Sales & Partner Training
Worldwide Sales Strategy & Operations

CVU Wireless

Ib Hansen
Systems Engineer
4 Januar 2017

Fra sidste CVU:

Udfordringer med de nye APer

Cisco Aironet 802.11ac Wave 2 Access Point Portfolio

Industry's most comprehensive and innovative

Enterprise Class

Mission Critical

Best in Class

DNA Ready | RF Excellence | CMX

Dual 5 GHz | Flexible Radio | HDX

Future Proof

1810 Wall Plate

- 2x2:2SS 80 MHz; 867 Mbps
- Tx Beam Forming
- 1 GE Port uplink
- 3 GE Local Ports, including 1 PoE out
- Local ports 802.1x ready
- Integrated BLE Gateway*

1810 Teleworker

- 2x2:2SS 80 MHz; 867 Mbps
- 3 GE Local Ports downlink, including 1 PoE out
- One or Two Local Ports can be tunneled back to corporate

1830

- 3x3:2SS 80MHz
- 867 Mbps Performance
- Tx Beam Forming
- 1 GE Port Uplink
- USB 2.0
- Mobility Express

1850

- 4x4:3SS 80Mhz
- 1.7 Gbps Performance
- Internal or External Antenna
- Tx Beam Forming
- 2 GE Ports Uplink
- USB 2.0
- Mobility Express

2800

- 4x4:3SS 160 MHz
- 5 Gbps Performance
- 2.4 and 5GHz or Dual 5GHz
- 2 GE Ports Uplink
- CleanAir and ClientLink
- Internal or External Antenna
- Smart Antenna Connector
- Enhanced Location[1] (External Antenna)
- USB 2.0
- Mobility Express

3800

- 4x4:3SS 160 MHz
- 5 Gbps Performance
- 2.4 and 5GHz or Dual 5GHz
- 2 GE Ports Uplink or 1 GE + 1 mGig (5G)
- CleanAir and ClientLink
- StadiumVision
- Internal or External Antenna
- Smart Antenna Connector
- Enhanced Location[1] (External Antenna)
- USB 2.0
- Mobility Express
- Investment Proof Modularity

Det var hardwaren, hvad med Softwaren ?

- Ny hardware kræver ny software !!!!
- Do and Don’ts
  - Læs release note
  - Brug almindelige features
  - 8.2.130 eller 8.2.140 (Slut november) ikke 8.3 !!!!!

Læs release notes:

Features Not Supported on Cisco Aironet 1810 OEAP, 1810W, 1830, 1850, 2800, and 3800 Series APs

Table 12 Features Not Supported on Cisco Aironet 1810 OEAP, 1810W, 1830, 1850, 2800 and 3800 Series APs

Operational Modes	• Spectrum Expert Connect • Workgroup Bridge (WGB) mode as a part of Cisco Mobility Express • Mesh mode • Flex plus Mesh • 802.1x supplicant for AP authentication on the wired port
Protocols	• 802.11u • Full Cisco Compatible Extensions (CCX) support • Rogue Location Discovery Protocol (RLDP) • Native IPv6 • Telnet
Security	• Encryption – Temporal Key Integrity Protocol (TKIP) • Locally Significant Certificate (LSC) • TrustSec SXP • Dynamic WEP • Static WEP key for TKIP or CKIP [6]
Quality of Service	• Cisco Air Time Fairness (ATF)
Spectrum Utilization	• Wi-Fi Tag • Aggressive Load Balancing
Packet Forwarding	• Split tunnels • PPPoE • NAT
Location Services	• Data RSSI (Fast Locate)
FlexConnect Features	• Per Client AAA (QoS Override) • Bidirectional rate-limiting • Split Tunneling • EoGRE • Multicast to Unicast (MC2UC) • Traffic Specification (TSpec) – Cisco Compatible Extensions (CCX) – Call Admission Control (CAC) • DHCP Option 60 • NAT/PAT support • VSA/Realm Match Authentication • Proxy ARP

http://www.cisco.com/c/en/us/td/docs/wireless/controller/release/notes/crn82mr1.html#pgfId-1469357

Læs release notes:

What's New in this Release

- Changes in Images and Installation Procedure for Cisco 2504 WLC, Cisco 5508 WLC, and Cisco WiSM2
- Access Point Provisioning Using Plug-n-Play
- Optimized Wi-Fi Connectivity and Prioritized Business Applications in Cisco and Apple Environments
- Cisco CMX Cloud Connector
- Client Troubleshooting Tool
- URL Filtering for Domains
- Default FlexConnect Group
- IPv6 Support for EoGRE Tunnels
- Mesh Off-Channel Background Scanning
- Support for NBAR2 Protocol Pack 19.1.0
- OfficeExtend Support for Wave 2 802.11ac Access Points
- Enabling RADIUS NAC on a WPA and WPA2-PSK WLAN
- Link Layer Discovery Protocol in Recovery Image
- EoGRE Enhancements
- Workgroup Bridge (WGB) Downstream Broadcast On Multiple VLANs
- Support for –M Regulatory Domain on Cisco Industrial Wireless 3700 Series APs
- Security Enhancements
- Cisco Hyperlocation Enhancements
- Cisco TrustSec Capabilities with FlexConnect
- Cisco WLC GUI Enhancements
- Important Note on Interoperability Issue Between Release 8.3 and SpectraLink Phones

http://www.cisco.com/c/en/us/td/docs/wireless/controller/release/notes/crn82mr1.html#pgfId-1469357

TAC Sager kørt for danske kunder:

- Manglende TKIP Support
- AP virker ikke på 802.1x enablet port på switch
- Spectrum Expert virker ikke

- Alle disse er nævnte som manglede features I release note

Status Januar 2017

Status Januar 2017

- 8.2.141 har løst mange problemer
- 8.2.141 blev releaset 6 December 2016
- 8.2.150 forventes 8-9 uger efter 8.2.141 dvs. omkring midten af Feb.
- Nuværende esclation image 8.2.141.7
  - Hvis I ser fejl få oprettet TAC sager

Udeståender

- De nye APer har ikke en 802.1x supplicant.
  - Så kan ikke anvendes på en switch port, der har 802.1x enablet.
  - Denne feature var lovet til 8.3mr1 men er rykket til en senere release

- Manglende TKIP
  - Denne feature har ikke været implementeret på anbefaling fra WiFi Alliance
    - The WIFI Alliance deprecated TKIP last year
    - https://www.wi-fi.org/download..php?file=/sites/default/files/private/WiFi_Alliance_Technical_Note_TKIP_v1.0.pdf

  - 8.2.141.7 og den kommende 8.2.150 får TKIP support igen.

Udeståender

Se release note !!!!!

http://www.cisco.com/c/en/us/td/docs/wireless/controller/release/notes/crn82mr4.html

Nuværende software anbefaling (oct. 2016)

Release 8.0 (MD release train)	8.0.140.0 is latest release, next release Q1CY17[1]	• 8.0.140.0
Release 8.1	No more MRs	• 8.2 release train
Release 8.2	8.2.130.0 is latest release, next release planned Q4CY16[1]	• Recommended for customers using 5520 or 8540 controllers or 1800, 1800-ME, 2800, or 3800 series access points
Release 8.3	8.3.102.0 is latest release, next release planned Q4CY16[1]	• For customers needing the latest feature set

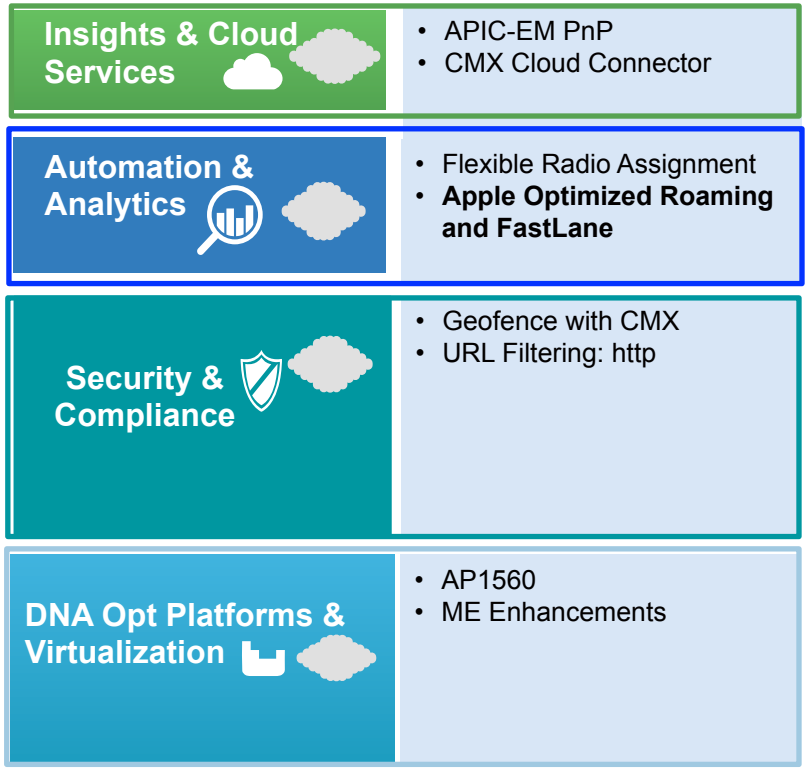
8.3 Update

Software anbefaling

- Brug ikke 8.3.102 sammen med 2800 / 3800 !!!!
- 8.3.110 forventes Februar 2017
- 8.3.120 forventes April 2017
- (Dette bliver den første release TAC anbefaler)
- 8.3 forventes, at blive et langt levende MD release train

Product Roadmap

AireOS 8.3/8.3 MR



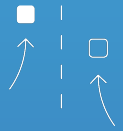
De nævnte AireOS features er gennemgået på sidste CVU og sidste Tech Update:

http://www.cisco.com/c/dam/global/da_dk/assets/training/seminaria-materials/Cisco_Virtual_Update_-_Wireless.pdf

http://www.cisco.com/c/dam/global/da_dk/training-events/seminaria-materials/Cisco_Tech_Update-Wireless-30-august_og_1-september_2016.pdf


CISCO

Optimizing Wi-Fi Connectivity



Prioritizing Business Apps

Integrating Voice and Collaboration

Hvad er omfattet af dette samarbejde ?

- Optimized Wi-Fi connectivity
  - Always-on 802.11k og v
  - Adaptive 802.11r (Apple only)

- Fastlane
  - AutoQOS
  - QoS profiling (Apple Only)
  - Voice Upstream Trust (Apple Only)

- Collaboration
  - iPhone UC integration with Jabber

Optimized Wi-Fi Connectivity

IOS Roaming

Associated to one AP, and not moving

- As long as you are associated, signal from the AP is good, and you are not moving, the IOS8 client will not scan.

Scan upon associating to SSID

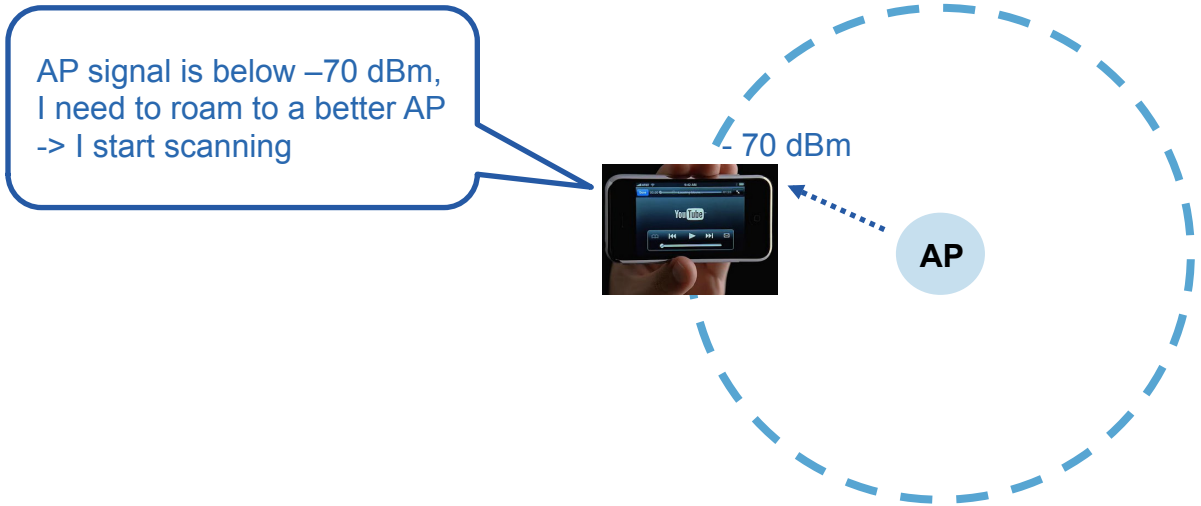
Time	Info
135.050995000	Probe Request, SN=276, FN=0, Flags=........C, SSID=Testwifi
135.072986000	Probe Request, SN=278, FN=0, Flags=........C, SSID=Testwifi
135.095734000	Probe Request, SN=279, FN=0, Flags=........C, SSID=Testwifi
135.117612000	Probe Request, SN=280, FN=0, Flags=........C, SSID=Testwifi
356.792520000	Probe Request, SN=420, FN=0, Flags=........C, SSID=Testwifi
356.814009000	Probe Request, SN=422, FN=0, Flags=........C, SSID=Testwifi
356.837398000	Probe Request, SN=423, FN=0, Flags=........C, SSID=Testwifi
356.858761000	Probe Request, SN=424, FN=0, Flags=........C, SSID=Testwifi
457.928791000	Probe Request, SN=1, FN=0, Flags=........C, SSID=Broadcast
457.984414000	Probe Request, SN=2, FN=0, Flags=........C, SSID=Broadcast
458.105541000	Probe Request, SN=3, FN=0, Flags=........C, SSID=Testwifi
2728.872815000	Probe Request, SN=1810, FN=0, Flags=op.P.MFT.

AP

Then no scan until you move far

Associated to one AP, and moving

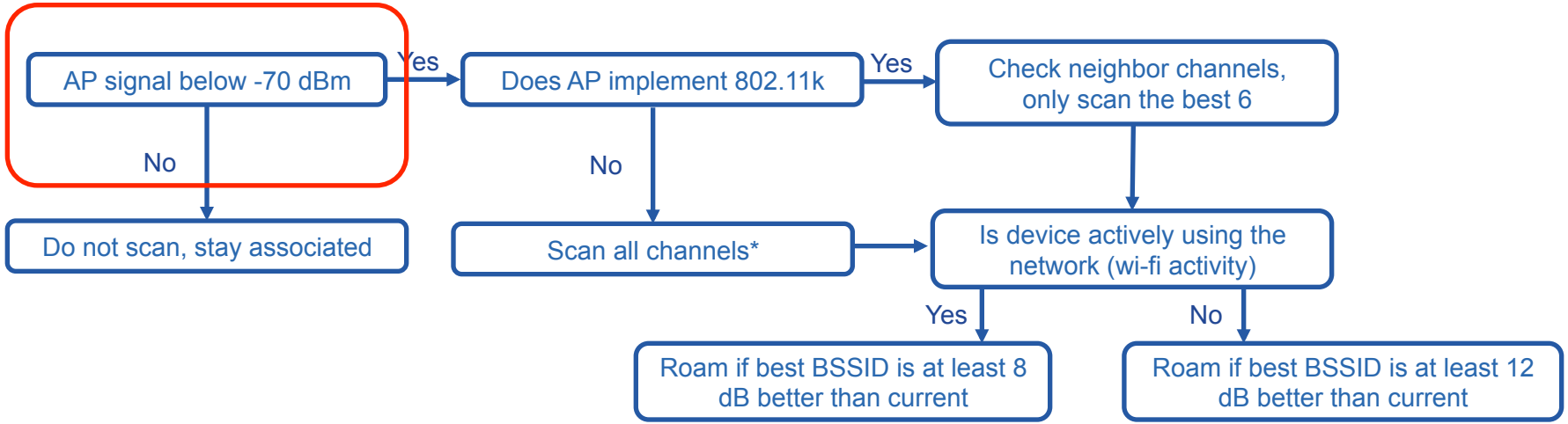
- IOS8 does not scan even if you move (no accelerometer trigger), until the AP signal falls below -70 dBm RSSI*. At that point phone scans and tries to roam.



* (any packet from the AP, beacon or data is used; signal has to be received at less than -70 dBm for more than one second to trigger behavior

Probing and Roaming Decisions

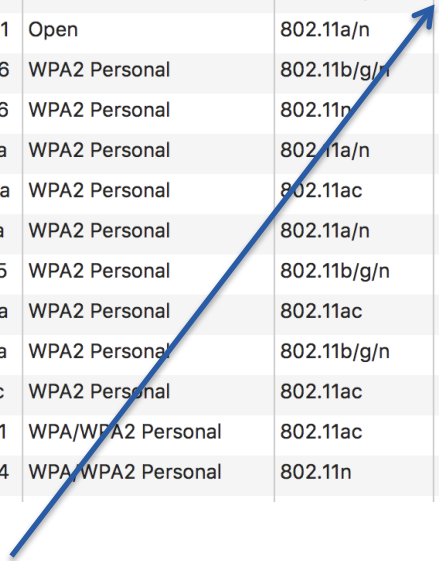
- IOS8 scanning and roaming behavior decision tree is as follows:



* All IOS8 tested devices scan 2.4 GHz, UNII1, UNII2, UNII3, and only scan passively once every 6 scan cycles UNII2e

Hvad checker vi først:

Network Name	BSSID	Security	Protocol	RSSI	Noise	Channel	Band	Width
AirCard-51B6	84:db:2f:46:51:b6	WPA/WPA2 Personal	802.11b/g/n	-73	0	3	2.4GHz	20 MH
EnviiButik	54:64:d9:81:67:1a	WPA2 Personal	802.11ac	-85	0	108	5 GHz	80 MH
FreeWifi Fields	98:4b:e1:22:36:e2	Open	802.11a/n	-90	0	36	5 GHz	40 MH
FreeWifi Fields	98:4b:e1:22:46:32	Open	802.11b/g/n	-70	-99	13	2.4GHz	20 MH
FreeWifi Fields	98:4b:e1:22:46:61	Open	802.11a/n	-75	0	36	5 GHz	40 MH
Halas iPhone	2a:a0:2b:02:e7:66	WPA2 Personal	802.11b/g/n	-59	0	11	2.4GHz	20 MH
HomeBox-14E0_2.4G	6c:2e:85:c3:14:e6	WPA2 Personal	802.11n	-72	-99	1	2.4GHz	20 MH
HomeBox-14E0_5G	6c:2e:85:c3:14:ea	WPA2 Personal	802.11a/n	-79	0	132	5 GHz	40 MH
HomeBox-2070_5G	54:64:d9:81:20:7a	WPA2 Personal	802.11ac	-78	0	44	5 GHz	80 MH
HomeBox-2830_5G	40:f2:01:a2:28:3a	WPA2 Personal	802.11a/n	-86	0	112	5 GHz	40 MH
HomeBox-318F	7c:03:4c:cb:31:95	WPA2 Personal	802.11b/g/n	-59	0	6	2.4GHz	20 MH
HomeBox-6E80_5G	54:64:d9:7f:6e:8a	WPA2 Personal	802.11ac	-67	0	36	5 GHz	80 MH
HomeBox-A934	7c:03:d8:ca:a9:3a	WPA2 Personal	802.11b/g/n	-69	0	6	2.4GHz	20 MH
NETGEAR05-5G	80:37:73:fe:27:9c	WPA2 Personal	802.11ac	-81	0	44	5 GHz	80 MH
Normal Staff	e2:55:6d:1e:9d:d1	WPA/WPA2 Personal	802.11ac	-88	0	104	5 GHz	80 MH
WLAN1-D195A2	5c:7d:5e:74:53:04	WPA/WPA2 Personal	802.11n	-68	0	11	2.4GHz	20 MH



RSSI -70dBm set med MBP

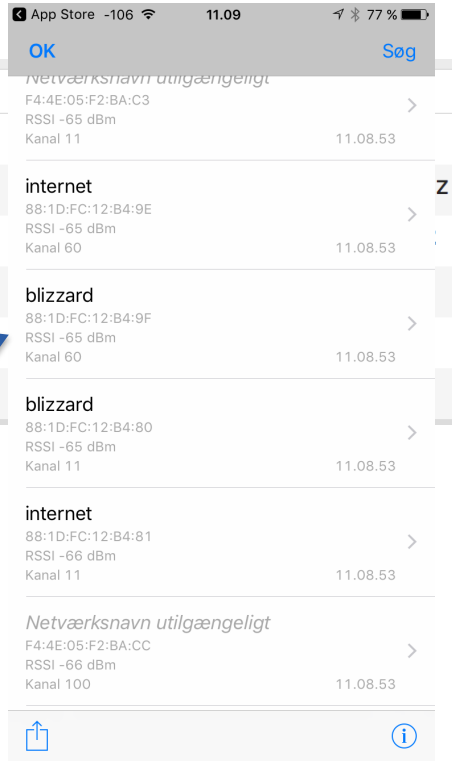
Hvad checker vi først:

Network Name	BSSID	Security	Protocol	RSSI	Noise	Channel	Band	Width
AirCard-51B6	84:db:2f:46:51:b6	WPA/WPA2 Personal	802.11b/g/n	-73	0	3	2.4GHz	20 MH
EnviiButik	54:64:d9:81:67:1a	WPA2 Personal	802.11ac	-85	0	108	5 GHz	80 MH
FreeWifi Fields	98:4b:e1:22:36:e2	Open	802.11a/n	-90	0	36	5 GHz	40 MH
FreeWifi Fields	98:4b:e1:22:46:32	Open	802.11b/g/n	-70	-99	13	2.4GHz	20 MH
FreeWifi Fields	98:4b:e1:22:46:61	Open	802.11a/n	-75	0	36	5 GHz	40 MH
Halas iPhone	2a:a0:2b:02:e7:66	WPA2 Personal	802.11b/g/n	-59	0	11	2.4GHz	20 MH
HomeBox-14E0_2.4G	6c:2e:85:c3:14:e6	WPA2 Personal	802.11n	-72	-99	1	2.4GHz	20 MH
HomeBox-14E0_5G	6c:2e:85:c3:14:ea	WPA2 Personal	802.11a/n	-79	0	132	5 GHz	40 MH
HomeBox-2070_5G	54:64:d9:81:20:7a	WPA2 Personal	802.11ac	-78	0	44	5 GHz	80 MH
HomeBox-2830_5G	40:f2:01:a2:28:3a	WPA2 Personal	802.11a/n	-86	0	112	5 GHz	40 MH
HomeBox-318F	7c:03:4c:cb:31:95	WPA2 Personal	802.11b/g/n	-59	0	6	2.4GHz	20 MH
HomeBox-6E80_5G	54:64:d9:7f:6e:8a	WPA2 Personal	802.11ac	-67	0	36	5 GHz	80 MH
HomeBox-A934	7c:03:d8:ca:a9:3a	WPA2 Personal	802.11b/g/n	-69	0	6	2.4GHz	20 MH
NETGEAR05-5G	80:37:73:fe:27:9c	WPA2 Personal	802.11ac	-81	0	44	5 GHz	80 MH
Normal Staff	e2:55:6d:1e:9d:d1	WPA/WPA2 Personal	802.11ac	-88	0	104	5 GHz	80 MH
WLAN1-D195A2	5c:7d:5e:74:53:04	WPA/WPA2 Personal	802.11n	-68	0	11	2.4GHz	20 MH

RSSI -70dBm set med MBP. **Hvilket AP skal den roame til ?**

Hvad checker vi først:

Network Name	BSSID	Security	Protocol	RSSI
AerohiveTEST	40:18:b1:cb:25:e8	WPA2 Personal	802.11a/n	-80
blizzard	88:1d:fc:12:b4:80	WPA2 Enterprise	802.11b/g/n	-66
blizzard	**88:1d:fc:12:b4:8f**	**WPA2 Enterprise**	**802.11ac**	**-62**
blizzard	88:1d:fc:12:b4:9f	WPA2 Enterprise	802.11ac	-59
blizzard	88:1d:fc:12:c2:4f	WPA2 Enterprise	802.11ac	-69
blizzard	f4:4e:05:f2:ba:cf	WPA2 Enterprise	802.11ac	-72



MBP ser Blizzard SSIDet med -59dBm
iPhone 7 ser Blizzard SSIDet med -65dBm

Check med det device, hvor roamingen er vigtigt

Sticky Clients:

- En IOS Client som ser APet med et RSSI over -70dBm roamer Ikke.
- Derfor kan devicet blive “hængende” på et AP som ikke er det nærmeste.
- Typisk hvis APet kører med høj transmit Power og der er “line of sight”
- Brug RF-Profiles til at begrænse Transmit Poweren og få en mere forudsigelig roaming

Sticky Clients:

- Hvis et IOS device prøver at roame, men ikke finder et AP med et bedre signal vil det blive hængende på det AP som det er connected til.
- Måske bedre at skifte til 3G / 4G
- Features:
  - Optimized Roaming
    - Eller
  - Low RSSI Check

- **Brug kun disse features hvis I forstår hvad de gør !!!!!!!!!!!!!**
- **Og ikke begge på samme tid.**

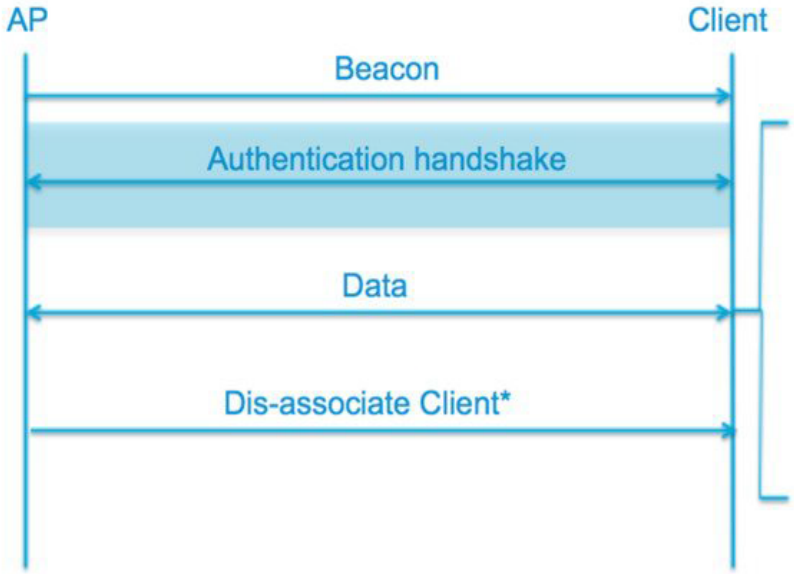
Optimized Roaming

Optimized Roaming:

- Løser problemet med Sticky Clients ved at De-authe Clienter, hvis følgende kriterier er opfyldt:
- RSSI på de fra clienten modtagne pakker kommer under en given threshold og clientens datarate kommer under en given hastighed.
- Man kan disable datarate så der kun kigges på RSSI

- http://www.cisco.com/c/en/us/td/docs/wireless/controller/8-0/configuration-guide/b_cg80/b_cg80_chapter_0101000.html

Optimized Roaming



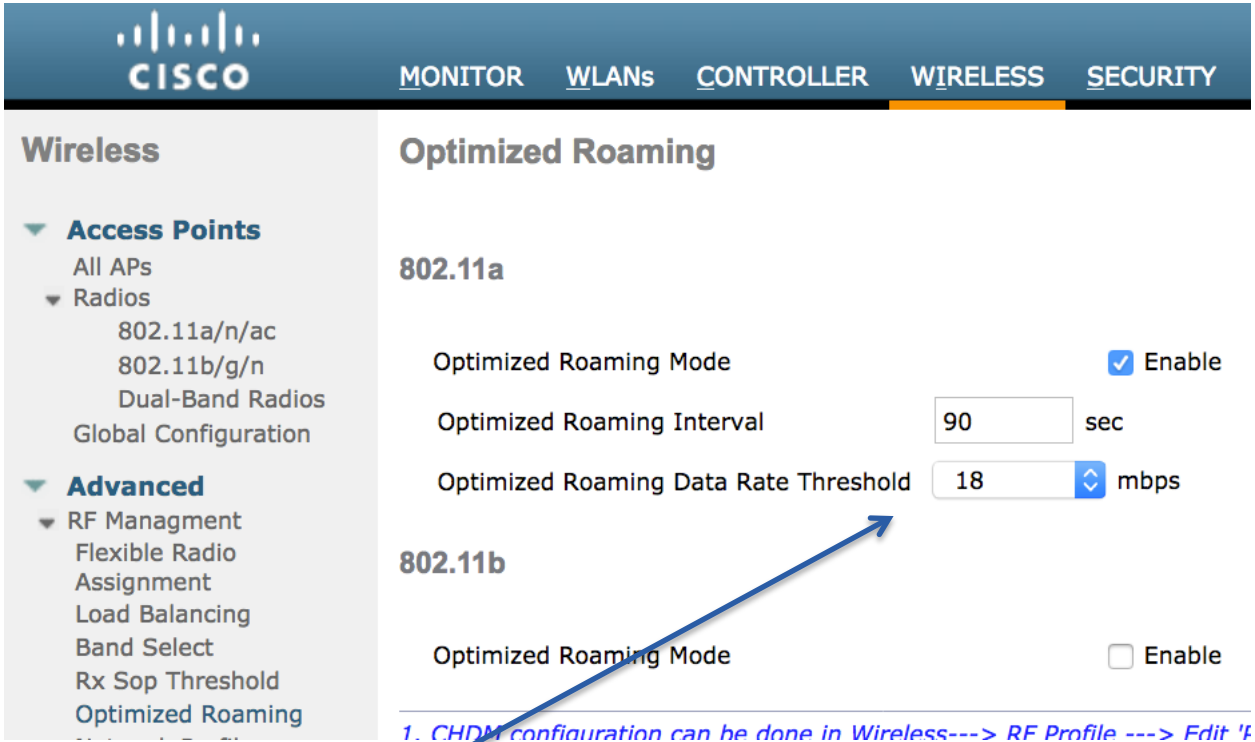
If more than X% of at least Y packets in a 5 sec period is less than Z RSSI, the AP will disassociate the client once the reporting interval expires

```
▷ Frame 85: 40 bytes on wire (320 bits), 40 bytes captured (320
▽ Radiotap Header v0, Length 26
    Header revision: 0
    Header pad: 0
    Header length: 26
  ▷ Present flags
    MAC timestamp: 4738705159
  ▷ Flags: 0x10
    Data Rate: 6.0 Mb/s
    Channel frequency: 5580 [A 116]
  ▷ Channel type: 802.11a (0x0140)
    SSI Signal: -84 dBm
    SSI Noise: -94 dBm
```

Key:
X – Coverage Exception Level Percentage
Y – Number of packets
Z – Data RSSI threshold value

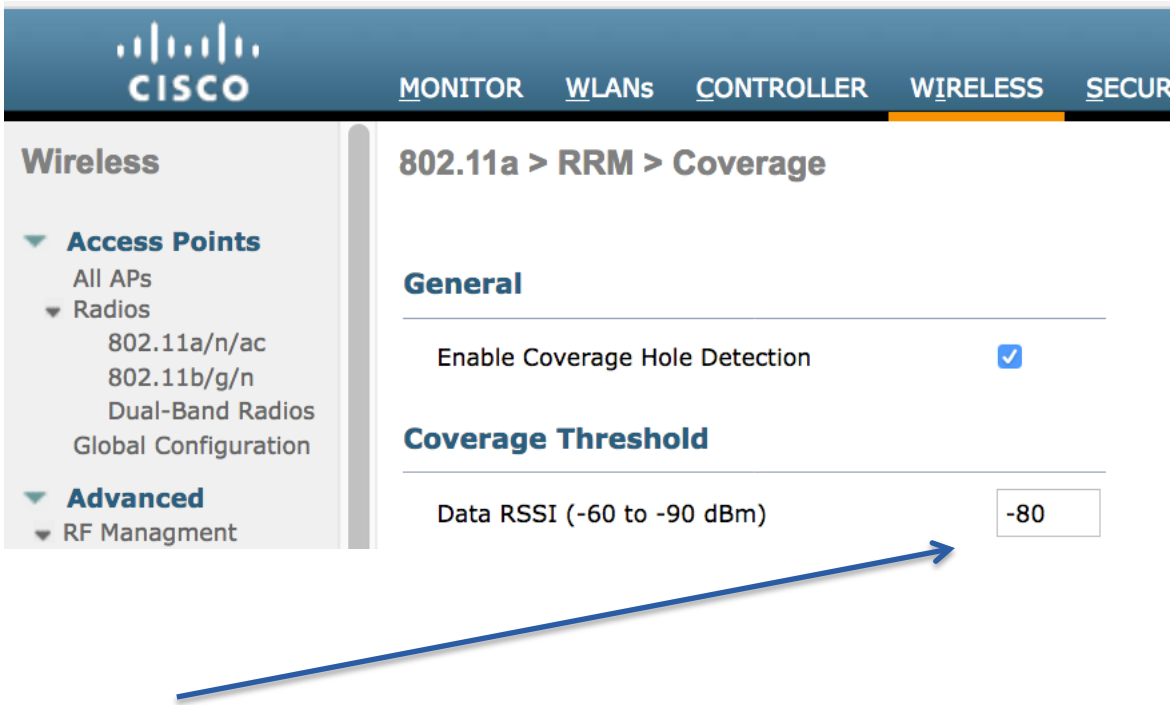
353196

Optimized Roaming



Datarate der checkes imod

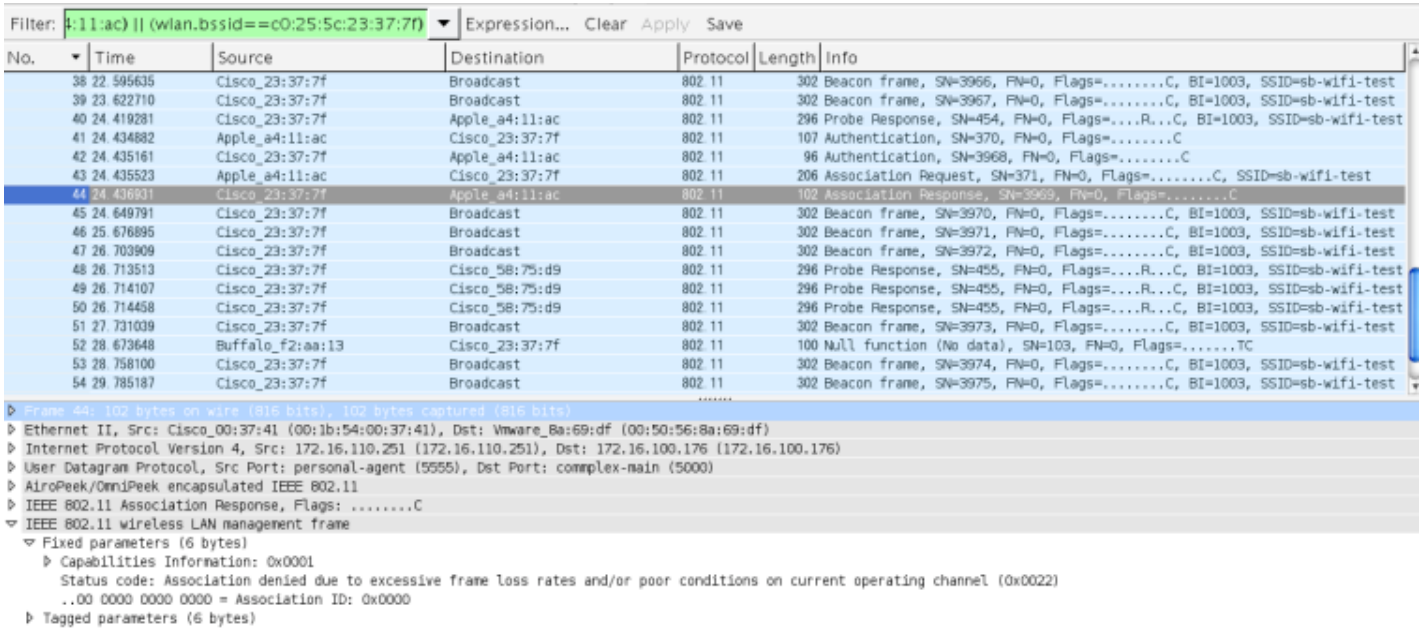
Optimized Roaming



RSSI Værdi der checkes imod

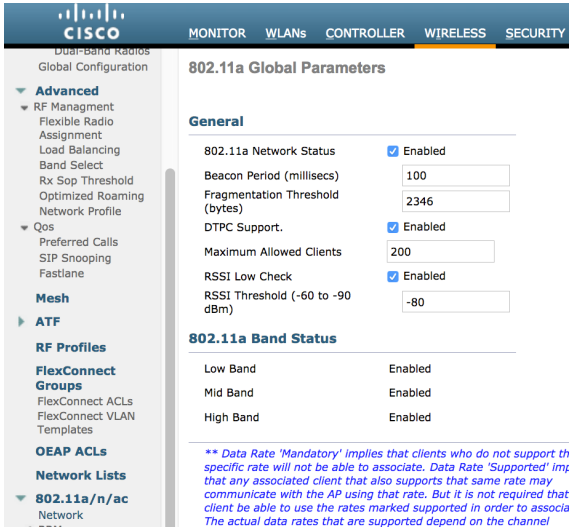
Optimized Roaming

- Optimized roaming checker også indkommend ass- requests mod Data RSSI. Hvis det indkommende signal ikke er min 6db bedre end det konfigurede RSSI kommer clienten ikke på !!!!!



Low RSSI Check

- With RSSI Low check enabled, a clients association requests will be ignored, unless the AP hears them stronger than -80 (configurable)Måske bedre at skifte til 3G / 4G

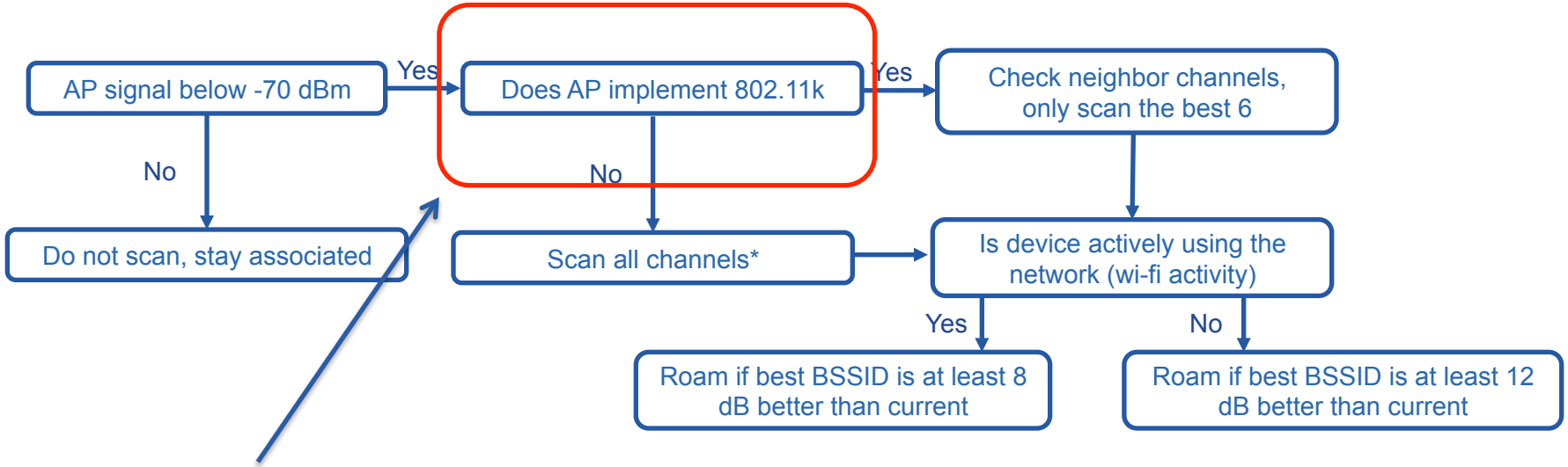


Test og forstå inden I konfigurerer disse

- Endten Optimized Roaming eller Low RSSi Check ikke begge

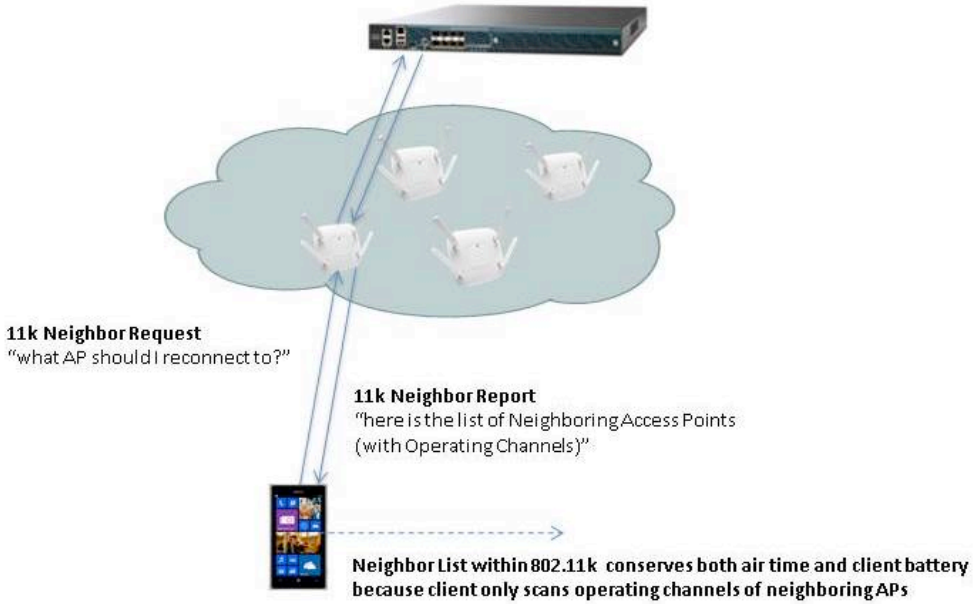
Probing and Roaming Decisions

- IOS8 scanning and roaming behavior decision tree is as follows:



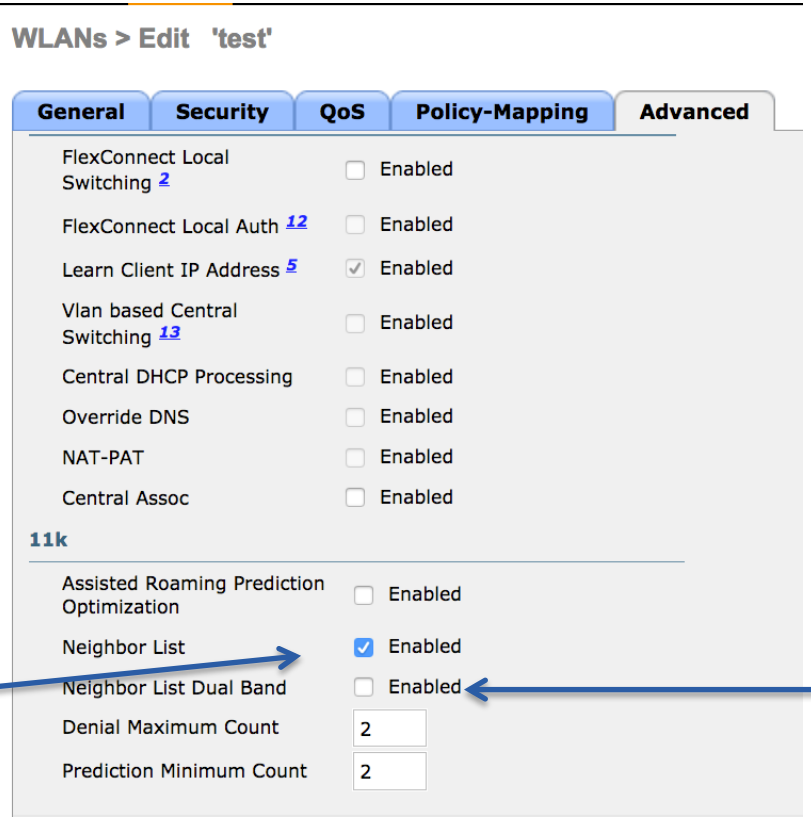
I AireOS 8.3 er 802.11K enablet som default

802.11K



http://blogs.cisco.com/wireless/why-the-802-11k-and-neighbor-report-are-important

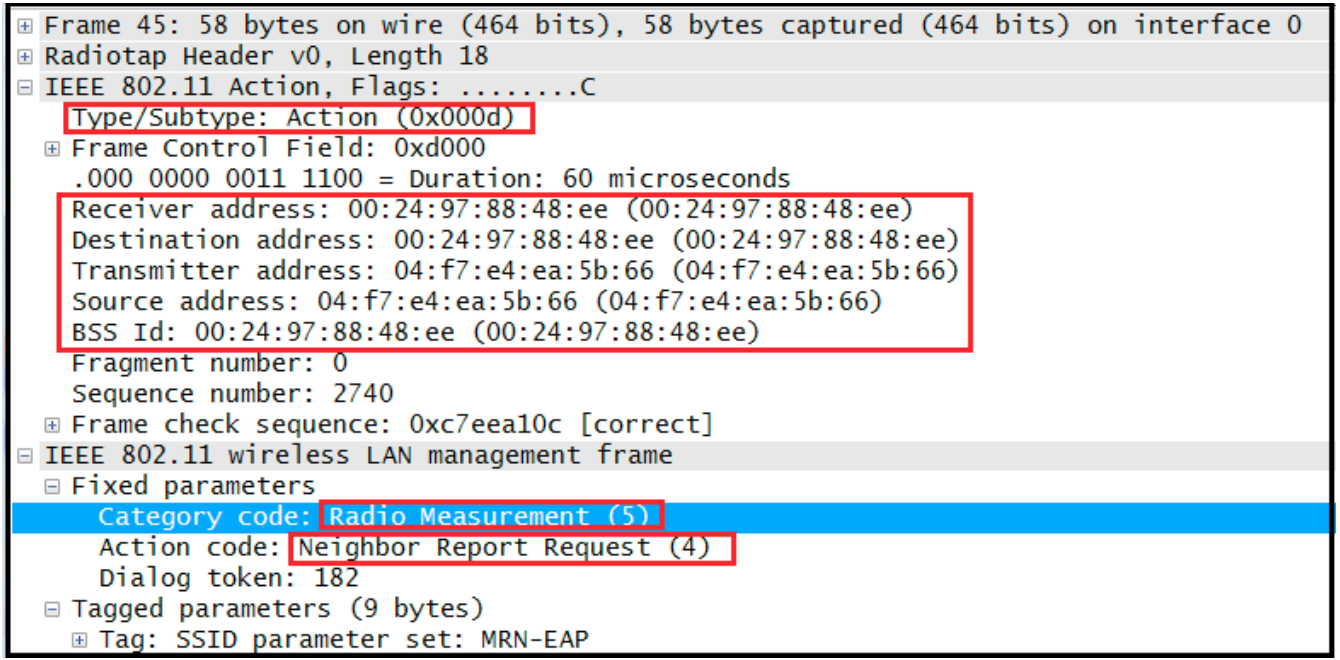
802.11K



Enablet

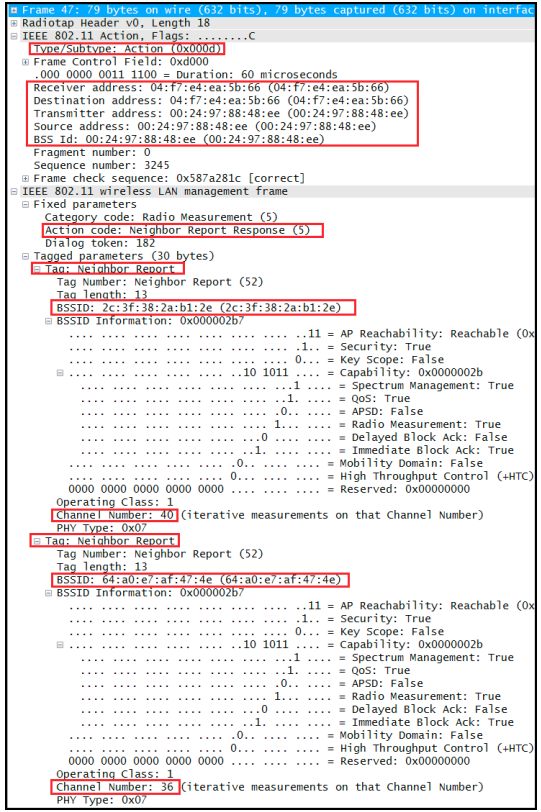
Bør ikke enables.
Tillader roaming mellem 2.4 / 5Ghz På samme AP

802.11K



- Se denne blog for detaljer:
  https://mrncciew.com/2014/09/11/cwsp-802-11k-ap-assisted-roaming/

802.11K



- Se denne blog for detaljer: https://mrncciew.com/2014/09/11/cwsp-802-11k-ap-assisted-roaming/

Cisco-Apple Optimized Roaming reduces management overhead by up to 50%

Legacy client **cannot** join the same SSID where 11r is enabled

Non-Cisco-AP

Legacy client that does not support 11r/k/v **can** join the same SSID

I recognize that you are an Apple device 11r is enabled for you

802.11k, 802.11v are on by default

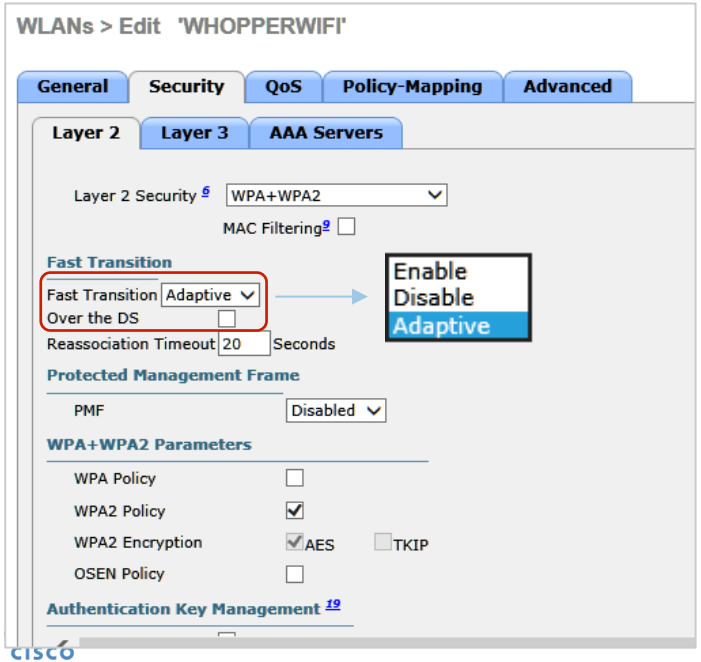
Association

Cisco-AP

Adaptive 11r

Feature enabled by default on a newly created SSID

- Even if 802.11r is not enabled on the WLAN, it is enabled for the WLAN for the Apple IOS 10 devices (adaptive 11r) by default:



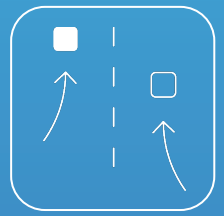

```
Show wlan 3
…/…
Security

    802.11 Authentication:..................... Open System
    FT Support................................. Adaptive
```

802.11r

Authentication method	Average Roaming time (ms)	Average Packet loss %	Maximum consecutive lost datagrams (Average)
Baseline – Full 802.1X EAP authentication	525	1.8	53
Fast Transition using 802.11r	42	0.2	6

http://blogs.cisco.com/wireless/what-is-802-11r-why-is-this-important



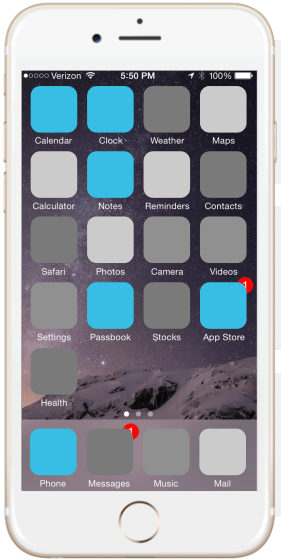
Prioritizing Business Apps

What Happens Today?

Inability to prioritize business-critical real-time traffic all the way from clients to the destination

- Today IT Administrators can classify traffic ONLY at the access point. this implies:
  - Inability to prioritize between the client and the AP
  - Burden on IT administrator to manage the applications across the enterprise

Prioritizing Business Apps



Prioritize business critical apps and real time data

Simplify configuration

IT has control over which Apps get priority

Fast Lane Configuration Profiles

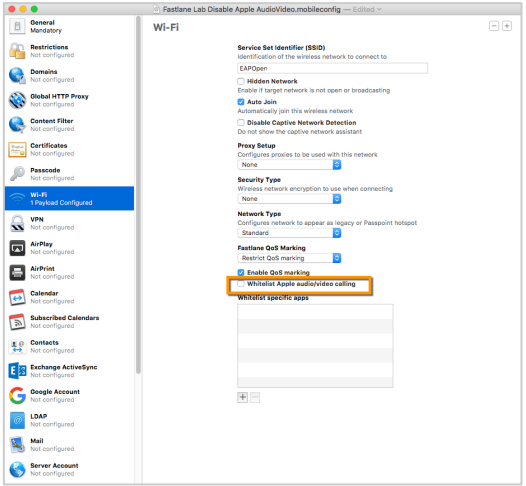
A QoS configuration profile will ONLY be acted upon on an iOS 10 client

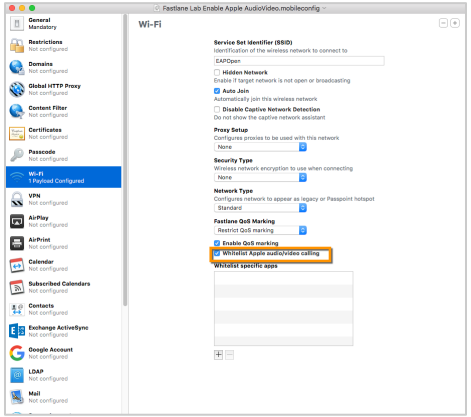
Uses standard Apple iOS Profiling techniques (MDM, email, Web-based)

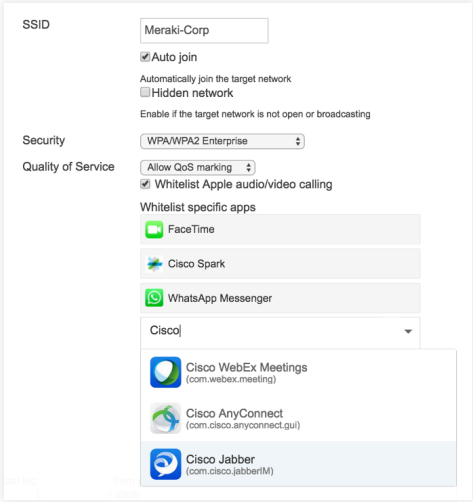
- Profile lists “whitelisted” applications in a dictionary file
- Whitelisted applications are allowed to mark QoS (DSCP/UP) upstream
- ‘Non-Whitelisted’ applications receive only BE/BK marking upstream

Used in Combination with Cisco and Apple mutual detection

Creating Fast Lane Profiles







Apple Configurator

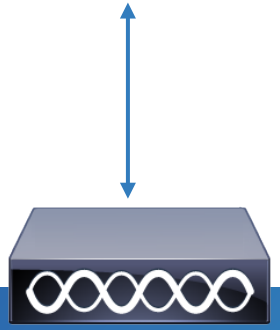
Meraki Systems Manager MDM

Fast Lane only applies to Cisco-Apple Deployments

QoS Profile or no QoS Profile

QoS Profile is not considered

Applications can only mark UP not DSCP

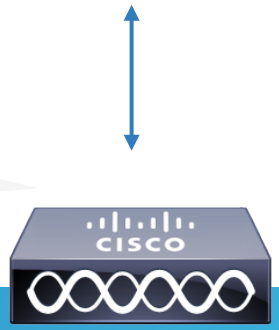


Non-Cisco-AP

QoS Profile

If a Profile was received, All apps in White list Can mark QoS upstream

Supports Fast Lane



Cisco-AP

* DSCP can be marked with IP_TOS/IPv6_TCLASS when SO_NET_SERVICE_TYPE is best effort

Fast Lane enables network administrator to prioritize applications per your environment

Supports Fast lane

Admin can provision Apple IOS device with a QoS profile*
Applications in whitelist get QoS marking**
Other applications get BE/BK

My profile for this environment:
Minecraft = Realtime-interactive
Viber = BE

My profile for this environment:
Minecraft = BE
Viber = Voice

Supports Fast lane

Supports Fast Lane

Cisco-AP

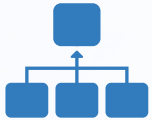
Supports Fast Lane

Cisco-AP

*Without a profile, all applications are whitelisted by default in a FastLane cell

**FastLane does NOT override apps QoS, it either allow the app QoS or apply BE

App prioritization elements



QoS Profile

Helps determine which applications should receive QoS upstream

Voice QoS Trust

Trust upstream voice traffic, with ACM and without TSPEC

AutoQoS

Benefits IT Administrator

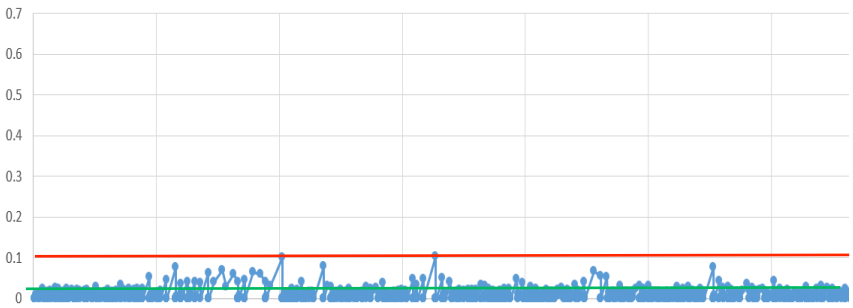
Configure optimal WLC QoS in one click

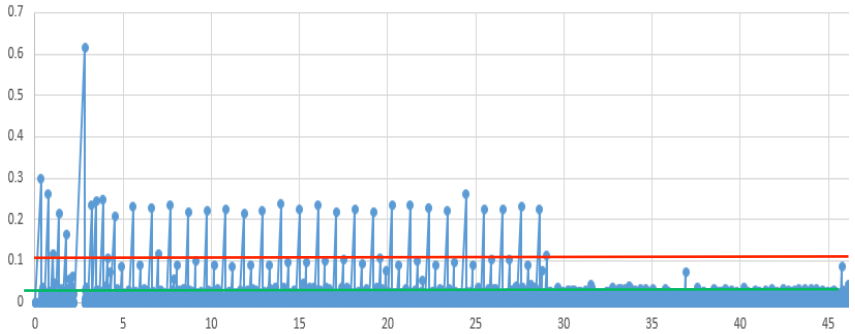
Better EDCA

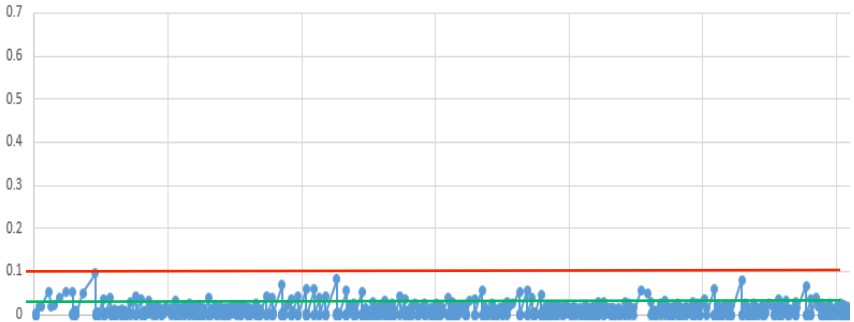
Ease of Use

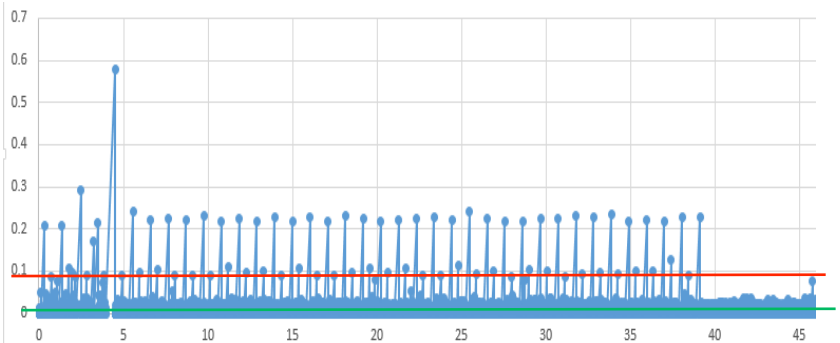
IEEE 802.11-2016 EDCA

Fast Lane Results : Upstream Frame Interval, Against Competing Traffic









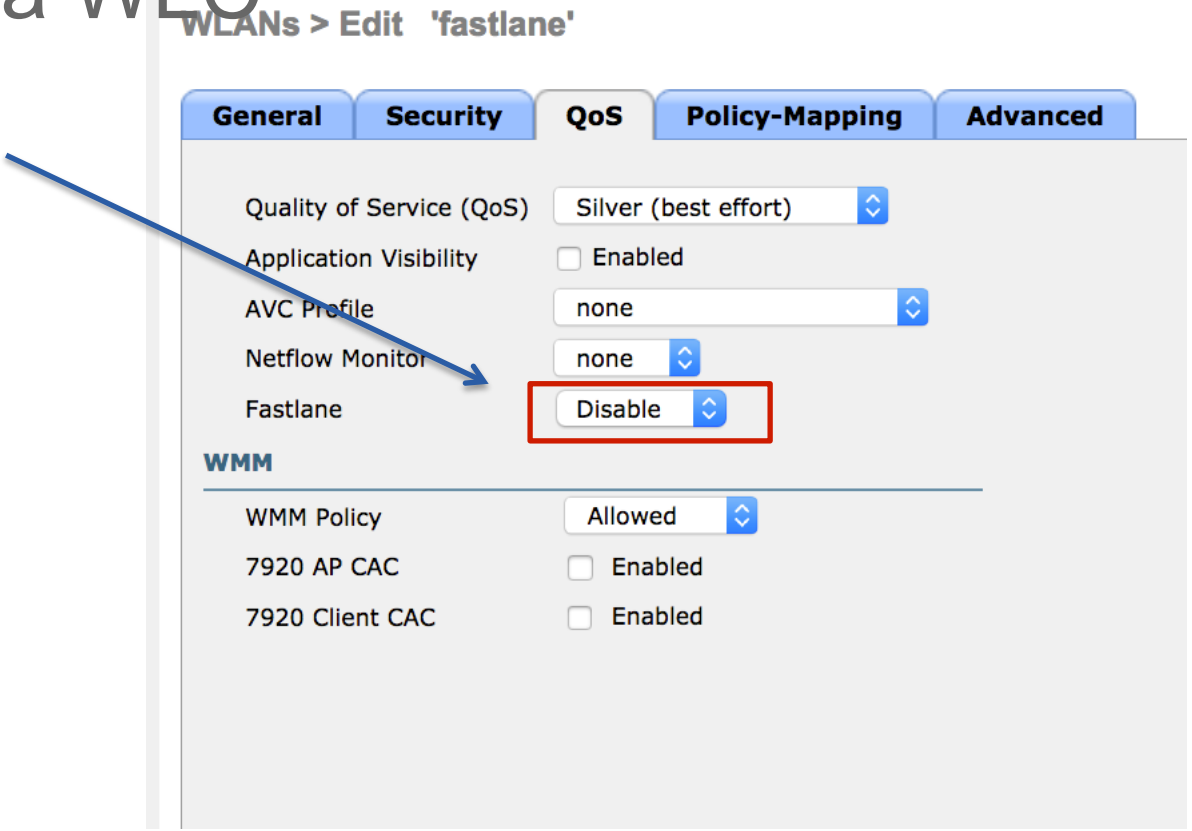
Interval between upstream frames (voice and video), for each station.

"table 1" (L3, L2 QoS enabled)

"table 2" (L3, L2 QoS disabled)

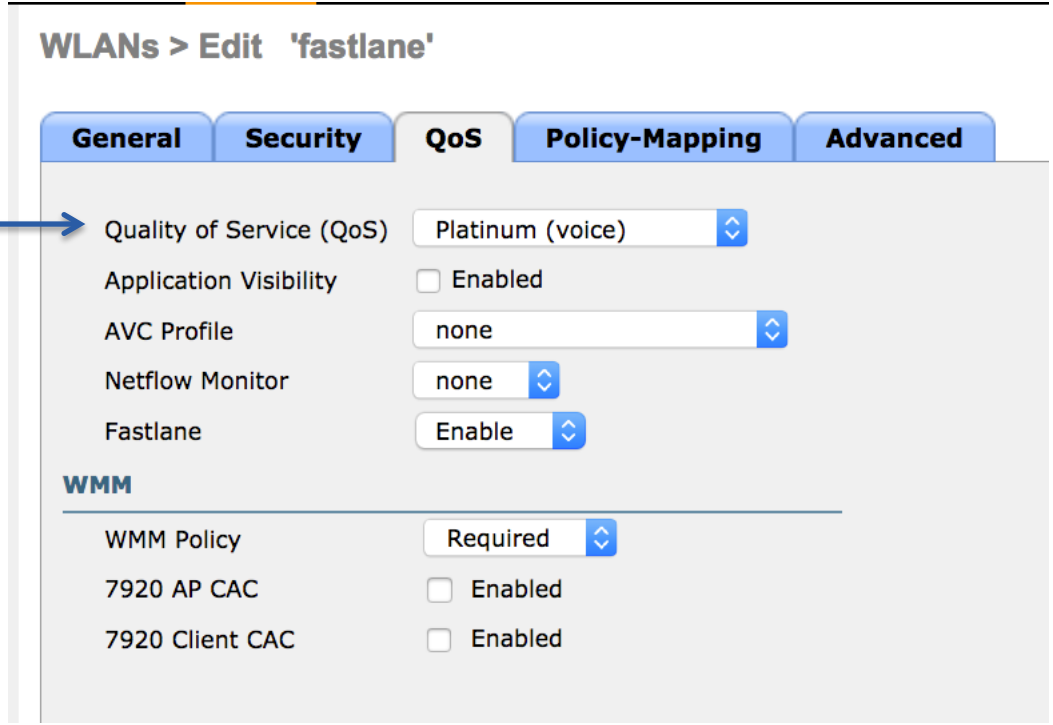
Fast Lane på WLC

- Enables fra QoS tab på WLAN configuration



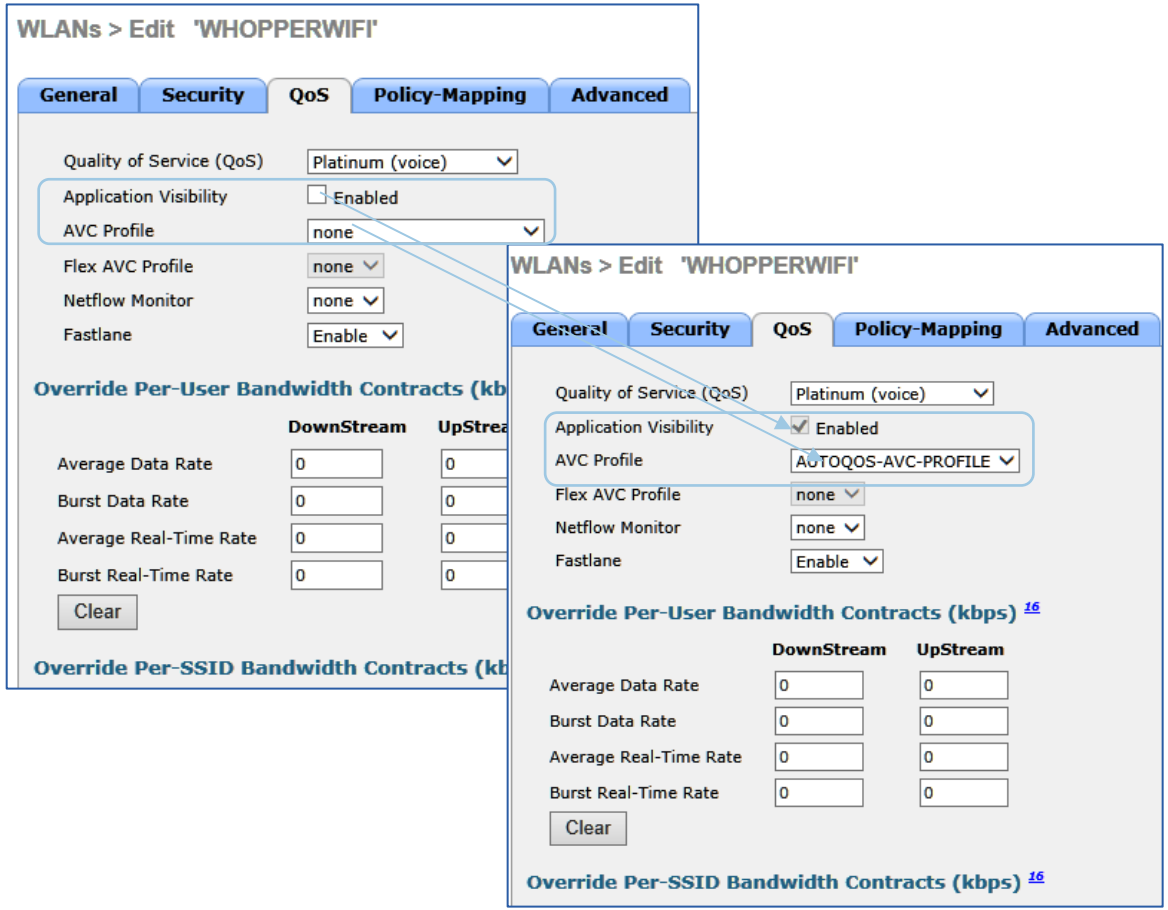
Fast Lane

- Enabling Fastlane:
- Configures best QoS globally
- Sets the WLAN for Platinum
- Sets WMM to Required
- (Notice AV is still disabled)



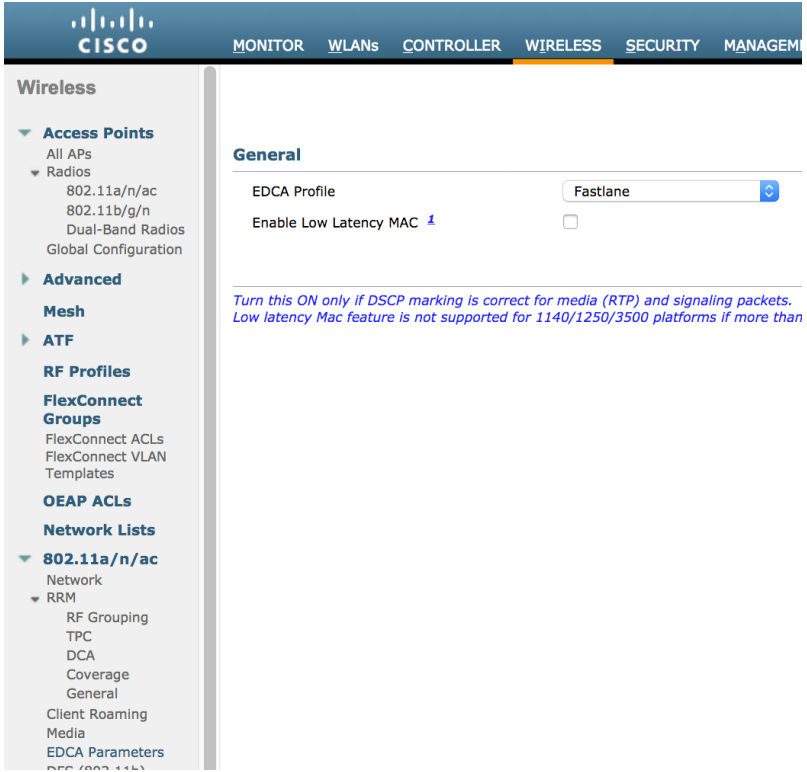
Fast Lane

- When Fastlane is enabled on a WLAN, enabling AV automatically applies the AUTOQOS-AVC-PROFILE



Fast Lane

- Ændrer også EDCA

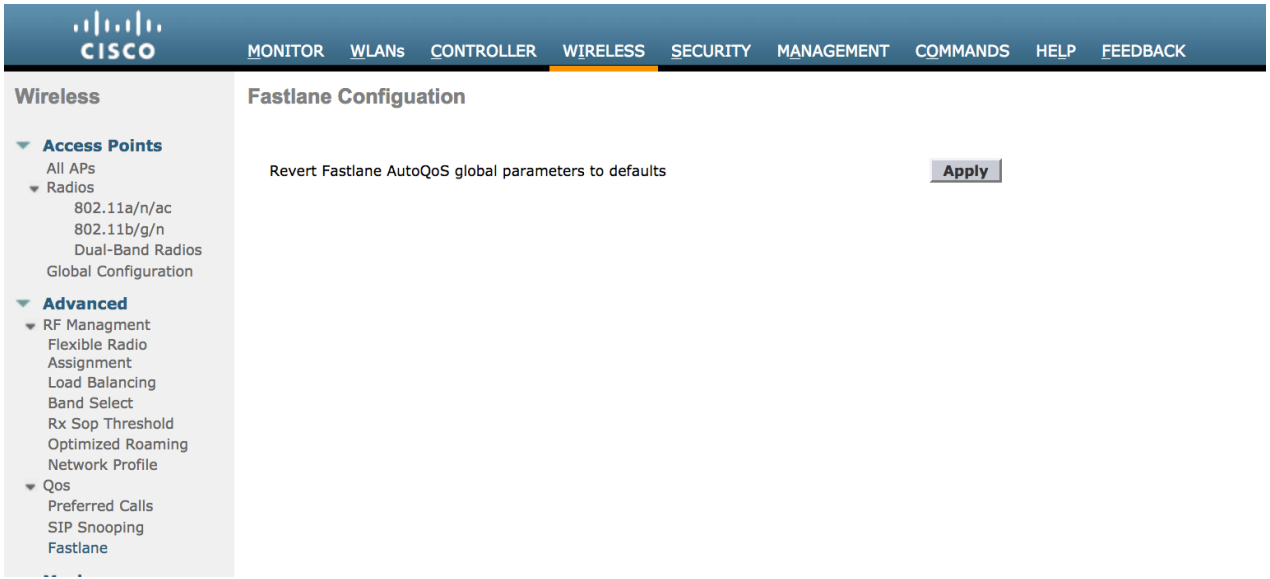


Cisco live Wireless QOS Session:

- By combining these timers, the theoretical probability of higher priority frames is greatly improved, but is not guaranteed

57

Revert Defaults



Recommended Platforms

Network Infrastructure

- Wireless controller: Running AireOS 8.3, 8.3MR or connected to Meraki cloud
- 802.11ac Aironet and Meraki MR Access points
- Catalyst and Meraki MS Multigigabit-capable switches
- Meraki Systems Manager EMM
- Software licenses, maintenance & support

Caching

- ISR 4000 Series
- WAAS – Wide Area Application Services
- Akamai Connect license
- Software licenses, maintenance & support

iOS devices

Optimized Efficient Roaming

- iPhone 6s and later
- iPhone 6s Plus and later
- iPad Air 2 and later
- iPad mini 4 and later
- iPad Pro and later
- iPhoneSE

Fast Lane

- iPhone 5 and later
- iPad mini 2 and later
- iPad Air and later
- iPad Pro
- iPod touch (6th generation)

Thank you.