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Migrating a Large Enterprise Wireless Network to IPv6

Steve Tam, Wireless Engineer
Meta

CSGEN-2000

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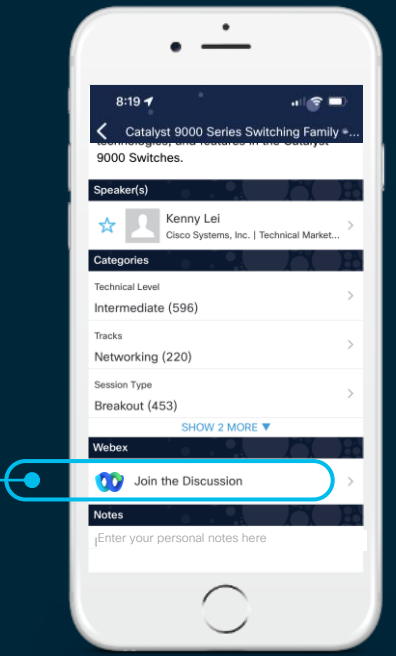

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Agenda

- Intro / About Me
- Why IPv6?
- Scope of Meta's WLAN
- Topology
- Timeline
- Migrating clients/infrastructure
- Lessons Learned

Intro / About Me

Intro

- This session is intended to:
  - Provide some insight on lessons learned & first-hand experience from migrating a large enterprise WLAN to using IPv6

- This session is not intended to cover:
  - Fundamentals of IPv6
    - Recommended session: **IPv6 – What Do you Mean there isn't a Broadcast? – BRKENT-1616**
  - A basic overview of how to implement IPv6 in your network
    - Recommended session: **Let's Deploy IPv6 NOW – BRKENT-2109**

About Me

- Wireless Network Engineer for Meta
  - (formerly known as Facebook)
  - Supporting the WiFi network in our offices & datacenters
- Graduated from North Carolina State University (Go Pack!)
- Deployed & supported enterprise-scale wireless networks for 16+ years

Why IPv6?

Why IPv6? (for an enterprise WLAN)

- Meta has been a heavy adopter of IPv6, both externally & internally
  - All of our internal user networks are dual-stacked
  - Dev servers are IPv6-only

- We began running out of private IPv4 space in 2018
  - Only the 172.16.0.0/12 and 192.168.0.0/16 ranges are used for the corporate network

- To keep opening new offices, we needed to be aggressive with migrating to IPv6 wherever we could

Why IPv6? (for an enterprise WLAN)

- From an operator perspective – simplified deployments
  - /64 for each AP subnet = 2^64 addresses available
  - No calculations needed up front to right-size the AP subnet
  - No need to resize the AP subnet when expanding a site

- Same goes for clients – no need to constantly add IPv4 space as client counts go up
  - Especially in a world where WiFi client counts are always increasing

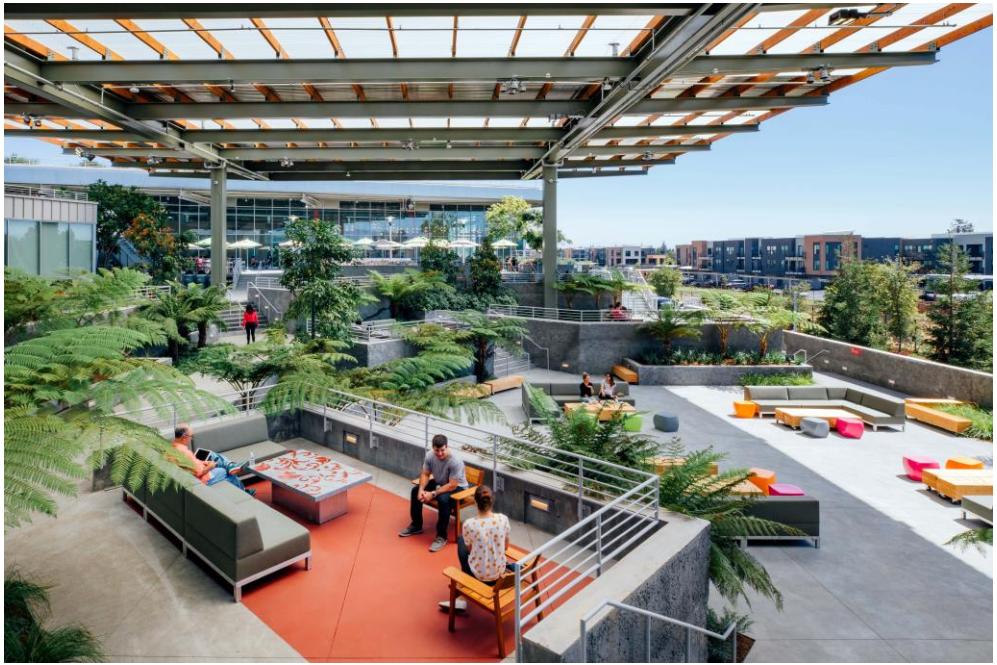
Scope of Meta’s WLAN

Scope – The Meta Corporate WLAN

- Covers all Meta locations:
  - Offices in 80+ cities worldwide
  - 18 data centers
  - 70k full-time employees
- 120k wireless clients daily:
  - macOS, Windows, Linux
  - iOS, Android
  - Oculus, Portal, etc.

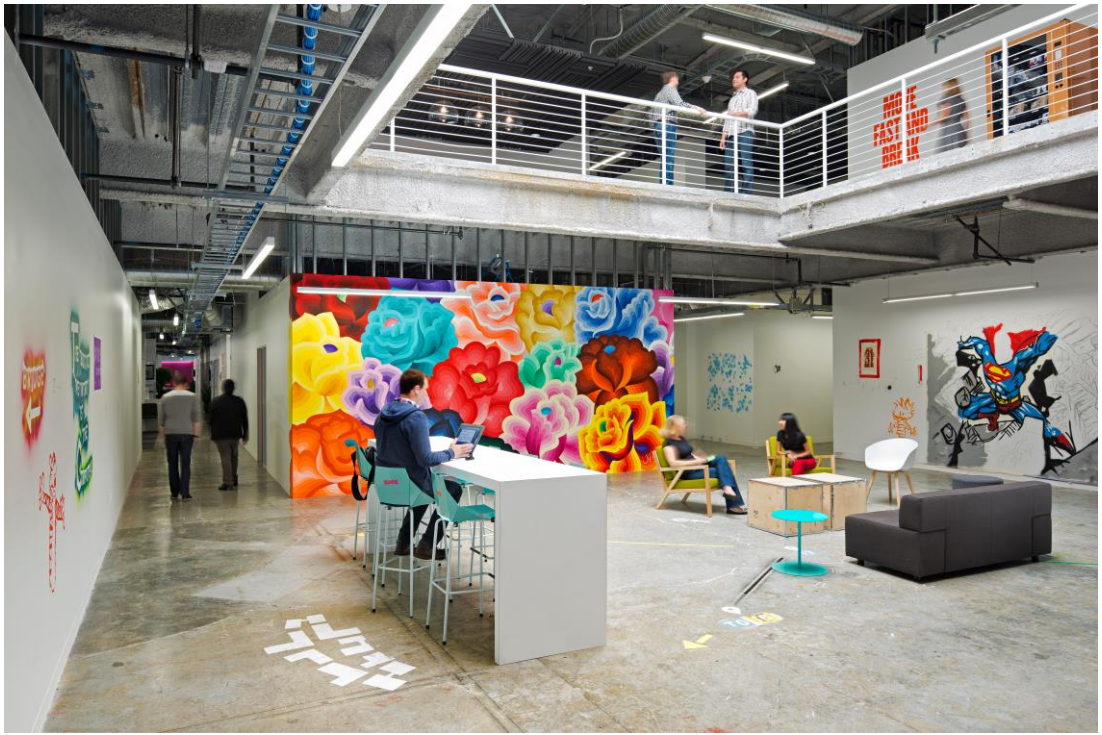
Scope – The Meta Corporate WLAN

- 15k+ office APs (Local mode)
  - Indoor: C9130
  - Outdoor: C1562, C9124
- 200+ Catalyst 9800 wireless controllers
- 1k+ lab APs (FlexConnect mode)
- DNA Center
- Connected Mobile Experiences (CMX)



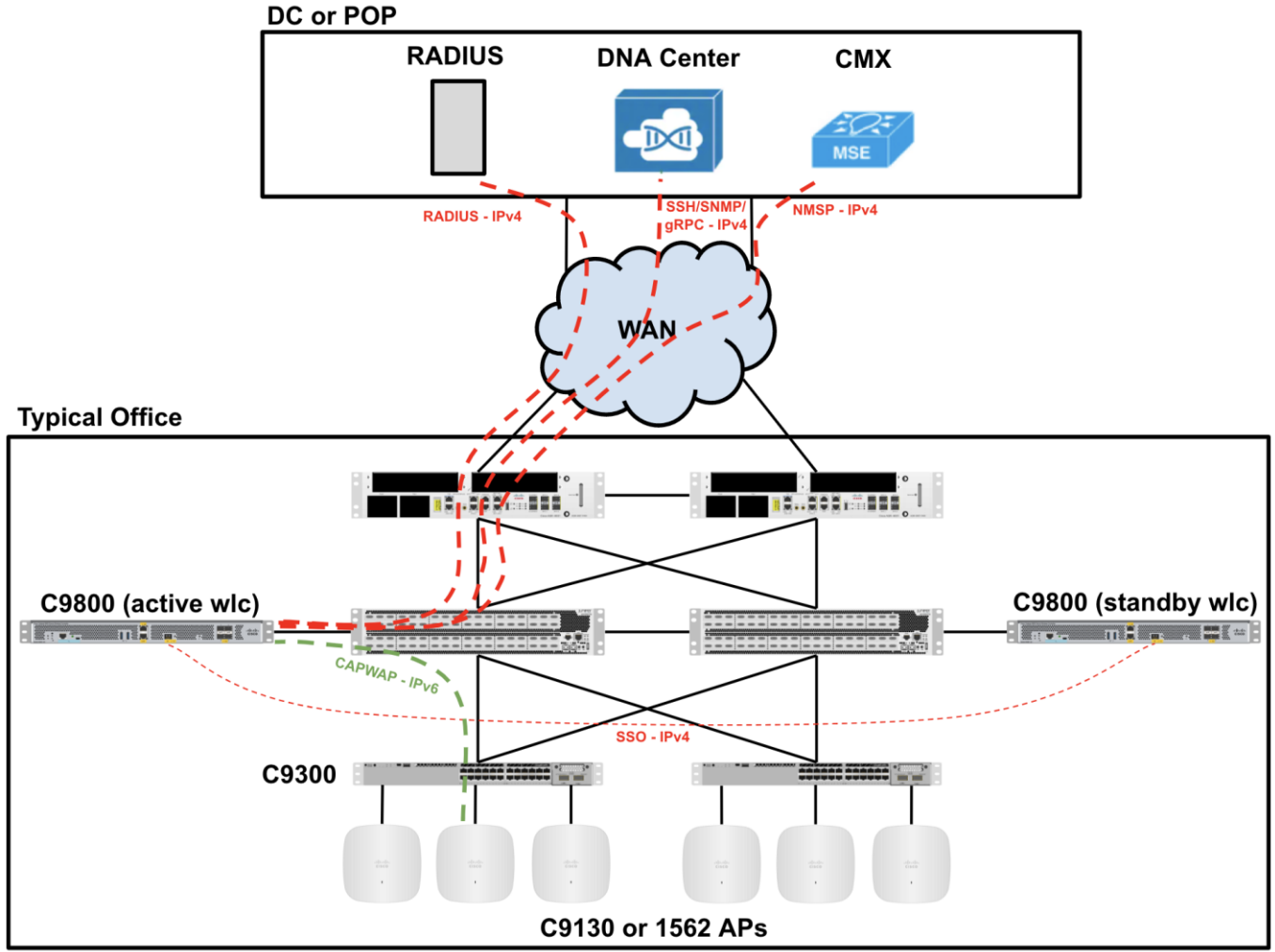
Scope – The Meta Corporate WLAN

- 3 main SSIDs:
  - Employee (802.1x)
  - Guest (PSK)
  - Lab (PSK + MAC auth)

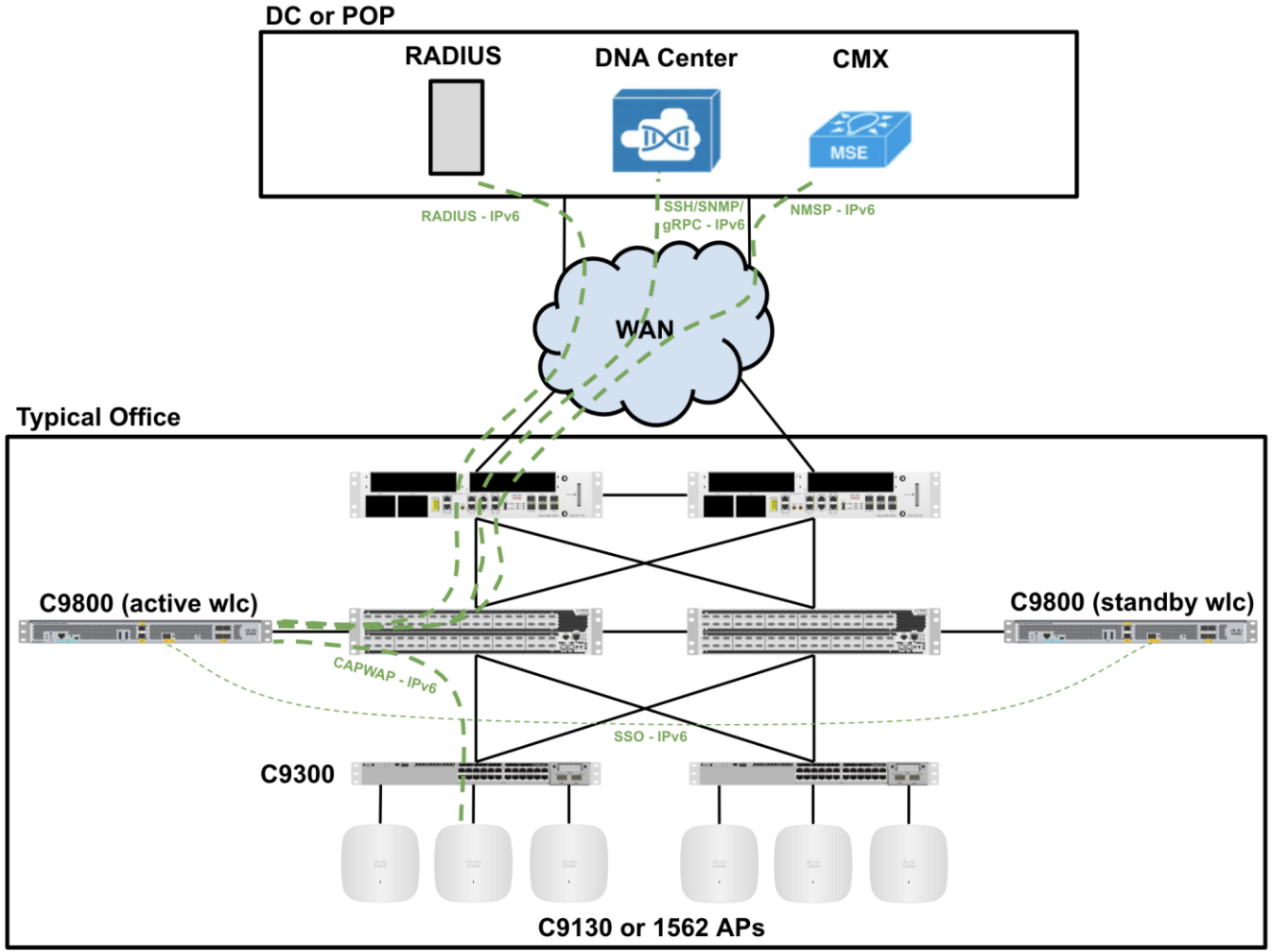


Topology

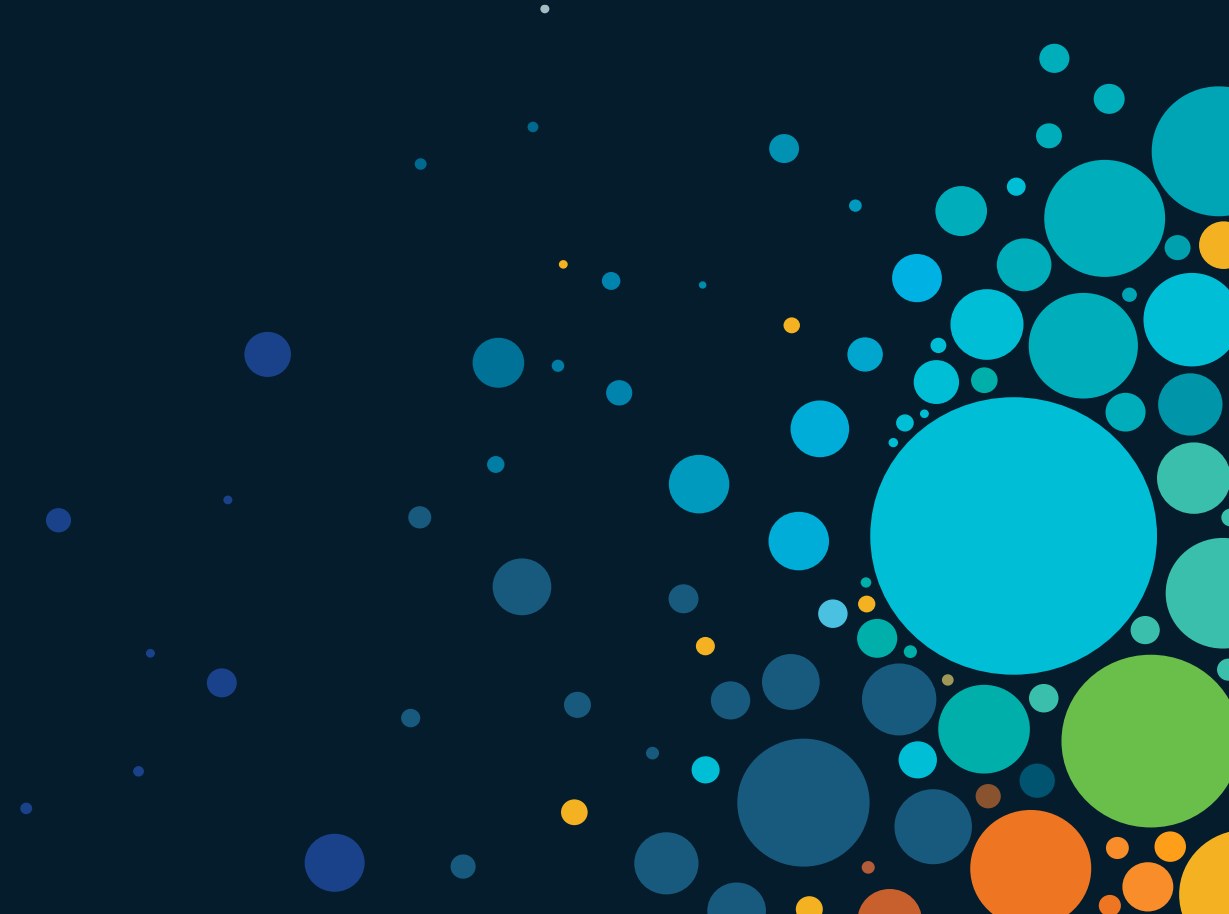
Topology
(early 2020)



Topology
(by mid 2021)



Timeline



Timeline – Where We Started From

- Early 2020
  - APs & controllers running 17.1.1 code
  - DNA Center & CMX using IPv4

- AP <-> Controllers using IPv6
- Controller <-> Controller SSO using IPv4
- DNA-C <-> Controllers using IPv4
- CMX <-> Controllers / DNA-C using IPv4
- All clients already dual-stacked

Timeline – 2021/2022

- Feb 2021
  - Controllers upgraded to 17.3.2 = migrated SSO to using IPv6
  - DNA Center upgraded to 2.2.1.0 = IPv6-only operation
- March 2021
  - CMX upgraded to 10.6.3-70 = added IPv6 support
- Feb 2022
  - RADIUS authentication over IPv6

Migrating Clients/Infrastructure

Migrating Clients

- IPv6 address allocation for clients:
  - DHCPv6 for stateful assignment
    - Android doesn't support DHCPv6
    - DHCPv6 is basically like DHCPv4
  - SLAAC for stateless auto-assignment
    - RDNSS for advertising DNS servers (not all platforms support this)

- Can mix the use of SLAAC & DHCPv6 with the managed-config and other-stateful-config flags in your router advertisements

Migrating Clients

- Really depends on what your clients can support
- Our user networks:
  - Employee – dual stacked
    - Making strides to convert to IPv6-only, like our mobile device VLAN
    - Have control over the device mix, tends to be all IPv6-capable
  - Guest – IPv6-only
    - DNS64 + NAT64 to help bridge the gap for IPv4-only websites
    - No control over device mix, or whether guests have IPv6 support disabled
  - Lab – dual-stacked
    - Some IPv4-only IoT devices

Migrating Infrastructure – Controller Discovery

- Typical methods:
  - Static
  - DNS
  - DHCPv6 option 52
    - Example: option dhcp6.capwap-ac-v6 fd00::100:192:168:1:50
    - Depending on your DHCPv6 server, you may need to use raw options

Migrating Infrastructure – Controller Discovery

- APs successfully discovering a controller using DHCPv6 option 52:

```
[*11/24/2019 23:35:58.7725] CAPWAP State: Discovery
[*11/24/2019 23:35:58.7732] Got WLC address fd00::100:192:168:1:50 from DHCPv6.
[*11/24/2019 23:35:58.7743] Discovery Request sent to fd00::100:192:168:1:50, discovery type DHCP(2)
[*11/24/2019 23:35:58.7753] Discovery Request sent to 255.255.255.255, discovery type UNKNOWN(0)
[*11/24/2019 23:35:58.7764] Discovery Request sent to ff02::18c, discovery type UNKNOWN(0)
[*11/24/2019 23:35:58.7767] Discovery Response from fd00::100:192:168:1:50
[*11/24/2019 23:36:08.2733] No IPv4 AP Mgr in IPv4 pref mode. Try IPv6 mode...
[*11/24/2019 23:36:08.0071]
[*11/24/2019 23:36:08.0071] CAPWAP State: DTLS Setup
[*11/24/2019 23:36:08.3386]
[*11/24/2019 23:36:08.3386] CAPWAP State: Join
[*11/24/2019 23:36:08.3406] Sending Join request to fd00::100:192:168:1:50 through port 5248
[*11/24/2019 23:36:08.4698] Join Response from fd00::100:192:168:1:50
[*11/24/2019 23:36:08.4698] AC accepted join request with result code: 0
[*11/24/2019 23:36:08.4705] Received wlcType 0, timer 30
[*11/24/2019 23:36:08.4705] TLV ID 2216 not found
[*11/24/2019 23:36:08.4705] TLV-DEC-ERR-1: No proc for 2216
[*11/24/2019 23:36:08.4760] RTNETLINK answers: No such file or directory
[*11/24/2019 23:36:08.5108]
[*11/24/2019 23:36:08.5108] CAPWAP State: Image Data
[*11/24/2019 23:36:08.5109] AP image version 8.10.104.96 backup 0.0.0.0, Controller 17.8.0.144
[*11/24/2019 23:36:08.5109] Version does not match.
[*11/24/2019 23:36:08.5523] do PRECHECK, part1 is active part
[*11/24/2019 23:36:08.5742] upgrade.sh: /tmp space: OK available 80492, required 40000
[*11/24/2019 23:36:08.5746] wtpImgFileReadRequest: request ap1g6a, local /tmp/part.tar
[*11/24/2019 23:36:08.5760] Image Data Request sent to fd00::100:192:168:1:50, fileName [ap1g6a], slaveStatus 0
[*11/24/2019 23:36:08.5859] Image Data Response from fd00::100:192:168:1:50
[*11/24/2019 23:36:08.5859] AC accepted join request with result code: 0
```

Migrating Infrastructure – Controller Discovery

- AP joined to the controller over IPv6:

```
WLC#sh ap summary
Number of APs: 1

AP Name                          Slots   AP Model          Ethernet MAC    Radio MAC       Location                        Country   IP Address                                State
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------
AP04EB.409E.2724                   3     C9130AXI-B        04eb.409e.2724  04eb.409f.9f80  default location                US        fd00::200:4ced:6526:d555:328e             Registered

WLC#sh wireless stats ap join summary
Number of APs: 1

Base MAC        Ethernet MAC    AP Name                    IP Address                                Status      Last Failure Phase    Last Disconnect Reason
-------------------------------------------------------------------------------------------------------------------------------------------------------------
04eb.409f.9f80  04eb.409e.2724  AP04EB.409E.2724           fd00::200:4ced:6526:d555:328e             Joined      Config                DTLS close alert from peer

WLC#
```

Lessons Learned

Lessons Learned

- APs newer than the following models should support IPv6 out-of-the-box:
  - 4800
  - 1562
  - Minimum code version on the AP:
    - AireOS: 8.5+
    - IOS-XE: 17.3.2+

- DNA Center can only run in IPv4-only or IPv6-only mode, not both

Minimum Code Versions Needed for IPv6 Support

- 9800
  - 17.3.2 for SSO
  - (other functions supported in earlier versions)
- DNA Center
  - 2.2.1.0
- CMX
  - 10.6.3-70

Questions?

stevetam@fb.com

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