.2G
DB Size after Shrink: 256M

DB Shrink operation completed successfully for set - SESSION-SET2
DB File count before Shrink: 28
DB File count after Shrink: 8
DB Size before Shrink: 4.0G
DB Size after Shrink: 128M

Executable on VMs
pcrfclient01/02

set_priority.sh

This command sets the priorities of replica-sets, and replica-set members for High Availability (HA) or Geo-Redundant (GR) CPS deployments.
By default, priority of mongo databases, replica-sets, and members are set in order (with higher priority) as defined in the Mongo Config (mongoConfig.cfg).

Use the `diagnostics.sh --get_replica_status` command to view the status and current priorities of all databases replica-sets.

**Note**

If a member is shown in an unknown state, it is likely that the member is not accessible from one of other members, mostly an arbiter. In that case, you must go to that member and check its connectivity with other members.

Also, you can login to mongo on that member and check its actual status.

**Syntax**

```
/var/qps/bin/support/mongo/set_priority.sh
```

The following options are supported:

- **Mandatory Options:**
  - `--db <db_name>`
    - `[all|session|spr|admin|balance|report|portal|audit|bindings]`

  The `set_priority --db all` command would set the priority of all replica-sets listed in mongoConfig.cfg in descending order. The member that is listed first in the configuration would be assigned the highest priority.

  The `set_priority --db session` command would set the priority of all replica-sets of db type SESSION. By default, priorities are set in descending order.

- **General Options:**
  - `--h [ --help ]` show syntax and usage information for this script
  - `--version` show version information of this script
  - `--asc` Set priority in ascending order (default is descending)
  - `--dsc` Set priority in descending order
  - `--priority <0|1000>` Set specific priority
  - `--force [false|true]` forces the new priority to be applied (default is false).

  **Note**

  The `--priority <0|1000>` option is not currently supported. Do not use.

  **Caution**

  Do not use the `--force` option unless instructed by a Cisco representative. By default, the `set_priority.sh` script will only attempt to set the priorities when all members of a replica set are in a healthy state. The `--force` option can be used when the members are NOT in a healthy state.

- **Specific Replica-set Options:**
  - `--replSet <setname>` specifies the replica-set name

  This option enables you to specify priority for a particular replica-set. You must provide the `<setname>`.

- **Geo-Redundancy Options:**
--sitename [site1|site2] specifies the GR site to which the operation applies

This option enables you to specify a GR site. The mongoConfig.cfg must have relevant start and end tags (like #SITE1_START and #SITE1_END).

**Executable on VMs**

Cluster Manager

**Examples**

**High Availability Options:**

```bash
set_priority.sh --db all
set_priority.sh --db session
set_priority.sh --db session --asc
set_priority.sh --db session --replSet set01
```

**Geo-Redundancy Options:**

```bash
set_priority.sh --db session --replSet set01 --sitename <site1|site2>
set_priority.sh --db session --replSet set01 --sitename <site1|site2>
set_priority.sh --db session --replSet set01 --sitename <site1|site2> --force true
```

**startall.sh**

This command is executed from Cluster Manager. It starts all Policy Server (QNS) services on all VMs in the CPS cluster. This command is also executed when a new software is installed on VMs.

Refer to **startqns.sh, on page 207** to start services on a specific VM as opposed to all VMs.

**Syntax**

```
/var/qps/bin/control/startall.sh
```

---

**Note**

When executing startall.sh command from qns-admin, prefix sudo before the command.

**Executable on VMs**

Cluster Manager

**Example**

```
/var/qps/bin/control/startall.sh
```

**startqns.sh**

This command is executed from Cluster Manager. It starts all Policy Server (QNS) services on the specified VM.
**statusall.sh**

This command displays whether the services managed by monit are stopped or running on all VMs. This script can be executed from Cluster Manager or OAM (pcrfclient).

**Syntax**
/var/qps/bin/control/statusall.sh

---

**Note**
When executing statusall.sh command from qns-admin, prefix sudo before the command.

**Executable on VMs**
- Cluster Manager
- pcrfclient01/02

**Output**
For each process or program, the command displays:

- **Status**
  - Running – the process/Program is healthy and running
  - Does not exist – the process id specified in the /var/run/processname-pid does not exist. This is a cause for concern if recurring.
  - Waiting – This is normal for a program/process monitored by monit
  - Status ok – This is normal for a program monitored by monit

- **Monitoring Status**
  - Monitored – The process/program is being monitored
• Not Monitored – The process/program is not under the control of monit

• Waiting – A transient state which reports as waiting depending upon when the statusall.sh command is run which internally uses monit status command.

Note For more details, see: https://bitbucket.org/tildeslash/monit/issue/114/.

• Uptime

The number of days, hours, and minutes the process or program has been running.

Example

[root@host /]# /var/qps/bin/control/statusall.sh
Executing 'sudo /usr/bin/monit status' on all QNS Servers
The Monit daemon 5.5 uptime: 2h 12m
Process 'snmptrapd'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'snmpd'
  status Running
  monitoring status Monitored
  uptime 2h 12m
Process 'sessionmgr-27017'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'qns-2'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'qns-1'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'memcached'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'logstash'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'elasticsearch'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'collectd'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'carbon-cache'
  status Running
  monitoring status Monitored
  uptime 15h 33m
Process 'carbon-aggregator'
  status Running
  monitoring status Monitored
stopall.sh

This command is executed from Cluster Manager. It stops the Policy Server (QNS) services on each VMs in the CPS cluster.

Refer to stopqns.sh, on page 210 to stop Policy Server (QNS) services on a specific VM as opposed to all VMs.

**Syntax**

```
/var/qps/bin/control/stopall.sh
```

**Note**

When executing stopall.sh command from qns-admin, prefix sudo before the command.

**Executable on VMs**

Cluster Manager

**Example**

```
/var/qps/bin/control/stopall.sh
```

stopqns.sh

This command is executed from Cluster Manager. It stops all Policy Server (QNS) services on the specified VM.

**Syntax**

```
/var/qps/bin/control/stopqns.sh hostname
```

**Note**

When executing stopqns.sh command from qns-admin, prefix sudo before the command.

**Executable on VMs**

Cluster Manager

**Example**

```
/var/qps/bin/control/stopqns.sh qns01
```
summaryall.sh

This command provides a brief status of the services managed by monit on all VMs in the CPS cluster.

Syntax

/var/qps/bin/control/summaryall.sh

When executing `summaryall.sh` command from qns-admin, prefix `sudo` before the command.

Executable on VMs
Cluster Manager

Example

```
/var/qps/bin/control/summaryall.sh
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmptrapd' Running
Process 'snmpd' Running
Program 'vip_trap' Status ok
Program 'gr_site_status_trap' Status ok
Process 'redis-2' Running
Process 'redis-1' Running
Process 'redis' Running
Process 'qns-4' Running
Process 'qns-3' Running
Process 'qns-2' Running
Process 'qns-1' Running
Process 'corosync' Running
File 'monitor-qns-4' Accessible
File 'monitor-qns-3' Accessible
File 'monitor-qns-2' Accessible
File 'monitor-qns-1' Accessible
Process 'memcached' Running
Process 'irqbalance' Running
Process 'haproxy-diameter' Running
Process 'haproxy' Running
Process 'cutter' Running
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'lb01' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmptrapd' Running
Process 'snmpd' Running
Program 'vip_trap' Status ok
Program 'gr_site_status_trap' Status ok
Process 'redis-2' Running
Process 'redis-1' Running

```
Process 'redis' Running
Process 'qns-4' Running
Process 'qns-3' Running
Process 'qns-2' Running
Process 'qns-1' Running
Process 'corosync' Running
File 'monitor-qns-4' Accessible
File 'monitor-qns-3' Accessible
File 'monitor-qns-2' Accessible
File 'monitor-qns-1' Accessible
Process 'memcached' Running
Process 'irqbalance' Running
Process 'haproxy-diameter' Running
Process 'haproxy' Running
Process 'cutter' Running
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'lb02' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'sessionmgr01' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'sessionmgr02' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns01' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns02'
The Monit daemon 5.14 uptime: 5d 19h 19m

Process 'whisper' Running
Process 'snmpd' Running
Program 'kpi_trap' Status ok
Program 'db_trap' Status ok
Program 'failover_trap' Status ok
Program 'gps_process_trap' Status ok
Program 'admin_login_trap' Status ok
Program 'vm_trap' Status ok
Program 'gps_message_trap' Status ok
Program 'ldap_message_trap' Status ok
Process 'qns-2' Running
Process 'qns-1' Running
Process 'corosync' Running
Program 'monitor_replica' Status ok
File 'monitor-qns-2' Accessible
File 'monitor-qns-1' Accessible
Process 'logstash' Running
Program 'mon_db_for_lb_faiilover' Status ok
Program 'mon_db_for_callmodel' Status ok
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'carbon-cache' Running
Process 'carbon-aggregator' Running
Process 'auditrpms.sh' Running
System 'pcrfclient01'
The Monit daemon 5.14 uptime: 5d 19h 52m

Process 'whisper' Running
Process 'snmpd' Running
Program 'kpi_trap' Status ok
Program 'db_trap' Status ok
Program 'failover_trap' Status ok
Program 'gps_process_trap' Status ok
Program 'admin_login_trap' Status ok
Program 'vm_trap' Status ok
Program 'gps_message_trap' Status ok
Program 'ldap_message_trap' Status ok
Process 'qns-2' Running
Process 'qns-1' Running
Process 'corosync' Running
Program 'monitor_replica' Status ok
File 'monitor-qns-2' Accessible
File 'monitor-qns-1' Accessible
Process 'logstash' Running
Program 'mon_db_for_lb_faiilover' Status ok
Program 'mon_db_for_callmodel' Status ok
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'carbon-cache' Running
Process 'carbon-aggregator' Running
Process 'auditrpms.sh' Running
System 'pcrfclient02'
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns03' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'sessionmgr03' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'sessionmgr04' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns05' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns06' Running
The Monit daemon 5.14 uptime: 6d 10h 52m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns07' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns08' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns09' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns10' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'qns-1' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns11' Running
The Monit daemon 5.14 uptime: 6d 10h 51m
Process 'auditrpms.sh' Running
System 'sessionmgr13' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'sessionmgr14' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns13' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'sessionmgr09' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
File 'monitor-qns-1' Accessible
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'qns14' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
Program 'cpu_load_monitor' Status ok
Program 'cpu_load_trap' Status ok
Program 'gen_low_mem_trap' Status ok
Process 'collectd' Running
Process 'auditrpms.sh' Running
System 'sessionmgr10' Running
The Monit daemon 5.14 uptime: 6d 10h 51m

Process 'whisper' Running
Process 'snmpd' Running
Process 'memcached' Running
System 'qns18' Running

- qns-1.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29532 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
  Main PID: 4937 (java)
  CGroup: /system.slice/qns-1.service
    └─4937 /usr/bin/java -server -XX:+PrintGCDetails -XX:+PrintGCTimeStamps
           -XX:+PrintGCDateStamps -XX:+PrintTenuringDistribution -XX...
- qns-2.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-2.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29426 ExecStop=/var/qps/bin/support/startqps stop 2 (code=exited, status=0/SUCCESS)
  Main PID: 4876 (java)
  CGroup: /system.slice/qns-2.service
    └─4876 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:ReservedCodeCacheSize...
- qns-3.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-3.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29846 ExecStop=/var/qps/bin/support/startqps stop 3 (code=exited, status=0/SUCCESS)
  Main PID: 4820 (java)
  CGroup: /system.slice/qns-3.service
    └─4820 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:ReservedCodeCacheSize...
- qns-4.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-4.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29697 ExecStop=/var/qps/bin/support/startqps stop 4 (code=exited, status=0/SUCCESS)
  Main PID: 4765 (java)
  CGroup: /system.slice/qns-4.service
    └─4765 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:ReservedCodeCacheSize...
- qns-1.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 17896 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
  Main PID: 11761 (java)
  CGroup: /system.slice/qns-1.service
    └─11761 /usr/bin/java -server -XX:+PrintGCDetails -XX:+PrintGCTimeStamps
            -XX:+PrintGCDateStamps -XX:+PrintTenuringDistribution -X...
- qns-2.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-2.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 16763 ExecStop=/var/qps/bin/support/startqps stop 2 (code=exited, status=0/SUCCESS)
  Main PID: 16763 (java)
  CGroup: /system.slice/qns-2.service
    └─16763 /usr/bin/java -server -XX:+PrintGCDetails -XX:+PrintGCTimeStamps
            -XX:+PrintGCDateStamps -XX:+PrintTenuringDistribution -X...
- qns-3.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-3.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 11690 ExecStop=/var/qps/bin/support/startqps stop 3 (code=exited, status=0/SUCCESS)
  Main PID: 11690 (java)
  CGroup: /system.slice/qns-3.service
    └─11690 /usr/bin/java -server -XX:+PrintGCDetails -XX:+PrintGCTimeStamps
            -XX:+PrintGCDateStamps -XX:+PrintTenuringDistribution -X...
- qns-4.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-4.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29426 ExecStop=/var/qps/bin/support/startqps stop 2 (code=exited, status=0/SUCCESS)
  Main PID: 4876 (java)
  CGroup: /system.slice/qns-4.service
    └─4876 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:ReservedCodeCacheSize...
- qns-1.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29532 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
  Main PID: 4937 (java)
  CGroup: /system.slice/qns-1.service
    └─4937 /usr/bin/java -server -XX:+PrintGCDetails -XX:+PrintGCTimeStamps
            -XX:+PrintGCDateStamps -XX:+PrintTenuringDistribution -XX...
- qns-2.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-2.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29426 ExecStop=/var/qps/bin/support/startqps stop 2 (code=exited, status=0/SUCCESS)
  Main PID: 4876 (java)
  CGroup: /system.slice/qns-2.service
    └─4876 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:ReservedCodeCacheSize...
- qns-3.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-3.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29846 ExecStop=/var/qps/bin/support/startqps stop 3 (code=exited, status=0/SUCCESS)
  Main PID: 4820 (java)
  CGroup: /system.slice/qns-3.service
    └─4820 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:ReservedCodeCacheSize...
- qns-4.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-4.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 29697 ExecStop=/var/qps/bin/support/startqps stop 4 (code=exited, status=0/SUCCESS)
  Main PID: 4765 (java)
  CGroup: /system.slice/qns-4.service
    └─4765 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:ReservedCodeCacheSize...
- qns-1.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 17896 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
  Main PID: 11761 (java)
  CGroup: /system.slice/qns-1.service
    └─11761 /usr/bin/java -server -XX:+PrintGCDetails -XX:+PrintGCTimeStamps
            -XX:+PrintGCDateStamps -XX:+PrintTenuringDistribution -X...
- qns-2.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-2.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 16763 ExecStop=/var/qps/bin/support/startqps stop 2 (code=exited, status=0/SUCCESS)
  Main PID: 16763 (java)
  CGroup: /system.slice/qns-2.service
    └─16763 /usr/bin/java -server -XX:+PrintGCDetails -XX:+PrintGCTimeStamps
            -XX:+PrintGCDateStamps -XX:+PrintTenuringDistribution -X...
- qns-3.service - CPS Application Start Script
  Loaded: loaded (/etc/systemd/system/qns-3.service; static; vendor preset: disabled)
  Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
  Process: 11690 ExecStop=/var/qps/bin/support/startqps stop 3 (code=exited, status=0/SUCCESS)
Main PID: 11706 (java)
CGroup: /system.slice/qns-2.service
├─11706 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass -XX:+TieredCompilation -XX:ReservedCodeCacheSize...
└─qns-3.service - CPS Application Start Script
    Loaded: loaded (/etc/systemd/system/qns-3.service; static; vendor preset: disabled)
    Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
    Process: 15817 ExecStop=/var/qps/bin/support/startqps stop 3 (code=exited, status=0/SUCCESS)

Process: 11888 ExecStart=/var/qps/bin/support/startqps start 3 (code=exited, status=0/SUCCESS)
Main PID: 11906 (java)
CGroup: /system.slice/qns-3.service
└─11906 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass -XX:+TieredCompilation -XX:ReservedCodeCacheSize...

● qns-3.service - CPS Application Start Script
    Loaded: loaded (/etc/systemd/system/qns-3.service; static; vendor preset: disabled)
    Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
    Process: 14704 ExecStop=/var/qps/bin/support/startqpsstop 4 (code=exited, status=0/SUCCESS)
    Process: 11812 ExecStart=/var/qps/bin/support/startqps start 4 (code=exited, status=0/SUCCESS)

Main PID: 821 (java)
CGroup: /system.slice/qns-1.service
└─821 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass -XX:+TieredCompilation -XX:+DisableExplicitGC -server -Xm...

● qns-1.service - CPS Application Start Script
    Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
    Active: active (running) since Wed 2018-04-18 18:18:47 IST; 4 days ago
    Process: 10934 ExecStop=/var/qps/bin/support/startqpsstop 1 (code=exited, status=0/SUCCESS)
    Process: 29166 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)

Main PID: 13565 (java)
CGroup: /system.slice/qns-1.service
└─13565 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass -XX:+TieredCompilation -XX:+DisableExplicitGC -server -...

● qns-1.service - CPS Application Start Script
    Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
    Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
    Process: 9805 ExecStop=/var/qps/bin/support/startqpsstop 1 (code=exited, status=0/SUCCESS)
    Process: 9787 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)

Main PID: 29204 (java)
CGroup: /system.slice/qns-2.service
└─29204 /usr/bin/java -server -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass -Xmx512m -Xmx1024m -javaagent:/opt/broadhop/qns...
Process: 28958 ExecStart=/var/qps/bin/support/startqps start 2 (code=exited, status=0/SUCCESS)
Main PID: 29007 (java)

CGroup: /system.slice/qns-2.service
/var/qps/bin/support/startqps start 2 (code=exited, status=0/SUCCESS)

Main PID: 29007 (java)
CGroup: /system.slice/qns-2.service
/usr/java/default/bin/java -server -XX:+UnlockDiagnosticVMOptions
-XX:+UnsyncloadClass -Xms2048m -Xmx2048m -javaagent:/opt/broadhop/qns...

● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 16610 ExecStop=/var/qps/bin/support/startqpsstop 1 (code=exited, status=0/SUCCESS)

Process: 18158 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 18185 (java)
CGroup: /system.slice/qns-1.service
/usr/java/default/bin/java -server -XX:+UnlockDiagnosticVMOptions
-XX:+UnsyncloadClass -Xms512m -Xmx1024m -javaagent:/opt/broadhop/qns...

● qns-2.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-2.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 16592 ExecStop=/var/qps/bin/support/startqpsstop 2 (code=exited, status=0/SUCCESS)

Process: 17959 ExecStart=/var/qps/bin/support/startqps start 2 (code=exited, status=0/SUCCESS)
Main PID: 17977 (java)
CGroup: /system.slice/qns-2.service
/usr/bin/java -server -XX:+UnlockDiagnosticVMOptions
-XX:+UnsyncloadClass -Xms2048m -Xmx2048m -javaagent:/op...

● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:49 IST; 4 days ago
Process: 9733 ExecStop=/var/qps/bin/support/startqpsstop 1 (code=exited, status=0/SUCCESS)

Process: 12732 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 12748 (java)
CGroup: /system.slice/qns-1.service
/usr/bin/java -XX:+TieredCompilation -XX:+DisableExplicitGC -server ...

CPS Operations Guide, Release 18.3.0 (Restricted Release)
CPS Commands
summaryall.sh

221
Process: 6327 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)

Process: 9157 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 9174 (java)
   CGroup: /system.slice/qns-1.service
          └─9174 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
               -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
   ● qns-1.service - CPS Application Start Script
   Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
   Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 596 ExecStop=/var/qps/bin/support/startqpsstop 1 (code=exited, status=0/SUCCESS)
Process: 3623 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 3639 (java)
   CGroup: /system.slice/qns-1.service
          └─3639 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
               -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
   ● qns-1.service - CPS Application Start Script
   Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
   Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 6463 ExecStop=/var/qps/bin/support/startqpsstop 1 (code=exited, status=0/SUCCESS)
Process: 9160 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 9176 (java)
   CGroup: /system.slice/qns-1.service
          └─9176 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
               -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
   ● qns-1.service - CPS Application Start Script
   Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
   Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 4861 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 4877 (java)
   CGroup: /system.slice/qns-1.service
          └─4877 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
               -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
   ● qns-1.service - CPS Application Start Script
   Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
   Active: active (running) since Wed 2018-04-18 18:18:47 IST; 4 days ago
Process: 3601 ExecStop=/var/qps/bin/support/startqpsstop 1 (code=exited, status=0/SUCCESS)
Process: 6350 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 6372 (java)
   CGroup: /system.slice/qns-1.service
          └─6372 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
               -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
   ● qns-1.service - CPS Application Start Script
   Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
   Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 32517 ExecStop=/var/qps/bin/support/startqpsstop 1 (code=exited, status=0/SUCCESS)
Process: 3098 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 3114 (java)
   CGroup: /system.slice/qns-1.service
          └─3114 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
               -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
   ● qns-1.service - CPS Application Start Script
   Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
   Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 6986 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
Main PID: 9808 (java)
  CGroup: /system.slice/qns-1.service
        └─9808 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 9788 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 9808 (java)
  CGroup: /system.slice/qns-1.service
        └─9808 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:49 IST; 4 days ago
Process: 2570 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
Main PID: 5609 (java)
  CGroup: /system.slice/qns-1.service
        └─5609 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 5592 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 5609 (java)
  CGroup: /system.slice/qns-1.service
        └─5609 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:47 IST; 4 days ago
Process: 6041 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
Main PID: 5609 (java)
  CGroup: /system.slice/qns-1.service
        └─5609 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 5592 ExecStart=/var/qps/bin/support/startqps start 1 (code=exited, status=0/SUCCESS)
Main PID: 5609 (java)
  CGroup: /system.slice/qns-1.service
        └─5609 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:47 IST; 4 days ago
Process: 32142 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
Main PID: 2458 (java)
  CGroup: /system.slice/qns-1.service
        └─2458 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 2369 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
Main PID: 5129 (java)
  CGroup: /system.slice/qns-1.service
        └─5129 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 2369 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
Main PID: 5129 (java)
  CGroup: /system.slice/qns-1.service
        └─5129 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass
            -XX:+TieredCompilation -XX:+DisableExplicitGC -server -X...
● qns-1.service - CPS Application Start Script
Loaded: loaded (/etc/systemd/system/qns-1.service; static; vendor preset: disabled)
Active: active (running) since Wed 2018-04-18 18:18:46 IST; 4 days ago
Process: 2900 ExecStop=/var/qps/bin/support/startqps stop 1 (code=exited, status=0/SUCCESS)
Main PID: 5905 (java)
  CGroup: /system.slice/qns-1.service
        └─5905 /usr/bin/java -XX:+UnlockDiagnosticVMOptions -XX:+UnsyncloadClass

CPS Operations Guide, Release 18.3.0 (Restricted Release)
sync_times.sh

This command synchronizes the time between all CPS VMs.

Syntax

For High Availability deployments:
/var/qps/bin/support/sync_times.sh ha

For Geographic Redundancy deployments:
/var/qps/bin/support/sync_times.sh gr

Executable on VMs

Cluster Manager

To check the current clock skew of the system, execute the following command:

diagnostics.sh --clock_skew -v

The output numbers are in seconds. Refer to the following sample output:

CPS Diagnostics Multi-Node Environment
----------------------------------------
Checking for clock skew...
Clock skew not detected between qns01 and lb01. Skew: 1...[PASS]
Clock skew not detected between qns02 and lb01. Skew: 0...[PASS]
Clock skew not detected between lb01 and lb01. Skew: 0...[PASS]
Clock skew not detected between sessionmgr01 and lb01. Skew: 0...[PASS]
Clock skew not detected between sessionmgr02 and lb01. Skew: 0...[PASS]
Clock skew not detected between pcrfclient01 and lb01. Skew: 0...[PASS]
Clock skew not detected between pcrfclient02 and lb01. Skew: 0...[PASS]

syncconfig.sh

This command is executed to synchronize the changes to the VM nodes. The files in the /var/qps/current_config/etc/broadhop are zipped to a file and stored in /var/www/html. The Puppet scripts in VM downloads the file to the VM and applies the changes to the VM.
Syntax
/var/qps/bin/update/syncconfig.sh
/var/qps/install/currentfolder/scripts/bin/update/syncconfig.sh

where, currentfolder is version of the current installation.

For example, for CPS 7.0.5, it is 7.0.5.
/var/qps/install/7.0.5/scripts/bin/update/syncconfig.sh

Executable on VMs
All

Example
[root@host /]# /var/qps/bin/update/syncconfig.sh
Building /etc/broadhop...
Copying to /var/qps/images/etc.tar.gz...
Creating MD5 Checksum...

terminatesessions

This utility submits bulk session terminate requests.

Note
For fresh installations of CPS 10.1.0, this feature is enabled by default. However, for upgrades from systems prior to CPS 10.1.0, this feature needs to be enabled as follows:

In the /etc/broadhop/pcrf/features file, add com.broadhop.policy.command.feature. For more information, refer to "Customize Features" in the "Deployment" section in CPS Installation Guide for VMware.

Important
To eliminate the impact of TPS and session count in the system, add the following entry in the /etc/broadhop/qns.conf file on the Cluster Manager VM:

-Ddistribution.blocked.duration=1800000

The entry value is in milliseconds, which converts to 30 minutes. The recommended value is multiples of 30 minutes.

After configuring the above values, run the following commands:

copytoall.sh /etc/broadhop/qns.conf
stopall.sh
startall.sh

Syntax
/var/qps/bin/support/command --username <USERNAME> --password <PASSWORD> terminatesessions
--criteria <criteria> [--disable_signaling <y/n - default n>] [--rate <throttling rate - default 100>]
Where,

- --username and --password are the user's Control Center credentials.
- --criteria: Identifies the session. Following are some examples:
  - ALL
  - APN eq SOS
  - APN except SOS
  - IMSIRANGE A-B

Remember
For the termination of sessions without any criteria (ALL) and termination of sessions with IMSI range as criteria (IMSIRANGE A-B), CPS must be configured to create sessions with tags field having **ImsiKey:imsi:<imsivalue>** as element. If this element is not configured, the command does not terminate sessions for ALL and IMSI range as criteria.

- --disable_signaling: Disables signaling on external interface.
- --rate: Defines the throttling rate.

/var/qps/bin/support/command terminatesessions -h shows help related to the command option.

**Executable on VMs**

perfcient01/02

**Example**

/var/qps/bin/support/command -u testuser -p cisco123 terminatesessions -c "ALL" -d y
Do you want to proceed with delete command? [y]|n: y
deleteBulkSession testuser "ALL" false 100
User is : testuser
Criterion is : ALL
Command Criteria type : ALL
Command Criteria value : null
Signalling is set to : false
Rate-Limiter value is set to : 100
CommandId submitted successfully : 1471941788159

**show**

This utility shows the status of the submitted command(s).

**Syntax**

/var/qps/bin/support/command --username <USERNAME> --password <PASSWORD> show [--all <All>]
[--id <ID>]

Where,

- --username and --password are the user's Control Center credentials.
• --all: Shows the status of all the command requests submitted.
• --id: Shows the status of the submitted command.

Executable on VMs
pcrfclient01/02

Example
/var/qps/bin/support/command -u testuser -p cisco123 show getCommands
BulkTerminateCommand(1471492548449)- state: COMPLETED submitted: Thu Aug 18 09:25:48 IST 2016 status:
[Eligible for Deletion = 1, Submitted For Deletion = 1, Not Submitted Due To Later Creation = 0]
BulkTerminateCommand(1471492739896)- state: COMPLETED submitted: Thu Aug 18 09:28:59 IST 2016 status:
[Eligible for Deletion = 1, Submitted For Deletion = 1, Not Submitted Due To Later Creation = 0]
BulkTerminateCommand(1471493146320)- state: COMPLETED submitted: Thu Aug 18 09:35:46 IST 2016 status:
[Eligible for Deletion = 1, Submitted For Deletion = 1, Not Submitted Due To Later Creation = 0]
BulkTerminateCommand(1471494348267)- state: COMPLETED submitted: Thu Aug 18 09:55:48 IST 2016 status:
[Eligible for Deletion = 1, Submitted For Deletion = 1, Not Submitted Due To Later Creation = 0]

/var/qps/bin/support/command -u testuser -p cisco123 show --id 1471494588431 getCommand 1471494588431
BulkTerminateCommand(1471494588431)- state: COMPLETED submitted: Thu Aug 18 09:59:48 IST 2016 status:
[Eligible for Deletion = 1, Submitted For Deletion = 1, Not Submitted Due To Later Creation = 0]

cancel

This utility cancels the further execution of the submitted command.

Syntax
/var/qps/bin/support/command --username <USERNAME --password <PASSWORD> cancel --id <ID>

Where,
• --username and --password are the user's Control Center credentials.
• --id: ID of the submitted command.

Executable on VMs
pcrfclient01/02
Example
/var/qps/bin/support/command -u testuser -p cisco123 cancel --id 1471941788159
Do you want to proceed with cancel command? [y]|n: y
  cancelCommand 1471941788159
  Command Already completed: 1471941788159

**top_qps.sh**

This command displays performance statistics of CPS VMs.

**Syntax**
/var/qps/bin/control/top_qps.sh <time>

where <time> is the number of seconds for which the statistics are to be captured.

---

**Note**
When executing top_qps.sh command from qns-admin, prefix sudo before the command.

**Executable on VMs**
perfcient01/02

**Output**
- Average time in ms.
- Number of message transactions processed during n seconds, where n is an integer value in seconds.
- Transactions per second (TPS) is messages/n.
- Error shows any error occurred during execution on the Policy Server (QNS) VM. It could be database error, authentication failure and so on. Details of the error can be seen in the consolidated engine or in the consolidated Policy Server (QNS) log.
- Times used is how much total time it took to process the message.
Diameter Synchronization Message Behavior

Some Diameter messages (like UDR) are synchronous Diameter calls, which means that the Policy Server (QNS) will be waiting for a response after sending the Diameter request.

Response of these Diameter message is not captured in top_qps as those message are not processed in policy engine separately.

Average time 3.3676 shown below is round trip time (from UDR sent to UDA received)

Sample Top_Qns

<table>
<thead>
<tr>
<th>Average Success</th>
<th>TPS</th>
<th>Error</th>
<th>Time Used</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.7211</td>
<td>2910</td>
<td>727.5000</td>
<td>0</td>
<td>diameter_Gx_CCR-I</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Success</th>
<th>TPS</th>
<th>Error</th>
<th>Time Used</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6854</td>
<td>2924</td>
<td>731.0000</td>
<td>0</td>
<td>com.broadhop.cache.impl.actions.GetSessionAction 3.676 2922 730.5000 0 9.8400 send.sync.diameter_Sh_UDR 0.7908 2919 729.7500 0 2.3083 com.broadhop.session.CreateEntry 0.1981 2924 731.0000 0 0.5793 com.broadhop.locking.impl.LockSessionAction 0.0480 2919 729.7500 0 0.0370 send.diameter_Gx_CCA-I 0.0126 2924 731.0000 0 0.0370 diameter.create.remote.session.Sh</td>
</tr>
</tbody>
</table>

Average time is not applicable for these response messages. However, number of response messages (UDA) received can be seen from Grafana.
vm-init.sh

This command is executed from the VM nodes from /etc/init.d, (starts up automatically if VM reboots too). It downloads all the Puppet script, CPS software, /etc/hosts files and updates the VM with the new software.

This command only updates the software and does not restart the CPS software. The new software will be run only after process restart (for example, by executing /var/qps/bin/control/restartall.sh script from Cluster Manager).

Syntax

/etc/init.d/vm-init.sh

Executable on VMs

Any CPS VM

Example

/etc/init.d/vm-init.sh