Cisco Expressway
Basic Configuration

Deployment Guide

Cisco Expressway X8.1

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Introduction

Cisco Expressway is designed specifically for comprehensive collaboration services provided through Cisco Unified Communications Manager. It features established firewall-traversal technology and helps redefine traditional enterprise collaboration boundaries, supporting our vision of any-to-any collaboration.

This document describes how to configure an Expressway-E and an Expressway-C as the cornerstones of a basic video infrastructure deployment.

- It takes the video network administrator through the series of tasks required to set up the Expressways and then describes how to check that the system is working as expected.
- It provides the required DNS, NAT and firewall configuration information but assumes that the network administrator has a working knowledge of configuring these systems.

Detailed reference information is contained in this document’s appendices:

- Appendix 1: Configuration details [p.36] lists the Expressway configuration details used in this document.
- Appendix 2: DNS records [p.40] describes the DNS records required for this example deployment.
- Appendix 3: Firewall and NAT settings [p.42] includes details of required NAT and firewall configurations. This document describes a small subset of the numerous NAT and firewall deployment options that are made possible by using the Expressway-E dual network interface and NAT features.
- Appendix 4: Advanced network deployments [p.45] explains how to deploy your system with a static NAT and Dual Network Interface architecture.

Descriptions of system configuration parameters can be found in Expressway Administrator Guide and the Expressway web application’s online field help and page help.

This document does not describe details of how to deploy a cluster of Expressways. For more details on clustering, see Expressway Cluster Creation and Maintenance Deployment Guide.

To configure your Expressway system for Unified Communications services, see Unified Communications Mobile and Remote Access via Expressway Deployment Guide.

Note that endpoints or other devices cannot register to the Expressway.
Example network deployment

The example network shown below is used as the basis for the deployment described in this document.

This example network includes internal and DMZ segments – in which Expressway-C and Expressway-E platforms are respectively deployed.
Network elements

Internal network elements

The internal network elements are devices which are hosted on the organization’s local area network. Elements on the internal network have an internal network domain name. This internal network domain name is not resolvable by a public DNS. For example, the Expressway-C is configured with an internally resolvable name of expc.internal-domain.net (which resolves to an IP address of 10.0.0.2 by the internal DNS servers).

Expressway-C

The Expressway-C is a SIP Proxy and communications gateway for Unified CM.

The Expressway-C is configured with a traversal client zone to communicate with the Expressway-E to allow inbound and outbound calls to traverse the NAT device.

EX90 and EX60

These are example endpoints hosted on the internal network which register to Unified CM.

Note that endpoints or other devices cannot register to the Expressway. Registration requests will be rejected and will be logged with 'License limit exceeded' messages.

DNS (local 1 & local 2)

DNS servers used by the Expressway-C, to perform DNS lookups (resolve network names on the internal network).

DHCP server

The DHCP server provides host, IP gateway, DNS server, and NTP server addresses to endpoints located on the internal network.

Router

The router device acts as the gateway for all internal network devices to route towards the DMZ (to the NAT device internal address).

Unified CM

Endpoint devices register to Unified CM and the Expressway acts as a Unified Communications gateway for third-party devices and to provide mobile and remote access.

To configure your Expressway system for Unified Communications services, see Unified Communications Mobile and Remote Access via Expressway Deployment Guide.

Syslog server

A logging server for Syslog messages (see Task 13: Configuring logging (optional) [p.30]).

DMZ network element

Expressway-E

The Expressway-E is a SIP Proxy for devices which are located outside the internal network (for example, home users and mobile worker registering to Unified CM across the internet and 3rd party businesses making calls to, or receiving calls from this network).
The Expressway-E is configured with a traversal server zone to receive communications from the Expressway-C in order to allow inbound and outbound calls to traverse the NAT device.

The Expressway-E has a public network domain name. For example, the Expressway-E is configured with an externally resolvable name of expe.example.com (which resolves to an IP address of 192.0.2.2 by the external / public DNS servers).

External network elements

Jabber
An example remote endpoint, which is registering over the internet to Unified CM via the Expressway-E and Expressway-C.

DNS (Host)
The DNS owned by service provider which hosts the external domain example.com.

DNS (external 1 & external 2)
The DNS used by the Expressway-E to perform DNS lookups.

NTP server pool
An NTP server pool which provides the clock source used to synchronize both internal and external devices.

NAT devices and firewalls
The example deployment includes:

- NAT (PAT) device performing port address translation functions for network traffic routed from the internal network to addresses in the DMZ (and beyond — towards remote destinations on the internet).
- Firewall device on the public-facing side of the DMZ. This device allows all outbound connections and inbound connections on specific ports. See Appendix 3: Firewall and NAT settings [p.42].
- Home firewall NAT (PAT) device which performs port address and firewall functions for network traffic originating from the EX60 device.
- See Appendix 4: Advanced network deployments [p.45] for information about how to deploy your system with a static NAT and Dual Network Interface architecture.

SIP and H.323 domain
The example deployment is configured to route SIP (and H.323) signaling messages for calls made to URIs which use the domain example.com.

- DNS SRV records are configured in the public (external) and local (internal) network DNS server to enable routing of signaling request messages to the relevant infrastructure elements.
- The internal SIP domain (example.com) is the same as the public DNS name. This enables both registered and non-registered devices in the public internet to call endpoints registered to the internal infrastructure.

The DNS SRV configurations are described in Appendix 2: DNS records [p.40].
Prerequisites and process summary

Prerequisites

Before starting the system configuration, make sure you have access to:

- the Expressway Administrator Guide and Expressway Getting Started Guide (for reference purposes)
- your Expressway system
- a PC connected via Ethernet to a LAN which can route HTTP(S) traffic to the Expressway
- a web browser running on the PC
- a serial interface on the PC and cable (if the initial configuration is to be performed over the serial interface)

The following non-Expressway system configuration should also be completed:

- internal and external DNS records (see Appendix 2: DNS records [p.40])
- NAT & firewall configuration (see Appendix 3: Firewall and NAT settings [p.42])
- DHCP server configuration (not described in this document)

Summary of process

The configuration process consists of the following tasks.

Expressway system configuration:

- Task 1: Performing initial configuration [p.9]
- Task 2: Setting the system name [p.9]
- Task 3: Configuring DNS [p.10]
- Task 4: Replacing the default server certificate [p.12]
- Task 5: Configuring NTP servers [p.13]

Routing configuration:

- Task 6: Configuring transforms [p.14]
- Task 7: Configuring the traversal zone [p.15]
- Task 8: Configuring traversal zone search rules [p.19]
- Task 9: Configuring the DNS zone [p.22]
- Task 10: Configuring DNS zone search rules [p.23]
- Task 11: Configuring external (unknown) IP address routing [p.24]

Optional configuration tasks:

- Task 12: Configuring routes to a neighbor zone (optional) [p.29]
- Task 13: Configuring logging (optional) [p.30]
- Task 14: Restricting access to ISDN gateways (optional) [p.31]
Expressway system configuration

Task 1: Performing initial configuration

Assuming the Expressway is in the factory delivered state, follow the Initial configuration steps described in the Expressway Getting Started Guide to configure the basic network parameters:

- LAN1 IP (IPv4 or IPv6) address
- Subnet mask (if using IPv4)
- Default Gateway IP address (IPv4 or IPv6)

Note that Expressway requires a static IP address (it will not pick up an IP address from a DHCP server).

The initial configuration can be performed in one of three ways:

- using a serial cable
- via the front panel of the Expressway appliance
- via the default IP address of 192.168.0.100

See the "Initial configuration" section in Expressway Getting Started Guide for details.

This deployment guide is based on configuration using the web interface. If you cannot access the Expressway using the web interface after completing the initial configuration (assigning the IP address), speak to your network administrator.

The follow configuration values are used in the example deployment:

<table>
<thead>
<tr>
<th></th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAN1 IPv4 address</td>
<td>10.0.0.2</td>
<td>192.0.2.2</td>
</tr>
<tr>
<td>IPv4 gateway</td>
<td>10.0.0.1</td>
<td>192.0.2.1</td>
</tr>
<tr>
<td>LAN1 subnet mask</td>
<td>255.255.255.0</td>
<td>255.255.255.0</td>
</tr>
</tbody>
</table>

Task 2: Setting the system name

The System name defines the name of the Expressway.

The System name appears in various places in the web interface, and in the display on the front panel of the appliance (so that you can identify it when it is in a rack with other systems).

You are recommended to give the Expressway a name that allows you to easily and uniquely identify it. If the system name is longer than 16 characters, only the last 16 characters will be shown in the display on the front panel.

To configure the System name:

1. Go to System > Administration.
2. Configure the System name as follows:

<table>
<thead>
<tr>
<th>System name</th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enter EXPc</td>
<td>Enter EXPe</td>
</tr>
</tbody>
</table>
3. Click **Save**.

### Task 3: Configuring DNS

#### System host name

The **System host name** defines the DNS hostname that this system is known by. Note that this is not the fully-qualified domain name, just the host label portion.

Note that `<System host name>.<Domain name>` = FQDN of this Expressway.

To configure the **System host name**:

1. Go to **System > DNS**.
2. Configure the **System host name** as follows:

<table>
<thead>
<tr>
<th>System host name</th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter expc</td>
<td>Enter expe</td>
<td></td>
</tr>
</tbody>
</table>

3. Click **Save**.

#### Domain name

The **Domain name** is the name to append to an unqualified host name before querying the DNS server.

To configure the **Domain name**:

1. Go to **System > DNS**.
2. Configure the **Domain name** as follows:

<table>
<thead>
<tr>
<th>Domain name</th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter internal-domain.net</td>
<td></td>
<td>Enter example.com</td>
</tr>
</tbody>
</table>

3. Click **Save**.
DNS servers

The DNS server addresses are the IP addresses of up to 5 domain name servers to use when resolving domain names. You must specify at least one default DNS server to be queried for address resolution if you want to either:

- use FQDNs (Fully Qualified Domain Names) instead of IP addresses when specifying external addresses (for example for LDAP and NTP servers, neighbor zones and peers)
- use features such as URI dialing or ENUM dialing

The Expressway only queries one server at a time; if that server is not available the Expressway will try another server from the list.

In the example deployment 2 DNS servers are configured for each Expressway, which provides a level of DNS server redundancy. The Expressway-C is configured with DNS servers which are located on the internal network. The Expressway-E is configured with DNS servers which are publicly routable.

To configure the Default DNS server addresses:

1. Go to System > DNS.
2. Configure the DNS server Address fields as follows:

<table>
<thead>
<tr>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Address 1</strong></td>
<td>Enter 10.0.0.11</td>
</tr>
<tr>
<td><strong>Address 2</strong></td>
<td>Enter 10.0.0.12</td>
</tr>
</tbody>
</table>

3. Click Save.

Expressway-C has a Fully Qualified Domain Name of expc.internal-domain.net
Expressway-E has a Fully Qualified Domain Name of expe.example.com

**DNS**

- **Local host name**: expe
- **Domain name**: example.com
- **DNS requests port range**: Use the ephemeral port range

**Default DNS servers**

- **Address 1**: 194.72.6.57
- **Address 2**: 194.73.62.242
- **Address 3**: 194.73.62.242
- **Address 4**: 194.73.62.242
- **Address 5**: 194.73.62.242

---

**Task 4: Replacing the default server certificate**

For extra security, you may want to have the Expressway communicate with other systems (such as LDAP servers, neighbor Expressways, or clients such as SIP endpoints and web browsers) using TLS encryption.

For this to work successfully in a connection between a client and server:

- The server must have a certificate installed that verifies its identity. This certificate must be signed by a Certificate Authority (CA).
- The client must trust the CA that signed the certificate used by the server.

The Expressway allows you to install appropriate files so that it can act as either a client or a server in connections using TLS. The Expressway can also authenticate client connections (typically from a web browser) over HTTPS. You can also upload certificate revocation lists (CRLs) for the CAs used to verify LDAP server and HTTPS client certificates.

The Expressway can generate server certificate signing requests (CSRs). This removes the need to use an external mechanism to generate and obtain certificate requests.

For secure communications (HTTPS and SIP/TLS) we recommend that you replace the Expressway default certificate with a certificate generated by a trusted certificate authority.

Note that in connections:

- to an endpoint, the Expressway acts as the TLS server
- to an LDAP server, the Expressway is a client
- between two Expressway systems, either Expressway may be the client with the other Expressway being the TLS server
- via HTTPS, the web browser is the client and the Expressway is the server
TLS can be difficult to configure. For example, when using it with an LDAP server we recommend that you confirm that your system is working correctly before you attempt to secure the connection with TLS. You are also recommended to use a third party LDAP browser to verify that your LDAP server is correctly configured to use TLS.

**Note:** be careful not to allow your CA certificates or CRLs to expire as this may cause certificates signed by those CAs to be rejected.

To load the trusted CA list, go to Maintenance > Security certificates > Trusted CA certificate.

To generate a CSR and/or upload the Expressway’s server certificate, go to Maintenance > Security certificates > Server certificate.

Additional server certificate requirements apply when configuring your Expressway system for Unified Communications. For full information, see *Expressway Certificate Creation and Use Deployment Guide*.

**Task 5: Configuring NTP servers**

The NTP server address fields set the IP addresses or Fully Qualified Domain Names (FQDNs) of the NTP servers to be used to synchronize system time.

The Time zone sets the local time zone of the Expressway.

To configure the NTP server address and Time zone:

1. Go to System > Time.
2. Configure the fields as follows (on both Expressway-C and Expressway-E):

<table>
<thead>
<tr>
<th>NTP server 1</th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTP server 1</td>
<td>Enter pool.ntp.org</td>
<td>Enter pool.ntp.org</td>
</tr>
<tr>
<td>Time zone</td>
<td>GMT in this example</td>
<td>GMT in this example</td>
</tr>
</tbody>
</table>

3. Click Save.
Routing configuration

Pre-search transforms

Pre-search transform configuration allows the destination alias (called address) in an incoming search request to be modified. The transformation is applied by the Expressway before any searches are sent to external zones.

The pre-search transform configuration described in this document is used to standardize destination aliases originating from both H.323 and SIP devices. This means that the same call searches will work for calls from both H.323 and SIP endpoints.

For example, if the called address is an H.323 E.164 alias “01234”, the Expressway will automatically append the configured domain name (in this case example.com) to the called address (that is, 01234@example.com making it into a URI), before attempting to set up the call.

- Pre-search transforms should be used with care because they apply to all signaling messages – if they match, they will affect the routing of Unified Communications messages, provisioning and presence requests as well as call requests.
- Transformations can also be carried out in search rules – consider whether it is best to use a pre-search transform or a search rule to modify the called address to be looked up.

Search rules

Search rules define how the Expressway routes calls (to destination zones, such as to Unified CM or to a Cisco VCS) in specific call scenarios. When a search rule is matched, the destination alias can be modified according to the conditions defined in the search rule.

The search rules described in this document are used to ensure that SIP (and H.323, if registered to a Cisco VCS for example) endpoints can dial H.323 devices that have registered E.164 numbers or H.323 IDs without a domain portion. The search rules first search for received destination aliases without the domain portion of the URI, and then search with the full URI.

The routing configuration in this document searches for destination aliases that have valid SIP URIs (that is, using a valid SIP domain, such as id@domain).

You can configure routing which enables calls to unregistered devices on an internal network (routing to the addresses of IP of the devices) by configuring a search rule with a mode of Any IP address. However this is not recommended (and not described in this document). The best practice is to register all devices and route using destination aliases.

Task 6: Configuring transforms

The pre-search transform configuration described in this document is used to standardize destination aliases originating from both H.323 and SIP devices.

The following transform modifies the destination alias of all call attempts made to destination aliases which do not contain an '@'. The old destination alias has @example.com appended to it. This has the effect of standardizing all called destination aliases into a SIP URI format.

To configure the transform:
1. Go to **Configuration > Dial plan > Transforms**.
2. Click **New**.
3. Configure the transform fields as follows:

<table>
<thead>
<tr>
<th>Field</th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
<td>Enter 1</td>
<td>Same as Expressway-C</td>
</tr>
<tr>
<td>Description</td>
<td>Transform destination aliases to URI format</td>
<td></td>
</tr>
<tr>
<td>Pattern type</td>
<td>Regex</td>
<td></td>
</tr>
<tr>
<td>Pattern string</td>
<td>Enter ([^@]*)</td>
<td></td>
</tr>
<tr>
<td>Pattern behavior</td>
<td>Replace</td>
<td></td>
</tr>
<tr>
<td>Replace string</td>
<td>Enter \<a href="mailto:1@example.com">1@example.com</a></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>

4. Click **Create transform**.

---

**Task 7: Configuring the traversal zone**

The traversal zone configuration defines a connection between the Expressway-C and Expressway-E platforms.

- A traversal zone connection allows firewall traversal for signaling and media between the two platforms.
- The Expressway-C is configured with a traversal client zone, and the Expressway-E with a traversal server zone.

To configure the traversal zone:

1. Go to **Configuration > Zones > Zones**.
2. Click **New**.
3. Configure the fields as follows (leave all other fields with default values):
<table>
<thead>
<tr>
<th>Name</th>
<th>Expressway-C: Enter Traversal zone</th>
<th>Expressway-E: Enter Traversal zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Traversal client</td>
<td>Traversal server</td>
</tr>
<tr>
<td>Username</td>
<td>exampleauth</td>
<td>exampleauth</td>
</tr>
<tr>
<td>Password</td>
<td>ex4mpl3.c0m</td>
<td>Not applicable</td>
</tr>
<tr>
<td>H.323 Mode</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>H.323 Protocol</td>
<td>Assent</td>
<td>Assent</td>
</tr>
<tr>
<td>H.323 Port</td>
<td>Enter 6001</td>
<td>Enter 6001</td>
</tr>
<tr>
<td>H.323 H.460.19 demultiplexing mode</td>
<td>Not applicable</td>
<td>Off</td>
</tr>
<tr>
<td>SIP Mode</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>SIP Port</td>
<td>Enter 7001</td>
<td>Enter 7001</td>
</tr>
<tr>
<td>SIP Transport</td>
<td>TLS</td>
<td>TLS</td>
</tr>
<tr>
<td>SIP TLS verify mode</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Location Peer 1 address</td>
<td>Enter 192.0.2.2</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

4. Click **Create zone**.
Create zone

**Configuration**
- Name: TraversalZone
- Type: Traversal client
- Hop count: 15

**Connection credentials**
- Username: exampleauth
- Password: ********

**H.323**
- Mode: On
- Protocol: Assert
- Port: 5060

**SIP**
- Mode: On
- Port: 7001
- Transport: TLS
- TLS verify mode: Off
- Media encryption mode: Auto
- ICE support: Off
- Poison mode: Off

**Authentication**
- Authentication policy: Do not check credentials

**Client settings**
- Retry interval: 120

**Location**
- Peer 1 address: 192.0.2.2

Expressway-C
To configure the authentication credentials in the **Local authentication database** (which are configured in the Expressway-E only):

1. Go to **Configuration > Authentication > Devices > Local database**.
2. Click **New**.
3. Configure the fields as follows:

<table>
<thead>
<tr>
<th></th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Not applicable</td>
<td>Enter exampleauth</td>
</tr>
<tr>
<td>Password</td>
<td>Not applicable</td>
<td>Enter ex4mpl13.c0m</td>
</tr>
</tbody>
</table>

4. Click Create credential.

Configuring traversal zones for Unified Communications

To support Unified Communications features such as mobile and remote access or Jabber Guest, there must be a secure traversal zone connection between the Expressway-C and the Expressway-E:

- The traversal client zone and the traversal server zone must be configured to use SIP TLS with **TLS verify mode** set to On, and **Media encryption mode** must be **Force encrypted**.
- Both Expressways must trust each other's server certificate. As each Expressway acts both as a client and as a server you must ensure that each Expressway’s certificate is valid both as a client and as a server.
- If a H.323 or a non-encrypted connection is required, a separate pair of traversal zones must be configured.

Task 8: Configuring traversal zone search rules

To create the search rules to route calls via the traversal zone.

1. Go to Configuration > Dial plan > Search rules.
2. Click New.
3. Configure the fields as follows:

<table>
<thead>
<tr>
<th></th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rule name</strong></td>
<td>&quot;Traversal zone search rule&quot; for example</td>
<td>&quot;Traversal zone search rule&quot; for example</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>&quot;Search traversal zone - EXPe&quot; for example</td>
<td>&quot;Search traversal zone - EXPc&quot; for example</td>
</tr>
<tr>
<td><strong>Priority</strong></td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td><strong>Protocol</strong></td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td><strong>Request must be authenticated</strong></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Mode</strong></td>
<td>Any alias</td>
<td>Any alias</td>
</tr>
<tr>
<td><strong>On successful match</strong></td>
<td>Continue</td>
<td>Continue</td>
</tr>
<tr>
<td><strong>Target</strong></td>
<td>Traversal zone</td>
<td>Traversal zone</td>
</tr>
<tr>
<td><strong>State</strong></td>
<td>Enabled</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

4. Click Create search rule.

![Create search rule](image-url)
## Create search rule

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule name</td>
<td>Traversal zone search rule</td>
</tr>
<tr>
<td>Description</td>
<td>Search traversal zone - EXPc</td>
</tr>
<tr>
<td>Priority</td>
<td>100</td>
</tr>
<tr>
<td>Protocol</td>
<td>Any</td>
</tr>
<tr>
<td>Source</td>
<td>Any</td>
</tr>
<tr>
<td>Request must be authenticated</td>
<td>No</td>
</tr>
<tr>
<td>Mode</td>
<td>Any alias</td>
</tr>
<tr>
<td>On successful match</td>
<td>Continue</td>
</tr>
<tr>
<td>Target</td>
<td>TraversalZone</td>
</tr>
<tr>
<td>State</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

**Create search rule**  
**Cancel**
Task 9: Configuring the DNS zone

The DNS zone is used to search for externally hosted systems (such as for business to business calling). Destination aliases are searched for by a name using a DNS lookup.

To configure the DNS zone:

1. Go to Configuration > Zones > Zones.
2. Click New.
3. Configure the fields as follows (leave all other fields with default values):

<table>
<thead>
<tr>
<th>Field</th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Not applicable</td>
<td>Enter DNSZone for example</td>
</tr>
<tr>
<td>Type</td>
<td>Not applicable</td>
<td>DNS</td>
</tr>
<tr>
<td>H.323 Mode</td>
<td>Not applicable</td>
<td>On</td>
</tr>
<tr>
<td>SIP Mode</td>
<td>Not applicable</td>
<td>On</td>
</tr>
<tr>
<td>Fallback transport protocol</td>
<td>Not applicable</td>
<td>TCP</td>
</tr>
<tr>
<td>Include address record</td>
<td>Not applicable</td>
<td>Off</td>
</tr>
</tbody>
</table>

4. Click Create zone.
Task 10: Configuring DNS zone search rules

The DNS search rule defines when the DNS zone should be searched.

A specific regular expression is configured which will prevent searches being made using the DNS zone (i.e. on the public internet) for destination addresses (URIs) using any SIP domains which are configured on the local network (local domains).

To create the search rules to route via DNS:

1. Go to Configuration > Dial plan > Search rules.
2. Click New.
3. Configure the fields as follows:

<table>
<thead>
<tr>
<th>Field</th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule name</td>
<td>Not applicable</td>
<td>Enter DNS zone search rule for example</td>
</tr>
<tr>
<td>Description</td>
<td>Not applicable</td>
<td>Enter Search DNS zone (external calling) for example</td>
</tr>
<tr>
<td>Priority</td>
<td>Not applicable</td>
<td>150</td>
</tr>
<tr>
<td>Protocol</td>
<td>Not applicable</td>
<td>Any</td>
</tr>
<tr>
<td>Source</td>
<td>Not applicable</td>
<td>All zones</td>
</tr>
<tr>
<td>Request must be</td>
<td>Not applicable</td>
<td>No</td>
</tr>
<tr>
<td>authenticated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode</td>
<td>Not applicable</td>
<td>Alias pattern match</td>
</tr>
<tr>
<td>Pattern type</td>
<td>Not applicable</td>
<td>Regex</td>
</tr>
<tr>
<td>Pattern string</td>
<td>Not applicable</td>
<td>Enter (?!.<em>@%localdomains%.</em>$).*</td>
</tr>
<tr>
<td>Pattern behavior</td>
<td>Not applicable</td>
<td>Leave</td>
</tr>
<tr>
<td>On successful match</td>
<td>Not applicable</td>
<td>Continue</td>
</tr>
<tr>
<td>Target</td>
<td>Not applicable</td>
<td>DNSZone</td>
</tr>
<tr>
<td>State</td>
<td>Not applicable</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

4. Click Create search rule.
Note that the regular expression used to prevent local domains being searched via the DNS zone can be broken down into the following components:

\(.(.*)\) = match all pattern strings

\(!@\%localdomains\.*\)\* = do not match any pattern strings ending in @localdomains

In the deployment example, calls destined for @cisco.com would be searched via the DNS zone, whereas calls destined for @example.com would not.

**Task 11: Configuring external (unknown) IP address routing**

The following configuration defines how an Expressway routes calls (and other requests) to external IP addresses. An external IP address is an IP address which is not ‘known’ to the Expressway and therefore assumed to be a publicly routable address.

- All requests destined for external IP addresses, originating at the Expressway-C are routed to the Expressway-E using a search rule.
- The Expressway-E then attempts to open a connection directly to the IP address.

To configure how the Expressway will handle calls to unknown IP addresses:

1. Go to **Configuration > Dial plan > Configuration**.
2. Configure the fields as follows:

<table>
<thead>
<tr>
<th>Calls to unknown IP addresses</th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indirect</td>
<td>Direct</td>
</tr>
</tbody>
</table>
3. Click **Save**.

### Expressway-C

![Expressway-C configuration](image)

### Expressway-E

![Expressway-E configuration](image)

To create the search rules to route calls to IP addresses to the Expressway-E:

1. Go to **Configuration > Dial plan > Search rules**.
2. Click **New**.
3. Configure the fields as follows:

<table>
<thead>
<tr>
<th></th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rule name</strong></td>
<td>Enter External IP address search rule</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Enter Route external IP address</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Priority</strong></td>
<td>Enter 100</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Protocol</strong></td>
<td>Any</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>Any</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Request must be authenticated</strong></td>
<td>No</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Mode</strong></td>
<td>Any IP address</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>On successful match</strong></td>
<td><strong>Continue</strong></td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Target</strong></td>
<td>Traversal Zone</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>State</strong></td>
<td>Enabled</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

4. Click **Create search rule**.
### Create search rule

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule name</td>
<td>External IP address search rule</td>
</tr>
<tr>
<td>Description</td>
<td>Route external IP address</td>
</tr>
<tr>
<td>Priority</td>
<td>100</td>
</tr>
<tr>
<td>Protocol</td>
<td>Any</td>
</tr>
<tr>
<td>Source</td>
<td>Any</td>
</tr>
<tr>
<td>Request must be authenticated</td>
<td>No</td>
</tr>
<tr>
<td>Mode</td>
<td>Any IP address</td>
</tr>
<tr>
<td>On successful match</td>
<td>Continue</td>
</tr>
<tr>
<td>Target</td>
<td>TraversalZone</td>
</tr>
<tr>
<td>Status</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

**Buttons:**
- Create search rule
- Cancel
System checks

Zone status

Go to Status > Zones on both Expressway-C and Expressway-E to check that the traversal zone is Active. You can also check the zone status via Configuration > Zones > Zones.

If the traversal zone is not active:

- Review the traversal zone configuration.
- Confirm that the relevant ports are enabled for outbound routing on the NAT and firewall devices located between the Expressway-C and Expressway-E (see Appendix 3: Firewall and NAT settings [p.42]).
- Confirm that the username and password credentials are configured correctly (and match) on Expressway-C and Expressway-E traversal zones and in the authentication database on the Expressway-E.

Call signaling

If calls do not complete:

- Review the Expressway-C search rule configuration.
- Review the Expressway-E search rule configuration.
- Check the search history page for search attempts and failures (Status > Search history).
- Check the Event Log for call connection failure reasons (Status > Logs > Event Log).
Maintenance routine

Creating a system backup

To create a backup of Expressway system data:

1. Go to **Maintenance > Backup and restore**.

2. Optionally, enter an **Encryption password** with which to encrypt the backup file. If a password is specified, the same password will be required to restore the file.

3. Click **Create system backup file**.

4. After the backup file has been prepared, a pop-up window appears and prompts you to save the file (the exact wording depends on your browser). The default name is in the format:
   
   `<software version>_<hardware serial number>_<date>_<time>_backup.tar.gz`

   (The file extension is normally `.tar.gz.enc` if an encryption password is specified. However, if you use Internet Explorer to create an encrypted backup file, the filename extension will be `.tar.gz.gz` by default. These different filename extensions have no operational impact; you can create and restore encrypted backup files using any supported browser.)

   The preparation of the system backup file may take several minutes. Do not navigate away from this page while the file is being prepared.

5. Save the file to a designated location.

Log files are not included in the system backup file.
Optional configuration tasks

Task 12: Configuring routes to a neighbor zone (optional)

You can optionally set up neighbor zones and associated search rules on the Expressway-C if you need to route calls to other systems such as a Cisco VCS or Unified CM.

Example: Cisco VCS neighbor zone

For example, you may want to route calls towards devices (typically H.323 devices) that are registered to a Cisco VCS. In this example, the devices that are registered to Cisco VCS have an address (destination alias) in the format <alias>@vcs.domain. (Note that you may need additional rules or transforms if the H.323 devices have registered E.164 numbers or H.323 IDs without a domain portion).

To configure a neighbor zone to the Cisco VCS:

1. Go to Configuration > Zones > Zones.
2. Click New.
3. Configure the fields as follows (leave all other fields with default values):

<table>
<thead>
<tr>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Enter Neighbor zone to VCS</td>
</tr>
<tr>
<td>Type</td>
<td>Neighbor</td>
</tr>
<tr>
<td>H.323 Mode</td>
<td>On</td>
</tr>
<tr>
<td>H.323 Port</td>
<td>Enter 1719</td>
</tr>
<tr>
<td>SIP Mode</td>
<td>On</td>
</tr>
<tr>
<td>SIP Port</td>
<td>Enter 5061</td>
</tr>
<tr>
<td>SIP Transport</td>
<td>TCP</td>
</tr>
<tr>
<td>Location Peer 1 address</td>
<td>Enter the address of the Cisco VCS neighbor system</td>
</tr>
</tbody>
</table>

4. Click Create zone.

To configure the search rule to route calls to the Cisco VCS:

1. Go to Configuration > Dial plan > Search rules.
2. Click New.
3. Configure the search rule fields as follows:
4. Click **Create search rule.**

**SIP trunks to Unified CM**

To configure a SIP trunk to Unified CM, see [Cisco Unified Communications Manager with Expressway Deployment Guide](#).

**Task 13: Configuring logging (optional)**

The following configuration will enable event logs to be sent to an external logging server (using the SYSLOG protocol).

- The **Log level** controls the granularity of event logging. 1 is the least verbose, 4 the most.
- A minimum log level of 2 is recommended, as this level provides both system and basic signaling message logging.

Expressway-E external logging server configuration requires additional firewall / NAT configuration – See [Appendix 3: Firewall and NAT settings](#) [p.42].

To configure a logging server:

1. Go to **Maintenance > Logging.**
2. Configure the fields as follows:

<table>
<thead>
<tr>
<th></th>
<th>Expressway-C</th>
<th>Expressway-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log level</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Remote syslog server 1: Address</td>
<td>Enter 10.0.0.13</td>
<td>Enter 10.0.0.13</td>
</tr>
<tr>
<td>Remote syslog server 1: Mode</td>
<td>IETF syslog format</td>
<td>IETF syslog format</td>
</tr>
</tbody>
</table>
Task 14: Restricting access to ISDN gateways (optional)

Expressway users are recommended to take appropriate action to restrict unauthorized access to any ISDN gateway resources (also known as toll-fraud prevention). This optional step shows some methods in which this can be achieved.

In these examples, an ISDN gateway is a neighbour zone that routes calls starting with a 9.

Expressway-E

Two search rules are created on the Expressway-E:

- both search rules have a pattern string that matches calls directed at the ISDN gateway — in this example, calls that are prefixed by a 9
- the first rule has a Source of All zones; this allows calls from neighbor zones to be passed through to the traversal zone
- the second rule is similar to the first rule but has a Source of All; this means that non-registered endpoints (which are excluded from the previous rule) are included by this rule and can be stopped by defining the Replace string as "do-not-route-this-call"
- both rules stop any further search rules from being looked at (On successful match = Stop).

To create the search rules:

1. Go to Configuration > Dial plan > Search rules.
2. Click New.
3. Configure the fields as follows:

<table>
<thead>
<tr>
<th>Expressway-E</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule name</td>
<td>Enter Allow ISDN call for example</td>
</tr>
<tr>
<td>Description</td>
<td>Enter Allow ISDN calls for neighbors</td>
</tr>
<tr>
<td>Priority</td>
<td>Enter 40</td>
</tr>
</tbody>
</table>

(these rules must be the highest priority in the search rule configuration)
### Expressway-E

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Any</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>All zones</td>
</tr>
<tr>
<td>Request must be authenticated</td>
<td>No</td>
</tr>
<tr>
<td>Mode</td>
<td>Alias pattern match</td>
</tr>
<tr>
<td>Pattern type</td>
<td>Regex</td>
</tr>
<tr>
<td>Pattern string</td>
<td>Enter (9\d+)@example.com</td>
</tr>
<tr>
<td>Pattern behavior</td>
<td>Replace</td>
</tr>
<tr>
<td>Replace string</td>
<td>Enter 1</td>
</tr>
<tr>
<td>On successful match</td>
<td>Stop</td>
</tr>
<tr>
<td>Target</td>
<td>TraversalZone</td>
</tr>
<tr>
<td>State</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

#### Create search rule

- **Rule name**: Enter Block ISDN call for example
- **Description**: Allow ISDN calls for neighbors
- **Priority**: 40
- **Protocol**: Any
- **Source**: All Zones
- **Request must be authenticated**: No
- **Mode**: Alias pattern match
- **Pattern type**: Regex
- **Pattern string**: Enter (9\d+)@example.com
- **Pattern behavior**: Replace
- **Replace string**: Enter 1
- **On successful match**: Stop
- **Target**: TraversalZone
- **State**: Enabled

4. Click **Create search rule**.
5. Click **New**.
6. Configure the fields as follows:
Optional configuration tasks

---

### Expressway-E

<table>
<thead>
<tr>
<th>Description</th>
<th>Enter Blocks everything (including non-registered endpoints)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
<td>Enter 41</td>
</tr>
<tr>
<td>Protocol</td>
<td>Any</td>
</tr>
<tr>
<td>Source</td>
<td>Any</td>
</tr>
<tr>
<td>Request must be authenticated</td>
<td>No</td>
</tr>
<tr>
<td>Mode</td>
<td>Alias pattern match</td>
</tr>
<tr>
<td>Pattern type</td>
<td>Regex</td>
</tr>
<tr>
<td>Pattern string</td>
<td>Enter (9\d+)(@example.com)</td>
</tr>
<tr>
<td>Pattern behavior</td>
<td>Replace</td>
</tr>
<tr>
<td>Replace string</td>
<td>Enter do-not-route-this-call for example</td>
</tr>
<tr>
<td>On successful match</td>
<td>Stop</td>
</tr>
<tr>
<td>Target</td>
<td>TraversalZone</td>
</tr>
<tr>
<td>State</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

---

#### Create search rule

You are here: **Configuration** → **Search rules** → **Create search rule**

```
<table>
<thead>
<tr>
<th>Rule name</th>
<th>Description</th>
<th>Priority</th>
<th>Protocol</th>
<th>Source</th>
<th>Request must be authenticated</th>
<th>Mode</th>
<th>Pattern type</th>
<th>Pattern string</th>
<th>Replace string</th>
<th>On successful match</th>
<th>Target</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block ISDN call</td>
<td>Enter Blocks everything (including non-registered endpoints)</td>
<td>41</td>
<td>Any</td>
<td>Any</td>
<td>No</td>
<td>Alias pattern match</td>
<td>Regex</td>
<td>(9\d+)@example.com</td>
<td>do-not-route-this-call</td>
<td>Stop</td>
<td>TraversalZone</td>
<td>Enabled</td>
</tr>
</tbody>
</table>
```

---

7. Click **Create search rule**.

---

Cisco Expressway Basic Configuration Deployment Guide

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Expressway-C

This example shows how to configure the Expressway-C to stop calls coming in via the gateway from being able to route calls back out of the gateway. This is done by loading some specially constructed CPL onto the Expressway-C and configuring its Call policy mode to use Local CPL.

Creating a CPL file

The CPL file to be uploaded onto the Expressway can be created in a text editor.

Here are 2 example sets of CPL. In these examples the “GatewayZone” is the neighbour zone to the ISDN gateway:

This example CPL excludes any checking of whether the calling party is authenticated or not:

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<cl xmlns="urn:ietf:params:xml:ns:cpl"
xmlns:taa="http://www.tandberg.net/cpl-extensions"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:ietf:params:xml:ns:cpl cpl.xsd">
<taa:routed>
  <taa:rule-switch>
    <!-- Check that gateway is not hairpinning call - Neighbor zone -->
    <taa:rule originating-zone="GatewayZone" destination="9.*">
      <!-- Calls coming from the gateway may not send calls back out of this gateway -->
      <taa:rule origin=".*" destination=".*">
        <!-- All other calls allowed -->
        <proxy/>
      </taa:rule>
    </taa:rule-switch>
  </taa:routed>
</cl>
```

This example CPL also ensures that the calling party is authenticated:

```xml
<?xml version="1.0" encoding="UTF-8" ?>
<cl xmlns="urn:ietf:params:xml:ns:cpl"
xmlns:taa="http://www.tandberg.net/cpl-extensions"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="urn:ietf:params:xml:ns:cpl cpl.xsd">
<taa:routed>
  <taa:rule-switch>
    <!-- Check that calling party is authenticated -->
    <taa:rule authenticated-origin="" destination="9.*">
      <!-- Reject call with a status code of 403 (Forbidden) -->
      <reject status="403" reason="ISDN call denied as unauthenticated caller"/>
    </taa:rule>
    <!-- Check that gateway is not hairpinning call - Neighbor zone -->
    <taa:rule originating-zone="GatewayZone" destination="9.*">
      <!-- Calls coming from the gateway may not hairpin and send calls back out -->
      <taa:rule origin=".*" destination=".*">
        <!-- Reject call with a status code of 403 (Forbidden) -->
        <reject status="403" reason="ISDN hairpin call denied"/>
      </taa:rule>
    </taa:rule-switch>
  </taa:routed>
</cl>
```
Optional configuration tasks

Loading the CPL onto Expressway-C

To configure the Expressway-C to use the CPL:

1. Go to Configuration > Call Policy > Configuration.
2. Click Browse... and select your CPL file (created above) from your file system.
3. Click Upload file.
   - You should receive a "File upload successful" message.
   - If you receive an "XML invalid" message then you must correct the problems with the CPL file and upload it again.
4. Select a Call policy mode of Local CPL.
5. Click Save.
Appendix 1: Configuration details

This appendix summarizes the configuration required for the Expressway-C and Expressway-E. It is broken down into 3 sections:

- Expressway-C (configuration to apply to the Expressway-C only)
- Expressway-E (configuration to apply to the Expressway-E only)
- Expressway-C and Expressway-E (configuration to apply to both the Expressway-C and Expressway-E)

Expressway-C configuration details

<table>
<thead>
<tr>
<th>Configuration item</th>
<th>Value</th>
<th>Expressway page</th>
</tr>
</thead>
<tbody>
<tr>
<td>System configuration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System name</td>
<td>EXPc</td>
<td>System &gt; Administration</td>
</tr>
<tr>
<td>LAN1 IPv4 address</td>
<td>10.0.0.2</td>
<td>System &gt; IP</td>
</tr>
<tr>
<td>IPv4 gateway</td>
<td>10.0.0.1</td>
<td>System &gt; IP</td>
</tr>
<tr>
<td>LAN1 subnet mask</td>
<td>255.255.255.0</td>
<td>System &gt; IP</td>
</tr>
<tr>
<td>DNS server address 1</td>
<td>10.0.0.11</td>
<td>System &gt; DNS</td>
</tr>
<tr>
<td>DNS server address 2</td>
<td>10.0.0.12</td>
<td>System &gt; DNS</td>
</tr>
<tr>
<td>DNS Domain name</td>
<td>internal-domain.net</td>
<td>System &gt; DNS</td>
</tr>
<tr>
<td>DNS System host name</td>
<td>expc</td>
<td>System &gt; DNS</td>
</tr>
<tr>
<td>NTP server 1</td>
<td>pool.ntp.org</td>
<td>System &gt; Time</td>
</tr>
<tr>
<td>Time zone</td>
<td>GMT</td>
<td>System &gt; Time</td>
</tr>
<tr>
<td>Traversal zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone Name</td>
<td>TraversalZone</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Zone Type</td>
<td>Traversal client</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Protocol SIP port</td>
<td>7001</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Protocol H.323 port</td>
<td>6001</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Location Peer 1 address</td>
<td>192.0.2.2</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Authentication username</td>
<td>exampleauth</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Authentication password</td>
<td>ex4mpl3.c0m</td>
<td>Configuration &gt; Authentication &gt; Devices &gt; Local database</td>
</tr>
<tr>
<td>Traversal search rule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rule name</td>
<td>Traversal zone search rule</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Description</td>
<td>Search traversal zone (Expressway-C)</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Priority</td>
<td>100</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Source</td>
<td>Any</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Mode</td>
<td>Any alias</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
</tbody>
</table>
## Expressway-E configuration details

<table>
<thead>
<tr>
<th>Configuration item</th>
<th>Value</th>
<th>Expressway page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System configuration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System name</td>
<td>EXPe</td>
<td>System &gt; Administration</td>
</tr>
<tr>
<td>LAN1 IPv4 address</td>
<td>192.0.2.2</td>
<td>System &gt; IP</td>
</tr>
<tr>
<td>IPv4 gateway</td>
<td>192.0.2.1</td>
<td>System &gt; IP</td>
</tr>
<tr>
<td>LAN1 subnet mask</td>
<td>255.255.255.0</td>
<td>System &gt; IP</td>
</tr>
<tr>
<td>DNS server address 1</td>
<td>194.72.6.57</td>
<td>System &gt; DNS</td>
</tr>
<tr>
<td>DNS server address 2</td>
<td>194.73.82.242</td>
<td>System &gt; DNS</td>
</tr>
<tr>
<td>DNS Domain name</td>
<td>example.com</td>
<td>System &gt; DNS</td>
</tr>
<tr>
<td>DNS System host name</td>
<td>expe</td>
<td>System &gt; DNS</td>
</tr>
<tr>
<td>NTP server 1</td>
<td>pool.ntp.org</td>
<td>System &gt; Time</td>
</tr>
<tr>
<td>Time zone</td>
<td>GMT</td>
<td>System &gt; Time</td>
</tr>
<tr>
<td><strong>Traversal zone</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone Name</td>
<td>TraversalZone</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Zone Type</td>
<td>Traversal server</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Client authentication username</td>
<td>exampleauth</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Protocol SIP port</td>
<td>7001</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Protocol H.323 port</td>
<td>6001</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
</tbody>
</table>
### Configuration details

<table>
<thead>
<tr>
<th>Configuration item</th>
<th>Value</th>
<th>Expressway page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>exampleauth</td>
<td>Configuration &gt; Authentication &gt; Devices &gt; Local database</td>
</tr>
<tr>
<td>Password</td>
<td>ex4mpl3.c0m</td>
<td>Configuration &gt; Authentication &gt; Devices &gt; Local database</td>
</tr>
<tr>
<td>Traversal zone search rule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rule name</td>
<td>Traversal zone search rule</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Description</td>
<td>Search traversal zone (Expressway-E)</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Priority</td>
<td>100</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Source</td>
<td>Any</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Mode</td>
<td>Any alias</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>On successful match</td>
<td>Continue</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Target</td>
<td>TraversalZone</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>DNS zone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zone Name</td>
<td>DNSZone</td>
<td>Configuration &gt; Zones</td>
</tr>
<tr>
<td>Zone Type</td>
<td>DNS</td>
<td>Configuration &gt; Zones &gt; Zones</td>
</tr>
<tr>
<td>Transform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pattern string</td>
<td>([^@]*)</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Pattern type</td>
<td>Regex</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>On successful match</td>
<td>Continue</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Target</td>
<td>DNSZone</td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Calls to unknown IP addresses</td>
<td>Direct</td>
<td>Configuration &gt; Dial plan &gt; Configuration</td>
</tr>
</tbody>
</table>

### Expressway-C and Expressway-E configuration details

<table>
<thead>
<tr>
<th>Configuration item</th>
<th>Value</th>
<th>Expressway page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pattern string</td>
<td>&quot;(^[@&quot;])&quot;</td>
<td>Configuration &gt; Dial plan &gt; Transforms</td>
</tr>
<tr>
<td>Pattern type</td>
<td>Regex</td>
<td>Configuration &gt; Dial plan &gt; Transforms</td>
</tr>
</tbody>
</table>

---

Cisco Expressway Basic Configuration Deployment Guide
### Local search rules

<table>
<thead>
<tr>
<th>Rule name</th>
<th>Description</th>
<th>Page Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local search rule 1</td>
<td></td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Rule name</td>
<td>Local zone – no domain</td>
<td></td>
</tr>
<tr>
<td>Priority</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>Mode</td>
<td>Alias pattern match</td>
<td></td>
</tr>
<tr>
<td>Pattern type</td>
<td>Regex</td>
<td></td>
</tr>
<tr>
<td>Pattern string</td>
<td>(.+)@example.com.*</td>
<td></td>
</tr>
<tr>
<td>Pattern behavior</td>
<td>Replace</td>
<td></td>
</tr>
<tr>
<td>Replace string</td>
<td>\1</td>
<td></td>
</tr>
<tr>
<td>On successful match</td>
<td>Continue</td>
<td></td>
</tr>
<tr>
<td>Target</td>
<td>LocalZone</td>
<td></td>
</tr>
<tr>
<td>Local search rule 2</td>
<td></td>
<td>Configuration &gt; Dial plan &gt; Search rules</td>
</tr>
<tr>
<td>Rule name</td>
<td>Local zone – full URI</td>
<td></td>
</tr>
<tr>
<td>Priority</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>Mode</td>
<td>Alias pattern match</td>
<td></td>
</tr>
<tr>
<td>Pattern type</td>
<td>Regex</td>
<td></td>
</tr>
<tr>
<td>Pattern string</td>
<td>(.+)@example.com.*</td>
<td></td>
</tr>
<tr>
<td>Pattern behavior</td>
<td>Leave</td>
<td></td>
</tr>
<tr>
<td>On successful match</td>
<td>Continue</td>
<td></td>
</tr>
<tr>
<td>Target</td>
<td>LocalZone</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2: DNS records

DNS configuration on host server

The following records are required in the external DNS which hosts the externally routable domain: example.com to allow messages from non-registered endpoints (or other infrastructure devices) to be routed to the Expressway-E

Host DNS A record

<table>
<thead>
<tr>
<th>Host</th>
<th>Host IP address</th>
</tr>
</thead>
<tbody>
<tr>
<td>expe.example.com</td>
<td>192.0.2.2</td>
</tr>
</tbody>
</table>

DNS SRV records

<table>
<thead>
<tr>
<th>Name</th>
<th>Service</th>
<th>Protocol</th>
<th>Priority</th>
<th>Weight</th>
<th>Port</th>
<th>Target host</th>
</tr>
</thead>
<tbody>
<tr>
<td>example.com.</td>
<td>h323cs</td>
<td>tcp</td>
<td>10</td>
<td>10</td>
<td>1720</td>
<td>expe.example.com.</td>
</tr>
<tr>
<td>example.com.</td>
<td>h323ls</td>
<td>udp</td>
<td>10</td>
<td>10</td>
<td>1719</td>
<td>expe.example.com.</td>
</tr>
<tr>
<td>example.com.</td>
<td>sip</td>
<td>tcp</td>
<td>10</td>
<td>10</td>
<td>5060</td>
<td>expe.example.com.</td>
</tr>
<tr>
<td>example.com.</td>
<td>sip</td>
<td>udp</td>
<td>10</td>
<td>10</td>
<td>5060</td>
<td>expe.example.com.</td>
</tr>
<tr>
<td>example.com.</td>
<td>sips</td>
<td>tcp</td>
<td>10</td>
<td>10</td>
<td>5061</td>
<td>expe.example.com.</td>
</tr>
<tr>
<td>example.com.</td>
<td>turn</td>
<td>udp</td>
<td>10</td>
<td>10</td>
<td>3478</td>
<td>expe.example.com.</td>
</tr>
</tbody>
</table>

* SIP UDP is disabled on Expressway by default.

** On Large VM server deployments you should configure multiple records for the range 3478 – 3483.

For example, the DNS records would be:

```
_h323cs._tcp.example.com. 86400 IN SRV 10 10 1720 expe.example.com.
_h323ls._udp.example.com. 86400 IN SRV 10 10 1719 expe.example.com.
_sip._tcp.example.com. 86400 IN SRV 10 10 5060 expe.example.com.
_sip._udp.example.com. 86400 IN SRV 10 10 5061 expe.example.com.
_sips._tcp.example.com. 86400 IN SRV 10 10 5061 expe.example.com.
_turn._udp.example.com. 86400 IN SRV 10 10 3478 expe.example.com.
expe.example.com. 86400 IN A 192.0.2.2
```

If you have a cluster of Expressway-Es, you must set up DNS A and SRV records for each peer/host in the cluster. See Expressway Cluster Creation and Maintenance Deployment Guide for more information.

DNS configuration (internal DNS server)

The following records are required in the local DNS which hosts the internally routable domain: internal-domain.net to allow internal messages to be routed to the Expressway-C.
Local DNS A record

<table>
<thead>
<tr>
<th>Host</th>
<th>Host IP address</th>
</tr>
</thead>
<tbody>
<tr>
<td>expc.internal-domain.net</td>
<td>10.0.0.2</td>
</tr>
</tbody>
</table>

Local DNS SRV records

<table>
<thead>
<tr>
<th>Name</th>
<th>Service</th>
<th>Protocol</th>
<th>Priority</th>
<th>Weight</th>
<th>Port</th>
<th>Target host</th>
</tr>
</thead>
<tbody>
<tr>
<td>internal-domain.net.</td>
<td>h323cs</td>
<td>tcp</td>
<td>10</td>
<td>10</td>
<td>1720</td>
<td>expc.internal-domain.net.</td>
</tr>
<tr>
<td>internal-domain.net.</td>
<td>h323ls</td>
<td>udp</td>
<td>10</td>
<td>10</td>
<td>1719</td>
<td>expc.internal-domain.net.</td>
</tr>
<tr>
<td>internal-domain.net.</td>
<td>sip</td>
<td>tcp</td>
<td>10</td>
<td>10</td>
<td>5060</td>
<td>expc.internal-domain.net.</td>
</tr>
<tr>
<td>internal-domain.net.</td>
<td>sip</td>
<td>udp *</td>
<td>10</td>
<td>10</td>
<td>5060</td>
<td>expc.internal-domain.net.</td>
</tr>
<tr>
<td>internal-domain.net.</td>
<td>sips</td>
<td>tcp</td>
<td>10</td>
<td>10</td>
<td>5061</td>
<td>expc.internal-domain.net.</td>
</tr>
</tbody>
</table>

* SIP UDP is disabled on Expressway by default.

For example, the DNS records would be:

```
_h323cs._tcp.internal-domain.net. 86400 IN SRV 10 10 1720 expc.internal-domain.net.
_h323ls._udp.internal-domain.net. 86400 IN SRV 10 10 1719 expc.internal-domain.net.
_sip._tcp.internal-domain.net.   86400 IN SRV 10 10 5060 expc.internal-domain.net.
_sip._udp.internal-domain.net.   86400 IN SRV 10 10 5060 expc.internal-domain.net.
_sips._tcp.internal-domain.net.  86400 IN SRV 10 10 5061 expc.internal-domain.net.
expc.internal-domain.net.        86400 IN A 10.0.0.2
```

If you have a cluster of Expressway-Cs, you must set up DNS A and SRV records for each peer/host in the cluster. See *Expressway Cluster Creation and Maintenance Deployment Guide* for more information.
Appendix 3: Firewall and NAT settings

Internal firewall configuration

In many deployments outbound connections (from internal network to DMZ) will be permitted by the NAT/firewall device. If the administrator wants to restrict this further, the following tables provide the permissive rules required. For further information, see Expressway IP Port Usage for Firewall Traversal.

Ensure that any SIP or H.323 ‘fixup’ ALG or awareness functionality is disabled on the NAT firewall – if enabled this will adversely interfere with the Expressway functionality.

### Outbound (Internal network > DMZ)

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Source</th>
<th>Dest. Source IP</th>
<th>Source port</th>
<th>Transport protocol</th>
<th>Dest. IP</th>
<th>Dest. port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>Management computer</td>
<td>EXPe</td>
<td>As required</td>
<td>TCP</td>
<td>192.0.2.2</td>
<td>80 / 443 / 22 / 23</td>
</tr>
<tr>
<td>SNMP monitoring</td>
<td>Management computer</td>
<td>EXPe</td>
<td>As required</td>
<td>UDP</td>
<td>192.0.2.2</td>
<td>161</td>
</tr>
<tr>
<td>H.323 traversal calls using Assent</td>
<td>EXPc</td>
<td>EXPe</td>
<td>Any</td>
<td>15000 to 19999</td>
<td>TCP</td>
<td>192.0.2.2</td>
</tr>
<tr>
<td>RTP Assent</td>
<td>EXPc</td>
<td>EXPe</td>
<td>Any</td>
<td>36002 to 59999</td>
<td>36000 *</td>
<td>36001 *</td>
</tr>
<tr>
<td>RTCP Assent</td>
<td>EXPc</td>
<td>EXPe</td>
<td>Any</td>
<td>36002 to 59999 *</td>
<td>UDP</td>
<td>192.0.2.2</td>
</tr>
<tr>
<td>SIP traversal calls</td>
<td>EXPc</td>
<td>EXPe</td>
<td>10.0.0.2</td>
<td>25000 to 29999</td>
<td>TCP</td>
<td>192.0.2.2</td>
</tr>
<tr>
<td>RTP Assent</td>
<td>EXPc</td>
<td>EXPe</td>
<td>10.0.0.2</td>
<td>36002 to 59999 *</td>
<td>UDP</td>
<td>192.0.2.2</td>
</tr>
<tr>
<td>RTCP Assent</td>
<td>EXPc</td>
<td>EXPe</td>
<td>10.0.0.2</td>
<td>36002 to 59999 *</td>
<td>UDP</td>
<td>192.0.2.2</td>
</tr>
</tbody>
</table>

* The default media port range is 36000 to 59999. The first 2 ports in the range are used for multiplexed traffic only (with Large VM deployments the first 12 ports in the range – 36000 to 36011 – are used).

### Inbound (DMZ > Internal network)

As Expressway-C to Expressway-E communications are always initiated from the Expressway-C to the Expressway-E (Expressway-E sending messages by responding to Expressway-C’s messages) no ports need to be opened from DMZ to Internal for call handling.

However, if the Expressway-E needs to communicate with local services, such as a Syslog server, some of the following NAT configurations may be required:
Traffic destined for logging or management server addresses (using specific destination ports) must be routed to the internal network.

**External firewall configuration requirement**

In this example it is assumed that outbound connections (from DMZ to external network) are all permitted by the firewall device.

Ensure that any SIP or H.323 “fixup” ALG or awareness functionality is disabled on the NAT firewall – if enabled this will adversely interfere with the Expressway functionality.

**Inbound (Internet > DMZ)**

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Source</th>
<th>Dest. IP</th>
<th>Source port</th>
<th>Transport protocol</th>
<th>Dest. IP</th>
<th>Dest. port</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.323 calls using Assent</td>
<td></td>
<td></td>
<td></td>
<td>TCP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q.931/H.225 and H.245</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>TCP</td>
<td>192.0.2.2</td>
<td>2776</td>
</tr>
<tr>
<td>RTP Assent</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>UDP</td>
<td>192.0.2.2</td>
<td>36000</td>
</tr>
<tr>
<td>RTCP Assent</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>UDP</td>
<td>192.0.2.2</td>
<td>36001</td>
</tr>
<tr>
<td>H.323 endpoints with public IP addresses</td>
<td></td>
<td></td>
<td></td>
<td>TCP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q.931/H.225</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>TCP</td>
<td>192.0.2.2</td>
<td>1720</td>
</tr>
<tr>
<td>H.245</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>TCP</td>
<td>192.0.2.2</td>
<td>15000 to 19999</td>
</tr>
<tr>
<td>RTP &amp; RTCP</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>UDP</td>
<td>192.0.2.2</td>
<td>36002 to 59999</td>
</tr>
<tr>
<td>SIP endpoints using UDP / TCP or TLS</td>
<td></td>
<td></td>
<td></td>
<td>TCP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIP TCP</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>TCP</td>
<td>192.0.2.2</td>
<td>5060</td>
</tr>
<tr>
<td>SIP UDP</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>UDP</td>
<td>192.0.2.2</td>
<td>5060</td>
</tr>
<tr>
<td>SIP TLS</td>
<td>Endpoint</td>
<td>Any</td>
<td>&gt;=1024</td>
<td>TCP</td>
<td>192.0.2.2</td>
<td>5061</td>
</tr>
</tbody>
</table>
**Purpose** | **Source** | **Dest.** | **Source IP** | **Source port** | **Transport protocol** | **Dest. IP** | **Dest. port** |
--- | --- | --- | --- | --- | --- | --- | --- |
RTP & RTCP | Endpoint | EXPe | Any | >=1024 | UDP | 192.0.2.2 | 36002 to 59999 |
TURN server control | Endpoint | EXPe | Any | >=1024 | UDP | 192.0.2.2 | 3478 ** |
TURN server media | Endpoint | EXPe | Any | >=1024 | UDP | 192.0.2.2 | 24000 to 29999 |

**On Large VM server deployments you can configure a range of TURN request listening ports. The default range is 3478 – 3483.**

**Outbound (DMZ > Internet)**

If you want to restrict communications from the DMZ to the wider Internet, the following table provides information on the outgoing IP addresses and ports required to permit the Expressway-E to provide service to external endpoints.

| Purpose | Source | Dest. | Source IP | Source port | Transport protocol | Dest. IP | Dest. port |
--- | --- | --- | --- | --- | --- | --- | --- |
H.323 endpoints with public IP address | | | | | |
Q.931/H.225 | EXPe | Endpoint | 192.0.2.2 | 15000 to 19999 | TCP | Any | 1720 |
H.245 | EXPe | Endpoint | 192.0.2.2 | 15000 to 19999 | TCP | Any | >=1024 |
RTP & RTCP | EXPe | Endpoint | 192.0.2.2 | 36000 to 59999 | UDP | Any | >=1024 |

SIP endpoints using UDP / TCP or TLS | | | | | |
SIP TCP & TLS | EXPe | Endpoint | 192.0.2.2 | 25000 to 29999 | TCP | Any | >=1024 |
SIP UDP | EXPe | Endpoint | 192.0.2.2 | 5060 | UDP | Any | >=1024 |
RTP & RTCP | EXPe | Endpoint | 192.0.2.2 | 36000 to 59999 | UDP | Any | >=1024 |
TURN server media | EXPe | Endpoint | 192.0.2.2 | 24000 to 29999 | UDP | Any | >=1024 |

Other services (as required) | | | | | |
DNS | EXPe | DNS server | 192.0.2.2 | >=1024 | UDP | DNS servers | 53 |
NTP (time sync) | EXPe | NTP server | 192.0.2.2 | 123 | UDP | NTP servers | 123 |
Appendix 4: Advanced network deployments

This section discusses network deployments that use static NAT or Dual Network Interface architectures.

Prerequisites

Deploying an Expressway-E behind a NAT mandates the use of the Advanced Networking option key. It enables the static NATing functionality of the Expressway-E as well as dual network interfaces. Although certain call scenarios involving an Expressway-E behind NAT could potentially work with the help of router/firewall-based ALGs, proper functionality cannot be guaranteed; you must use the Expressway to perform the static NATing on its own interface. More background on this can be found in the Routers/firewalls with SIP/H.323 ALG [p.49] section later in this appendix. The Advanced Networking option is available only on the Expressway-E.

When deploying an Expressway-E behind a NAT with static NAT configuration in place on the Expressway-E, it is highly recommended to disable SIP and H.323 ALGs (SIP / H.323 awareness) on routers/firewalls carrying network traffic to or from the Expressway-E (experience shows that these tend to be unable to handle video traffic properly).

Background

When deploying an Expressway-E for business to business communications, or for supporting home workers and travelling workers, it is usually desirable to deploy the Expressway-E in a NATed DMZ rather than having the Expressway-E configured with a publicly routable IP address.

Network Address Translation (NAT) poses a challenge with SIP and H.323 applications, as with these protocols, IP addresses and port numbers are not only used in OSI layer 3 and 4 packet headers, but are also referenced within the packet payload data of H.323 and SIP messages themselves.

This usually breaks SIP/H.323 call signaling and RTP media packet flows, since NAT routers/firewalls will normally translate the IP addresses and port numbers of the headers, but leave the IP address and port references within the SIP and H.323 message payloads unchanged.

To provide an example of this, assume you have an Expressway-E deployed behind a NAT router and two endpoints. The Expressway-E has static NAT disabled on LAN2, but the NAT router is configured with a static 1:1 NAT, NATing the public address 64.100.0.10 to the Expressway-E LAN2 IP address 10.0.10.2:

- NAT router with local IP address 10.0.10.1 and NAT IP address 64.100.0.10, statically NATed to 10.0.10.2
- Expressway-E LAN1 (internally-facing interface) with IP address 10.0.20.2
- Expressway-E LAN2 (externally-facing interface) with IP address 10.0.10.2 (and with static NAT disabled)
- Expressway-E default gateway set to 10.0.10.1 (inside address of NAT firewall, reachable via LAN2)
Endpoint A with IP address 10.0.20.3
Endpoint B with IP address 64.100.0.20, located on the Internet

Assume that endpoint A places a SIP call towards endpoint B. The call will arrive at the Expressway-E, which will proxy the SIP INVITE towards endpoint B. The Expressway-E to Endpoint B will then be a traversal call, which means that the Expressway-E will take both signaling and media, and the packet carrying the SIP INVITE message will have the following contents as it arrives at the NAT router (the actual INVITE contents have been simplified for ease of reading):

**Packet header:**
Source IP: 10.0.10.2
Destination IP: 64.100.0.20

**SIP payload:**
INVITE sip: 64.100.0.20 SIP/2.0
Via: SIP/2.0/TLS 10.0.10.2:5061
Via: SIP/2.0/TLS 10.0.20.3:55938
Call-ID: 20ec9fd084eb3dd2@127.0.0.1
CSeq: 100 INVITE
Contact: <sip:EndpointA@10.0.20.3:55938;transport=tls>
From: "Endpoint A" <sip:EndpointA@cisco.com>;tag=9a42af
To: <sip:64.100.0.20>
Max-Forwards: 70
Content-Type: application/sdp
Content-Length: 2825

v=0
c=tandberg 1 2 IN IP4 10.0.10.2
s=IN IP4 10.0.10.2
b=AS:2048
...
...
...

Figure 3: SIP INVITE arriving at NAT router

In the example above, the SDP (session description protocol) within the SIP payload contains a reference to the Expressway-E IP address, marked in yellow: **c=IN IP4 10.0.10.2**.

Upon receiving the SIP INVITE packet, the NAT router will rewrite the layer 3 source IP address header (marked in green: **10.0.10.2**) and replace 10.0.10.2 (Expressway-E LAN2 IP address) with its own public NAT address (64.100.0.10) and route the packet out to the Internet, so that the SIP INVITE message will have the following contents as it arrives at endpoint B:

**Packet header:**
Source IP: 64.100.0.10
Destination IP: 64.100.0.20

**SIP payload:**
INVITE sip:64.100.0.20 SIP/2.0
Via: SIP/2.0/TLS 10.0.10.2:5061
Via: SIP/2.0/TLS 10.0.20.3:55938
Call-ID: 20ec9fd084eb3dd2@127.0.0.1
CSeq: 100 INVITE
Contact: <sip:EndpointA@10.0.20.3:55938;transport=tls>
From: "Endpoint A" <sip:EndpointA@cisco.com>;tag=9a42af
To: <sip:64.100.0.20>
Max-Forwards: 70
Content-Type: application/sdp
Content-Length: 2825

v=0
s=-
c=IN IP4 10.0.10.2

b=AS:2048
...
...

Figure 4: SIP INVITE arriving at Endpoint B

As can be seen from the example above, endpoint B will see that the SIP INVITE was received from IP 64.100.0.10 (NAT router), so the endpoint will know where to send its reply messages for the INVITE itself.

The c-line within the SDP of the SIP INVITE is however still set to c=IN IP4 10.0.10.2, which means that endpoint B will attempt to send RTP media to the IP address 10.0.10.2, an address which is not routable on the Internet.

The result in this scenario will therefore be that endpoint A will never receive media sent by endpoint B (while endpoint B will normally receive media from endpoint A, since endpoint B is assigned with a publicly routable IP address).

Similar behavior will be seen in H.323 calls, since H.323 uses the same principles as SIP in terms of embedding IP address and port references within the message payload.

**Solution**

To ensure that call signaling and media connectivity remains functional in scenarios where the Expressway-E is deployed behind a NAT (as in the example above), the Expressway-E will have to modify the parts of SIP and H.323 messages which contain references to its actual LAN2 network interface IP address (10.0.10.2) and replace these with the public NAT address of the NAT router (64.100.0.10).

This can be achieved by enabling Static NAT mode on selected network interfaces on the Expressway-E. The Static NAT mode feature on the Expressway-E is made available with the Advanced Networking option key.

This option key allows the use of two network interfaces (LAN1 and LAN2) and for Static NAT mode to be enabled on one or both of these interfaces. It is not compulsory to use both interfaces; you may use only a single interface and have Static NAT mode enabled on that.

When static NAT has been enabled on an interface, the Expressway will apply static NAT for all outbound SIP and H.323 traffic for this interface, which means that H.323 and SIP devices have to communicate with this interface using the static NAT address rather than the local interface address.

When the Advanced Networking key is installed on the Expressway-E, the IP configuration page (System > IP) has additional options, allowing the user to decide whether to Use dual network interfaces, to nominate which interface is the External LAN interface, to enable Static NAT mode on selected interfaces and configure an IPv4 static NAT address for each interface.

Using the example deployment above, the Expressway-E would be configured as follows:
Dual interfaces are selected and the external LAN interface is set to LAN2.
- Configuration > IPv4 gateway is set to 10.0.10.1, the local IP address of the NAT router.
- LAN1 > IPv4 address is set to 10.0.20.2
- LAN1 > IPv4 static NAT mode is set to Off
- LAN2 > IPv4 address is set to 10.0.10.2
- LAN2 > IPv4 static NAT mode is set to On
- LAN2 > IPv4 static NAT address is set to 64.100.0.10, the public NAT address of the NAT router.

When enabling IPv4 static NAT mode on an interface (LAN2 in our example), the Expressway-E will modify the payload of H.323 and SIP messages sent out via this interface, so that references to the LAN2 interface address (10.0.10.2) are replaced with the IPv4 static NAT address configured for this interface (64.100.0.10). This means that when looking at the payload of SIP and H.323 messages sent out via this interface, it will appear as if the LAN2 interface has an IP address of 64.100.0.10.

It is important to note that the Expressway-E will not modify the layer 3 source address of outgoing H.323 and SIP packets sent out of this interface, as this will be done by the NAT router.

With this configuration in place, the SIP INVITE shown in Figure 4 will now look as follows as it arrives at endpoint B:

**Packet header:**
Source IP: 64.100.0.10
Destination IP: 64.100.0.20

**SIP payload:**
INVITE sip: 64.100.0.20 SIP/2.0
Appendix 4: Advanced network deployments

Figure 5: SIP INVITE arriving at Endpoint B - Static NAT mode enabled

With static NAT enabled on LAN2 of the Expressway-E, the c-line of the SIP INVITE has now been rewritten to c=IN IP4 64.100.0.10, and this means that when endpoint B sends outbound RTP media to endpoint A, this will be sent to IP address 64.100.0.10, the public NAT address of the NAT router, which is 1:1 NATed to the LAN2 IP address of the Expressway-E, 10.0.10.2. As RTP media from endpoint B arrives at the NAT router with a destination IP address of 64.100.0.10, the NAT router will forward these packets to the Expressway-E at 10.0.10.2 and two-way media is achieved.

Routers/firewalls with SIP/H.323 ALG

Some routers and firewalls have SIP and H.323 ALG capabilities. ALG is also referred to as Fixup, Inspection, Application Awareness, Stateful Packet Inspection, Deep Packet Inspection and so forth. This means that the router/firewall is able to identify SIP and H.323 traffic as it passes through and inspect, and in some cases modify, the payload of the SIP and H.323 messages. The purpose of modifying the payload is to help the H.323 or SIP application from which the message originated to traverse NAT, i.e. to perform a similar process to what the Expressway-E does.

The challenge with router/firewall-based SIP and H.323 ALGs is that these were originally intended to aid relatively basic H.323 and SIP applications to traverse NAT, and these applications had, for the most part, very basic functionality and often only supported audio.

Over the years, many H.323 and SIP implementations have become more complex, supporting multiple video streams and application sharing (H.239, BFCP), encryption/security features (H.235, DES/AES), firewall traversal (Assent, H.460) and other extensions of the SIP and H.323 standards.

For a router/firewall to properly perform ALG functions for SIP and H.323 traffic, it is therefore of utmost importance that the router/firewall understands and properly interprets the full content of the payload it is inspecting. Since H.323 and SIP are standards/recommendations which are in constant development, it is not likely that the router/firewall will meet these requirements, resulting in unexpected behavior when using H.323 and SIP applications in combination with such routers/firewalls.

There are also scenarios where the router/firewall normally will not be able to inspect the traffic at all, for example when using SIP over TLS, where the communication is end-to-end secure and encrypted as it passes through the router/firewall.
As per the recommendations in the Introduction section of this appendix, it is highly recommended to disable SIP and H.323 ALGs on routers/firewalls carrying network traffic to or from a Expressway-E, as, when enabled this is frequently found to negatively affect the built-in firewall/NAT traversal functionality of the Expressway-E itself. This is also mentioned in Appendix 3: Firewall and NAT settings [p.42].

**General guidelines and design principles**

With Expressway-E deployments involving NAT and/or dual network interfaces, some general guidelines and principles apply, as described below.

**Non-overlapping subnets**

If the Expressway-E will be configured to use both LAN interfaces, the LAN1 and LAN2 interfaces must be located in non-overlapping subnets to ensure that traffic is sent out the correct interface.

**Clustering**

When clustering Expressways that have the Advanced Networking option installed, cluster peers have to be addressed with their LAN1 interface address. In addition, clustering must be configured on an interface that does not have Static NAT mode enabled.

We therefore recommend that you use LAN2 as the externally facing interface, and that LAN2 is used as the static NAT interface where applicable.

**Static NAT restrictions when using SIP media encryption**

You should not configure an Expressway for SIP media encryption if that same Expressway is also configured for static NAT. If you do so, the private IP address will be sent in the SDP rather than the static NAT address and this will cause calls to fail.

Note that the recommended configuration for Expressway-C with Expressway-E deployments is to:

- configure the same media encryption policy setting on the traversal client zone on Expressway-C, the traversal server zone on Expressway-E, and every zone on Expressway-E
- use static NAT on the Expressway-E only

With this configuration the encryption B2BUA will be enabled on the Expressway-C only.

**External LAN interface setting**

The External LAN interface configuration setting on the IP configuration page controls on which network interface TURN relays are allocated. In a dual network interfaces Expressway-E configuration, this should normally be set to the externally-facing LAN interface on the Expressway-E.

**Dual network interfaces**

The following diagram shows an example deployment involving the use of an Expressway-E with dual network interfaces and static NAT, an Expressway-C acting as a traversal client, and two firewalls/routers. Typically in this DMZ configuration, FW A cannot route traffic to FW B, and devices such as the dual interface Expressway-E are required to validate and forward traffic from FW A’s subnet to FW B’s subnet (and vice versa).
This deployment consists of:

- DMZ subnet 1 – 10.0.10.0/24, containing:
  - the internal interface of Firewall A – 10.0.10.1
  - the LAN2 interface of the Expressway-E – 10.0.10.2
- DMZ subnet 2 – 10.0.20.0/24, containing:
  - the external interface of Firewall B – 10.0.20.1
  - the LAN1 interface of the Expressway-E – 10.0.20.2
- LAN subnet – 10.0.30.0/24, containing:
  - the internal interface of Firewall B – 10.0.30.1
  - the LAN1 interface of the Expressway-C – 10.0.30.2
  - the network interface of the Cisco TMS server – 10.0.30.3
- Firewall A is the publicly-facing firewall; it is configured with a NAT IP (public IP) of 64.100.0.10 which is statically NATed to 10.0.10.2 (the LAN2 interface address of the Expressway-E)
- Firewall B is the internally-facing firewall
- Expressway-E LAN1 has static NAT mode disabled
- Expressway-E LAN2 has static NAT mode enabled with Static NAT address 64.100.0.10
- Expressway-C has a traversal client zone pointing to 10.0.20.2 (LAN1 of the Expressway-E)
- Cisco TMS has Expressway-E added with IP address 10.0.20.2

With the above deployment, there is no regular routing between the 10.0.20.0/24 and 10.0.10.0/24 subnets. The Expressway-E bridges these subnets and acts as a proxy for SIP/H.323 signaling and RTP/RTCP media.

**Static routes**

With a deployment such as that shown in Figure 6, the Expressway-E should be configured with a default gateway address of 10.0.10.1. This means that all traffic sent out via LAN2 will by default be sent to the IP address 10.0.10.1.

If Firewall B is doing NAT for traffic sent from the 10.0.30.0 subnet to the LAN1 interface of the Expressway-E (for example traversal client traffic from Expressway-C or management traffic from TMS), this means that this traffic will appear as coming from the external interface of firewall B (10.0.20.1) as it reaches LAN1 of the Expressway-E. The Expressway-E will therefore be able to reply to this traffic via its LAN1 interface, since the apparent source of that traffic is located on the same subnet.

If firewall B is not doing NAT however, traffic sent from the Expressway-C to LAN1 of the Expressway-E will appear as coming from 10.0.30.2. If the Expressway does not have a static route added for the 10.0.30.0/24 subnet, it will send replies for this traffic to its default gateway (10.0.10.1) out from LAN2, as it has not been told that the 10.0.30.0/24 subnet is located behind the 10.0.20.1 firewall. Therefore, a static route needs to be added, using the `xCommand RouteAdd` CLI command, which is run from an admin SSH shell on the Expressway.
In this particular example, we want to tell the Expressway-E that it can reach the 10.0.30.0/24 subnet behind the 10.0.20.1 firewall (router), which is reachable via the LAN1 interface. This is accomplished using the following `xCommand RouteAdd` syntax:

```
xCommand RouteAdd Address: 10.0.30.0 PrefixLength: 24 Gateway: 10.0.20.1 Interface: LAN1
```

In this example, the `Interface` parameter could also be set to `Auto` as the gateway address (10.0.20.1) is only reachable via LAN1.

If firewall B is not doing NAT and the Expressway-E needs to communicate with devices in subnets other than 10.0.30.0 which are also located behind firewall B (for example for communicating with management stations for HTTPS and SSH management or for reaching network services such as NTP, DNS, LDAP/AD and syslog servers), static routes will also have to be added for these devices/subnets.

The `xCommand RouteAdd` command and syntax is described in full detail in *Expressway Administrator Guide*.

**Example deployments**

The following section contains additional reference designs which depict other possible deployment scenarios.

**Single subnet DMZ using single Expressway-E LAN interface**

In this case, FW A can route traffic to FW B (and vice versa). Expressway-E allows video traffic to be passed through FW B without pinholing FW B from outside to inside. Expressway-E also handles firewall traversal on its public side.

This deployment consists of:

- a single subnet DMZ – 10.0.10.0/24, containing:
  - the internal interface of firewall A – 10.0.10.1
  - the external interface of firewall B – 10.0.10.2
  - the LAN1 interface of the Expressway-E – 10.0.10.3
- a LAN subnet – 10.0.30.0/24, containing:
  - the internal interface of firewall B – 10.0.30.1
  - the LAN1 interface of the Expressway-C – 10.0.30.2
  - the network interface of Cisco TMS – 10.0.30.3

A static 1:1 NAT has been configured on firewall A, NATing the public address 64.100.0.10 to the LAN1 address of the Expressway-E. **Static NAT mode** has been enabled for LAN1 on the Expressway-E, with a static NAT address of 64.100.0.10.

The traversal client zone on the Expressway-C needs to be configured with a peer address which matches the static NAT address of the Expressway-E, in this case 64.100.0.10. This is because, since the Expressway-E has static NAT mode enabled, it will request that incoming signaling and media traffic should...
be sent to its static NAT address, which means that the traversal client zone has to be configured accordingly.

This means that firewall A must allow traffic from the Expressway-C with a destination address of 64.100.0.10. This is also known as NAT reflection, and it should be noted that this is not supported by all types of firewalls.

The Expressway-E should be configured with a default gateway of 10.0.10.1. Whether or not static routes are needed in this scenario depends on the capabilities and settings of FW A and FW B. Expressway-C to Expressway-E communications will be to the 64.100.0.10 address of the Expressway-E; the return traffic from the Expressway-E to Expressway-C might have to go via the default gateway. If a static route is added to the Expressway-E so that reply traffic goes from the Expressway-E and directly through FW B to the 10.0.30.0/24 subnet, this will mean that asymmetric routing will occur and this may or may not work, depending on the firewall capabilities.

The Expressway-E can be added to Cisco TMS with the IP address 10.0.10.3 (or with IP address 64.100.0.10 if FW A allows this), since Cisco TMS management communications are not affected by static NAT mode settings on the Expressway-E.

3-port firewall DMZ using single Expressway-E LAN interface

In this deployment, a 3-port firewall is used to create

- a DMZ subnet (10.0.10.0/24), containing:
  - the DMZ interface of firewall A - 10.0.10.1
  - the LAN1 interface of the Expressway-E - 10.0.10.2
- a LAN subnet (10.0.30.0/24), containing
  - the LAN interface of firewall A - 10.0.30.1
  - the LAN1 interface of the Expressway-C – 10.0.30.2
  - the network interface of Cisco TMS – 10.0.30.3

A static 1:1 NAT has been configured on firewall A, NATing the public address 64.100.0.10 to the LAN1 address of the Expressway-E. Static NAT mode has been enabled for LAN1 on the Expressway-E, with a static NAT address of 64.100.0.10.

The Expressway-E should be configured with a default gateway of 10.0.10.1. Since this gateway must be used for all traffic leaving the Expressway-E, no static routes are needed in this type of deployment.

The traversal client zone on the Expressway-C needs to be configured with a peer address which matches the static NAT address of the Expressway-E, in this case 64.100.0.10, for the same reasons as those described in the previous example deployment, “Single subnet DMZ using single Expressway-E LAN interface”.
This means that firewall A must allow traffic from the Expressway-C with a destination address of 64.100.0.10. This is also known as NAT reflection, and it should be noted that this is not supported by all types of firewalls.

The Expressway-E can be added to Cisco TMS with the IP address 10.0.10.2 (or with IP address 64.100.0.10 if FW A allows this), since Cisco TMS management communications are not affected by static NAT mode settings on the Expressway-E.
Checking for updates and getting help

If you experience any problems when configuring or using the product, consult the online help available from the user interface. The online help explains how the individual features and settings work.

If you cannot find the answer you need, check the web site at http://www.cisco.com/cisco/web/support/index.html where you will be able to:

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  - the serial number and product model number of the unit (if applicable)
  - the software build number which can be found on the product user interface (if applicable)
  - your contact email address or telephone number
  - a full description of the problem
## Document revision history

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<tr>
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