Mobility Groups

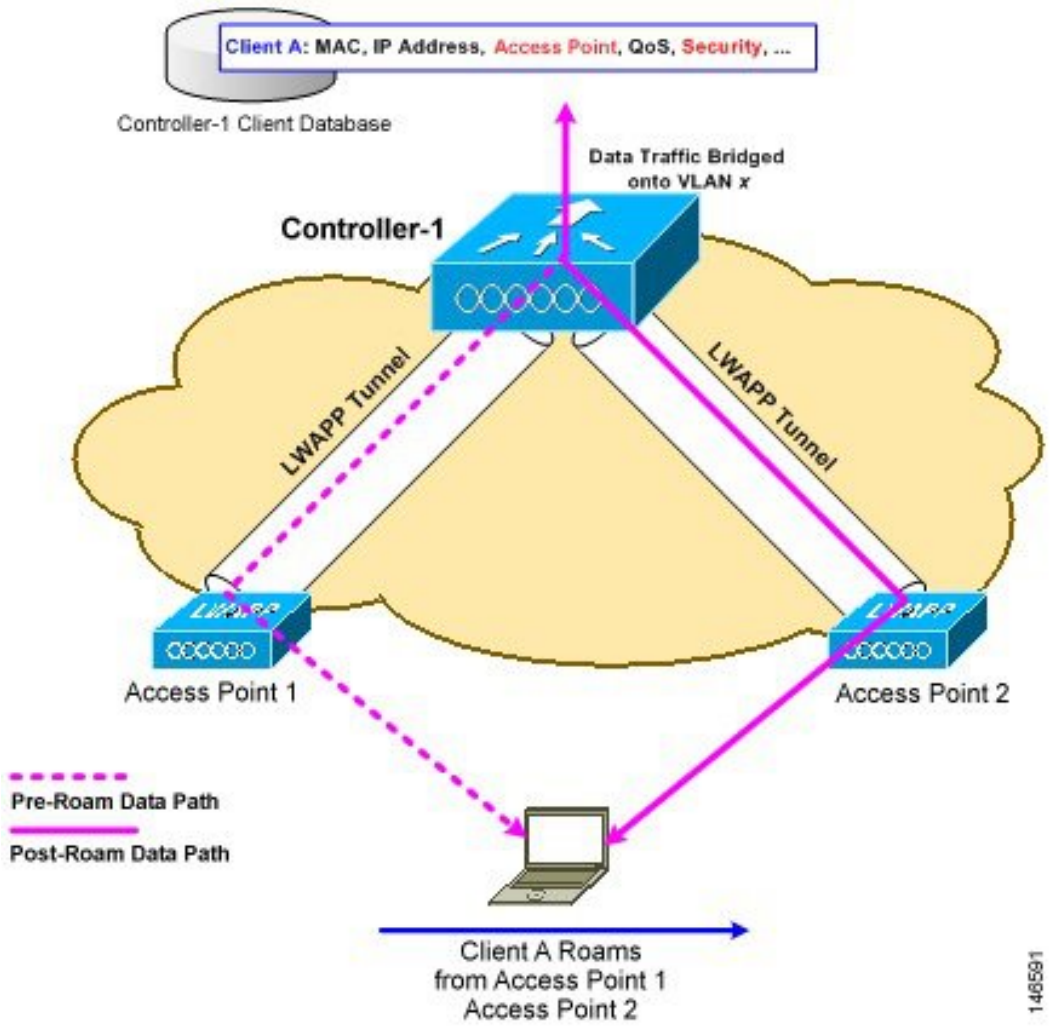
Information About Mobility

Mobility, or roaming, is a wireless LAN client's ability to maintain its association seamlessly from one access point to another securely and with as little latency as possible. This section explains how mobility works when controllers are included in a wireless network.

When a wireless client associates and authenticates to an access point, the access point's controller places an entry for that client in its client database. This entry includes the client's MAC and IP addresses, security context and associations, quality of service (QoS) contexts, the WLAN, and the associated access point. The controller uses this information to forward frames and manage traffic to and from the wireless client.

This figure shows a wireless client that roams from one access point to another when both access points are joined to the same controller.

Figure 1: Intracontroller Roaming

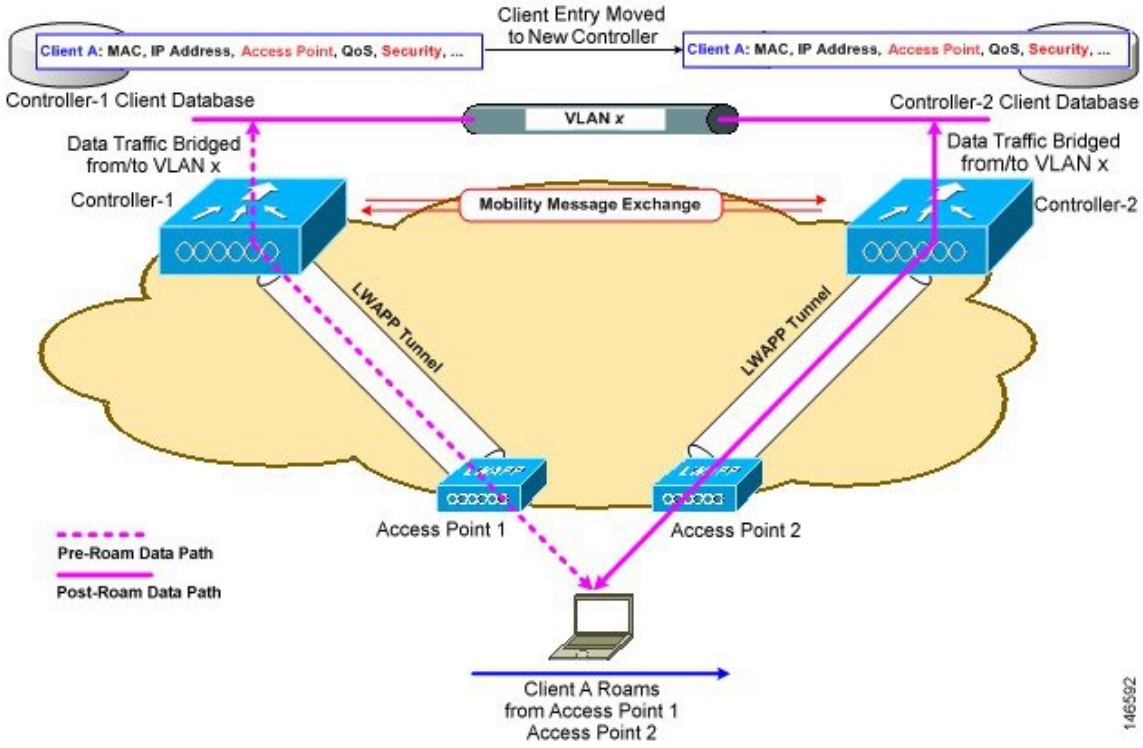


When the wireless client moves its association from one access point to another, the controller simply updates the client database with the newly associated access point. If necessary, new security context and associations are established as well.

The process becomes more complicated, however, when a client roams from an access point joined to one controller to an access point joined to a different controller. It also varies based on whether the controllers are operating on the same subnet.

This figure shows intercontroller roaming, which occurs when the wireless LAN interfaces of the controllers are on the same IP subnet.

Figure 2: Intercontroller Roaming

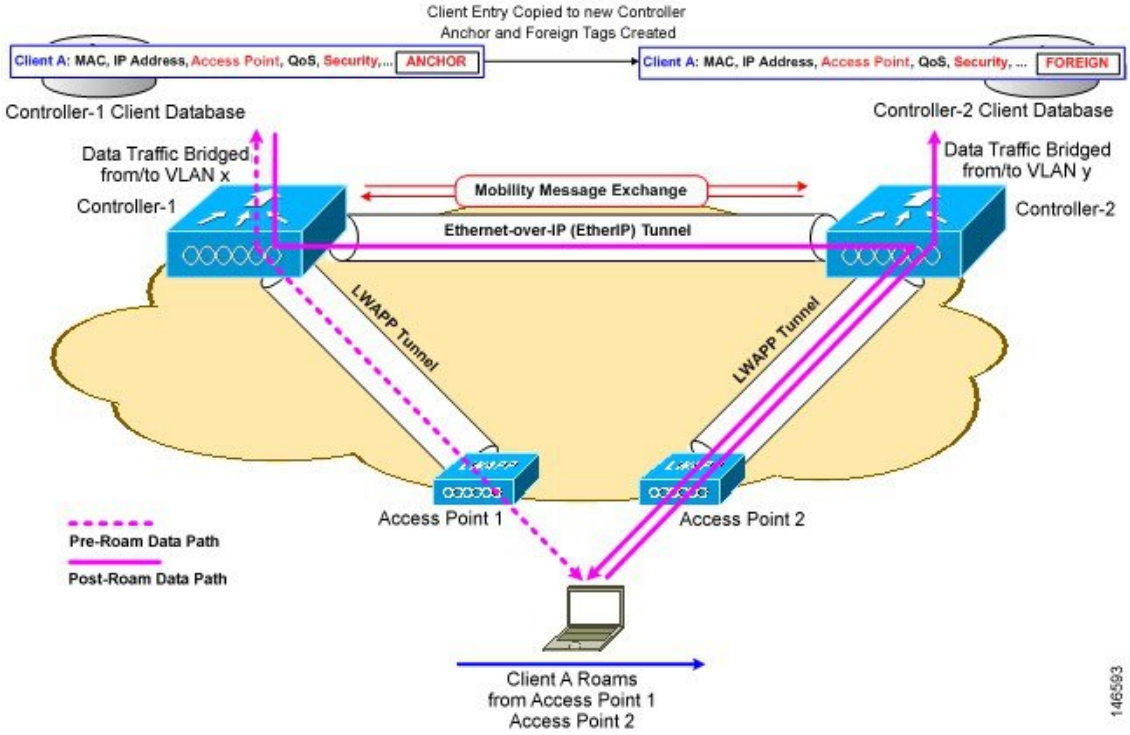


When the client associates to an access point joined to a new controller, the new controller exchanges mobility messages with the original controller, and the client database entry is moved to the new controller. New security context and associations are established if necessary, and the client database entry is updated for the new access point. This process remains transparent to the user.

Note All clients configured with 802.1X/Wi-Fi Protected Access (WPA) security complete a full authentication in order to comply with the IEEE standard.

This figure shows intersubnet roaming, which occurs when the wireless LAN interfaces of the controllers are on different IP subnets.

Figure 3: Intersubnet Roaming



Inter-subnet roaming is similar to inter-controller roaming in that the controllers exchange mobility messages on the client roam. However, instead of moving the client database entry to the new controller, the original controller marks the client with an “Anchor” entry in its own client database. The database entry is copied to the new controller client database and marked with a “Foreign” entry in the new controller. The roam remains transparent to the wireless client, and the client maintains its original IP address.

In inter-subnet roaming, WLANs on both anchor and foreign controllers need to have the same network access privileges and no source-based routing or source-based firewalls in place. Otherwise, the clients may have network connectivity issues after the handoff.

In a static anchor setup using controllers and RADIUS server, if AAA override is enabled to dynamically assign VLAN and QoS, the foreign controller updates the anchor controller with the right VLAN after a Layer 2 authentication (802.1x). For Layer 3 RADIUS authentication, the RADIUS requests for authentication are sent by the anchor controller.

Mobility is not supported for SSIDs with security type configured for web authentication on MAC filter failure.

If the management VLAN of one controller is present as a dynamic VLAN on another controller, the mobility feature is not supported.

Note If a client roams in web authentication state, the client is considered as a new client on another controller instead of considering it as a mobile client.

Note When the primary and secondary controller fail to ping each other's IPv6 addresses, and they are in the same VLAN, you need to disable snooping to get the controller to ping each other successfully.

Note New Mobility with WebAuth and MAC filter is not supported. For a client, if L2 authentication fails and it falls back to L3 authentication and then tries to roam to a different controller, the roaming will fail. The same behavior is applicable to FlexConnect central switching and local mode as well.

Note Cisco Wireless Controllers (that are mobility peers) must use the same DHCP server to have an updated client mobility move count on intra-VLAN.

Definitions of Mobility-related Terms

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Mobility Groups

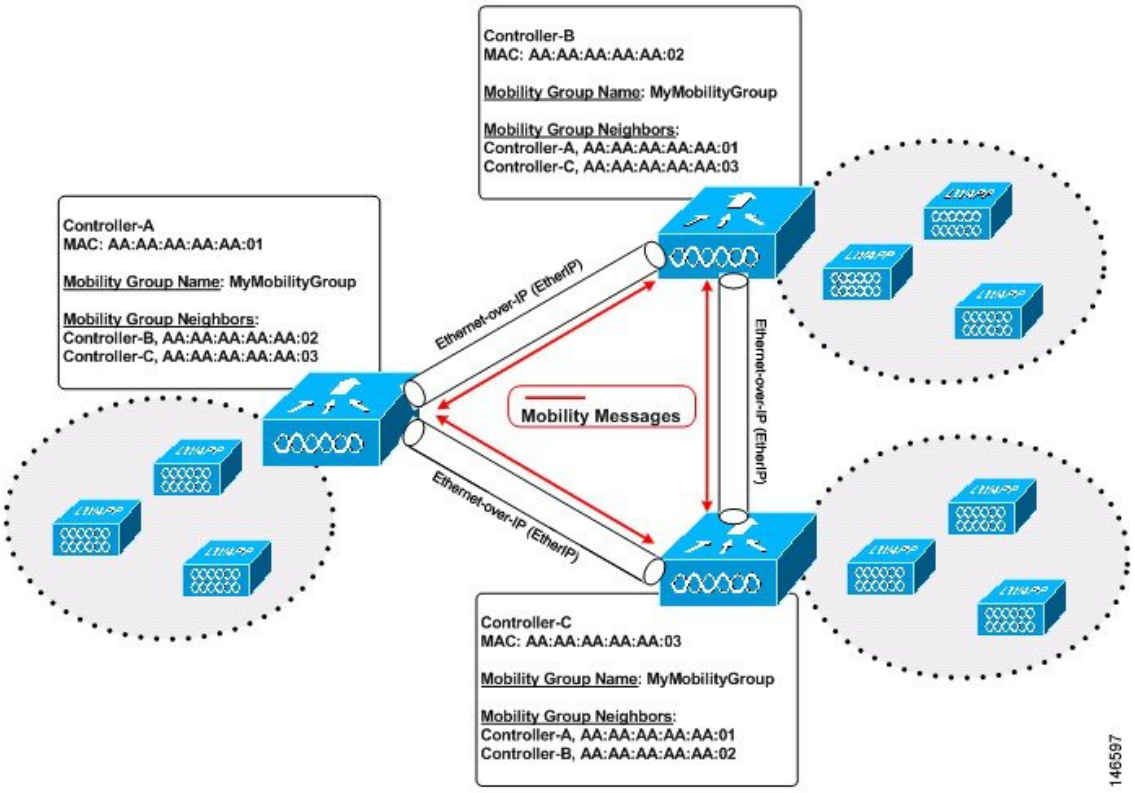
Information About Mobility Groups

A mobility group is a set of controllers, identified by the same mobility group name, that defines the realm of seamless roaming for wireless clients. By creating a mobility group, you can enable multiple controllers in a network to dynamically share information and forward data traffic when inter-controller or inter-subnet roaming occurs. Controllers in the same mobility group can share the context and state of client devices as well as their list of access points so that they do not consider each other's access points as rogue devices. With this information, the network can support inter-controller wireless LAN roaming and controller redundancy.

Note When an AP moves from one Cisco WLC to another Cisco WLC (when both Cisco WLCs are mobility peers), a client associated to the first WLC before the move may be anchored to it even after the move. To prevent such a scenario, you should remove the mobility peer configuration of the WLC.

Note Controllers do not have to be of the same model to be a member of a mobility group. Mobility groups can be comprised of any combination of controller platforms.

Figure 4: Example of a Single Mobility Group



As shown above, each controller is configured with a list of the other members of the mobility group. Whenever a new client joins a controller, the controller sends out a unicast message (or multicast message if mobility multicast is configured) to all of the controllers in the mobility group. The controller to which the client was previously connected passes on the status of the client.

For example, if a controller supports 6000 access points, a mobility group that consists of 24 such controllers supports up to 144,000 access points (24 * 6000 = 144,000 access points).

Mobility groups enable you to limit roaming between different floors, buildings, or campuses in the same enterprise by assigning different mobility group names to different controllers within the same wireless network.

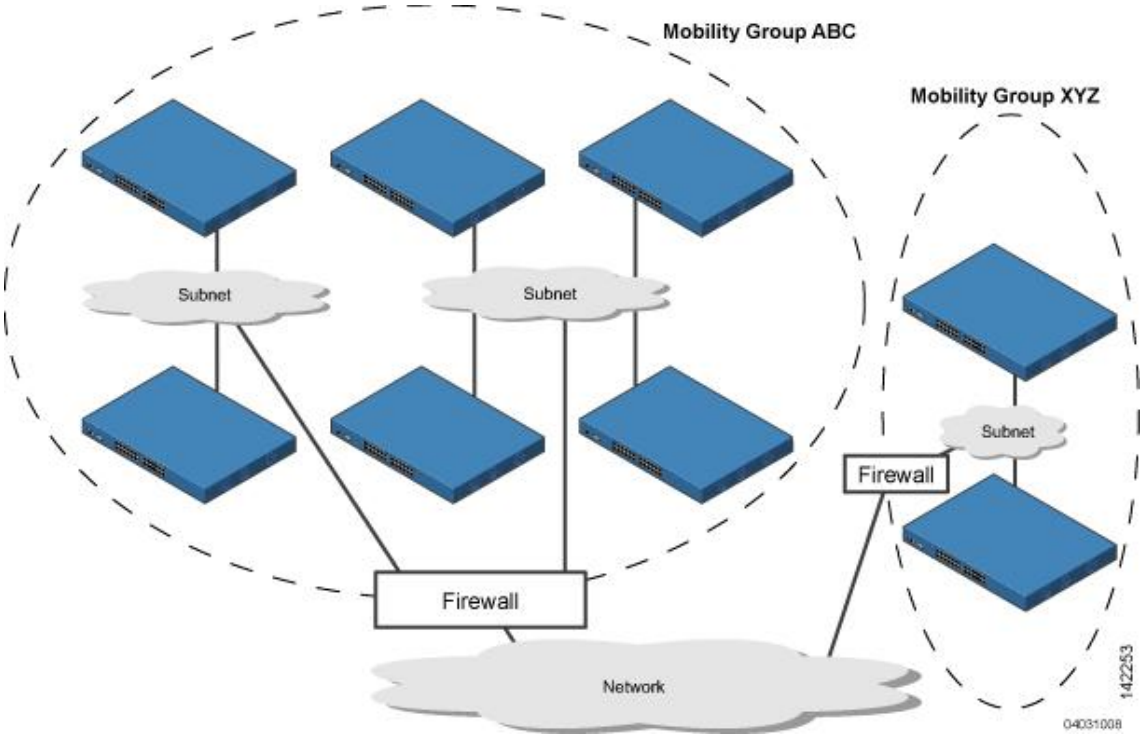
You can configure both IPv4 and IPv6 multicast address for a mobility group. When both the address formats are configured:

- For all IPv4 mobility group members in the mobility group, the IPv4 multicast group is displayed in the mobility summary information.
- For all IPv6 mobility group members in the mobility group, the IPv6 multicast group is displayed in the mobility summary information.

- If you have configured IPv4 multicast for a mobility group, the IPv4 multicast address is not displayed in the mobility summary information if there are no IPv4 mobility group members.
- If you have configured IPv6 multicast for a mobility group, the IPv6 multicast address is not displayed in the mobility summary information if there are no IPv6 mobility group members.

This figure shows the results of creating distinct mobility group names for two groups of controllers.

Figure 5: Two Mobility Groups



The controllers in the ABC mobility group share access point and client information with each other. The controllers in the ABC mobility group do not share the access point or client information with the XYZ controllers, which are in a different mobility group. Likewise, the controllers in the XYZ mobility group do not share access point or client information with the controllers in the ABC mobility group. This feature ensures mobility group isolation across the network.

Every controller maintains information about its peer controllers in a mobility list. Controllers can communicate across mobility groups and clients may roam between access points in different mobility groups if the controllers are included in each other's mobility lists. In the following example, controller 1 can communicate with either controller 2 or 3, but controller 2 and controller 3 can communicate only with controller 1 and not with each other. Similarly, clients can roam between controller 1 and controller 2 or between controller 1 and controller 3 but not between controller 2 and controller 3.

Table 1: Example

Controller 1 Mobility group: A	Controller 2 Mobility group: A	Controller 3 Mobility group: C
Mobility list:	Mobility list:	Mobility list:
Controller 1 (group A)	Controller 1 (group A)	Controller 1 (group A)
Controller 2 (group A)	Controller 2 (group A)	Controller 3 (group C)
Controller 3 (group C) ?		

In a mobility list, the following combinations of mobility groups and members are allowed:

- 3 mobility groups with 24 members in each group
- 12 mobility groups with 6 members in each group
- 24 mobility groups with 3 members in each group
- 72 mobility groups with 1 member in each group

The controller supports seamless roaming across multiple mobility groups. During seamless roaming, the client maintains its IP address across all mobility groups; however, Cisco Centralized Key Management (CCKM) and proactive key caching (PKC) are supported only for inter-mobility-group roaming. When a client crosses a mobility group boundary during a roam, the client is fully authenticated, but the IP address is maintained, and mobility tunneling is initiated for Layer 3 roaming.

Note When a controller is added to a mobility group, some of the APs (which are running in local mode) do not get the complete controllers list updated, those APs are connected to controllers that are in the same mobility group. You can view the controller list in the APs using the command "show capwap client config" AP-NAME command. For example, if the mobility group is for 19 controllers and then you add two more controllers to the mobility group, the AP shows 19 controllers instead of 21 in its list. To address this issue, you can reboot the AP or move it to another controller that is part of the same mobility group to get the controller list updated. This issue is observed in AP1242 connected to different Cisco 5508 WLCs running code 7.6.120.0.

Note When client moves to a non anchored SSID from an anchored sSSID on foreign, there is a stale entry on foreign .This happens when multicast mobile announce does not reach from foreign to guest anchor due to whatsoever reason, due to this the service is not impacted and configuration goes unnoticed but silently leaks MSCB on GA .There is no debug or error message shown nor does the GA runs a timer per client to cleanup. A HandoffEnd needs to be sent from foreign to Anchor since there is no timer.

Messaging Among Mobility Groups

The controller provides intersubnet mobility for clients by sending mobility messages to other member controllers.

- The controller sends a Mobile Announce message to members in the mobility list each time that a new client associates to it. The controller sends the message only to those members that are in the same group as the controller (the local group) and then includes all of the other members while sending retries.
- You can configure the controller to use multicast to send the Mobile Announce messages. This behavior allows the controller to send only one copy of the message to the network, which destines it to the multicast group that contains all the mobility members. To derive the maximum benefit from multicast messaging, we recommend that it be enabled on all group members.

Using Mobility Groups with NAT Devices

Mobility message payloads carry IP address information about the source controller. This IP address is validated with the source IP address of the IP header. This behavior is a problem when a NAT device is introduced in the network because it changes the source IP address in the IP header. In the guest WLAN feature, any mobility packet, that is being routed through a NAT device is dropped because of the IP address mismatch.

The mobility group lookup uses the MAC address of the source controller. Because the source IP address is changed due to the mapping in the NAT device, the mobility group database is searched before a reply is sent to get the IP address of the requesting controller. This process is done using the MAC address of the requesting controller.

When configuring the mobility group in a network where NAT is enabled, enter the IP address that is sent to the controller from the NAT device rather than the controller's management interface IP address. Also, make sure that the following ports are open on the firewall if you are using a firewall such as PIX:

- UDP 16666 for tunnel control traffic
- IP protocol 97 for user data traffic
- UDP 161 and 162 for SNMP

Note Client mobility among controllers works only if auto-anchor mobility (also called guest tunneling) is enabled. See the Configuring Auto-Anchor Mobility and Mobility Tunneling sections for details on these mobility options.

Rogue Detection Behavior in Mobility Groups

The Rogue Detection Behavior in Mobility Groups in RRM perspective is:

- The AP's recognize another as a valid RF neighbor if the RF domain name is the same.
- The AP sends the information to WLC.
- The WLC uses the AP's information to establish a connection with other valid WLC's and each WLC would do a series of checks during this time (for country matches, version, hierarchy, scale limits, and others) before forming an auto mode RF group(RRM) either as a leader or a member.
- All AP's which are not part of this RF group is considered to be a foreign AP (equivalent to a rogue AP).
- Rogue found on wire via Rogue Detector AP will be contained using APs that are seeing the Rouge through wirelessly.

The scenario where there are different RF group names if the APs can hear each other is:

- RF group names are usually consistent across a single deployment.
- APs which have unrecognizable neighbor packets or wrong entries are deemed rogues.
- If there are Cisco APs with two different RF groups. They would hear each other but will not populate the other in the RF neighbor list. (This RF list is sent to WLC for further munching as discussed above)
- Usually when two local neighborhoods have widely varying RF characteristics, then the network admin may adopt two RF group names to separate the two RF neighborhood or they may belong two different networks.
- AP neighborhood determines RF grouping(auto-mode) /Rogue classification and other and not vice-versa.

Prerequisites for Configuring Mobility Groups

Before you add controllers to a mobility group, you must verify that the following requirements have been met for all controllers that are to be included in the group:

- IP connectivity must exist between the management interfaces of all controllers.

Note You can verify IP connectivity by pinging the controllers.

Note Mobility control packets can use any interface address as the source, based on routing table. It is recommended that all controllers in the mobility group should have the management interface in the same subnet. A topology where one controller's management interface and other controller's dynamic interface are on same subnet not recommended for seamless mobility.

- When controllers in the mobility list use different software versions, Layer 2 or Layer 3 clients have limited roaming support. Layer 2 or Layer 3 client roaming is supported only between controllers that use the same version or with controllers that run versions 7.X.X.

Note If you inadvertently configure a controller with a failover controller that runs a different software release, the access point might take a long time to join the failover controller because the access point starts the discovery process in CAPWAP and then changes to LWAPP discovery.

- All controllers must be configured with the same virtual interface IP address.

Note If necessary, you can change the virtual interface IP address by editing the virtual interface name on the Controller > Interfaces page.

Note If all the controllers within a mobility group are not using the same virtual interface, inter-controller roaming may appear to work, but the handoff does not complete, and the client loses connectivity for a period of time.

- You must have gathered the MAC address and IP address of every controller that is to be included in the mobility group. This information is necessary because you will be configuring all controllers with the MAC address and IP address of all the other mobility group members.

Note You can find the MAC and IP addresses of the other controllers to be included in the mobility group on the Controller > Mobility Groups page of each controller's GUI.

- When you configure mobility groups using a third-party firewall, for example, Cisco PIX, or Cisco ASA, you must open port 16666, and IP protocol 97.
- For intercontroller CAPWAP data and control traffic, you must open the ports 5247 and 5246.

This table lists the protocols and port numbers that must be used for management and operational purposes:

Table 2: Protocol/Service and Port Number

Protocol/Service	Port Number
SSH/Telnet	TCP Port 22 or 29
TFTP	UDP Port 69
NTP/SNTP	UDP Port 123
SNMP	UDP Port 161 for gets and sets and UDP port 162 for traps.
HTTPS/HTTP	TCP port 443 for HTTPS and port 80 for HTTP
Syslog	TCP port 514
Radius Auth/Account	UDP port 1812 and 1813

Note To view information on mobility support across controllers with different software versions, see the http://www.cisco.com/c/en/us/td/docs/wireless/compatibility/matrix/compatibility-matrix.html. .

Note You cannot perform port address translation (PAT) on the firewall. You must configure one-to-one network address translation (NAT).

Configuring Mobility Groups (GUI)

Step 1 Choose **Controller** > **Mobility Management** > **Mobility Groups** to open the Static Mobility Group Members page. This page shows the mobility group name in the Default Mobility Group text box and lists the MAC address and IPv4/IPv6 address of each controller that is currently a member of the mobility group. The first entry is the local controller, which cannot be deleted.

Note If you want to delete any of the remote controllers from the mobility group, hover your cursor over the blue drop-down arrow for the desired controller and choose **Remove**.

Step 2 Perform one of the following to add controllers to a mobility group:

- If you are adding only one controller or want to individually add multiple controllers, click **New**.

  OR

- If you are adding multiple controllers and want to add them in bulk, click **EditAll**.

Note The EditAll option enables you to enter the MAC and IPv4/IPv6 addresses of all the current mobility group members and then copy and paste all the entries from one controller to the other controllers in the mobility group.

Step 3 Click **New** to open the **Mobility Group Member** > **New** page.

Step 4 Add a controller to the mobility group as follows:

1. In the Member IP Address text box, enter the management interface IPv4/IPv6 address of the controller to be added.

   Note If you are configuring the mobility group in a network where network address translation (NAT) is enabled, enter the IPv4/IPv6 address that is sent to the controller from the NAT device rather than the controller's management interface IPv4/IPv6 address. Otherwise, mobility will fail among controllers in the mobility group.
2. In the **Member MAC Address** text box, enter the MAC address of the controller to be added.
3. In the **Group Name** text box, enter the name of the mobility group.

   Note The mobility group name is case sensitive.
4. In the **Hash** text box, enter the hash key of the peer mobility controller, which should be a virtual controller in the same domain.

   You must configure the hash only if the peer mobility controller is a virtual controller in the same domain.

   Note Hash is not supported for IPv6 members.
5. Click **Apply** to commit your changes. The new controller is added to the list of mobility group members on the **Static Mobility Group Members** page.
6. Click **Save Configuration**.
7. Repeat Step a through Step e to add all of the controllers in the mobility group.
8. Repeat this procedure on every controller to be included in the mobility group. All controllers in the mobility group must be configured with the MAC address and IPv4/IPv6 address of all other mobility group members.

The **Mobility Group Members** > **EditAll** page lists the MAC address, IPv4/IPv6 address, and mobility group name (optional) of all the controllers currently in the mobility group. The controllers are listed one per line with the local controller at the top of the list.

Note If desired, you can edit or delete any of the controllers in the list.

Step 5 Add more controllers to the mobility group as follows:

1. Click inside the edit box to start a new line.
2. Enter the MAC address, the management interface IPv4/IPv6 address, and the name of the mobility group for the controller to be added.

   Note You should enter these values on one line and separate each value with one or two spaces.

   Note The mobility group name is case sensitive.
3. Repeat Step a and Step b for each additional controller that you want to add to the mobility group.
4. Highlight and copy the complete list of entries in the edit box.
5. Click **Apply** to commit your changes. The new controllers are added to the list of mobility group members on the **Static Mobility Group Members** page.
6. Click **Save Configuration**to save your changes.
7. Paste the list into the text box on the Mobility Group Members > Edit All page of all the other controllers in the mobility group and click **Apply** and **Save Configuration**.

Step 6 Choose **Mobility Management** > **Multicast Messaging** to open the **Mobility Multicast Messaging** page. The names of all the currently configured mobility groups appear in the middle of the page.

Step 7 On the **Mobility Multicast Messaging** page, check the **Enable Multicast Messaging** check box to enable the controller to use multicast mode to send Mobile Announce messages to the mobility members. If you leave it unselected, the controller uses unicast mode to send the Mobile Announce messages. The default value is unselected.

Step 8 If you enabled multicast messaging in the previous step, enter the multicast group IPv4 address for the local mobility group in the **Local Group Multicast IPv4 Address** text box. This address is used for multicast mobility messaging.

Note In order to use multicast messaging, you must configure the IPv4 address for the local mobility group.

Note In release 8.0, IPv6 is not supported for mobility multicast.

Step 9 Click **Apply** to commit your changes.

Step 10 If desired, you can also configure the multicast group IPv4 address for non-local groups within the mobility list. To do so, click the name of a non-local mobility group to open the Mobility Multicast Messaging > Edit page, and enter the multicast group IPv4 address for the non-local mobility group in the Multicast IP Address text box.

Note If you do not configure the multicast IPv4 address for non-local groups, the controller uses unicast mode to send mobility messages to those members.

Step 11 Click **Apply**.

Step 12 Click **Save Configuration**.

Configuring Mobility Groups (CLI)

Step 1 Check the current mobility settings by entering this command:

show mobility summary

Step 2 Create a mobility group by entering this command:
config mobility group domain *domain_name*

Note Enter up to 31 case-sensitive ASCII characters for the group name. Spaces are not allowed in mobility group names.

Step 3 Add a group member by entering this command:
config mobility group member add *mac_address ip_address*

Note If you are configuring the mobility group in a network where network address translation (NAT) is enabled, enter the IP address that is sent to the controller from the NAT device rather than the controller's management interface IP address. Otherwise, mobility will fail among controllers in the mobility group.

Note Enter the **config mobility group member delete** *mac_address* command if you want to delete a group member.

Step 4 To configure the hash key of a peer mobility controller, which is a virtual controller in the same domain, enter this command:
config mobility group member hash *peer-ip-address key*

Step 5 Enable or disable multicast mobility mode by entering this command:
config mobility multicast-mode {**enable** | **disable**} *local_group_multicast_address*

where *local_group_multicast_address* is the multicast group IPv4 address for the local mobility group. This address is used for multicast mobility messaging.

Note In order to use multicast messaging, you must configure the IPv4 address for the local mobility group.

Note In release 8.0, IPv6 is not supported for mobility multicast..

If you enable multicast mobility mode, the controller uses multicast mode to send Mobile Announce messages to the local group. If you disable multicast mobility mode, the controller uses unicast mode to send the Mobile Announce messages to the local group. The default value is disabled.

Step 6 (Optional) You can also configure the multicast group IPv4 address for non-local groups within the mobility list. To do so, enter this command:
config mobility group multicast-address *group_name IP_address*

If you do not configure the multicast IPv4 address for non-local groups, the controller uses unicast mode to send mobility messages to those members.

Step 7 Verify the mobility configuration by entering this command:
show mobility summary

Step 8 To see the hash key of mobility group members in the same domain, enter this command:
show mobility group member hash

Step 9 Save your changes by entering this command:
save config

Step 10 Repeat this procedure on every controller to be included in the mobility group. All controllers in the mobility group must be configured with the MAC address and IP address of all other mobility group members.

Step 11 Enable or disable debugging of multicast usage for mobility messages by entering this command:
debug mobility multicast {**enable** | **disable**}