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CLUSTER MANAGER

Technical Climb Webinar

10:00 GMT | 11:00 CET | 13:00 GST
May 30th, 2017

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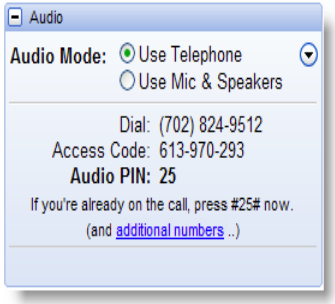

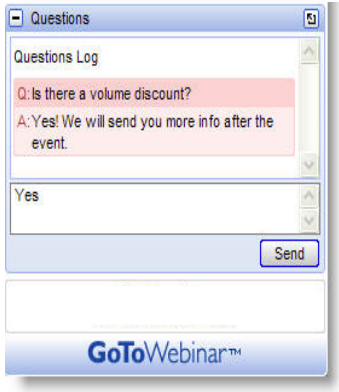

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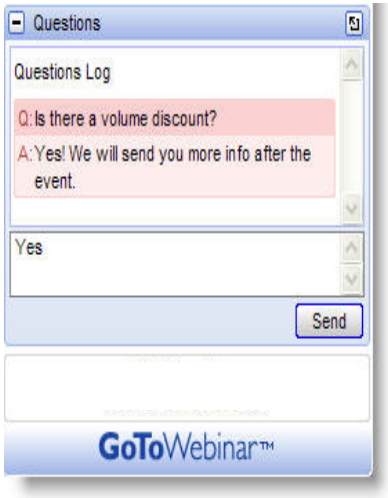

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CLUSTER MANAGER

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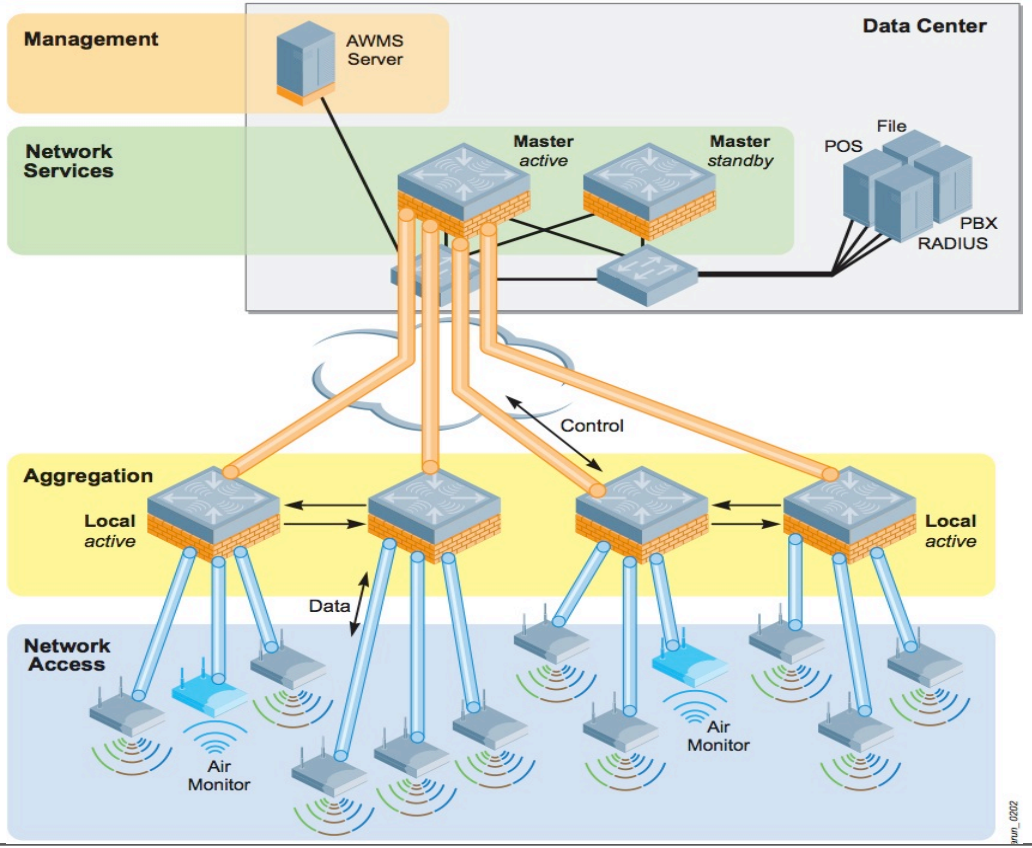
Agenda

- Objectives
- Clustering Highlights
- Cluster Leader
- Cluster Roles
- Cluster Hitless Failover
- Cluster Load Balancing
- Cluster Manual/CLI (re)assignment of AP (and AP-group) to any controller

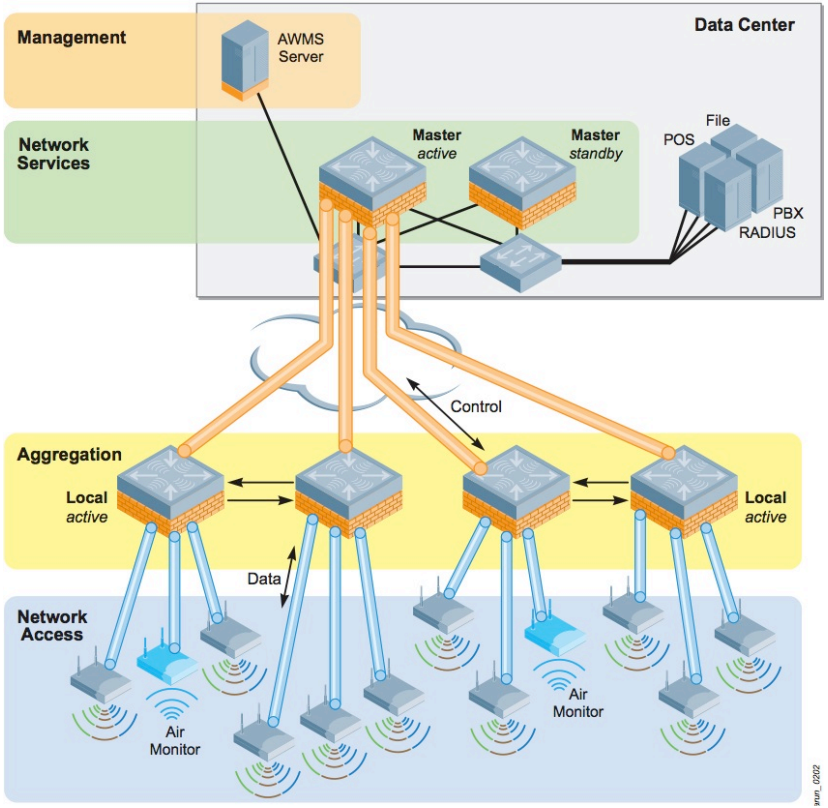
Aruba's MOVE Architecture



HA/Fast-Failover:

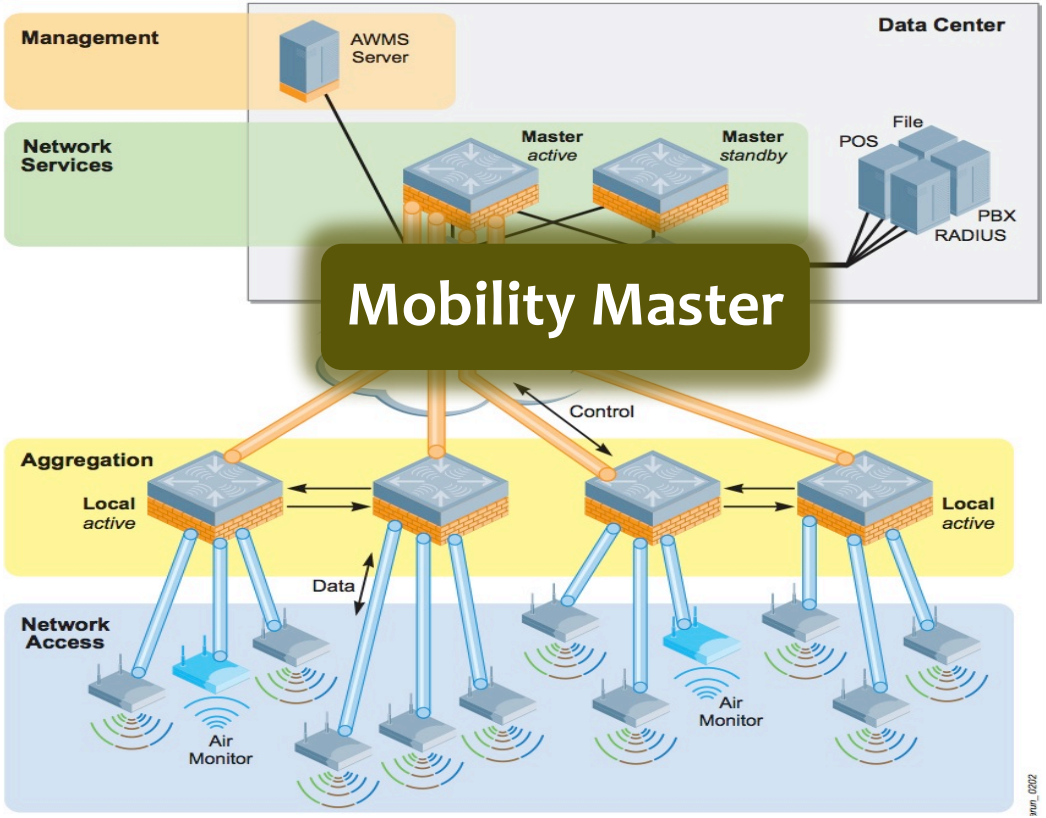
- The high availability: Fast Failover feature supports APs in campus mode using tunnel or decrypt-tunnel forwarding modes, but does not support campus APs in bridge mode.
- This feature is not supported on remote APs and mesh APs in any mode.
- With 8 consecutive heartbeat misses (default), AP will detect that the Active controller is no longer available and will failover to Standby controller.
- AP will deauth clients before failover to ensure that client will come up properly on backup controller.
- AP's standby tunnel will become active without having to rebootstrap. The SSIDs remains up during failover.
- Clients will reconnect to SSID, authenticate and start passing traffic again.
- Once primary controller is back up, APs will form standby tunnels to it. If preemption for HA is enabled. APs will move back to primary controller after "LMS hold down" time configured in AP system profile

What's New in ArubaOS 8.0?



- Ideal for Control Plane Functions
- Not in the path of traffic
- Often need more Memory & more Processing Capacity
- Current Form Factor
  - **Same as Locals**
  - **Optimized for Packet Fwd'ing**
  - **Limited CPU & Memory**
  - **Limited Scale**

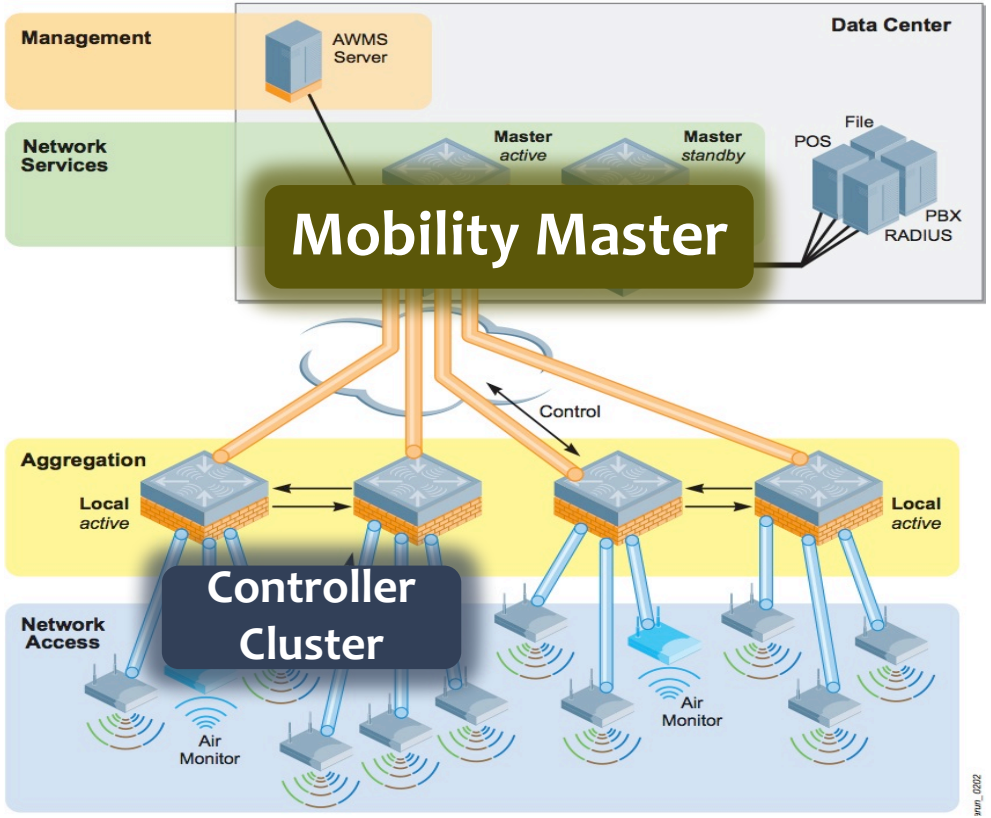
In ArubaOS 8.0



Mobility Master

- **Runs on X86 (VM in 8.0 – Hardware Appliance in post 8.0 releases)**
- **Scales vertically as needed**
- **Flexible CPU/Memory/Disk allocation**
- **Ideal for Control Plane functions**
- **No AP Termination**
- **Software Only option**
- **Economical Solution for Customers**

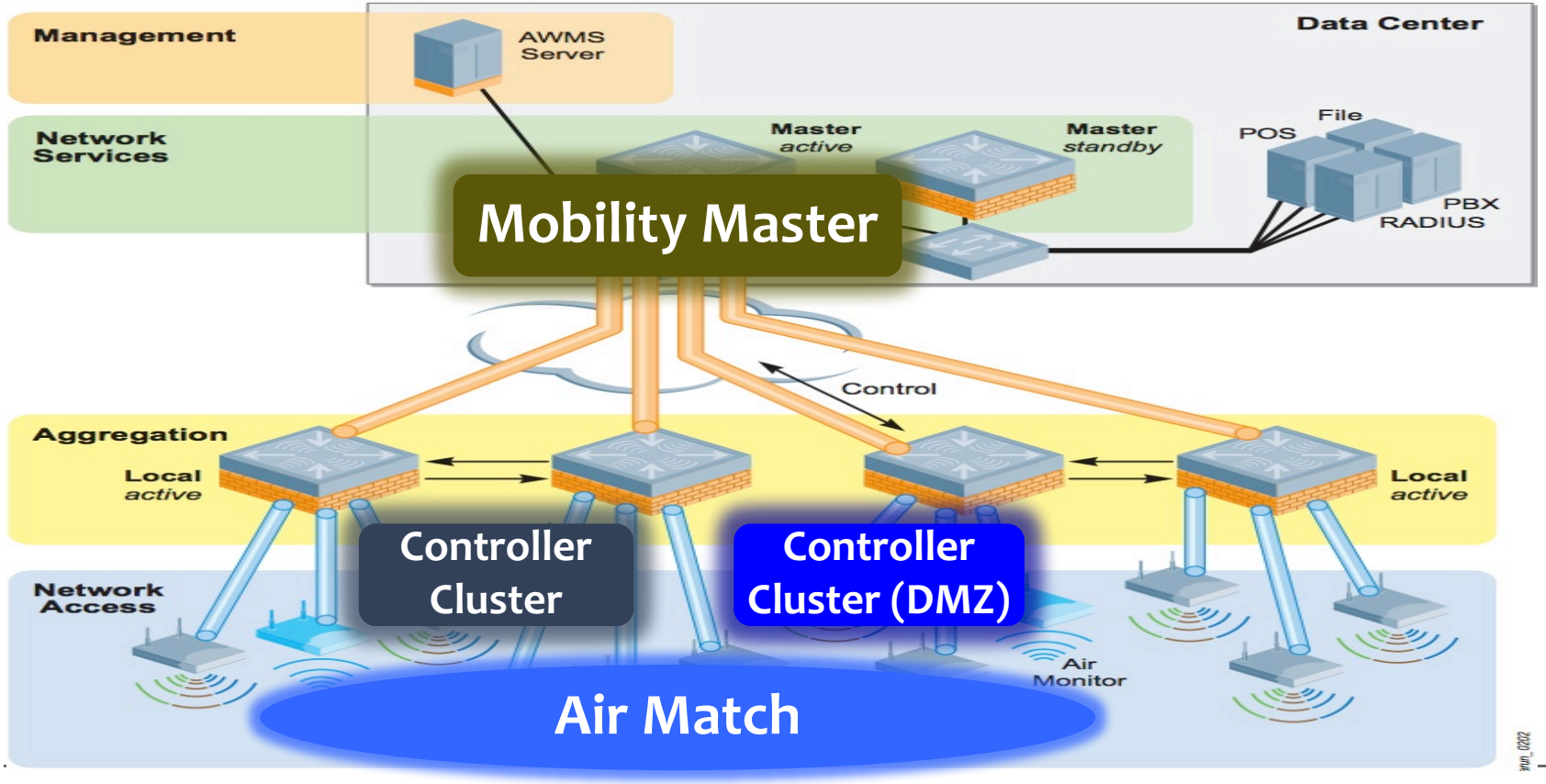
In ArubaOS 8.0:



Controller Cluster

- **Cluster of Controllers performing Control & Data Plane Functions**
- **Cluster up to 12 Nodes**
- **Auto Load balancing of APs and Stations**
- **100% Redundancy**
- **Active – Active Mode of Operations**
- **High Value Sessions are sync'ed**
- **Sub-Second Switchover**

In ArubaOS 8.0:

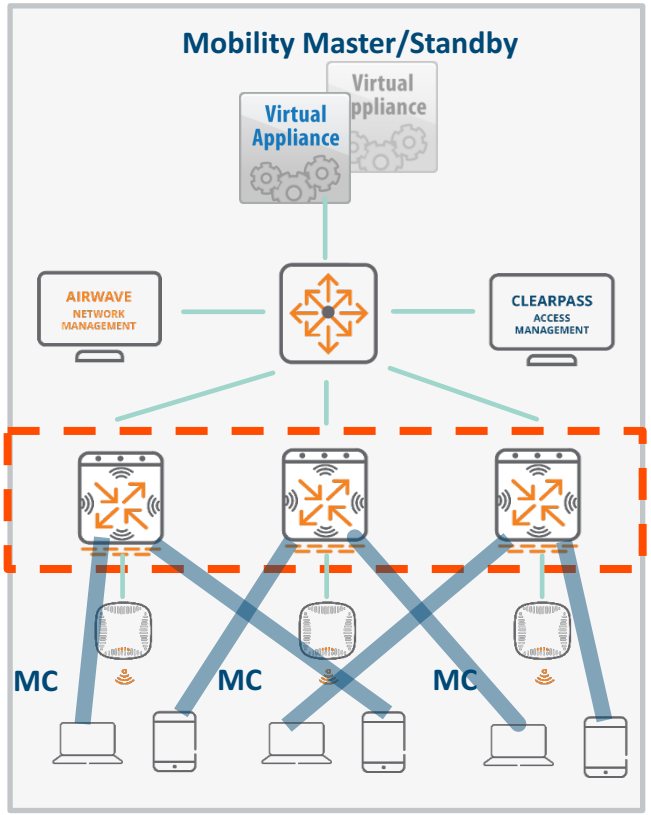


Clustering for Mission Critical Networks

1. **Seamless Campus Roaming**
   Clients stay anchored to a single MD when roaming across controllers

2. **Hitless Client Failover**
   User traffic uninterrupted upon cluster member failure

3. **Client Load Balancing**
   Users automatically load balanced across cluster members



CLUSTERING HIGHLIGHTS

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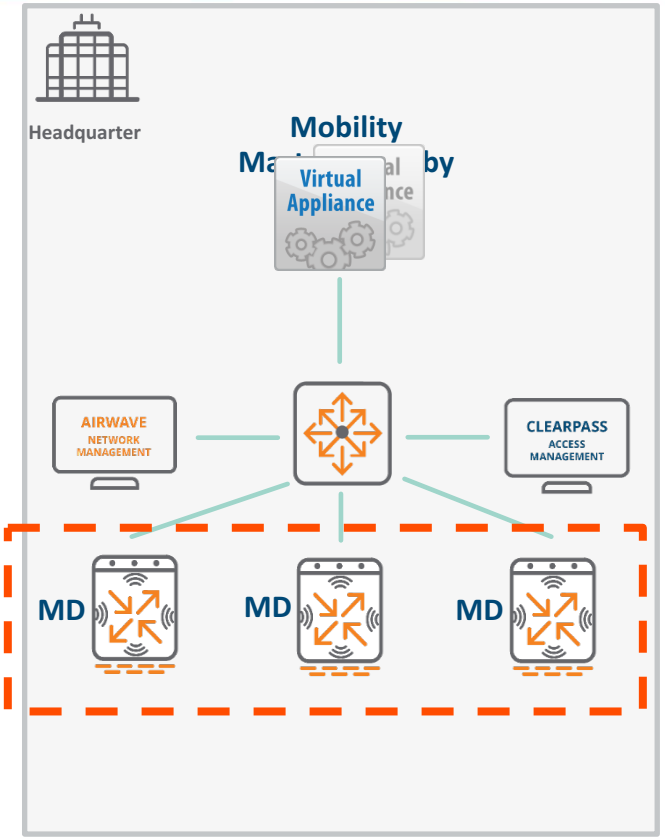
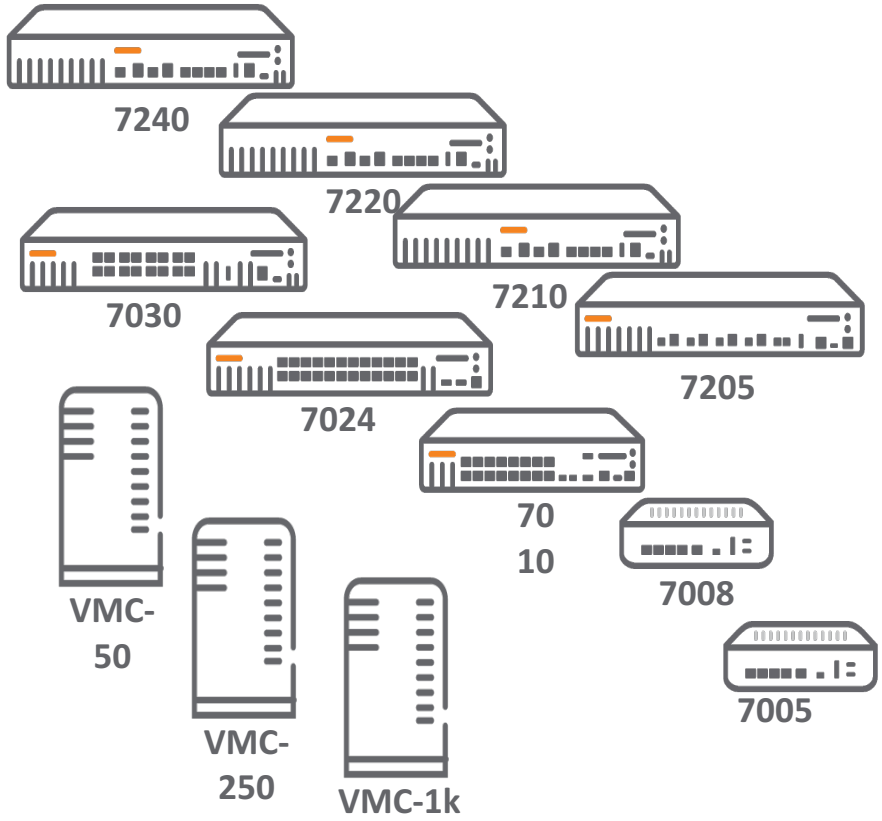
Highlights

1. Available ONLY with Mobility Master
2. Only among Managed Devices (not MM)
3. No License needed
4. CAP, RAP and Mesh AP support



Highlights

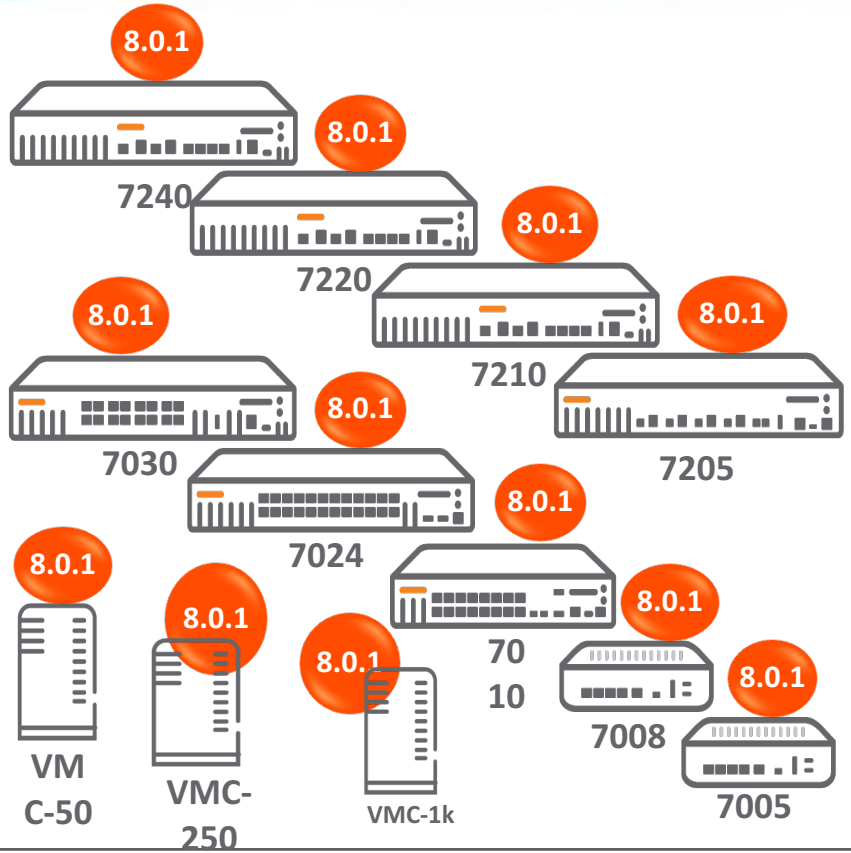
5 72xx, 70xx and VMC supported



Highlights

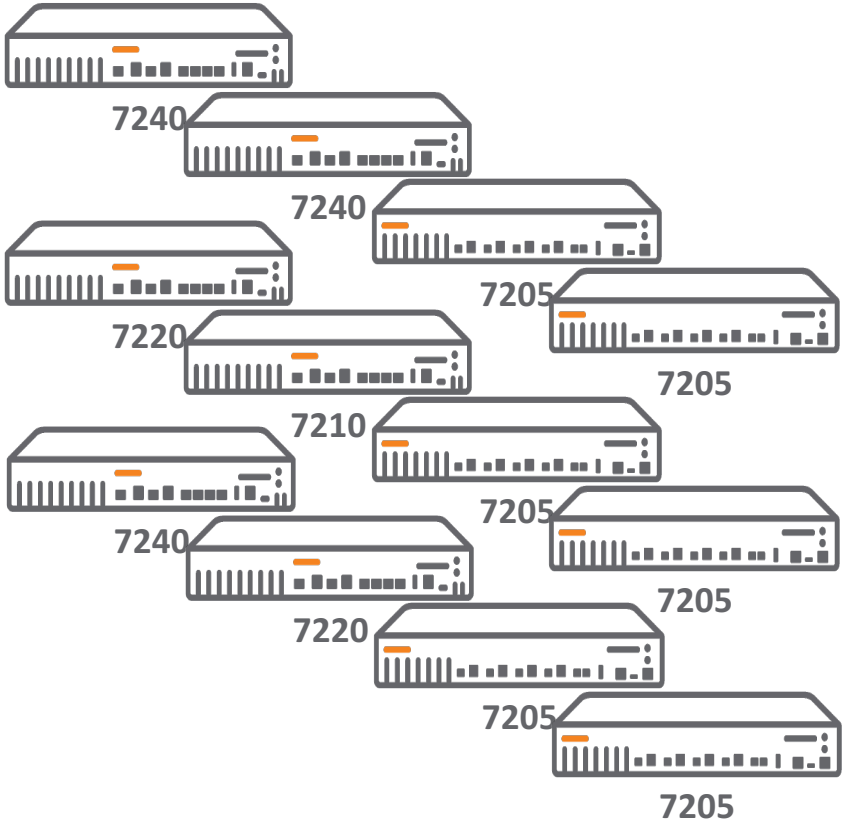
5 72xx, 70xx and VMC supported

6 All Managed Devices need to run the same software version



Cluster Capacity:

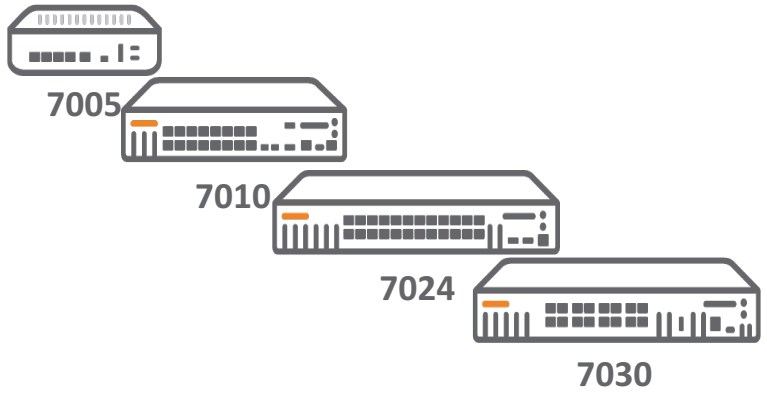
1 Up to 12 nodes in a cluster when using 72xx devices



Cluster Capacity:

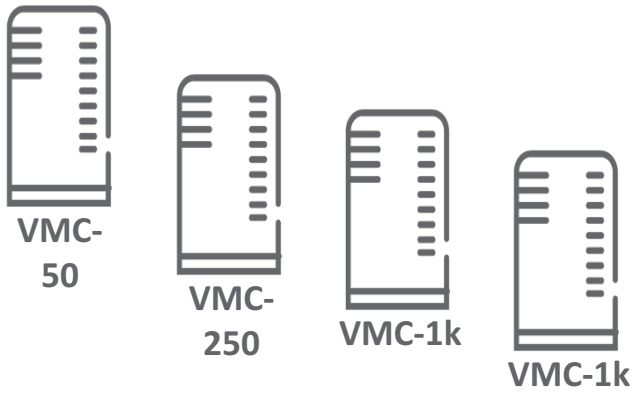
1. Up to 12 nodes in a cluster when using 72xx devices

2. Up to 4 nodes in a cluster when using 70xx devices



Cluster Capacity:

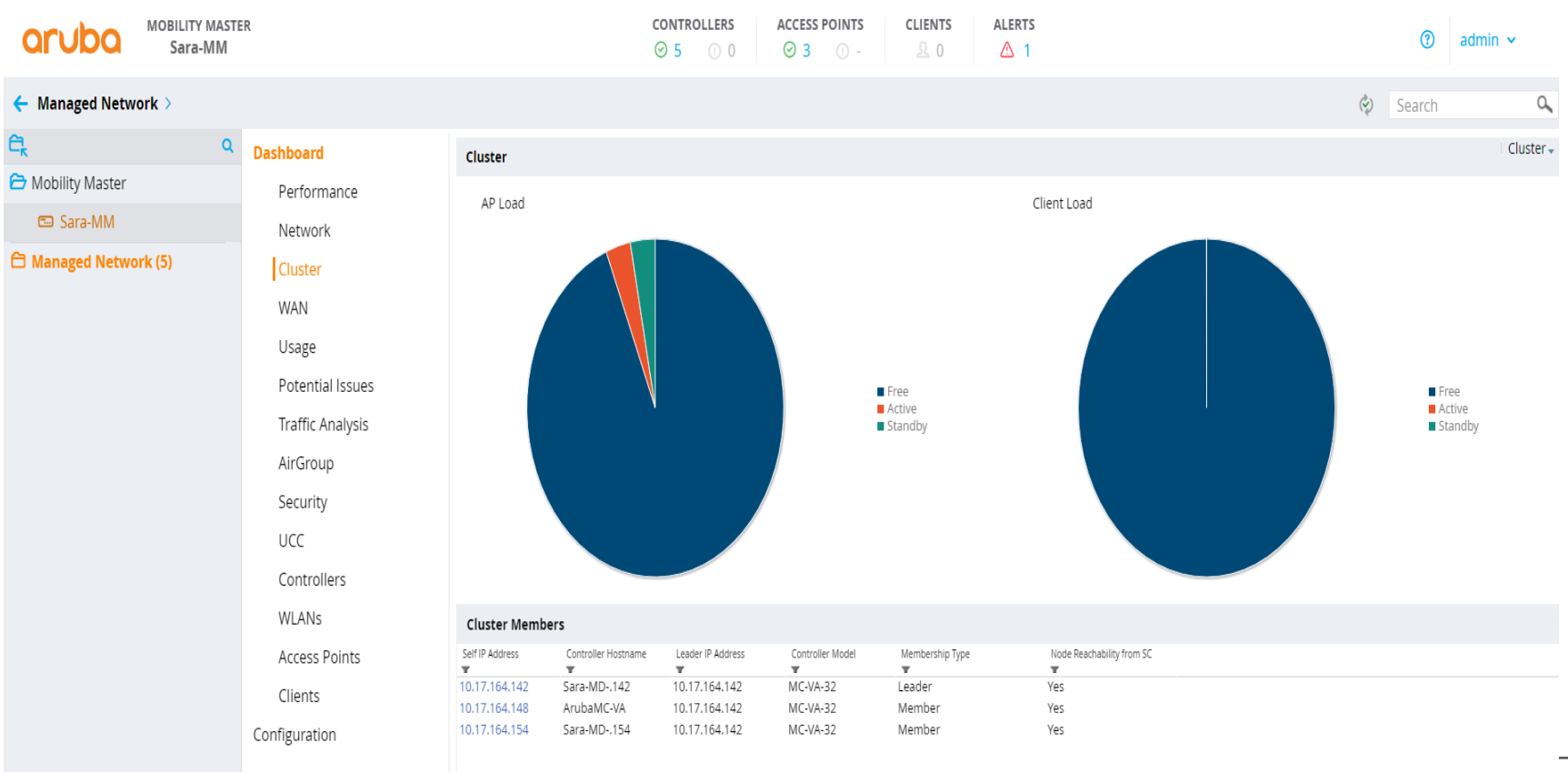
1. Up to 12 nodes in a cluster when using 72xx devices
2. Up to 4 nodes in a cluster when using 70xx devices
3. Up to 4 nodes in a cluster when using VMC devices



Key Considerations:

1. Clustering and HA-AP Fast Failover mutually exclusive
2. Cluster members need to run the same firmware version
3. Size of Cluster terminating RAPs limited to 4
4. Mix of 72xx and 70xx devices in a cluster not recommended

Cluster Dashboard:



CLUSTER LEADER

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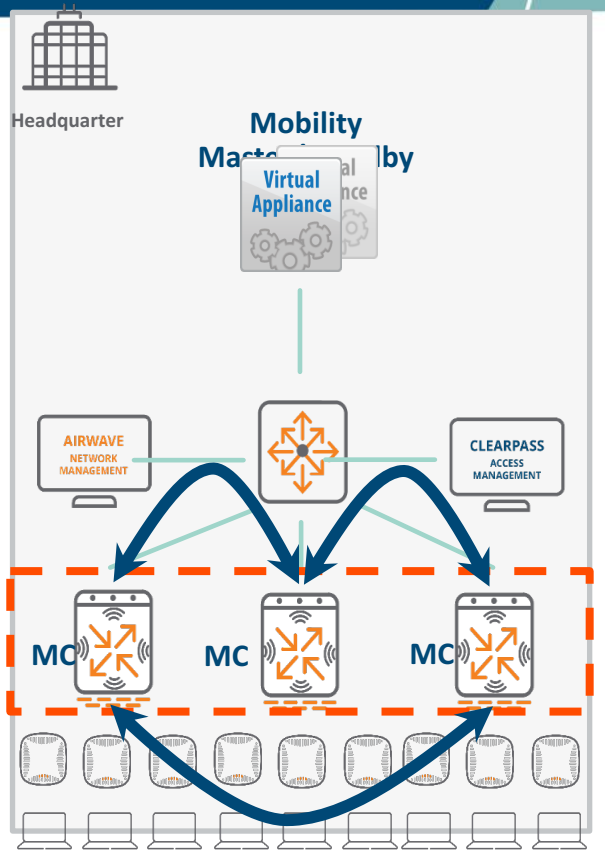
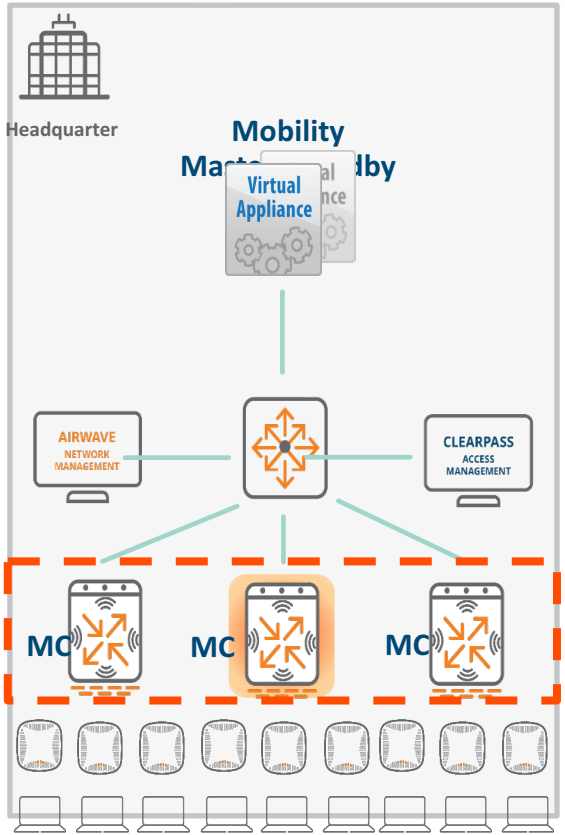
How is a Cluster Leader Elected?

1 Hello Messages exchanged during Cluster Formation



How is a Cluster Leader Elected?

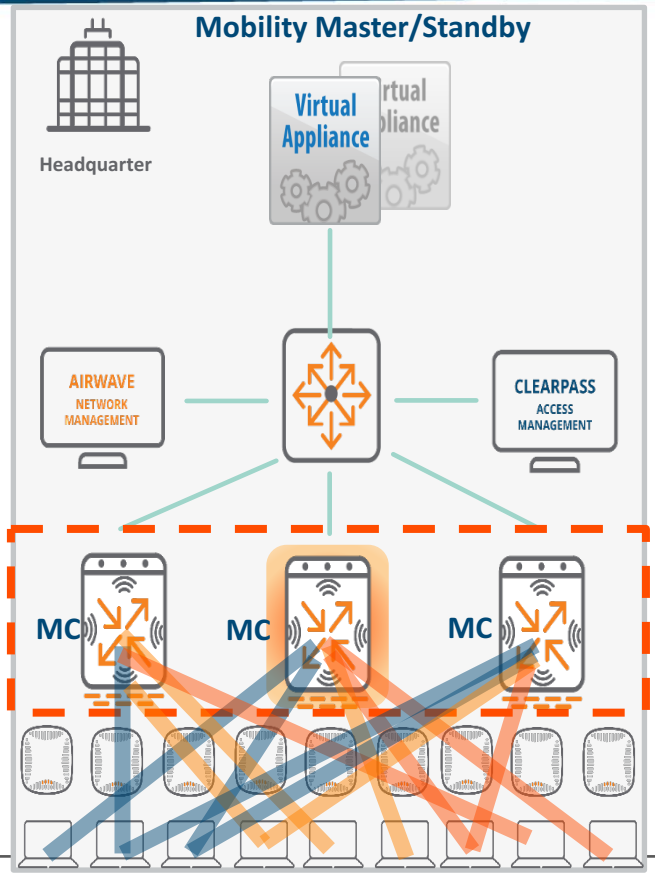
1. Hello Messages exchanged during Cluster Formation
2. Cluster Leader Election
   Defined by highest effective priority derived from Configured Priority, Platform Value & MAC
3. All controllers end up in fully meshed IPSEC tunnels between each pair
4. Cluster can be formed over a L2 (recommended) or L3 Network



What role does a Cluster Leader play?

1. Dynamically Load Balance clients on increasing load or member addition

2. Identify Standby MDs for Clients and APs to ensure hitless failover



Cluster Connection Types

1 L2- Connected

Cluster members sharing same VLANs

```
Cluster Info Table
------------------
Type IPv4 Address    Priority Connection-Type STATUS
---- --------------- -------- --------------- ------
self     10.29.163.2      200             N/A CONNECTED (Leader)
peer     10.29.163.3      128    L2-Connected CONNECTED (Member, last HBT_RSP 38ms ago, RTD = 0.490 ms)
```

2 L3-Connected

Cluster members NOT sharing same VLANs

```
Cluster Info Table
------------------
Type IPv4 Address    Priority Connection-Type STATUS
---- --------------- -------- --------------- ------
self     10.29.163.2      200             N/A CONNECTED (Leader)
peer     10.29.163.3      128    L3-Connected CONNECTED (Member, last HBT_RSP 25ms ago, RTD = 0.000 ms)
```

VLAN Probing:

- CM process will send a broadcast packet, with source mac as a special mac and destination mac as FF:FF:FF:FF:FF:FF, with vlan set to one of the vlans defined on the controller.
- If the cluster member is L2 connected then this broadcast packet will be received by it and an entry with the special mac corresponding to that vlan will be created in the bridge table.
- The CM will repeat the broadcast for every vlan defined.
- If the bridge table on the peer controller (i.e. cluster member) has entries for this special mac corresponding to every vlan then the two peers are said to be L2-connected, in which case the state of the cluster member will be moved to L2-CONNECTED.

CLUSTER ROLES

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Two Managed Devices (MD) Roles

1. AP Anchor Controller (AAC)
2. User Anchor Controller (UAC)

Redundancy

3. Standby-AAC (S-AAC)
4. Standby-UAC (S-UAC)

Terminology

- **AAC –**
  - AP Anchor Controller, a role given to a controller from individual AP perspective.
  - AAC handles all the management functions for a given AP and its radios. The AP is assigned to a given AAC through the existing mechanism of LMS-IP/Backup-LMS-IP configuration for the given AP in the AP-Group profile.
- **UAC**
  - User Anchor Controller, a role given to a controller from individual User perspective.
  - UAC handles all the wireless client traffic, including association/disassociation notification, authentication, and all the unicast traffic between controller and the client.
  - The purpose of UAC is to fix the controller so that when wireless client roams between APs, the controller remains the same within the cluster.
  - UAC assignment spreads the load of users among available controllers in the cluster

Terminology

- **S-AAC –**
  - Standby Controller from the AP perspective
  - AP fails over to this controller on Active AAC down
- **S-UAC**
  - Standby Controller from the User perspective
  - User fails over to this controllers on Active UAC down

AP ANCHOR CONTROLLER (AAC)

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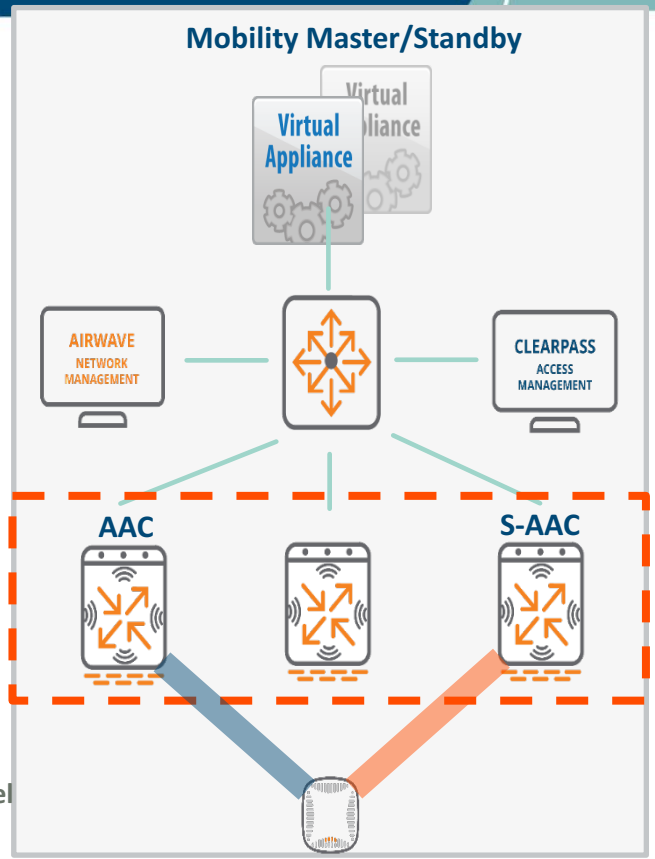
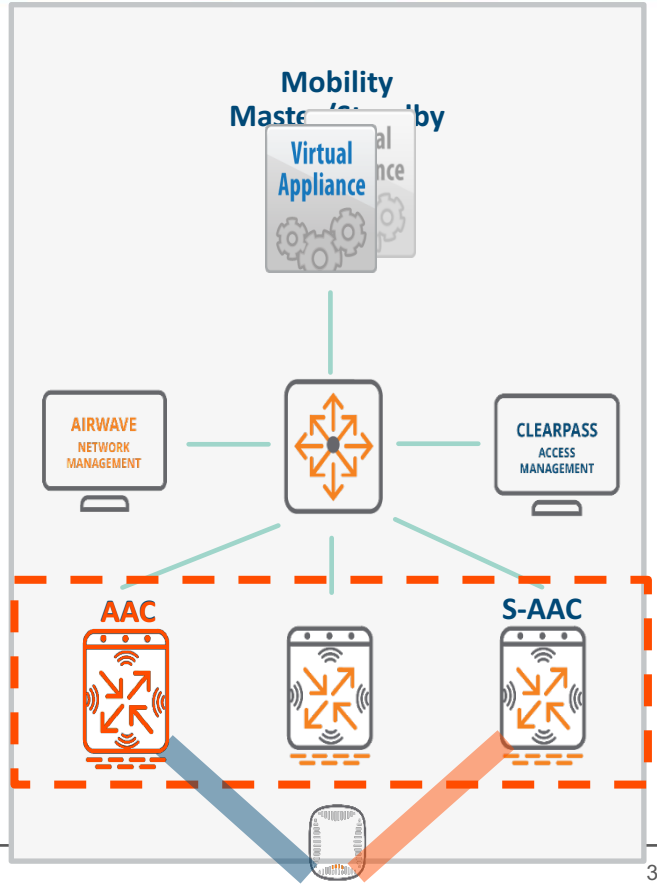
AP Anchor Controller (AAC)

1. AP sets up Active Tunnels with its LMS (AAC)
2. S-AAC is dynamically assigned from other cluster members
3. AP sets up Standby Tunnels with S-AAC



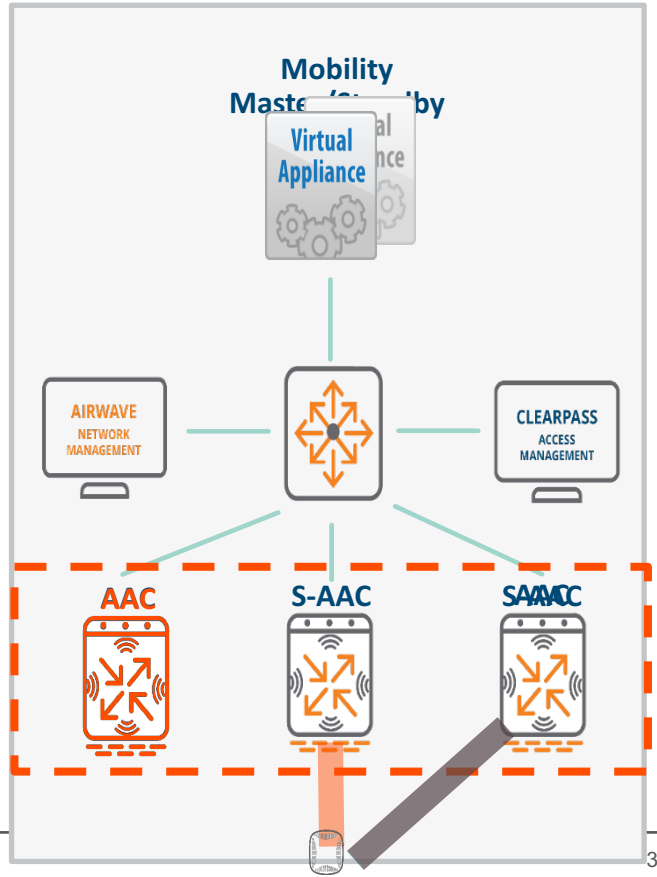
AAC Failover

1. AAC fails and Failure detected by S-AAC
2. AP tears tunnel and S-AAC instructs AP to fail over



AAC Failover

1. AAC fails and Failure detected by S-AAC
2. AP tears tunnel and S-AAC instructs AP to fail over
3. AP builds Active tunnels with new AAC
4. New S-AAC is assigned by Cluster Leader



USER ANCHOR CONTROLLER (UAC)

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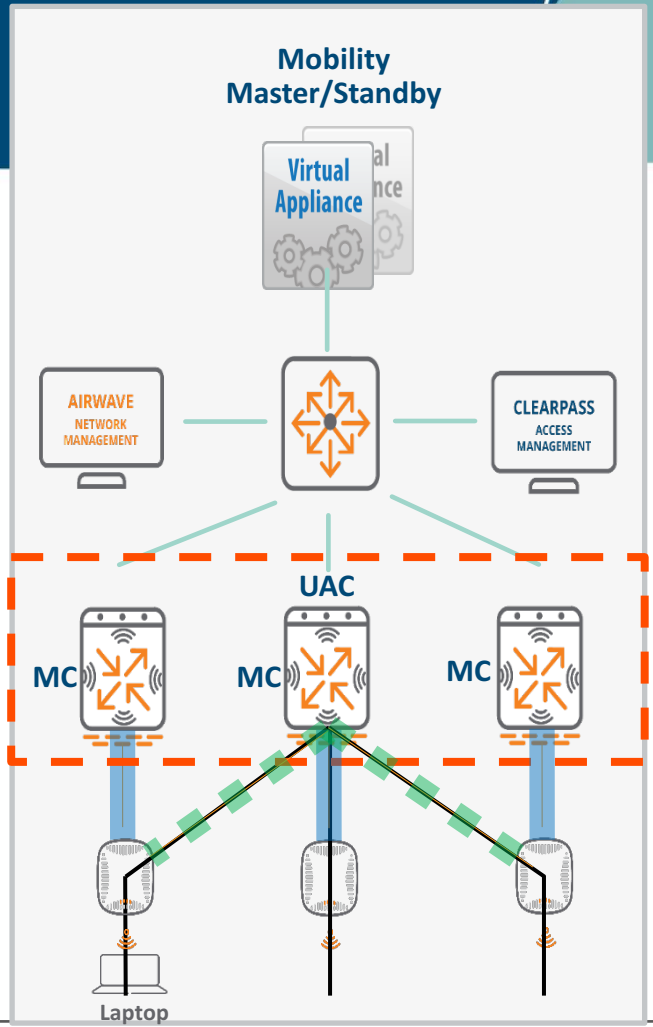
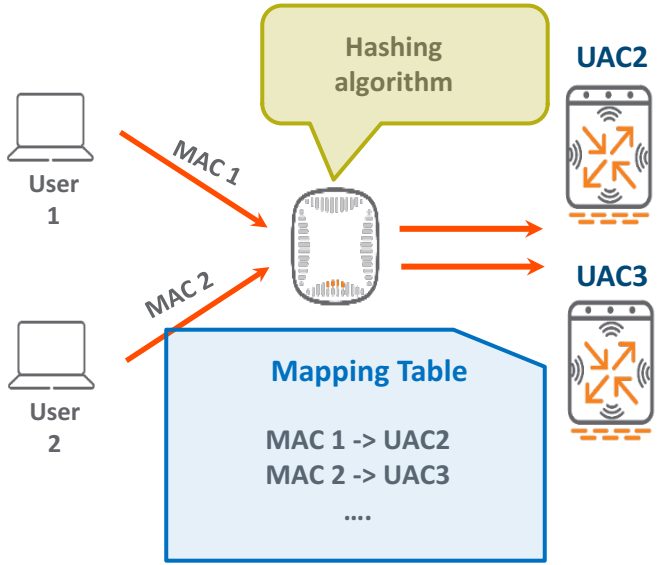
User Anchor Controller (UAC)

1. AP creates dynamic tunnel to client UAC
2. When client roams, old AP tears down dynamic tunnel
3. User traffic is always tunneled to its UAC



How does a User remain anchored to a single controller (UAC)?

1. User mapped to its UAC via a hashing algorithm at AP level
2. Hashing -> Index to Mapping Table
3. Same Mapping is pushed to all APs by Cluster Leader
4. Cluster Leader selects S-UAC on per User basis



CLI Output:

```
(Sara-MD-.142) #show user
This operation can take a while depending on number of users. Please be patient ....

Users
-----
    IP                      MAC           Name     Role      Age(d:h:m)  Auth  VPN link  AP name           Roaming   Essid/Bssid/Phy                  Profile     Forward mode  Type  Host Name  User Type
----------                  ------------  -------  ----      ----------  ----  --------  -------           -------   ---------------                  -------     ------------  ----  ---------  ---------
10.17.164.3                 c0:ee:fb:52:69:95            logon     00:00:01                    40:e3:d6:cd:e4:9a  Wireless  Aruba-test/40:e3:d6:5e:49:b0/a-VHT  Aruba-test  tunnel                       WIRELESS
fe80::c2ee:fbff:fe52:6995   c0:ee:fb:52:69:95            logon     00:00:01                    40:e3:d6:cd:e4:9a  Wireless  Aruba-test/40:e3:d6:5e:49:b0/a-VHT  Aruba-test  tunnel                       WIRELESS

User Entries: 2/2
 Curr/Cum Alloc:4/11 Free:0/7 Dyn:4 AllocErr:0 FreeErr:0
(Sara-MD-.142) #show station-table

Station Entry
-------------
     MAC           Name     Role      Age(d:h:m)  Auth  AP name           Essid       Phy    Remote  Profile     User Type
-----------        ------   ----      ----------  ----  -------           -----       ---    ------  -------     ---------
c0:ee:fb:52:69:95           logon     00:00:01    No    40:e3:d6:cd:e4:9a  Aruba-test  a-VHT  No      Aruba-test  WIRELESS

Station Entries: 1
```

```
(Sara-MD-.142) #show aaa cluster essid-all users

Active Users for ESSID : Aruba-test
-----------------------------------
BUCKET   MAC                IP              Active UAC       Standby UAC
------   ---                --              ----------       -----------
174      c0:ee:fb:52:69:95   10.17.164.3     10.17.164.142    10.17.164.154
```

CLI Output for Bucketmap:

```
(Sara-MD-.142) #show ap remote debug  bucketmap stm  ap-name  40:e3:d6:cd:e4:9a

Bucket map for essid Aruba-test
-------------------------------
Item                          Value
----                          -----
Essid                         Aruba-test
UAC 0                         10.17.164.142 (Up)
UAC 1                         10.17.164.148 (Up)
UAC 2                         10.17.164.154 (Up)
Current Map [0-31]            00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 00 01 02 00 01 02 00 01 02 00 01
Current Map [32-63]           02 00 01 02 02 00 01 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 00 01 02 00 01 02 00
Current Map [64-95]           01 02 00 01 02 02 00 01 02 00 01 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 00 01 02
Current Map [96-127]          00 01 02 00 01 02 02 00 01 02 00 01 02 00 01 00 01 02 00 01 02 02 00 01 02 00 01 02 02 00 01 02
Current Map [128-159]         01 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 02 00 01 02 00 01 00 01 02 02 00 01 02 00 01 02
Current Map [160-191]         00 01 02 00 01 02 00 01 00 01 02 02 00 01 00 02 01 02 00 01 02 00 01 02 00 01 00 01 02 02 00 01
Current Map [192-223]         02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00
Current Map [224-255]         01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02

Active Map [0-31]             00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 00 01 02 00 01 02 00 01 02 00 01
Active Map [32-63]            02 00 01 02 02 00 01 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 00 01 02 00 01 02 00
Active Map [64-95]            01 02 00 01 02 02 00 01 02 00 01 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 00 01 02
Active Map [96-127]           00 01 02 00 01 02 02 00 01 02 00 01 02 00 01 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 02 00
Active Map [128-159]          01 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 02 00 01 02 00 01 00 01 02 02 00 01 02 00 01 02
Active Map [160-191]          00 01 02 00 01 02 00 01 00 01 02 02 00 01 00 02 01 02 00 01 02 00 01 02 00 01 00 01 02 02 00 01
Active Map [192-223]          02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00
Active Map [224-255]          01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02

Standby Map [0-31]            01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 00 02 00 01 02 01 01 00 00 02 02 01 01 00
Standby Map [32-63]           00 02 02 01 00 02 00 01 02 01 01 00 00 02 02 01 01 00 00 01 02 02 00 02 00 01 02 01 01 00 00 02
Standby Map [64-95]           02 01 01 00 00 01 02 02 00 02 00 01 02 01 01 00 00 02 02 01 01 00 00 01 02 02 00 02 00 01 02 01
Standby Map [96-127]          01 00 00 02 02 01 00 02 02 01 01 00 00 02 00 01 02 01 01 00 00 02 02 01 00 02 02 01 01 00 00 02
Standby Map [128-159]         00 01 02 01 01 00 00 02 02 01 00 02 02 01 01 00 00 02 02 01 01 00 00 01 02 02 00 02 02 01
Standby Map [160-191]         01 00 00 02 02 01 01 00 01 00 00 01 02 02 02 00 02 01 01 00 00 02 02 01 01 00 01 00 00 01 02 02
Standby Map [192-223]         00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02
Standby Map [224-255]         02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01

L2 Connectedness [0-31]       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2 Connectedness [32-63]      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2 Connectedness [64-95]      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2 Connectedness [96-127]     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2 Connectedness [128-159]    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2 Connectedness [160-191]    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2 Connectedness [192-223]    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2 Connectedness [224-255]    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

Current Map Timestamp Wed May 24 12:31:57 2017 (23h:47m:11s ago); gen_num=8 Reason=Bmap Message Trigger=Normal Bmap
Bucket Map Rcvd Timestamp Wed May 24 12:31:57 2017 (23h:47m:11s ago)
radio_bg 1, radio_a 1:
Bucket Index 174, list 0xe50678:
        sta:c0:ee:fb:52:69:95
(Sara-MD-.142) #
```

CLI Output for Bucketmap:

```
(Sara-MD-.142) #show aaa cluster essid-all bucketmap


Bucket map for Aruba-test, Rcvd at : Wed May 24 12:31:56 2017

------------------------------------------------------------------
Item                    Value
----                    -----
Essid                   Aruba-test
UAC0                    10.17.164.142
UAC1                    10.17.164.148
UAC2                    10.17.164.154
Active Map[0-31]        00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 00 01 02 00 01 02 00 01 02 00 01
Active Map[32-63]       02 00 01 02 02 00 01 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 00 01 02 00 01 02 00
Active Map[64-95]       01 02 00 01 02 02 00 01 02 00 01 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01
Active Map[96-127]      00 01 02 00 01 02 02 00 01 02 00 01 02 00 01 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 02 00
Active Map[128-159]     01 00 01 02 00 01 02 00 01 02 02 00 01 02 00 01 02 00 01 02 00 01 00 01 02 02 00 01 02 00 01 02
Active Map[160-191]     00 01 02 00 01 02 00 01 00 01 02 02 00 01 00 02 01 02 00 01 02 00 01 02 00 01 00 01 02 02 00 01
Active Map[192-223]     02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00
Active Map[224-255]     01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02 00 01 02

Standby Map[0-31]       01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 00 02 00 01 02 01 01 00 00 02 02 01 01 00
Standby Map[32-63]      00 02 02 01 00 02 00 01 02 01 01 00 00 02 02 01 01 00 00 01 02 02 00 02 00 01 02 01 01 00 00 02
Standby Map[64-95]      02 01 01 00 00 01 02 02 00 02 00 01 02 01 01 00 00 02 02 01 01 00 00 01 02 02 00 02 00 01 02 01
Standby Map[96-127]     01 00 00 02 02 01 00 02 02 01 01 00 00 02 00 01 02 01 01 00 00 02 02 01 00 02 02 01 01 00 00 02
Standby Map[128-159]    00 01 02 01 01 00 00 02 02 01 00 02 02 01 01 00 00 02 02 01 01 00 01 00 00 01 02 02 00 02 02 01
Standby Map[160-191]    01 00 00 02 02 01 01 00 01 00 00 01 02 02 02 00 02 01 01 00 00 02 02 01 01 00 00 01 02 02 02 00
Standby Map[192-223]    00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02
Standby Map[224-255]    02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01 01 00 00 02 02 01

L2connect[0-31]         1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2connect[32-63]        1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2connect[64-95]        1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2connect[96-127]       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2connect[128-159]      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2connect[160-191]      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2connect[192-223]      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
L2connect[224-255]      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

IsActive[0-31]          1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0 1 0 0 1 0 0 1 0 0 1 0
IsActive[32-63]         0 1 0 0 0 1 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 1 0 1 0 0 1 0 0 1
IsActive[64-95]         0 0 1 0 0 0 1 0 0 1 0 1 0 0 1 0 0 1 0 0 0 1 0 0 1 0 1 0 0 1 0 0
IsActive[96-127]        1 0 0 1 0 0 0 1 0 0 1 0 0 1 0 1 0 0 1 0 0 1 0 0 0 1 0 0 1 0 0 1
IsActive[128-159]       0 1 0 0 1 0 0 1 0 0 0 1 0 0 1 0 0 1 0 1 0 0 0 1 0 0 1 0 1 0 0 0
IsActive[160-191]       1 0 0 1 0 0 1 0 1 0 0 0 1 0 1 0 0 0 1 0 0 1 0 0 1 0 1 0 0 0 1 0
IsActive[192-223]       0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1
IsActive[224-255]       0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0
(Sara-MD-.142) #
```

CLUSTER CONFIGURATION

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Configuration:

Creating a new cluster group profile (should be done on the MM)

(MM) [cluster2] (config) #lc-cluster group-profile vmc2

(MM) ^[cluster2] (Classic Controller Cluster Profile "vmc2") #controller 10.29.161.98

(MM) ^[cluster2] (Classic Controller Cluster Profile "vmc2") #controller 10.29.161.251

Registering to a cluster group (should be done on the MM with the managed node as its path)

(MM) ^[cluster2] (config) #cd /md/cluster2/00:0c:29:bc:2a:96

(MM) ^[00:0c:29:bc:2a:96] (config) #lc-cluster group-membership vmc2

CLUSTER HITLESS FAILOVER

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Cluster Hitless Failover

TWO CONDITIONS

1. Redundancy Mode enabled
2. L2-Connected
   Cluster members sharing same VLANs

```
(MD-Cluster1) #show lc-cluster group-membership

Cluster Enabled, Profile Name = "acme"
Redundancy Mode On
Active Client Rebalance Threshold = 50%
Standby Client Rebalance Threshold = 75%
Unbalance Threshold = 5%
Cluster Info Table
------------------
Type IPv4 Address     Priority Connection-Type STATUS
---- ---------------- -------- --------------- ------
self     10.70.211.11      128             N/A CONNECTED (Leader)
peer     10.70.211.12      128    L2-Connected CONNECTED (Member, last HBT_RSP 9ms ago, RTD = 0.000 ms)
peer     10.70.211.13      128    L2-Connected CONNECTED (Member, last HBT_RSP 9ms ago, RTD = 0.000 ms)
```

Cluster Hitless Failover

- **How is Hitless Failover achieved?**

1. Client State sync'ed to S-UAC
   Sta, user, L2_user, L3-user, key_cache, pmk_cache,etc..
2. High-Value sessions sync'ed to S-UAC
   FTP, Telnet, SSH, DPI qualified sessions..
3. NO Client de-Auth w/ failover to S-UAC

```
(MD-Cluster2) #show user-table standby

Dormant Mac Hash Table
----------------------

 IP              MAC                l2role         l3role    vlan   Essid/Bssid/Tunnelid                  Counts(User/PTK)    Active UAC IP
---              -----              --------       --------  ------ ----------------------                --------------------  ---------------
10.70.215.248   5c:f9:38:94:55:5e  authenticated            215    secure-acme/18:64:72:40:bb:1d/0x1000a  2/1                 10.70.211.13
10.70.215.245   5c:f9:38:97:5c:9c  authenticated            215    secure-acme/18:64:72:40:bb:1d/0x1000a  1/1                 10.70.211.13

Total Entries   : 2
```

CLUSTER LOAD BALANCING

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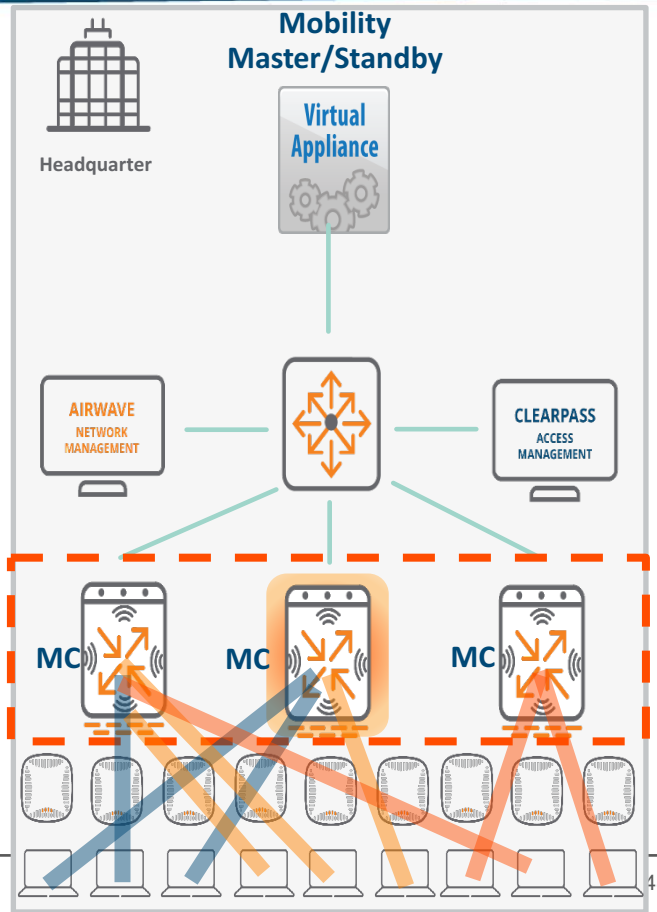
Cluster Load Balancing

- **Why Load Balance Clients?**

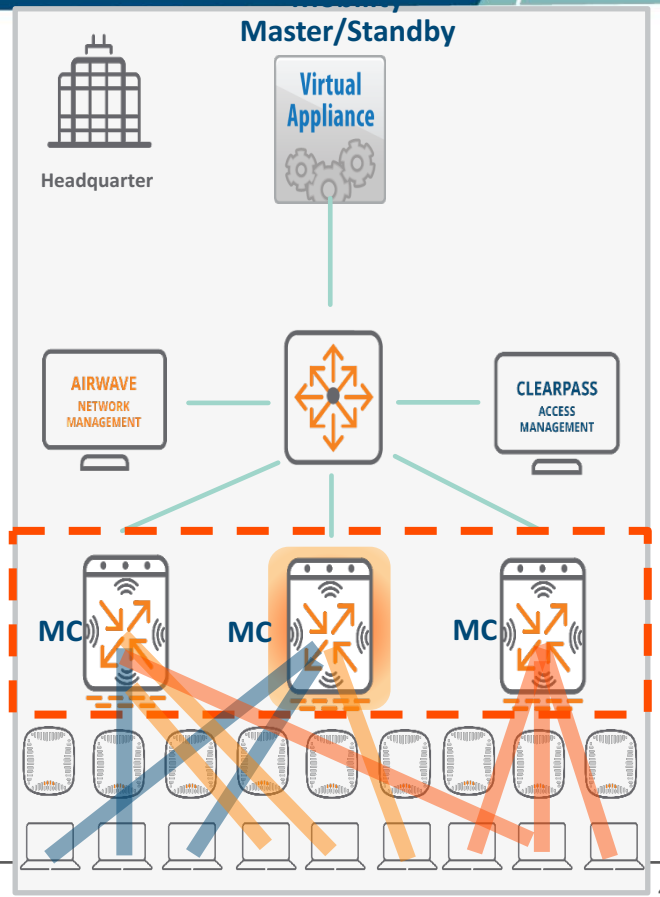
1. Assume clients are disproportionately balanced
2. Not efficient use of system resources



Cluster Load Balancing

- **Why Load Balance Clients?**

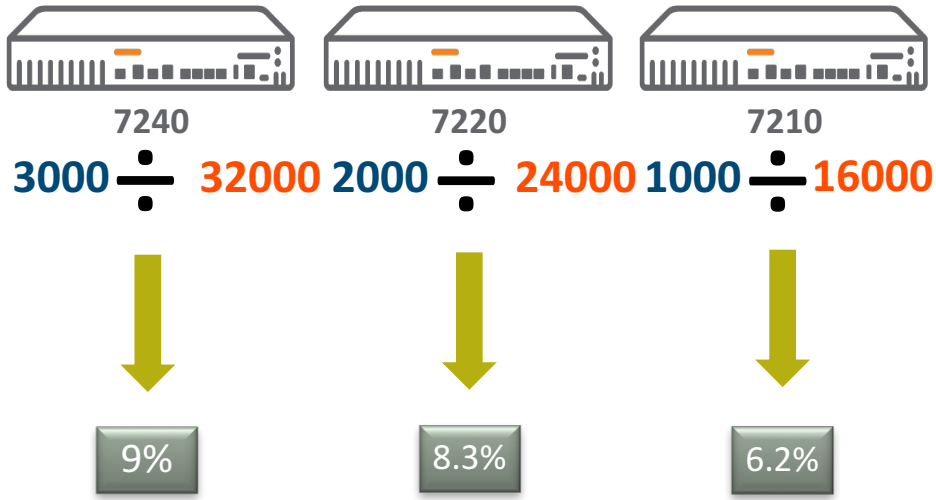
1. Assume clients are disproportionately balanced
2. Not efficient use of system resources
3. Load Balance clients to optimally load users across a cluster



Cluster Load Balancing

- **How does Load on a controller calculated?**

1. Identify the controller model
2. Get current client count on controllers
3. Get total client capacity for controller
4. Ratio of the two will give the load
5. Based on the load and additional triggers load balancing takes place



Cluster Load Balancing

- **How is the Load Balancing triggered?**

1. Rebalance Thresholds
   Load on cluster node exceeds threshold
   - Active Client Rebalance Threshold (50%)
   - Standby Client Rebalance Threshold (75%)
2. Unbalance Threshold (5%)

One Rebalance Threshold and the Unbalance Threshold both exceeded

Functionality

- **As cluster members can be of different controller models, the LB trigger is based on individual node's current load and not the combined cluster load.**
- **Admin can control when the LB gets triggered by configuring the threshold parameters in the cluster profile.**

  - Active Client Rebalance Threshold:50% (default)
    (*Will redistribute active client load when active load on any cluster node is beyond this configured percentage*)
  - Standby Client Rebalance Threshold:75% (default)
    (*Will redistribute standby client load when standby load on any cluster node is beyond this configured percentage. Applicable only when redundancy is ON*)
  - Unbalance Threshold:5% (default)
    (*The minimum difference in load percentage between max loaded cluster node and min loaded cluster node to let load balancing algorithm kick in*)

Functionality

- The LB process flow is as follows
  - Trigger → Evaluate → Rebalance

- LB is triggered only when BOTH load balance threshold and unbalance threshold are met.

- "Rebalance" is the process of moving the station (s) from one node to another. This adjustment is done by changing the UAC index in the bucket map for the affected bucket on a per ESS-bucket.

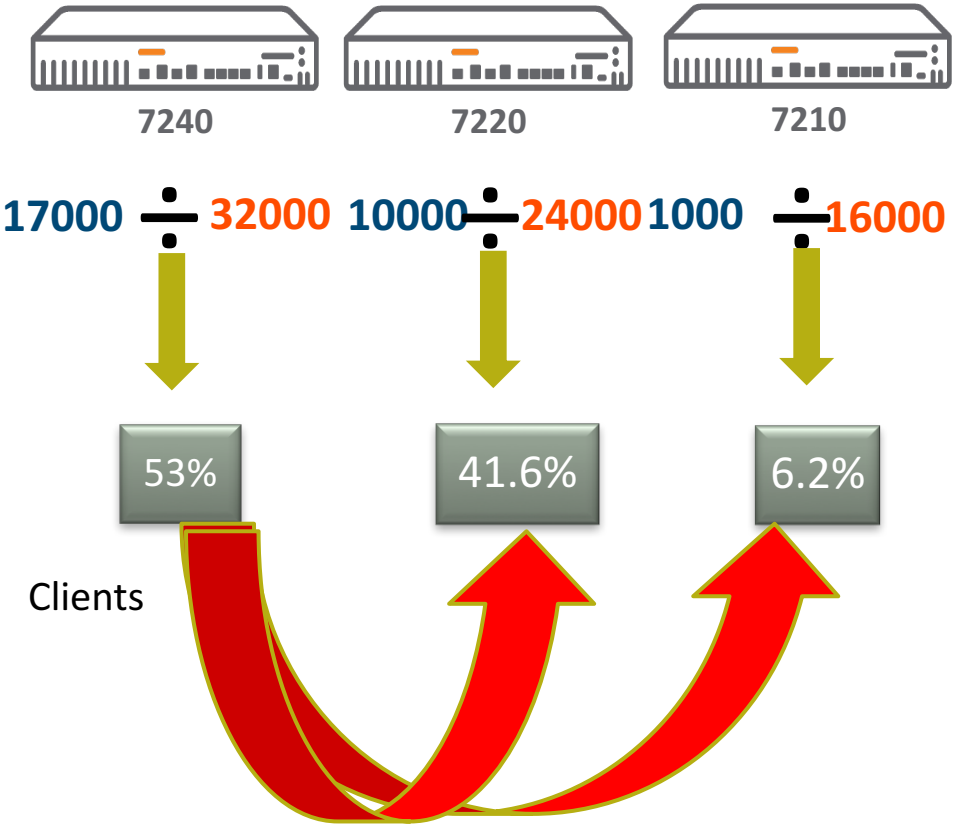
- The LB action of moving the clients across nodes to maintain balance will be hitless.

- When cluster redundancy is enabled, the LB will additionally trigger and rebalance the standby STA load, just like the active STA load.

Cluster Load Balancing

- **Load Balance trigger example**

1. Identify the controller model
2. Get current client count on controllers
3. Get total client capacity for controller
4. Ratio of the two will give the load
5. LB triggered -> Rebalance from 7240 between 7210 and 7220



Example case studies

- **active-client-rebalance-threshold 10%**
- **unbalance-threshold 5%**

Case1:

- 7240 (A): 3,000 clients
- 7220 (B): 2,000 clients

Result: No LB. Because neither threshold is met! (A is 9%, B is 8%)

Case2:

- 7240 (A): 4,000 clients
- 7220 (B): 700 clients

Result: LB is triggered. (A is 12.5%, B is 2.8%, and unbalance is > 5%)

Case3:

- 7240 (A): 500 clients
- 7220 (B): 0 clients (node just rebooted)

Result: No LB. Because neither threshold is met! (A is 1.5% and unbalance is < 5%)

LB Internals

- Cluster redundancy disabled
  - LB uses the standby-UAC designation to alter the replication from none to a target new controller first.
  - Once replication is done, CM will re-publish the bucket map to change the active-UAC and then clear the standby-UAC of the bucket.
  - The active-UAC designation of a bucket causes AP to switch clients to the new UAC, which already receives the data as a “temporary standby”, so that client can switch to new UAC with minimal disruption.
- Cluster redundancy enabled.
  - LB will set the standby-UAC to the new UAC. Once completed, LB will swap the active-UAC and standby-UAC in the bucket map.
  - Once done, the new UAC will be the active one, and the original active UAC will be the standby.
  - It is up to Load Balancer to decide whether to transition back and use the original standby-UAC for the switched bucket or not, depending on the overall load distribution target that Load Balancer concludes.

Configuration

- **Load balancing is enabled by default when cluster is configured.**

  - Aruba7210) #show lc-cluster group-profile testlb

```
Redundancy:No
L2-Connected:No
Active Client Rebalance Threshold:50%
Standby Client Rebalance Threshold:75%
Unbalance Threshold:5%
```

- **The threshold parameters can be configured in cluster group profile from MM**

```
(ArubaSC) [md] (config) #lc-cluster group-profile Clusterlb
(ArubaSC) ^[md] (Classic Controller Cluster Profile "Clusterlb") #active-client-rebalance-threshold
60
(ArubaSC) ^[md] (Classic Controller Cluster Profile "Clusterlb") #standby-client-rebalance-threshold
70
(ArubaSC) ^[md] (Classic Controller Cluster Profile "Clusterlb") #unbalance-threshold  10
```

Questions ?

THANK YOU!

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