Cisco Expressway Cluster Creation and Maintenance

Deployment Guide

Cisco Expressway X8.1

Contents

Introduction

Cisco Expressway (Expressway) clusters are designed to extend the resilience and capacity of an Expressway installation. Expressway peers in a cluster share bandwidth usage as well as routing, zone and other configuration among themselves.

Call licensing is carried out on a per-cluster basis. Any call licenses that have been installed on a cluster peer are available for use by any peer within the cluster. If a cluster peer becomes unavailable, the call licenses installed on that peer will remain available to the rest of the cluster peers for two weeks from the time the cluster lost contact with the peer. This will maintain the overall license capacity of the cluster — however, note that each peer is limited by its physical capacity.

Every Expressway peer in the cluster must have the same routing capabilities — if any Expressway can route a call to a destination it is assumed that all Expressway peers in that cluster can route a call to that destination. If the routing is different on different Expressway peers, then separate Expressways / Expressway clusters must be used.

This guide describes how to create and maintain Expressway clusters. It provides information on:

- Setting up a new cluster of Expressway peers [p.6]
- Adding an Expressway to an existing cluster [p.9]
- Specifying peer-specific items [p.13]
- Removing a live Expressway from a cluster (permanently) [p.15]
- Removing an out-of-service Expressway from a cluster (permanently) [p.17]
- Disbanding an Expressway cluster [p.19]
- Changing the primary peer of an Expressway cluster [p.21]
- Changing the IP address of an Expressway peer [p.22]
- Replacing an Expressway peer [p.23]

Prerequisites

Before setting up a cluster of X8.1 Expressway peers or adding an X8.1 Expressway to a cluster, ensure that:

- All clusters peers are running the same version of code. The only occasion where different peers are allowed to run different versions of code is for the short period of time while a cluster is being upgraded from one version of code to another, during which time the cluster will operate in a partitioned fashion.

- A DNS SRV record is available for the cluster which contains A or AAAA records for each peer of the cluster.

- Each peer has a different LAN configuration (a different IPv4 address and a different IPv6 address, where enabled).

- Each peer in a cluster is within a 15ms hop (30ms round trip delay) of each and every other Expressway in or to be added to the cluster.

- Each peer in a cluster is directly routable to each and every other Expressway in or to be added to the cluster. (There must be no NAT between cluster peers – if there is a firewall ensure that the required ports are opened.)

- Each peer is running on a hardware platform with equivalent capabilities; for example, you cannot cluster a peer running on a 2 core Medium VM with peers running on 8 core Large VMs.

- All peers have the same set of option keys installed:
  - The number of call license keys may be different on different peers; all other license keys must be identical on each peer.
  - The Expressway must be restarted after installing some option keys in order to fully activate them.

- Each peer has a different system name.

- H.323 mode is enabled on each peer (**Configuration > Protocols > H.323**, and for **H.323 mode** select *On*); even if all endpoints in the cluster are SIP only, H.323 signaling is used for endpoint location searching and sharing bandwidth usage information with other peers in the cluster.

- The Expressway cluster has a DNS SRV record that defines all cluster peers.

- The DNS servers used by the Expressway peers must support both forward and reverse DNS lookups of all Expressway peer addresses; the DNS servers must also provide address lookup for any other DNS functionality required, such as:
  - NTP servers or the external manager if they configured using DNS names
  - Microsoft Lync Server FQDN lookup
  - LDAP server forward and reverse lookup (reverse lookups are frequently provided through PTR records).
  Note that DNS server configuration is specific to each peer.

Setting up a new cluster of Expressway peers

Note: This procedure requires a period of downtime for the Expressway service. Ensure that these instructions are followed in a scheduled maintenance window.

Process summary

This process initiates a cluster of a single Expressway. Do not use this process if the cluster already exists.

To complete the cluster containing multiple Expressways, when this section is complete, follow the instructions in Adding an Expressway to an existing cluster [p.9] to add the non-primary peers to the cluster.

Prerequisites

- If a firewall exists between cluster peers, it must be configured to permit the traffic documented in Appendix 2: IP ports and protocols [p.26].
- All Expressways to be included in the cluster must be running the same version (X8.1) of Expressway software.

Set up the primary peer of the cluster

This process sets up the first (primary) peer of this new cluster – additional peers are added afterwards using the Adding an Expressway to an existing cluster [p.9] process.

Before proceeding, the Expressway that will be the primary must be determined. The primary Expressway will be the source of the configuration information for all Expressway peers in the cluster. Non-primary Expressway peers will have their configuration deleted and replaced by that from the primary.

On other Expressways:

Check that no other Expressway (anywhere in the organization) has this Expressway's IP address in its clustering peers list.

On this primary Expressway:

1. Check that the Expressway is running X8.1 software.
2. Backup the Expressway (**Maintenance > Backup and restore**).
3. Using the web interface, review the configuration to ensure that the Expressway has:
   - A valid Ethernet speed (**System > Ethernet**).
   - Valid IP address and IP gateway (**System > IP**).
   - The same set of option keys installed as those that will be installed on all other peers of the cluster (**Maintenance > Option keys**).
     Note that the number of call license keys may be different on different peers; all other license keys must be identical on each peer.
   - At least one valid DNS server configured, and that if unqualified DNS names are used elsewhere (e.g. for the NTP server), that the correct **Domain name** is also configured (**Domain name** is added as a suffix to an unqualified DNS name to make it into an FQDN) (**System > DNS**).
   - A valid and working NTP server configured (**System > Time**; in the Status section, the State should be "Synchronized").

- No peers configured (**System > Clustering** – all Peer x IP address fields on this page should be blank. If not, delete any entries and click **Save**).

4. Ensure that this Expressway does not list any of the Expressways that are to be peers in this new cluster in any of its neighbor zones or traversal zones (**Configuration > Zones > Zones** then check each neighbor and traversal zone).

5. Go to **System > DNS** and ensure that **System host name** is the DNS hostname for this Expressway (typically the same as the **System name** in **System > Administration**, but excluding spaces, and unique for each Expressway in the cluster). If it is not configured correctly, set it up appropriately and click **Save**.
Note: <System host name>.<DNS domain name> = FQDN of this Expressway

6. Go to **Configuration > Call routing** and set **Call signaling optimization** to *On*.

7. Click **Save**.

8. Enable maintenance mode:
   a. Go to **Maintenance > Maintenance mode**.
   b. Set **Maintenance mode** to *On*.
   c. Click **Save** and click **OK** on the confirmation dialog.

9. Wait for all calls to clear on this peer.
If necessary, manually remove any calls on this peer that do not clear automatically (using the web browser go to **Status > Calls**, then select the check box next to the calls you want to terminate and click **Disconnect**).

10. Go to **System > Clustering** and ensure that **Cluster name** is the routable Fully Qualified Domain Name used in SRV records that address this Expressway cluster, for example `cluster1.example.com`. (See Appendix 4: Cluster name and DNS SRV records [p.28]).
Change the **Cluster name** if necessary.

11. Click **Save**.

12. On the **Clustering** page configure the fields as follows:

Configuration primary	1
Cluster pre-shared key	Enter a password (any characters)
Peer 1 IP address	Set to the IP address of this (the primary peer) Expressway

Note: If the Expressway has advanced networking, the **Peer IP address** MUST specify the LAN 1 interface address. Also, this interface must not have NAT enabled on it.

13. Click **Save**.
To the right of the **Peer 1 IP address** field the words "This system" should appear (though this may require the page to be refreshed before they appear).

14. Restart the Expressway (go to **Maintenance > Restart options**, then click **Restart** and confirm **OK**).

After the restart, on the primary Expressway web interface:

1. Check that configuration data exists as expected (**System**, **Configuration** and **Application** menus).

2. Backup the Expressway (**Maintenance > Backup and restore**).

On other devices:

If you have any other Expressways neighbored (or connected via a traversal zone) to this primary Expressway peer, ensure that their zone configuration for this cluster is updated to only include the address

of this primary Expressway.

On this primary Expressway peer:

1. Log in to the web browser of this Expressway.
2. Go to **Status > Alarms**.
   If there is an alarm that the Expressway must be restarted, go to **Maintenance > Restart options** and then click **Restart**.
3. If the Expressway did not need to be restarted, ensure that maintenance mode is disabled.
   a. Go to **Maintenance > Maintenance mode**.
   b. Set **Maintenance mode** to *Off*.
   c. Click **Save**.

After the primary peer configuration

Go to **Status > Alarms** and ensure that all alarms are acted upon and cleared.

The setup of the new cluster (of one Expressway) is complete; add other Expressways to the cluster using Adding an Expressway to an existing cluster [p.9].

If Microsoft Lync is to be connected to this cluster, see Appendix 3: Impact of clustering on other Expressway applications [p.27].

Adding an Expressway to an existing cluster

Follow this process if you have an existing X8.1 cluster (of one or more peers) to which you want to add another Expressway peer. If you do not have an existing cluster, following the instructions in the section Setting up a new cluster of Expressway peers [p.6].

This process will add an X8.1 Expressway to the cluster and replicate the cluster primary's configuration onto that Expressway. Note that:

- You can have up to 6 Expressways, including the primary Expressway, in a cluster.
- Only one Expressway must be added to the cluster at a time.

Prerequisites

All Expressways to be included in the cluster must be running the same version (X8.1) of Expressway software.

Add the new peer

On the primary Expressway:

Ensure that the primary Expressway does not list this new Expressway peer in any of its neighbor zones or traversal zones (**Configuration > Zones > Zones**).

Note: The primary Expressway will be the source of the configuration for this new Expressway peer and all other Expressway peers in the cluster. When an Expressway is added to the cluster, its configuration will be deleted and replaced by that from the primary.

On the Expressway to be added to the cluster:

1. Check that no other Expressway (anywhere in the organization) has this Expressway's IP address in its clustering peers list.
2. Backup the Expressway (**Maintenance > Backup and restore**).
3. Using the web interface, review the configuration to ensure that the Expressway has:
   - A valid Ethernet speed (**System > Ethernet**).
   - Valid IP address and IP gateway (**System > IP**).
   - The same set of option keys installed as those that will be installed on all other peers of the cluster (**Maintenance > Option keys**).
     Note that the number of call license keys may be different on different peers; all other license keys must be identical on each peer.
   - At least one valid DNS server configured, and that if unqualified DNS names are used elsewhere (e.g. for the NTP server), that the correct **Domain name** is also configured (**Domain name** is added as a suffix to an unqualified DNS name to make it into an FQDN) (**System > DNS**).
   - A valid and working NTP server configured (**System > Time**; in the Status section, the State should be "Synchronized").
   - No peers configured (**System > Clustering** – all Peer x IP address fields on this page should be blank. If not, delete any entries and click **Save**).

Go to **Status > Alarms**. If there is an alarm that the Expressway must be restarted, go to **Maintenance > Restart options** and then click **Restart**.

If multiple peers need restarting: restart each peer in turn, waiting for the peer to be accessible through the web interface before restarting the next peer.

1. Enable maintenance mode:
   a. Go to **Maintenance > Maintenance mode**.
   b. Set **Maintenance mode** to *On*.
   c. Click **Save** and click **OK** on the confirmation dialog.
2. Wait for all calls to clear on this peer.
   If necessary, manually remove any calls on this peer that do not clear automatically (using the web browser go to **Status > Calls**, then select the check box next to the calls you want to terminate and click **Disconnect**).

On the primary Expressway:

1. Go to **System > Clustering**.
   One or more of the **Peer x IP address** fields should be empty.
2. In the first empty field, enter the IP address of the new Expressway peer.

   Note:
   - Only one Expressway must be added to the cluster at a time (repeat the whole process if multiple Expressway peers are being added).
   - If the new Expressway peer has advanced networking, the Peer IP address MUST specify the LAN 1 interface address – also this interface must not have NAT enabled on it.

3. Click **Save**.
   Peer 1 should indicate 'This system'. The new peer may indicate 'Unknown' and then with a refresh should indicate 'Failed' as the Expressway is not completely added to the cluster.

   Note:
   - A cluster communication failure alarm will be raised on the primary and on other non-primary peers already in the cluster advising that this new Expressway peer is not communicating – this will clear later.
   - Cluster configuration replication is suspended at this point until the new Expressway has been completely added. Any changes made to the configuration of the cluster will not be replicated until this Expressway has been completely added.

On every other non-primary Expressway already in the cluster (not the Expressway being added):

1. Go to **System > Clustering** and configure the fields as follows:

Cluster name	Identical to the **Cluster name** configured on the primary Expressway
Cluster pre-shared key	Identical to that configured on the primary Expressway
Configuration primary	Identical to that configured on the primary Expressway
Peer 1 IP address …Peer 6 IP address	Identical to those configured on the primary Expressway

2. Click **Save**.

On the additional non-primary Expressway being added to the cluster:

1. Log in as admin on an SSH or other CLI interface. At the Expressway command prompt, type:
   ```
   xcommand DefaultValuesSet Level: 2
   xcommand DefaultLinksAdd
   ```

   Note: This command removes any LDAP authentication configuration – ensure that you have the web admin password before executing this command.

2. Go to **Users > Administrator accounts**.

3. Delete all entries except the default admin account.

4. Go to **System > DNS** and ensure that **System host name** is the DNS hostname for this Expressway (typically the same as the **System name** in **System > Administration**, but excluding spaces, and unique for each Expressway in the cluster). If it is not configured correctly, set it up appropriately and click **Save**.
   Note: <System host name>.<DNS domain name> = FQDN of this Expressway

5. Go to **System > Clustering** and configure the fields as follows:

Cluster name	Identical to the **Cluster name** configured on the primary Expressway
Cluster pre-shared key	Identical to that configured on the primary Expressway
Configuration primary	Identical to that configured on the primary Expressway
Peer 1 IP address …Peer 6 IP address	Identical to those configured on the primary Expressway

6. Click **Save**.
   Note that a cluster communication failure alarm will be raised on this Expressway peer advising that this new Expressway is not communicating – this will clear after the restart.

7. Restart the Expressway (go to **Maintenance > Restart options**, then click **Restart** and confirm **OK**).
   If multiple peers need restarting: restart each peer in turn, waiting for the peer to be accessible through the web interface before restarting the next peer.

8. After the restart, wait approximately 2 minutes – this is the frequency with which configuration is copied from the primary.

9. Go to **Status > Alarms**. If there is an alarm that the Expressway must be restarted, go to **Maintenance > Restart options** and then click **Restart**.
   If multiple peers need restarting: restart each peer in turn, waiting for the peer to be accessible through the web interface before restarting the next peer.

10. Check that configuration data exists as expected (**System**, **Configuration** and **Application** menus).

On other devices:

If you have any other Expressways neighbored (or connected via a traversal zone) to this cluster of Expressway peers, ensure that their zone configuration for this cluster is updated to include the address of this new peer.

On each Expressway peer (including the primary and this new Expressway peer):

Go to **Status > Alarms**. If there is an alarm that the Expressway must be restarted, go to **Maintenance > Restart options** and then click **Restart**.

If multiple peers need restarting: restart each peer in turn, waiting for the peer to be accessible through the web interface before restarting the next peer.

Check replication status

It can take 5 or more minutes before Expressway reports the successful status. If problems are seen, refresh the screen after waiting 5 minutes.

Go to **System > Clustering** and check that the cluster database status reports as Active.

Additional cluster configuration

If the cluster has non-default trusted CA certificate and / or non default server certificate ensure that the added peer is configured with the required trusted CA certificate and an appropriate server certificate.

Adding an X8.1 Expressway to an Expressway X8.1 cluster is now complete.

Specifying peer-specific items

Most items of configuration are applied to all peers in a cluster. However, the following items (marked with a † on the web interface) must be specified separately on each cluster peer.

Cluster configuration (System > Clustering)

The list of **Peer IP addresses** (including the peer's own IP address) that make up the cluster has to be specified on each peer and they must be identical on each peer.

The **Cluster name** and **Cluster pre-shared key** have to be specified on each peer and must be identical for all peers.

Ethernet speed (System > Ethernet)

The **Ethernet speed** is specific to each peer. Each peer may have slightly different requirements for the connection to their Ethernet switch.

IP configuration (System > IP)

LAN configuration is specific to each peer.

- Each peer must have a different **IPv4 address** and a different **IPv6 address**.
- **IP gateway** configuration is peer-specific. Each peer can use a different gateway.
- IP routes (also known as static routes) are peer-specific. If these are used, they can be different for each peer.

Note that the IP protocol is applied to all peers, because each peer must support the same protocols.

System name (System > Administration)

The **System name** must be different for each peer in the cluster.

DNS servers and DNS host name (System > DNS)

DNS servers are specific to each peer. Each peer can use a different set of DNS servers.

The **System host name** and **Domain name** are specific to each peer.

NTP servers and time zone (System > Time)

The **NTP servers** are specific to each peer. Each peer may use one or more different NTP servers.

The **Time zone** is specific to each peer. Each peer may have a different local time.

SNMP (System > SNMP)

SNMP settings are specific to each peer. They can be different for each peer.

Logging (Maintenance > Logging)

The Event Log and Configuration Log on each peer only report activity for that particular Expressway. The **Log level** and the list of **Remote syslog servers** are specific to each peer. We recommend that you set up a remote syslog server to which the logs of all peers can be sent. This allows you to have a global view of activity across all peers in the cluster.

Security certificates (Maintenance > Security certificates)

The trusted CA certificate, server certificate and certificate revocation lists (CRLs) used by the Expressway must be uploaded individually per peer.

Administration access (System > Administration)

The following system administration access settings are specific to each peer:

- Serial port / console
- SSH service
- Web interface (over HTTPS)
- Redirect HTTP requests to HTTPS
- Automated protection service

Option keys (Maintenance > Option keys)

Option keys are specific to each peer. Each peer must have an identical set of option keys installed, but you must purchase these separately for each peer in the cluster. However, this does not apply to rich media session and TURN relay licenses; these licenses can be installed on any cluster peer and are available for use by any peer in the cluster.

Note: configuration data that is applied across all peers should not be modified on non-primary peers. At best it will result in the changes being overwritten from the primary; at worst it will cause cluster replication to fail.

Removing a live Expressway from a cluster (permanently)

This process removes one Expressway peer from an existing cluster. Configuration replication to this Expressway will be stopped and the Expressway will no longer be included in the list of peers in the cluster.

- If the whole cluster is to be disbanded then use the Disbanding an Expressway cluster [p.19] procedure instead.
- If the cluster peer to be removed is not accessible, use the procedure defined in Removing an out-of-service Expressway from a cluster (permanently) [p.17].

Before starting:

1. Ensure that the Expressway to be removed from the cluster is not indicated as the primary peer.
   If it is the primary, see Changing the primary peer of an Expressway cluster [p.21] for instructions on how to make a different peer the primary.

On the Expressway that is being removed:

1. Log into the web interface.
2. Go to **System > Clustering**:
   a. Change the **Cluster name** to a unique ID for this Expressway (ideally to the routable Fully Qualified Domain Name used in SRV records that address this individual Expressway, for example "expe1.example.com". See Appendix 4: Cluster name and DNS SRV records [p.28].)
   b. Delete the **Cluster pre-shared key**.
   c. Delete all entries in the **Peer x IP address** fields.
3. Click **Save**.
   Note that:
   - An alarm similar to that shown below may appear on the web interface and CLI of the Expressway being removed. This is not a problem, the alarm will be cleared when the Expressway is restarted:

4. If Microsoft Lync B2BUA was used in the cluster:
   a. Go to **Applications > B2BUA > Microsoft Lync > Configuration**.
   b. If **Microsoft Lync B2BUA** is *Enabled*, change it to *Disabled* and click **Save**.
5. Restart the Expressway (go to **Maintenance > Restart options**, then click **Restart** and confirm **OK**).

On the primary Expressway:

1. Go to **System > Clustering**.
2. Delete the IP address of the Expressway that has been removed.
3. If the Expressway being removed is not the last field in the list, move any other IP addresses up the list so that there are no empty fields between entries.
4. If the primary Expressway peer's IP address has been moved up the list in the previous step, alter the **Configuration primary** value to match its new location.
5. Click **Save**.

On all the remaining non-primary Expressway peers:

1. Go to **System > Clustering**.
2. Edit the **Peer x IP address** and **Configuration primary** fields so that they are identical to those configured on the primary Expressway.
3. Click **Save**.
4. Repeat for all remaining non-primary Expressway peers until they all have identical clustering configuration.

On other devices:

If you have any other systems neighbored (or connected via a traversal zone) to this cluster of Expressway peers, ensure that their zone configuration for this cluster is updated to exclude the address of the removed peer.

CAUTION: The removed Expressway will retain its configuration at the time it is removed from the cluster, and will continue to function as a non-clustered Expressway. After it has been removed from the cluster, we recommend that it is taken out of service (e.g. perform a factory reset as documented in Removing an out-of-service Expressway from a cluster (permanently) [p.17] before reconnecting the out-of-service Expressway back to the network) or an alternative configuration is applied to the Expressway, so that other devices no longer try to use it as a cluster peer.

Removing a live Expressway from a cluster is now complete.

Removing an out-of-service Expressway from a cluster (permanently)

Use the following procedure if:

- the Expressway is dead and needs to be RMAd, or
- the Expressway cannot be accessed for some other reason

If the whole cluster is to be disbanded then use the procedure defined in Disbanding an Expressway cluster [p.19].

If the cluster peer to be removed is accessible, use the procedure defined in Removing a live Expressway from a cluster (permanently) [p.15] which clears up the removed Expressway as well as its previous peers.

Note: This procedure does not delete clustering configuration from the removed Expressway. When removed, you must not reconnect the out-of-service Expressway without first deleting all of its peers and stopping configuration replication (see Before reconnecting the out-of-service Expressway back to the network [p.18] below).

Before starting:

If it is the primary Expressway, see Changing the primary peer of an Expressway cluster [p.21] for instructions on how to make a different peer the primary.

On the primary Expressway:

1. Go to **System > Clustering**.
2. Delete the IP address of the Expressway that has been removed.
3. If the Expressway being removed is not the last field in the list, move any other IP addresses up the list so that there are no empty fields between entries.
4. If the primary Expressway peer's IP address has been moved up the list in the previous step, alter the **Configuration primary** value to match its new location.
5. Click **Save**.

On all the remaining non-primary Expressway peers:

1. Go to **System > Clustering**.
2. Edit the **Peer x IP address** and **Configuration primary** fields so that they are identical to those configured on the primary Expressway.
3. Click **Save**.
4. Repeat for all remaining non-primary Expressway peers until they all have identical clustering configuration.

On other devices:

If you have any other systems neighbored (or connected via a traversal zone) to this cluster of Expressway peers, ensure that their zone configuration for this cluster is updated to exclude the address of the removed peer.

Removing an out-of-service Expressway from a cluster is now complete.

Before reconnecting the out-of-service Expressway back to the network

If the removed Expressway is ever recovered, before you reconnect it you must clear out its configuration. This is most easily implemented as follows:

1. Log into the Expressway as root (over serial or SSH – serial connection will show more details as the factory reset progresses).
2. Type **factory-reset**
3. Answer the prompts as follows:
   a. Keep option keys = YES
   b. Keep IP configuration = YES or NO - depends on whether the Expressway has been replaced with another at the same IP address
   c. Keep SSH keys = NO
   d. Keep root and admin passwords = YES or NO … as desired
   e. Save log files = NO … unless specifically requested for analysis purposes
   f. Replace hard disk = NO
   g. Are you sure you want to continue = YES
   Some messages will be displayed, then connection over serial / SSH will be lost.
   It may take some 20 or more minutes before Expressway is available to access again.
4. Log into the Expressway as admin over SSH.
5. Type **xcommand DefaultLinksAdd**

This ensures that the configuration of the recovered Expressway is returned to default and it will not interact with its ex-peers.

Disbanding an Expressway cluster

This process removes all Expressway peers from an existing cluster.

Each Expressway will retain its configuration at the time the cluster was disbanded, and will function as a stand-alone Expressway.

Before you start:

If any Expressway is not accessible, firstly remove it using the procedure Removing an out-of-service Expressway from a cluster (permanently) [p.17].
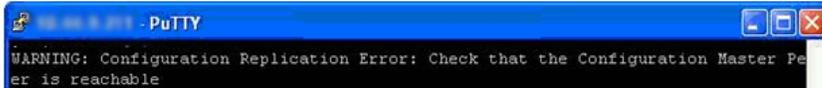
On each non-primary Expressway peer:

1. Log into the web interface.
2. Go to **System > Clustering**:
   a. Change the **Cluster name** to a unique ID for this Expressway (ideally to the routable Fully Qualified Domain Name used in SRV records that address this individual Expressway, for example "expe1.example.com". See Appendix 4: Cluster name and DNS SRV records [p.28].)
   b. Delete the **Cluster pre-shared key**.
   c. Delete all entries in the **Peer x IP address** fields.
3. Click **Save**.
   Note that:
   - An alarm similar to that shown below may appear on the web interface and CLI of the Expressway being removed. This is not a problem, the alarm will be cleared when the Expressway is restarted:

4. If Microsoft Lync B2BUA was used in the cluster:
   a. Go to **Applications > B2BUA > Microsoft Lync > Configuration**.
   b. If **Microsoft Lync B2BUA** is *Enabled*, change it to *Disabled* and click **Save**.
5. Restart the Expressway (go to **Maintenance > Restart options**, then click **Restart** and confirm **OK**).
   If multiple peers need restarting: restart each peer in turn, waiting for the peer to be accessible through the web interface before restarting the next peer.
6. Repeat for each non-primary Expressway.

On the primary Expressway:

1. Log into the web interface.
2. Go to **System > Clustering**:
   a. Optionally, change the **Cluster name** to a unique ID for this Expressway (ideally to the routable Fully Qualified Domain Name used in SRV records that address this individual Expressway, for example "expe1.example.com". (See Appendix 4: Cluster name and DNS SRV records [p.28].))
   b. Delete the **Cluster pre-shared key**.
   c. Delete all entries in the **Peer x IP address** fields.
3. Click **Save**.
   Note that:
   - An alarm similar to that shown below may appear on the web interface and CLI of the Expressway being removed. This is not a problem, the alarm will be cleared when the Expressway is restarted:

4. Restart the Expressway (go to **Maintenance > Restart options**, then click **Restart** and confirm **OK**).

On other devices:

If you have any other systems neighbored (or connected via a traversal zone) to this cluster of Expressway peers, ensure that they have those zones removed, or modified appropriately.

Disband a cluster of Expressways is now complete.

Changing the primary peer of an Expressway cluster

This procedure can be applied regardless of whether the old primary peer is accessible or not.

Note: The operations in this process should be performed successively so that the cluster is not left in a state where there are multiple Expressways which think they are cluster primary.

On the "new" primary Expressway:

1. Go to **System > Clustering**.
2. From the **Configuration primary** drop-down menu select the ID number of the peer entry that says 'This system'.
3. Click **Save**.
   While performing this change of primary peer, ignore any alarms on Expressway that report 'Cluster primary mismatch' or 'Cluster replication error' – they will be rectified as part of this procedure.

On all other Expressway peers, starting with the "old" primary peer (if it is still accessible):

1. Go to **System > Clustering**.
2. From the **Configuration primary** drop-down menu select the ID number of the "new" primary Expressway.
3. Click **Save**.

On each Expressway in the cluster (including the primary):

1. Confirm that the change to the **Configuration primary** has been accepted by going to **System > Clustering** and refreshing the page.
2. If any Expressways have not accepted the change, repeat the steps above.
3. Check that the cluster database status reports as Active.

Note that any alarms raised on the Expressway peers that relate to 'Cluster primary mismatch' and 'Cluster replication error' should clear automatically after approximately 2 minutes.

If the old primary is not available

If you are changing the primary because the "old" primary is not accessible, remove the "old" primary using the Removing an out-of-service Expressway from a cluster (permanently) [p.17] procedure.

If the "old" primary was not accessible when changing the cluster primary peer, but later becomes available, you must bring it back into the cluster using the Adding an Expressway to an existing cluster [p.9] procedure.

Changing the primary peer of an Expressway cluster is now complete.

Changing the IP address of an Expressway peer

To change the IP address of an Expressway peer you must remove the Expressway from the cluster, change its IP address, and then add the Expressway back into the cluster.

The process is as follows:

1. Ensure that the Expressway whose IP address is to be changed is not the primary Expressway.
   If it is the primary Expressway, follow the steps in Changing the primary peer of an Expressway cluster [p.21] to make a different peer the primary.
2. Carry out the process documented in Removing a live Expressway from a cluster (permanently) [p.15].
3. Change the IP address of the Expressway.
4. Carry out the process documented in Adding an Expressway to an existing cluster [p.9].

Changing the IP address of an Expressway peer is now complete.

Replacing an Expressway peer

This section summarizes the procedure for replacing a cluster peer Expressway with a different unit.

1. Ensure that the Expressway to be replaced is not the primary Expressway.
    If it is the primary Expressway, follow the steps in Changing the primary peer of an Expressway cluster [p.21] to make a different peer the primary.

2. Remove the existing peer from the cluster:
    a. If the cluster peer to be replaced is not accessible, use the procedure defined in Removing an out-of-service Expressway from a cluster (permanently) [p.17].
    b. If the cluster peer to be replaced is accessible, use the procedure defined in Removing a live Expressway from a cluster (permanently) [p.15].

3. Add the replacement peer to the cluster using the procedure defined in Adding an Expressway to an existing cluster [p.9].

Appendix 1: Troubleshooting

Expressway alarms and warnings

"Cluster name not configured: if clustering are in use a cluster name must be defined"

Ensure that the same cluster name is configured on each Expressway in the cluster.

The **Cluster name** should be the routable Fully Qualified Domain Name used in SRV records that address this Expressway cluster, for example "cluster1.example.com". (See Appendix 4: Cluster name and DNS SRV records [p.28]).

"Cluster replication error: <details> manual synchronization of configuration is required"

This may be:

- "Cluster replication error: manual synchronization of configuration is required"
- "Cluster replication error: cannot find primary or this subordinate's peer configuration file, manual synchronization of configuration is required"
- "Cluster replication error: configuration primary ID is inconsistent, manual synchronization of configuration is required"
- "Cluster replication error: this peer's configuration conflicts with the primary's configuration, manual synchronization of configuration is required"

If a non-primary Expressway reports an alarm: "Cluster replication error – <details> synchronization of configuration"

On that non-primary Expressway:

1. Log in as admin on an SSH or other CLI interface.
2. At the command prompt type:
   xcommand ForceConfigUpdate
   This will delete the non-primary Expressway configuration and then force it to update its configuration from the primary Expressway.

   CAUTION: Only use this command if the configuration on the primary Expressway is known to be in a good state. We recommend that you take a backup before running this command.

"Cluster replication error: the NTP server is unreachable"

Configure an accessible NTP server on the Expressway **System > Time** page.

"Cluster replication error: the local Expressway does not appear in the list of peers"

Check and correct the list of peers for this Expressway on the primary Expressway, and copy to all other Expressway peers (**System > Clustering**).

"Cluster replication error: automatic replication of configuration has been temporarily disabled because an upgrade is in progress"

Wait until the upgrade has completed.

"Invalid clustering configuration: H.323 mode must be turned On - clustering uses H.323 communications between peers"

Ensure that H.323 mode is on (see **Configuration > Protocols > H.323**).

"Expressway database failure: Please contact your Cisco support representative"

The support representative will help you work through the following steps:

1. Take a system snapshot and provide it to your support representative.
2. Remove the Expressway from the cluster using: Removing a live Expressway from a cluster (permanently) [p.15].
3. Restore that Expressway's database by restoring a backup taken on that Expressway previously.
4. Add the Expressway back to the cluster using Adding an Expressway to an existing cluster [p.9].

A second method is possible if the database does not recover:

1. Take a system snapshot and provide to TAC.
2. Remove the Expressway from the cluster using: Removing a live Expressway from a cluster (permanently) [p.15].
3. Log in as root and run `clusterdb_destroy_and_purge_data.sh`
4. Restore that Expressway's database by restoring a backup taken on that Expressway previously.
5. Add the Expressway back to the cluster using Adding an Expressway to an existing cluster [p.9].

Note: `clusterdb_destroy_and_purge_data.sh` is as dangerous as it sounds – only use this command in conjunction with instructions from your support representative.

Cluster with Advanced Networking is not replicating correctly

Expressway-Es with Advanced Networking are only designed to replicate through their LAN 1 interface. Ensure that the **Peer x IP Address** entries specified in **System > Clustering** all refer to LAN 1 interfaces.

Also, this replicating interface (LAN 1) must not have NAT enabled on it.

Cluster with static NAT is not replicating correctly

When using Expressway-Es with static NAT, the cluster replication must occur on the LAN interface which is not behind the NAT device. Therefore LAN interface 1 must be the non-NAT interface and the **Peer x IP Address** entries specified in **System > Clustering** must all refer to LAN 1 interfaces. LAN interface 2 must be configured for static NAT.

Appendix 2: IP ports and protocols

It is unusual to have any sort of firewall between cluster peers, but if there is, the IP protocols and ports that must be open between each and every Expressway peer in the cluster are listed below.

For cluster communications between Expressway peers:

- UDP port 500 (ISAKMP) is used for PKI (Public Key Infrastructure) key exchange
- Standard SIP and H.323 signaling ports are used for calls
- UDP port 1719 is used for bandwidth updates between Expressway peers
- IP protocol 51 (IPSec AH) is used for database synchronization
- UDP ephemeral ports are used for cluster management

If you are using the Expressway's built-in **Firewall rules** feature then you must ensure that it is not configured to drop or reject traffic sent to UDP ports 4369 – 4380.

IPSec communications

For IPSec between Expressway cluster peers:

- AES256 is used for encryption, SHA256 (4096 bit key length) is used for authentication; peers are identified by their IP address and are authenticated using a pre-shared key
- Main mode is used during the IKE exchange
- diffie-hellman group 'modp4096' is used

Appendix 3: Impact of clustering on other Expressway applications

Microsoft Lync

If Lync Server is to be configured to operate with an Expressway cluster, see *Microsoft Lync and Expressway Deployment Guide*.

Appendix 4: Cluster name and DNS SRV records

Using DNS SRV to convert a domain to an IP address has a number of benefits:

- The structure of the lookup includes service type and protocol as well as the domain, so that a common domain can be used to reference multiple different services which are hosted on different machines (e.g. html, sip, h.323).

- The DNS SRV response includes priority and weighting values which allow the specification of primary, secondary, tertiary etc groups of servers, and within each priority group, the weighting defines the proportion of accesses that should use each server.

- As the DNS SRV response contains details about priorities and weights of multiple servers, the receiving device can use a single lookup to search for an in-service server (where some servers are inaccessible) without the need to repeatedly query the DNS server. (This is in contrast to using round robin DNS which does require repeated lookups into the DNS server if initial servers are found to be inaccessible.)

The generic format of a DNS SRV query is:

- _service._protocol.<fully.qualified.domain>

The format of DNS SRV queries for sip (RFC 3263) and h.323 used by Expressway are:

- _sips._tcp.<fully.qualified.domain>
- _sip._tcp.<fully.qualified.domain>
- _sip._udp.<fully.qualified.domain> - not recommended for video calls, only use for audio-only calls
- _h323ls._udp.<fully.qualified.domain> - for UDP location (RAS) signaling, such as LRQ
- _h323cs._tcp.<fully.qualified.domain> - for H.323 call signaling

The format of DNS SRV queries for sip (RFC 3263) and h.323 typically used by an endpoint are:

- _sips._tcp.<fully.qualified.domain>
- _sip._tcp.<fully.qualified.domain>
- _sip._udp.<fully.qualified.domain> - not recommended for video calls, only use for audio-only calls
- _h323ls._udp.<fully.qualified.domain> - for UDP location (RAS) signaling, such as LRQ
- _h323cs._tcp.<fully.qualified.domain> - for H.323 call signaling

The DNS SRV response is a set of records in the format:

- _service._protocol.<fully.qualified.domain>. TTL Class SRV Priority Weight Port Target
  where Target is an A-record defining the destination.

Note that UDP is not a recommended transport medium for video signaling; SIP messaging for video system is too large to be reliably carried on datagram-based (rather than stream-based) transports.

Further details on DNS SRV can be found in *Expressway Administrator Guide* and *RFC 2782*.

The Expressway **Cluster name** (configured on the **System > Clustering** page) should be the <fully.qualified.domain> specified in the DNS SRV records that point to the Expressway cluster.

Example

DNS SRV records for 2 peers of an Expressway-E cluster for company.com

where:

- FQDN of Expressway-E peer 1: expe1.company.com
- FQDN of Expressway-E peer 2: expe2.company.com
- FQDN of Expressway-E cluster: company.com

```
_sips._tcp.company.com. 86400 IN SRV 1 1 5061 expe1.company.com.
_sips._tcp.company.com. 86400 IN SRV 1 1 5061 expe2.company.com.

_sip._tcp.company.com. 86400 IN SRV 1 1 5060 expe1.company.com.
_sip._tcp.company.com. 86400 IN SRV 1 1 5060 expe2.company.com.

_h323ls._udp.company.com. 86400 IN SRV 1 1 1719 expe1.company.com.
_h323ls._udp.company.com. 86400 IN SRV 1 1 1719 expe2.company.com.

_h323cs._tcp.company.com. 86400 IN SRV 1 1 1720 expe1.company.com.
_h323cs._tcp.company.com. 86400 IN SRV 1 1 1720 expe2.company.com.
```

Note that:

- Priorities are all the same. Only use different priorities if you have different clusters allowing failover from one primary cluster to another (secondary) cluster. In that case the primary cluster's peers should have one value and the other (secondary) cluster's peers a (larger) value.
- Weights should be the same – so that there is equal use of each peer.

Checking DNS SRV settings

Checking DNS SRV settings via web interface

1. Go to **Maintenance > Tools > Network utilities > DNS lookup**.
2. Enter the SRV path in the **Host** field.
3. Click **Lookup**.

Nslookup

nslookup -query=SRV _sip._tcp.example.com

Dig

dig _sip._tcp.example.com SRV

```
; <<>> DiG 9.4.1 <<>> _sip._tcp.example.com SRV
;; global options:  printcmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 44952
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 2, ADDITIONAL: 4

;; QUESTION SECTION:
```

```
;_sip._tcp.example.com.          IN      SRV

;; ANSWER SECTION:
_sip._tcp.example.com. 1183      IN      SRV     1 0 5060 expe1.example.com.
_sip._tcp.example.com. 1183      IN      SRV     1 0 5060 expe2.example.com.

;; AUTHORITY SECTION:
example.com.           87450     IN      NS      ns1.mydyndns.org.
example.com.           87450     IN      NS      ns2.mydyndns.org.

;; ADDITIONAL SECTION:
expe1.example.com.       1536     IN      A       194.73.59.53
expe2.example.com.       1376     IN      A       194.73.59.54
ns1.mydyndns.org.          75     IN      A       204.13.248.76
ns2.mydyndns.org.       10037     IN      A       204.13.249.76

;; Query time: 0 msec

~ #
```

Appendix 5: NAPTR records

NAPTR records are typically used to specify various methods to connect to a destination URI, for example by email, by SIP, by H.323. They can also be used to specify the priority to use for those connection types, for example to use SIP TLS in preference over using SIP TCP or SIP UDP.

NAPTR records are also used in ENUM, when converting a telephone number into a dialable URI. (For further details on ENUM see *ENUM Dialing on Expressway Deployment Guide*).

NAPTR record format

Example: SIP access to example.com, and for enum lookups for 557120, 557121, and 557122.

$ORIGIN example.com.

```
IN   NAPTR   10   100   "s"   "SIPS+D2T"   ""   _sips._tcp.example.com.
IN   NAPTR   12   100   "s"   "SIP+D2T"    ""   _sip._tcp.example.com.
IN   NAPTR   14   100   "s"   "SIP+D2U"    ""   _sip._udp.example.com.
```

$ORIGIN www.example.com.

```
IN   NAPTR   10   100   "s"   "http+I2R"   ""   _http._tcp.example.com.
IN   NAPTR   10   100   "s"   "ftp+I2R"    ""   _ftp._tcp.example.com.
```

$ORIGIN 0.2.1.7.5.5.enum.lookup.com.

```
IN   NAPTR   10   100   "u"   "E2U+sip"    "!^.*$!john.smith@tandberg.com!"        .
IN   NAPTR   12   100   "u"   "E2U+h323"   "!^.*$!john.smith@tandberg.com!"        .
IN   NAPTR   10   100   "u"   "mailto+E2U" "!^.*$!mailto:john.smith@tandberg.com!" .
```

$ORIGIN 1.2.1.7.5.5.enum.lookup.com.

```
IN   NAPTR   10   100   "u"   "E2U+sip"    "!^.*$!mary.jones@tandberg.com!"        .
```

$ORIGIN 2.2.1.7.5.5.enum.lookup.com.

```
IN   NAPTR   10   100   "u"   "E2U+h323"   "!^.*$!peter.archibald@myco.com!"       .
```

```
IN = Internet routing
    NAPTR = record type
            10 = order value (use lowest order value first)
                100 = preference value if multiple entries have the same order value
                    "u" = the result is a routable URI
                    "s" = the result is a DNS SRV record
                    "a" = the result is an 'A' or 'AAAA' record
                        "E2U+sip" to make SIP call
                        "E2U+h323" to make h.323 call
                                Regular expression:
                                ! = delimiter
                                "" = no expression used
                                … usual Regex expressions can be used
                                    Replace field; . = not used
```

Looking up an ENUM NAPTR record

```
dig 4.3.7.8.enum4.example.com. NAPTR
```

```
; <<>> ;; global options:  printcmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 38428
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 1, ADDITIONAL: 2

;; QUESTION SECTION:
;4.3.7.8.enum4.example.com. IN    NAPTR

;; ANSWER SECTION:
4.3.7.8.enum4.example.com. 60 IN NAPTR 10 100 "u" "E2U+sip" "!^.*$!bob@example.com!" .
4.3.7.8.enum4.example.com. 60 IN NAPTR 10 100 "u" "E2U+h323" "!^.*$!bob@example.com!" .

;; AUTHORITY SECTION:
enum4.example.com. 60   IN     NS     int-server1.example.com.

;; ADDITIONAL SECTION:
int-server1.example.com. 3600 IN A      10.44.9.144
int-server1.example.com. 3600 IN AAAA   3ffe:80ee:3706::9:144

;; Query time: 0 msec
```

Looking up a domain NAPTR record

Example: NAPTR record allowing endpoints to detect that they are in the public (external) network. The flag "s" is extended to "se" to indicate that it is "external".

~ # dig -t NAPTR example.com

```
; <<>> DiG 9.4.1 <<>> -t NAPTR example.com
;; global options:  printcmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 1895
;; flags: qr rd ra; QUERY: 1, ANSWER: 3, AUTHORITY: 6, ADDITIONAL: 4

;; QUESTION SECTION:
;example.com.            IN     NAPTR

;; ANSWER SECTION:
example.com.    2    IN   NAPTR   50 50 "se" "SIPS+D2T" "" _sips._tcp.example.com.
example.com.    2    IN   NAPTR   90 50 "se" "SIP+D2T" "" _sip._tcp.example.com.
example.com.    2    IN   NAPTR   100 50 "se" "SIP+D2U" "" _sip._udp.example.com.

;; AUTHORITY SECTION:
example.com.             320069 IN     NS     nserver2.example.com.
example.com.             320069 IN     NS     nserver.euro.example.com.
example.com.             320069 IN     NS     nserver.example.com.
example.com.             320069 IN     NS     nserver3.example.com.
example.com.             320069 IN     NS     nserver4.example.com.
example.com.             320069 IN     NS     nserver.asia.example.com.

;; ADDITIONAL SECTION:
nserver.example.com.     56190   IN     A     17.111.10.50
nserver2.example.com.    57247   IN     A     17.111.10.59
nserver3.example.com.    57581   IN     A     17.22.14.50
nserver4.example.com.    57452   IN     A     17.22.14.59

;; Query time: 11 msec
```

Document revision history

The following table summarizes the changes that have been applied to this document.

Revision	Date	Description
1	December 2013	Initial release.