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Mobility Master Configuration Hierarchy

Mobility Master (ArubaOS 8.x.x.x) uses a centralized, multi-tier architecture under a brand new UI that provides a clear separation between management, control, and forwarding functions. The entire configuration for both the Mobility Master and managed devices is set up from a centralized point, thereby simplifying and streamlining the configuration process. Mobility Master consolidates all-master, single master-multiple local, and multiple master-local deployments into a single deployment model.

Whereas, the architecture of ArubaOS 6.x and earlier versions consist of a flat configuration model that contains global and local configurations. The global configurations are applied to the master controller which propagates those to its local controllers. The local configurations are applied to the master or the local controller directly.

Mobility Master takes the place of a master controller in the network hierarchy. Mobility Master oversees controllers that are co-located (on-premises local controllers or off-campus branch office local controllers). All the controllers that connect to Mobility Master act as managed devices.

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Understanding Configuration Hierarchy

The Mobility Master hierarchy simplifies the configuration process by supporting multiple configurations for multiple deployments using a single Mobility Master. Configuration elements can be mapped to one or more end devices, such as a managed device or VPN concentrator. Common configurations across devices are extracted to a shared template, which merges with device-specific configurations to generate the configuration for an individual device.

Figure 1 *Example of the Configuration Hierarchy*

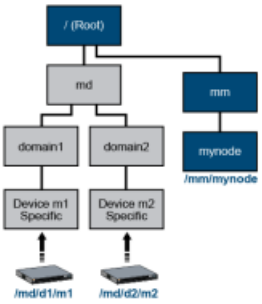

Figure 1 provides an example of the configuration hierarchy. The solid lines represent the hierarchy, the dotted arrows represent the device mapping, and each box represents a node in the hierarchy. When a device is added to Mobility Master, it must be mapped to a node or node-path in order to inherit configurations from the hierarchy. An explicit configuration node is also created for each device so that any device-specific configurations can be added directly to that node. Any device that is managed by Mobility Master is known as a managed device. For example, device **m2** in Figure 1 retrieves all device-specific configurations from the **Device m2 Specific** node. Since the **Device m2 Specific** node is mapped to the **domain2**, **md**, and **Root** nodes, the device also receives configurations from those nodes.

Each node contains a unique combination of common and device-specific configurations. The root node appears by default upon logging in to Mobility Master CLI.

The configuration hierarchy contains the following nodes and node structure:

Table 1: *Nodes and Node Structure*

Category	Node Name	Node Description
Mobility Master	/	Configurations common to Mobility Master and its managed devices (the root node). **NOTE:** Configuration changes are not allowed on the root node.
	/md	Configurations common to all managed devices. The user can create additional nodes under this node.
	/mm	Configurations common to the primary and standby Mobility Master (VRRP pair).
	/mm/mynode	Configurations specific to a particular Mobility Master. This can only be edited on the respective Mobility Master.
Stand-alone Controller	/mm	Configurations common to the primary and standby stand-alone controllers (VRRP pair).
	/mm/mynode	Configurations specific to a particular stand-alone controller. This can only be edited on the respective stand-alone controller.

The term "mm" refers to Mobility Master and "md" refers to managed device.

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Understanding the Node Hierarchy

You can view the hierarchy of the devices and groups on a Mobility Master at a global level. Mobility Masters are placed into the **/mm** group and managed devices are in the **/md** group.

- **/md**—This is the global or root level where anything configured is applicable to all the nodes globally. It is recommended not to edit or add additional configuration at this level.
- **/md/<group name>**— This is used to differentiate the sites physically or by the type of deployment such as DMZ, Branch, Campus, RAPs, and so on.

When you log in to the Mobility Master, you are placed in the **/mm/mynode** prompt by default.

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Navigating through Node Hierarchy

You can use one of the following two commands to navigate to any node from the current node:

- **change-config-node**
- **cd**

Both commands auto complete the group or folder names. You can also use the device hostname as an alias to navigate to a device node in the hierarchy. In doing so, your prompt changes to reflect where you are in the hierarchy:

```
(host) [mynode] #change-config-node Aruba7010
(host) [00:0b:86:99:97:57] #
```

The following CLI command displays your current node:

```
(host) [00:0b:86:99:97:57] #pwd
/md/Home-Production/00:0b:86:99:97:57
```

The following CLI command allows you to navigate one group up in the hierarchy:

```
(host) [00:0b:86:99:97:57] #cd ..
(host) [Home-Production] #
```

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Centralized Configuration

Mobility Master uses a centralized configuration application to maintain all configurations under the management domain, eliminating the use of multiple points of contact to apply global and local configurations to each managed device. You can organize all common configurations at a higher level of the hierarchy.

Mobility Master Configuration

The Mobility Master that provides this configuration service to other devices in the network also contains its own configuration. The Mobility Master configuration is obtained through nodes in the hierarchy labeled **/mm** or **/mm/mynode**. Configurations under the **/mm** node, which are shared by the redundant Mobility Master pair (primary and standby Mobility Masters), are synced to the standby Mobility Master. Configurations under **/mm/mynode** are synced to individual Mobility Master devices.

Allowed Node Operations

The following node operations are allowed on Mobility Master:

- **Create Node**: Creates a new node as the child of an existing node in the configuration hierarchy (system-generated or user-created)
- **Add Device**: Associates a device to an existing node in the hierarchy. This device inherits configurations from all nodes between the root node and the device (node-path).
- **Delete Node**: Deletes an existing user-created node or node without any child nodes. System-generated nodes cannot be deleted. Only leaf nodes without any child nodes can be deleted.
- **Delete Device**: Deletes a currently associated device from the configuration hierarchy. This will cause the device to reload and erase all configurations received from Mobility Master.
- **Clone Node**: Copies the configuration of an existing node into a new node. The new node is created as a child of an existing node in the hierarchy.
- **Move Node**: Moves an existing user-created node in the hierarchy to the specified destination node. System-generated nodes cannot be moved. Ensure the following points while moving a node or device, otherwise the move operation will fail:
  - The node to be moved is a leaf node and does not have any group node or a device node as a child node under it.
  - No configuration is pending on the parent nodes of the child node to be moved.
  - The configuration on the node to be moved is complaint with the configuration in the new ancestor nodes chain.
- **Rename Node**: Renames the existing node name to the specified name. The node paths of the child nodes under the renamed node are automatically updated.
- **Drag and Drop Node**: Allows you to move any controller from one group to another group within the hierarchy, without deleting the controller from the Mobility Master.

  Moving multiple controller or group within the network hierarchy is not supported.

- **Edit Action**: Allows you to rename a controller or a group in the managed network hierarchy.

Refer to the ArubaOS *Command Line Interface Reference Guide* for more details on the configuration commands for node and device management.

Access Permissions

The Mobility Master management domain can be large and widespread across various geographic regions. In a Mobility Master, the editing scope of the admin user can be restricted to individual node-paths within the configuration hierarchy, unlike the legacy ArubaOS management domain where an administrator can modify any configuration in the system.

Each management user is granted editing permissions for a given node, allowing the user to modify the configuration for that node and any child node within its node-path. The user, however, cannot modify any parent nodes or nodes on a different path in the hierarchy. Users can view configurations for any node in the hierarchy to refer to a parent node configuration or verify that the derived configuration for a device matches the parent node

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Configuration Validation

Mobility Master uses a centralized validation model that performs various types of validations for different targets. Configuration validation falls under one of the following categories:

- **Syntax Validation**: Basic parser validations (for example, making sure the syntax of a command is correct, the data type is correct, or a value is within a valid range).

  > Roles, ACLs, and pools (DHCP, VLAN, tunnel, and NAT) must be written in lower-case. Passwords, crypto keys, and ESSIDs can be written in both upper-case and lower-case.

- **Semantic Validation**: Custom application-specific validations (for example, dependency checks across commands or instance count limits). Dependency checks are limited to the nodes from which the target device inherits the configuration.
- **Platform Validation**: Platform model-specific validations (for example, determining which features are supported on a platform or the type and count of ports on a platform).

  > Validation is not available on the setup dialogue. Users must manually verify the setup dialogue information for each managed device.

Validation Failures

If a command does not pass validation, it is rejected and will not be included in the pending configuration for that node. If a new device that cannot support an existing configuration is added, the device add is rejected.

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Serviceability

Managed devices are always serviceable from the centralized management location. When a managed device boots up for the first time under the factory default state, it auto-provisions and establishes connectivity to Mobility Master through ZTP. Managed devices can also be provisioned manually through the setup dialog box. Managed devices can encounter connectivity loss due to bad configurations, network connectivity issues, and so on. The system attempts to recover from these situations when possible.

This section includes the following topics:

Bad Configuration Recovery

Certain configurations, such as those in the following list, can interfere with the connectivity between managed devices and Mobility Master:

- Uplink port shut
- Partially configured uplink VLAN
- Limiting bandwidth contract policy
- Bad ACL

Bad configurations can be caused by simple typo errors. Even if the user discovers the error, the bad configuration may have already caused connectivity loss, preventing the user from pushing the correct configuration to the managed device.

Mobility Master supports an auto-rollback mechanism that reverts the managed device to the last known good configuration prior to the management connectivity loss. Mobility Master also indicates if a device has recovered from a bad configuration through the **show switches** command output. The output for this command labels the **Configuration State** for the managed device as **CONFIG ROLLBACK** if the device has recovered connectivity using the rollback configuration. When the user fixes the bad configuration on Mobility Master, the managed device recovers automatically, and the state changes to UPDATE SUCCESSFUL.

Example output for the **show switches** command:

```
(host) [mynode] #show switches

Thu Jun 09 12:13:45.735 2016

All Switches
------------
IP Address     IPv6 Address  Name              Location          Type     Model         Version                  Status  C
onfiguration State  Config Sync Time (sec)  Config ID
----------     ------------  ----              --------          ----     -----         -------                  ------  -
------------------  ----------------------  ---------
192.192.192.1  None          TECHPUB_MASTER    Building1.floor1  master   ArubaMM       8.0.0.0-svcs-ctrl_55038  up      U
PDATE SUCCESSFUL    0                       27
192.192.192.2  None          TECHPUB_STANDBY   Building1.floor1  standby  ArubaMM       8.0.0.0-svcs-ctrl_55038  up      U
PDATE SUCCESSFUL    10                      27
192.192.189.1  None          TECHPUB_LC1_189.1 Building1.floor1  MD       Aruba7010     8.0.0.0-svcs-ctrl_55038  up      U
PDATE SUCCESSFUL    0                       27
192.192.192.3  None          TECHPUB_x86_LC    Building1.floor1  MD       VMC-TACTICAL  8.0.0.0-svcs-ctrl_55038  up      U
PDATE SUCCESSFUL    0                       27
192.192.189.2  None          TECHPUB_LC2_189.2 Building1.floor1  MD       Aruba7005     8.0.0.0-svcs-ctrl_55038  up      U
PDATE SUCCESSFUL    0                       27
Total Switches:5
```

Disaster Recovery

If auto-rollback from a bad configuration fails, and connectivity between the managed device and Mobility Master remains disrupted, users can enable **Disaster Recovery** mode on the managed device using the **disaster-recovery on** command. Under the regular mode, the **/mm** node downloads configurations from Mobility Master that cannot be modified directly on each managed device. **Disaster Recovery** mode grants users access to the **/mm** node through the managed devices while blocking any further configuration synchronizations from Mobility Master. With full control of the **/mm** node, users can make local modifications on each managed device to restore connectivity to Mobility Master.

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Mobility Master User Interface

The Mobility Master user interface provides ease-of-use through an intuitive layout and simple navigation model.

Navigation Model

Each page of the Mobility Master UI is divided into the following sections:

- **Header**, which includes the following:
  - **Aruba logo**: The Aruba logo.
  - **Deployment mode and hostname**: The deployment mode and hostname of the Mobility Master or managed device.
  - **Network Status Counters**: Counters for reachable and unreachable controllers, reachable and unreachable access points, clients, and alerts.
  - **Help**: Initiates help mode to display available help information in the UI. See "Help Mode" on page 1 for more details.
  - **User menu**: Drop-down menu that displays your username. It allows you to logout of the Mobility Master or managed device. The **Preferences** option allows you to enable or disable the **Profiles** link in the following pages:
    - **All Profiles** table of the Mobility Master node.
    - **WLANs** table and **AP Group** table of the Managed Device node.

      The **Profiles** link is displayed only when the **show advanced profiles** check box is selected in the **Preferences** option of the User menu.

    Limitations
    - Advanced profile configuration is controller specific (domain name)
    - Advanced profile configuration is not per-user specific
    - It is browser specific, irrespective of user login—for example, if a user enabled Preferences in the Chrome browser it will not carry forward to IE or Firefox.
- **Node-path**: Node-path within the network hierarchy.
- **Pending Changes**: List of all pending configuration changes. See "Pending Changes" on page 1 for more details.
- **Menu**: Main menu, which includes the **Dashboard**, **Configuration**, **Diagnostics**, and **Maintenance** menu items. Select a menu item to reveal the corresponding sub-menu items. See "Navigation Levels" on page 1 for more details.
- **Collapsible network tree**: Complete network hierarchy that is revealed or hidden when you click the menu or arrow button, respectively, next to the node-path. See "Network Tree" on page 1 for more details.
- **Work-screen**: Content description for a menu item or tab.

Figure 1 *Overview of the User Interface*

Network Tree

The Mobility Master UI allows users to create, modify, and delete any node in the network hierarchy from a central location. By clicking the menu

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MultiVersion Support

Starting with ArubaOS 8.2.0.0, Mobility Master provides the essential infrastructure for multiversion support across all managed devices in the network. With this enhancement, the ArubaOS version on each managed device can be different from that in the Mobility Master in the network.

The multiversion infrastructure performs the centralized validation for the configurations of different ArubaOS versions run on the managed devices. The configurations that are not compatible with the managed device's ArubaOS version will not be sent to the managed device.

This feature supports the following scenarios:

- Customers want to upgrade only the Mobility Master with the latest ArubaOS version to use centralized services.
- Customers want to upgrade only a few managed devices in their network with the latest ArubaOS version to test some features of their interest.
- Customers want to upgrade their network in certain geographical locations and plan to upgrade the entire network incrementally.

Important Points to Note

The following are important points to note before implementing the multiversion support in your network:

- ArubaOS 8.2.0.0 is the minimum supported version on the managed devices and the Mobility Master.
- The Mobility Master can run an ArubaOS version that is either the same or a higher version of ArubaOS than the versions on the managed devices; the minimum supported version on both platforms is ArubaOS 8.2.0.0.
- Multiversion is supported only if the Mobility Master is running two code versions higher than the code versions running on the managed devices. For example multiversion is supported if a Mobility Master is running ArubaOS 8.5.0.0 and the managed devices are running ArubaOS 8.3.0.0 and will not be supported if the managed devices are running ArubaOS 8.2.0.0 or ArubaOS 8.4.0.0.

UI Support for Multiversion

When the managed devices and the Mobility Master run different ArubaOS versions, the following rules apply:

- At all levels of hierarchy, the WebUI elements of the later ArubaOS version is always shown to the user.
- At the group level, the following rules apply:
  - All WebUI elements that are new in the ArubaOS version of the Mobility Master are shown.
  - The WebUI elements that are obsolete in the ArubaOS version of the Mobility Master are not shown.
- At the device level, the following rules apply:
  - The WebUI elements that are obsolete in the ArubaOS version of the Mobility Master but not obsolete on the ArubaOS version of the device are shown.
  - The WebUI elements that are obsolete on the ArubaOS version of the device are not shown.
  - The WebUI elements that are introduced in the ArubaOS version later than that on the device are not shown.

Display of ArubaOS Version Identifiers

The UI displays the ArubaOS versions running on the Mobility Master and the managed device:

The following changes are applicable in the WebUI of the managed device:

- **Mobility Master ArubaOS version identifier**: The ArubaOS version of the Mobility Master is displayed at the bottom of the left navigation pane. The Mobility Master version identifier is displayed as *Mobility Master: Version <version #>*.
- **Managed device ArubaOS version identifier:** If the ArubaOS version running on the managed device is different from that running on the Mobility Master, an information icon is displayed. It shows the ArubaOS version running on the managed device. The managed device version identifier is displayed as *Version <version #>*.

> The managed device version identifier is not displayed when the ArubaOS version running on the managed device and the Mobility Master are the same.

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