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Troubleshooting Wireless LANs

BRKEWN-3011

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Troubleshooting Wireless LANs

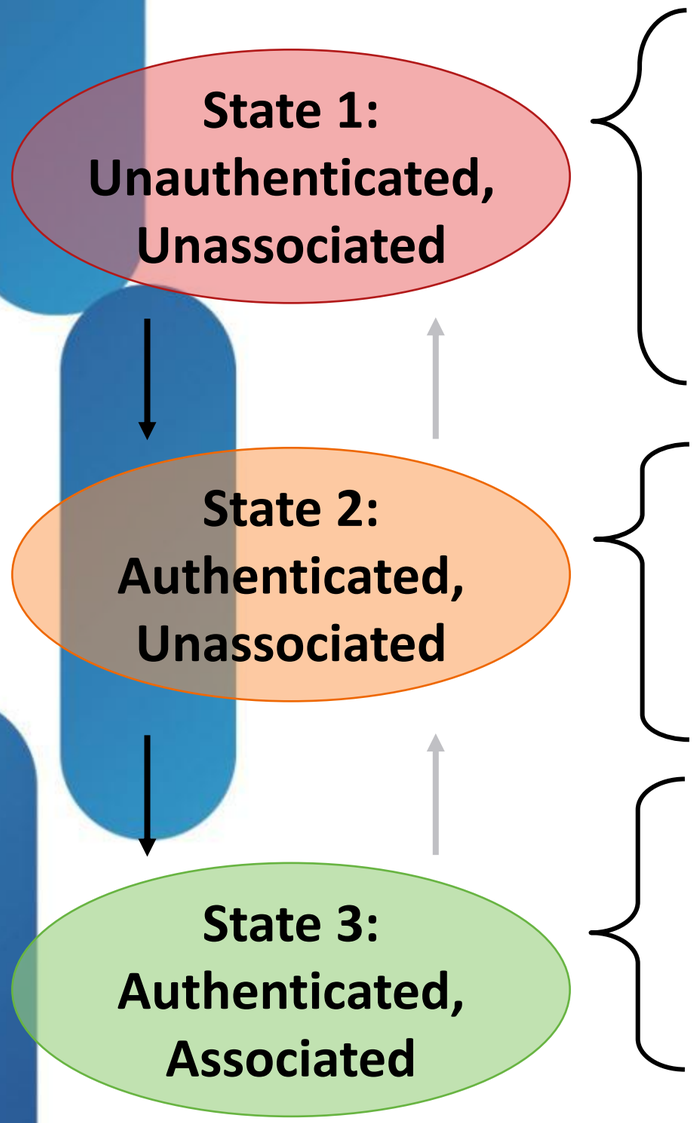
- Basic Concepts
- Best Practices
- Supportability
- AP Troubleshooting
- Troubleshooting Clients
- Voice over WiFi
- SE-Connect - Clean Air

Basic Concepts

Key Concepts

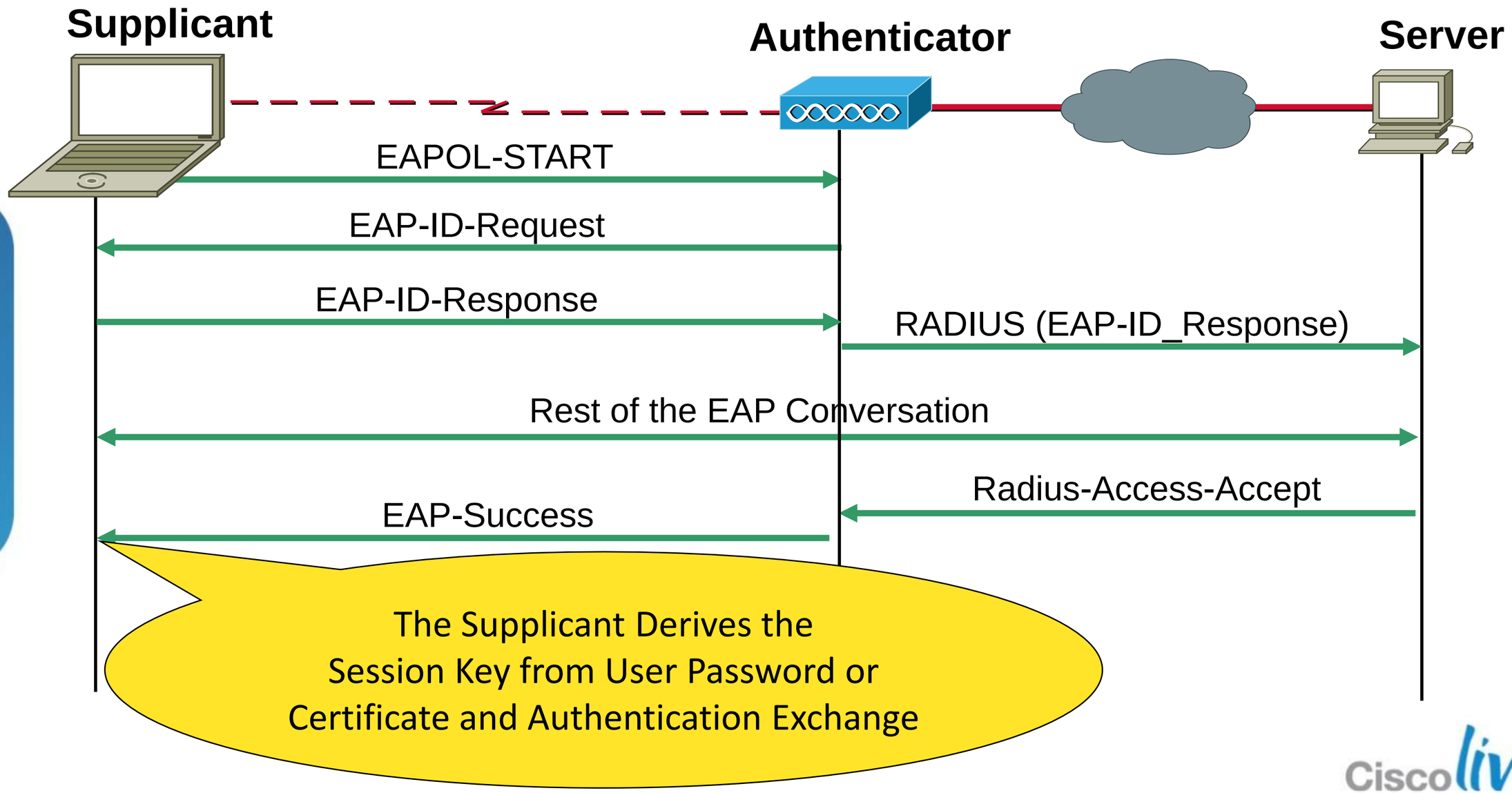
- 802.11/802.1X/WPA
- Cisco Unified Architecture/CAPWAP
- Cisco Unified Client Mobility
- Radio Resource Management (RRM)
- Client states

Steps to Building an 802.11 Connection



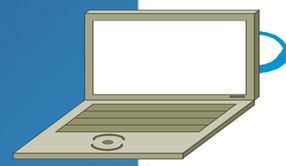
1. Listen for Beacons
2. Probe Request/Response
3. Authentication Request/Response
4. Association Request
5. Association Response
6. (Optional: EAPOL Authentication)
7. (Optional: Encrypt Data)
8. Move User Data

802.1X Authentication



Cisco Centralised WLAN Model

CAPWAP Defines Control Messaging and Data Encapsulation Between Access Points and Centralised WLAN Controller



Lightweight Access Point

Switched/Routed Wired Network

Control Messages
Data Encapsulation

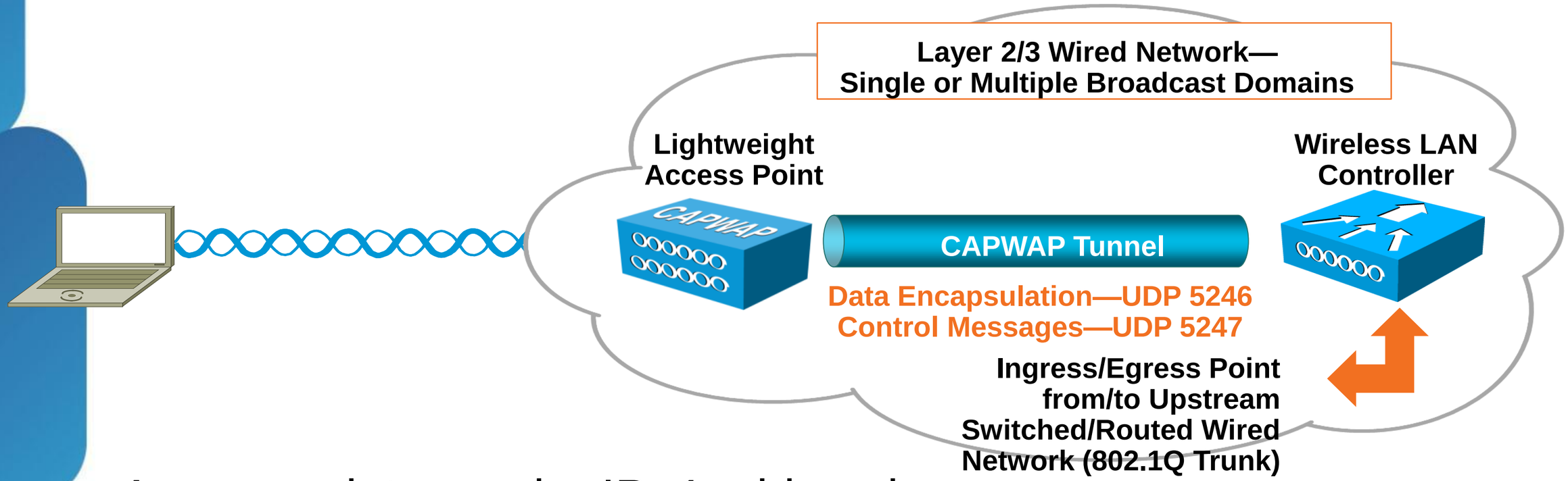
Wireless LAN Controller

Ingress/Egress Point from/to Upstream Switched/Routed Wired Network (802.1Q Trunk)

Access Points Are Lightweight Controlled by a Centralised WLAN Controller

Much of the Traditional WLAN Functionality Moved from Access Points to Centralised WLAN Controller

Layer 3 CAPWAP Architecture



- Access points require IPv4 addressing
- APs can communicate with WLC across routed boundaries

CAPWAP

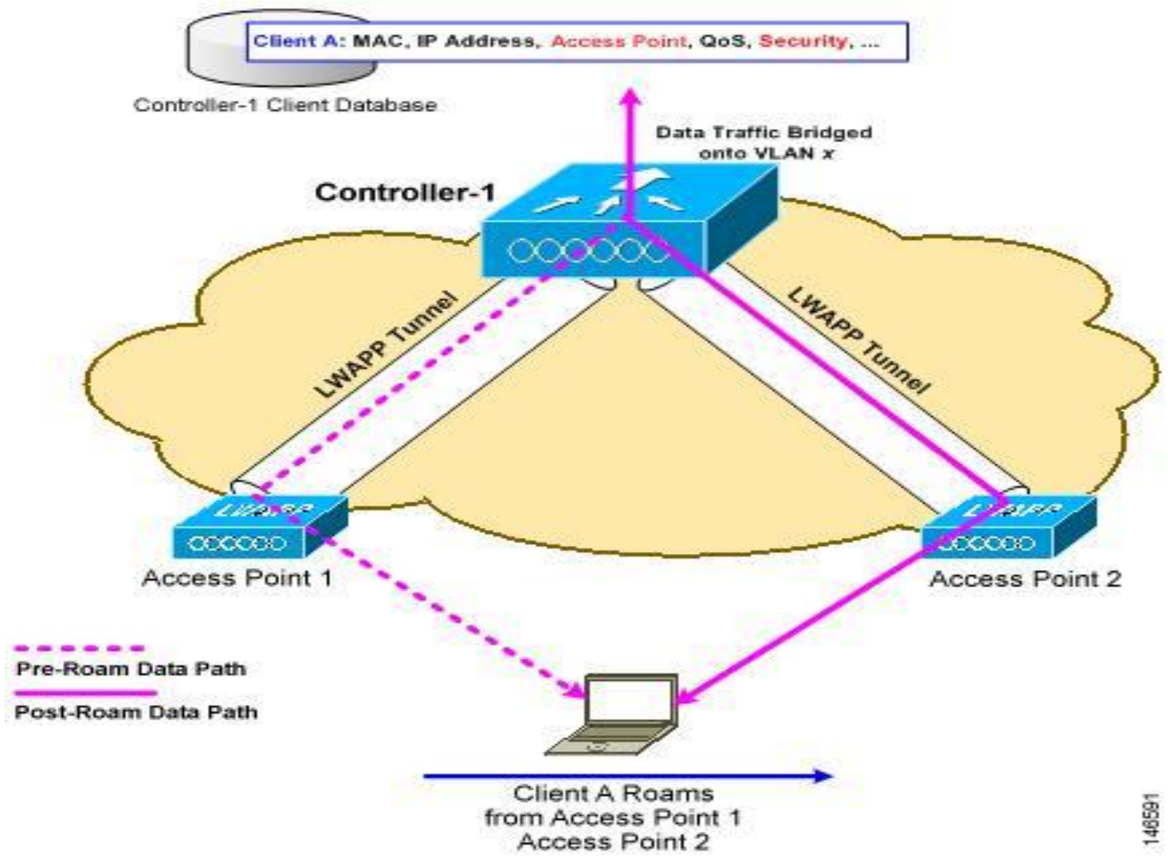
- Protocol starting with 5.2 for controllers and APs
- IETF Standard
- Support encryption of control and data planes
- L3 only
- Controllers still support LWAPP Discovery, Join, Image states to migrate APs
- Fragmentation and reassembly done in protocol, not in IP level

Differences between LWAPP and CAPWAP

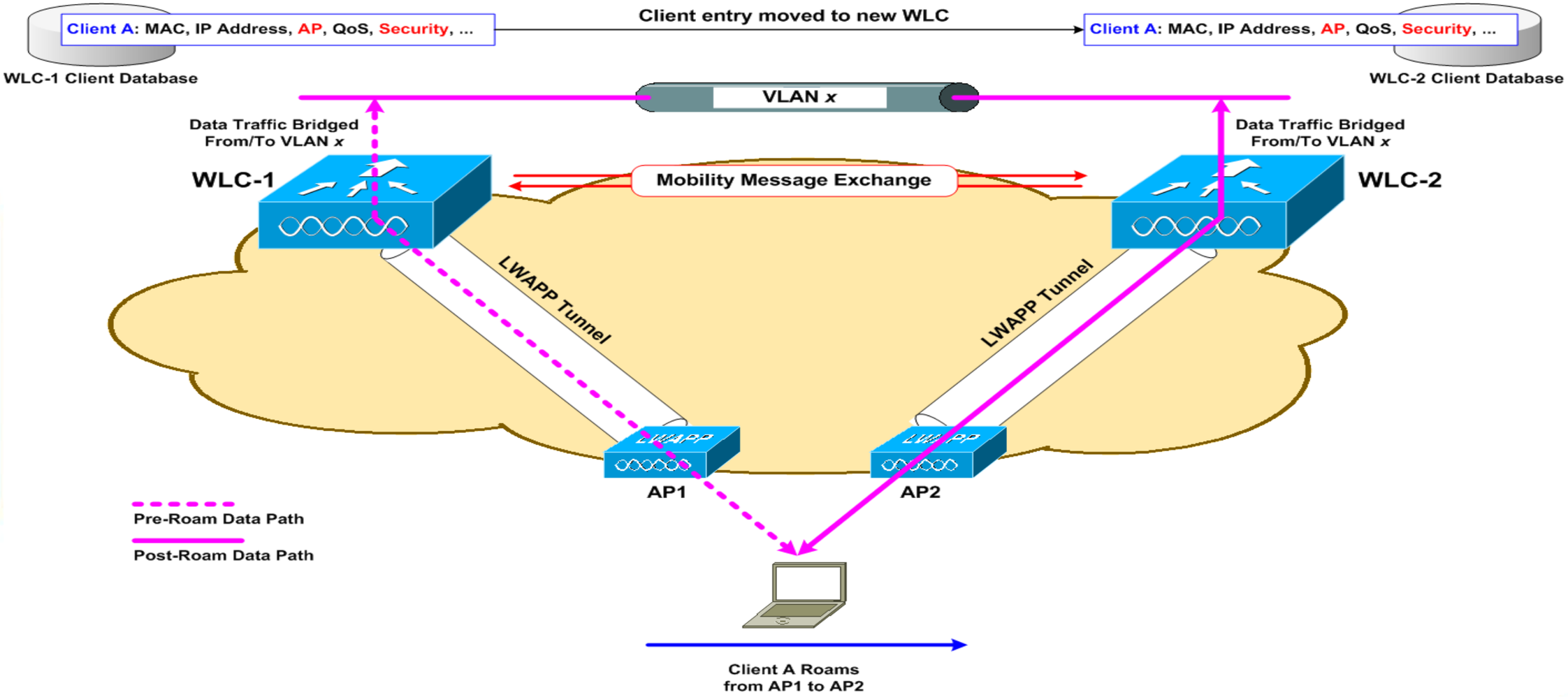
Description	LWAPP	CAPWAP
Fragmentation/ Re-assembly	Relies on IPv4	CAPWAP Itself Does Both
Path-MTU Discovery	Not Supported	Has a Robust P-MTU Discovery Mechanism, Can also Detect Dynamic MTU Changes
Control Channel Encryption between AP and WLC	Yes (Using AES)	Yes (Using DTLS)
Data Channel Encryption between AP and WLC	No	**Yes (Using DTLS)**
UDP Ports	12222(Data), 12223(Ctrl)	**5246 (Ctrl) 5247 (Data)**

Mobility—Intra-Controller

- Client roams between two APs on the same controller

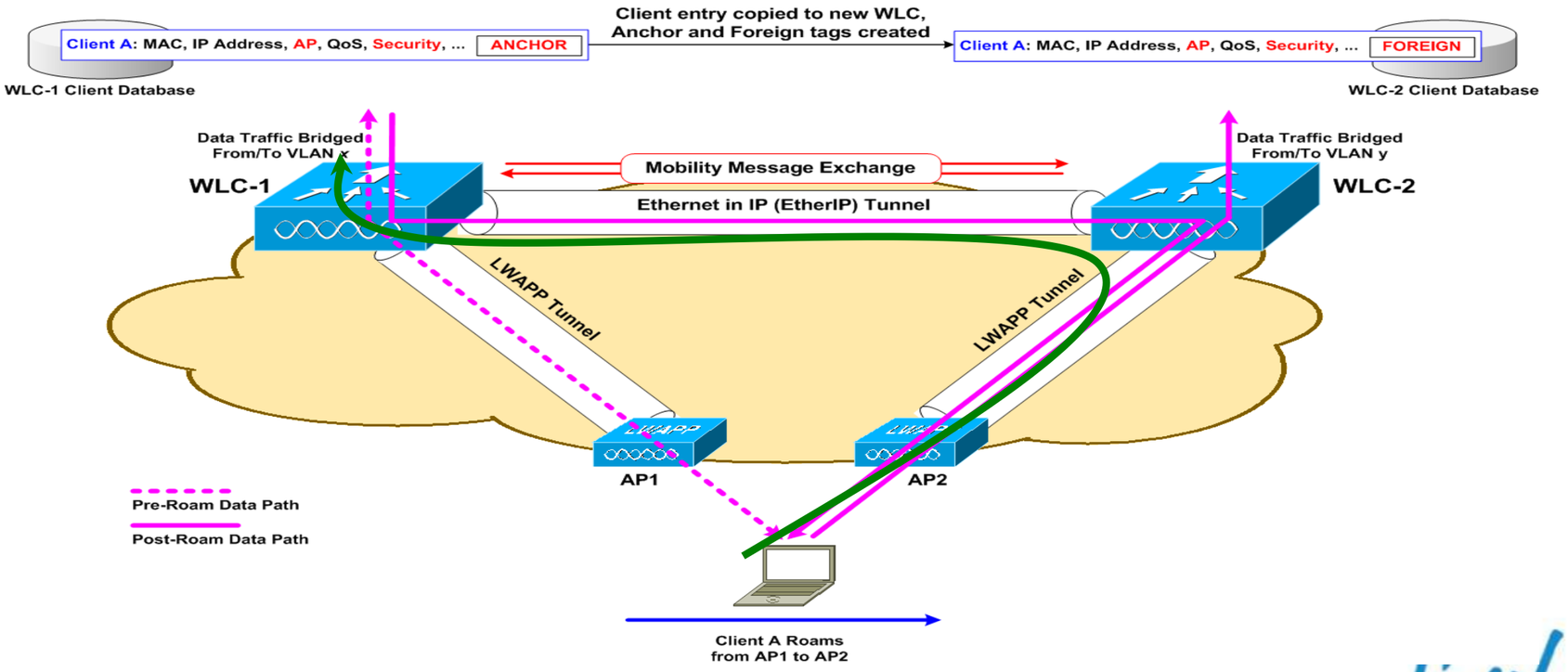


Mobility—Inter-Controller (Layer 2)



Mobility—Inter-Controller (Layer 3)

- Layer 3 roaming (a.k.a. **anchor/foreign**)
  - New WLC does not have an interface on the subnet the client is on
  - New WLC will tell the old WLC to forward all client traffic to the new WLC
- Asymmetric traffic path established (deprecated)
- **Symmetric** traffic path



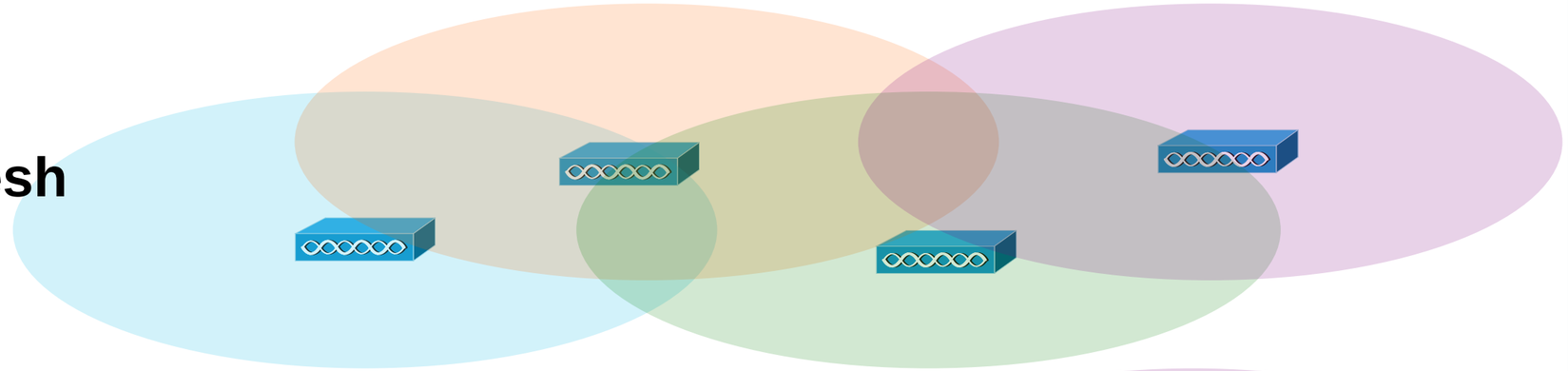
Radio Resource Management Refresher

- Dynamic Channel Assignment (**DCA**)
  - Selects channels for the radios to use
- Transmit Power Control (**TPC**)
  - Adjusts radio power level for the radios to use
- Coverage Hole Detection and Mitigation (**CHDM**)
  - Detects **coverage holes**, by identifying clients from which we are receiving a poor signal, and accordingly **increases** radio power, to compensate

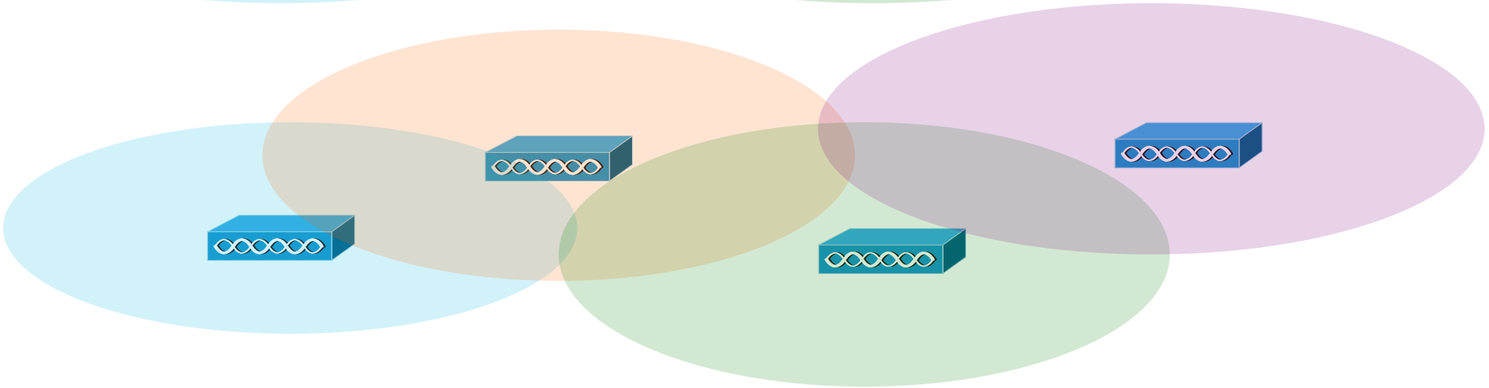
Radio Resource Management – auto RF

- **`config advanced 802.11[a|b] tx-power-control-thresh`** is the **master fader** for radio power (values in -60 to -80 dBm — lower values for denser installations)

Thresh –68



Thresh –73



Default:
-70 dBm

Use lower values for high density deployments

PEM - Client Forwarding

Name	Description
RUN	Normal Client Traffic Forwarding
DHCP_REQ	IP Learning State. One Packet from this Client Is Sent to CPU in Order to Learn the IP Address Used
WEBAUTH_REQ	Web Authentication Pending
8021X_REQ	802.1x Authentication Taking Place

Best Practices

Best Practices - RF

- Site survey, in case of doubts, **site survey**, after installation, **site survey …**
- Site survey **must** be meaningful
  - Same device types, coverage band, intended service
- Reduce unneeded WLANs
- Use BandSelect only on WLANs with mixed clients

Best Practices - RF

- Turn off lowest data rates when possible (more bandwidth, less channel utilisation, etc)
- Fine tune AutoRF (depending on density)
- Avoid aggressive load balancing, unless high-density and **never** use with voice

Best Practices - Network

- Do not use STP on controllers
- Filter VLANs toward WLC that are not in use
- LAG config on switch side must be consistent
- If no LAG, one AP manager per physical port
- Use multicast mode

Best Practices - Network

- For fastest failover, AP ports should be configured for:
  - Local mode:
  - **spanningtree portfast** and **switchport mode access**
  - - H-REAP / FlexConnect mode:
  - **spanningtree portfast** and **switchport mode access**
  - **spanningtree portfast trunk** and **switchport mode trunk** (VLAN support)

Best Practices - Mobility

- Do not create unnecessary **big** mobility groups
- Same virtual gateway address across all members
- VG address should **not** be routable
  - address 1.1.1.1 has been allocated, use 192.0.2.1 instead (RFC 5737)
- Same CAPWAP mode, symmetric setting, group name
- Use symmetric mobility (only option as of 5.2)

Best Practices - Security

- Increase RADIUS timeout (e.g. 5 seconds)
- Change SNMPv3 users
- Increase EAP identity timeout, not EAP retries!
- Increase AP authentication threshold
- NTP: must have for context-aware/location, MFP, debugging

Best Practices - Administration

- Back up before upgrade
- Downgrade is not supported (no longer true since XML configuration in 4.2+)
- Always set controller name on AP for join process
- Enable and set syslog server on APs
- Enable telnet/SSH and set up local credentials on AP
- Make sure AP name is representative of location

Supportability

Supportability

- WLC Supportability
  - Methods of Management
  - Using the GUI
  - Important Show Commands (CLI)
  - Important Debug Commands (CLI)
  - Best Practices
- AP Supportability
  - Methods of Accessing the AP
  - Important Show Commands

WLC Supportability

Methods of Management

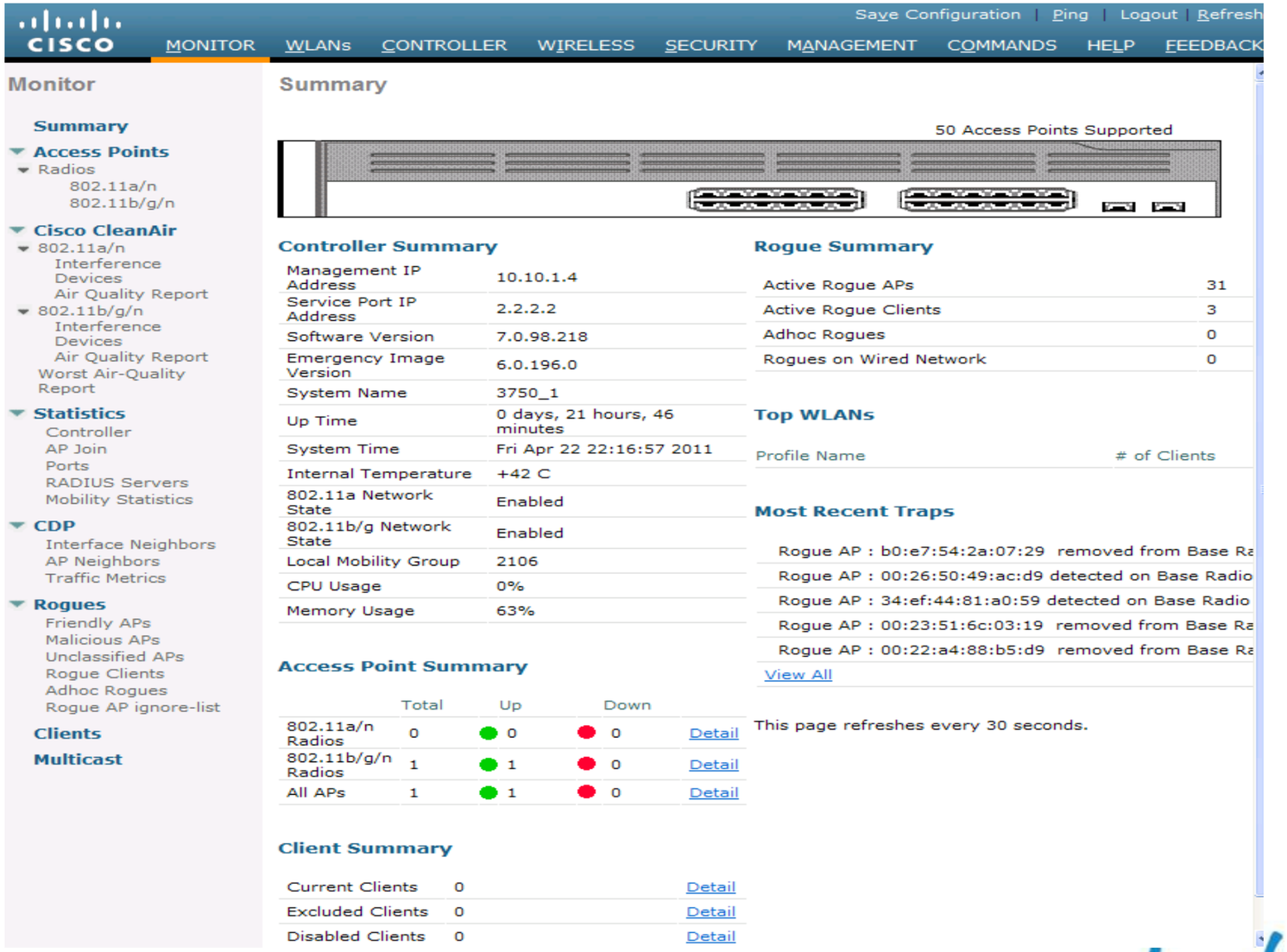
- GUI
  - HTTPS (E) / HTTP (D)
- CLI
  - Console / SSH (E) / Telnet (D)
- SNMP
  - V1 (D) / V2 (E) – Change me
  - V3 (E) – Change me

Default Mode
(E)=Enabled (D)=Disabled

WLC Supportability

Using the GUI

- Monitor
  - AP/Radio Statistics
  - WLC Statistics
  - Client Details
  - Trap Log



WLC Supportability

Using the GUI

AP Name	AP Model	AP MAC	AP Up Time
AP8843.e103.bda2	AIR-LAP1242G-A-K9	88:43:e1:03:bd:a2	0 d, 22 h 25 m 45 s

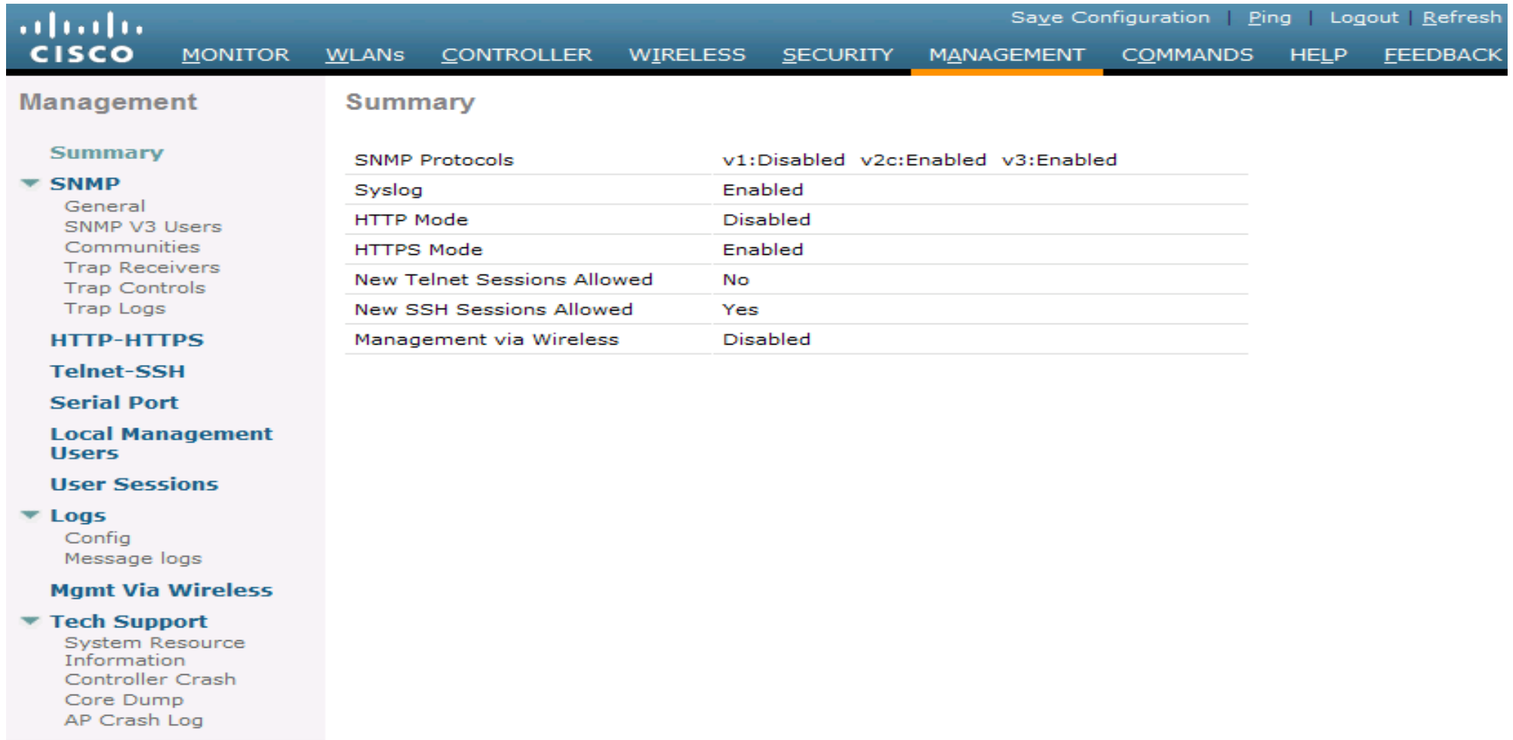
- Wireless > All APs
  - AP list shows AP Physical UP Time
  - APs are sorted by Controller Associated Time
  - Check bottom of AP list for any recent AP disruptions
  - Select AP to see Controller Associated Time (duration)

Time Statistics	
UP Time	0 d, 22 h 26 m 49 s
Controller Associated Time	0 d, 14 h 51 m 20 s
Controller Association Latency	0 d, 00 h 04 m 12 s

WLC Supportability

Using the GUI

- Management
  - SNMP Config
  - Logs
  - Tech Support



WLC Supportability

Important Show Commands (CLI)

- Show run-config
  - “show run-config commands” (like IOS show running-config)
  - “show run-config no-ap” (no AP information added)
- Show tech-support
- CLI Tip
  - Log all output
  - Config Paging Disable

WLC Supportability

Important Debugs (CLI)

- Debug client <client mac address>
- Debug capwap <event/error/detail/info> enable
- CLI Tips
  - Log all output
  - Debugs are session based, they end when session ends
  - “Config session timeout 60”, sets 60 minute idle timeout
  - Debug mac addr <mac address>

WLC Supportability

Best Practices

- Change default SNMP Parameters
- Configure Syslog for WLC and AP
- Enable Coredump for WLC and AP
- Configure NTP Server for Date/Time

AP Supportability

- Methods of Accessing the AP
  - Console
  - Telnet (D) / SSH (D)
  - No GUI support
  - AP Remote Commands
- Enabling Telnet/SSH
  - WLC CLI: config ap [telnet/ssh] enable <ap name>
  - WLC GUI: Wireless > All APs > Select AP > Advanced
  - Select [telnet/ssh] > Apply

Default Mode
(E)=Enabled (D)=Disabled

AP Supportability

AP Remote Commands (WLC CLI)

- Debug AP enable <AP name>
  - Enables AP Remote Debug
  - AP Must be associated to WLC
  - Redirects AP Console output to WLC session
- Debug AP command “<command>” <AP name>
  - Output is redirected to WLC session
  - AP runs IOS, numerous generic IOS commands available

AP Supportability

Show Commands (AP CLI or WLC Remote Cmd)

- Show controller Do[0/1] (or Show Tech)
- Show log
- WLC: show ap eventlog <ap name>
- Show capwap client <?>

  Debug capwap console cli

  Debug capwap client no-reload

```
AP#show cap client ?
  callinfo    Lwapp client Call Info
  config      CAPWAP Client NV Config File
  detailrcb   Lwapp client rcb Info
  ha          CAPWAP Client HA parameters
  mn          CAPWAP Client 80211 MN
  rcb         CAPWAP Client RCB
  timers      CAPWAP Client Timers
  traffic     CAPWAP Client 80211 Traffic
```

AP Troubleshooting

AP Troubleshooting

- Typical problems
  - Discovery/Join
  - Time set at WLC
  - Regulatory domain issues
  - Debug

AP Join Troubleshooting

- First, the AP must **hunt** for the IP addresses of possible WLCs to join
- Next, the AP sends **discover** messages to all the WLCs, to find out which ones are alive
- Then the AP picks the best WLC and tries to **join** it
- For details, see the “Controlling Lightweight Access Points” section of the WLC configuration guide.

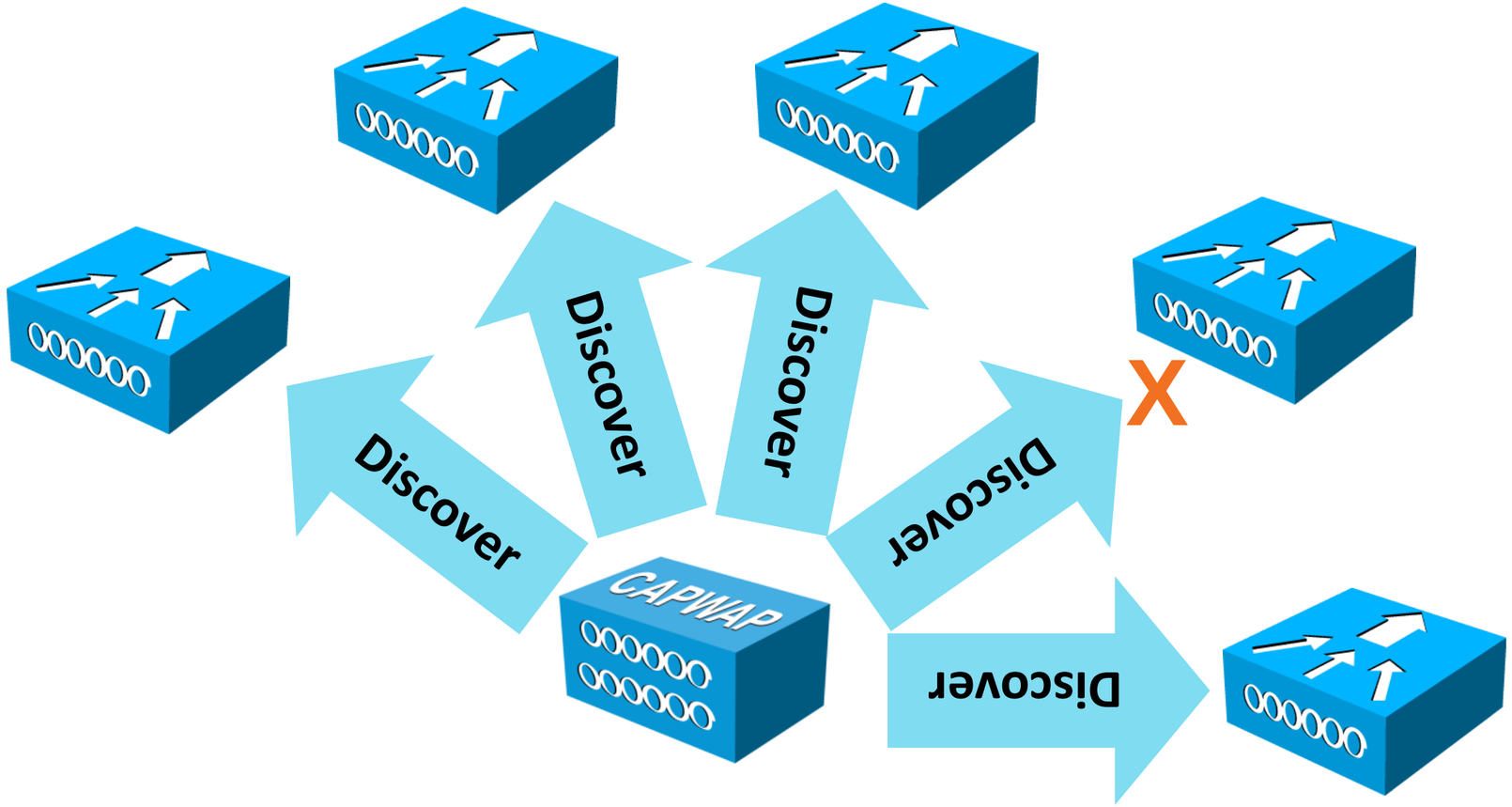
L3 WLC Address Hunting

AP Goes Through the Following Steps to Compile a Single List of WLAN Controllers

1. Discovery broadcast on local subnet
2. Locally-stored controller IP addresses
3. DHCP vendor specific option 43
4. DNS resolution of:
   - *"CISCO-CAPWAP-CONTROLLER.localdomain"*
   - *"CISCO-LWAPP-CONTROLLER.localdomain"*
5. If no controller found, start over

Note: The Actual Order of This Process Is Irrelevant Because Each AP Goes Through All Steps Before Proceeding to the Next Phase. Some Steps May Never Happen

L3 WLC Discovery



AP Tries to Send Discover Messages to All the WLC Addresses that Its Hunting Process Turned Up

Discovery Algorithm

- Once a list of WLAN controllers is compiled, the AP sends a unicast CAPWAP discovery request message to each of the controllers in the list
- WLAN controllers receiving the CAPWAP discovery messages respond with a discovery response
- Discovery response contain important information:
  - Controller name, controller type, AP capacity, current AP load, master controller status, AP-manager IP address(es)
- AP waits for its discovery interval to expire, then selects a controller and sends a join request to that controller

WLAN Controller Selection Algorithm

The AP Selects the Controller to Join using the Following Criteria

1. If the AP has been configured with primary, secondary, and/or tertiary controller, the AP will attempt to join these first
2. Attempt to join a WLAN controller configured as a master controller
3. Attempt to join the WLAN controller with the greatest excess AP capacity

Note: This Last Step Provides the Whole System with Automatic AP/WLC Load-Balancing Functionality

WLAN Controller Join Process Mutual Authentication

- AP CAPWAP Join request contains the AP's signed X.509 certificate
- WLAN controller validates the certificate before sending an CAPWAP join response
  - Manufacture Installed Certificate (MIC) all Cisco Aironet APs manufactured after July 18, 2005
  - Self-Signed Certificate (SSC) - Lightweight upgraded Cisco Aironet APs manufactured prior to July 18, 2005
  - SSC APs must be **authorised** on the WLAN controller

WLAN Controller Join Process Mutual Authentication

- If AP is validated, the WLAN controller sends the CAPWAP join response which contains the controller's signed X.509 certificate
- If the AP validates the WLAN controller, it will download firmware (if necessary) and then request its configuration from the WLAN controller

Troubleshooting Lightweight APs

- Can the AP and the WLC communicate?
- Make sure the AP is getting an address from DHCP (check the DHCP server leases for the AP's MAC address)
- If the AP's address is statically set, ensure it is correctly configured
- Try pinging the AP from the controller
- If pings are successful, ensure the AP has **at least one** method by which to discovery at least a single WLC
- Console or telnet/ssh into the controller to run debugs

Set the WLC's Time

- Make sure each controller has the correct time set
- Check the WLC's time:
  - `(WLC_CLI) >show time`
- Manually set the time:
  - `(WLC_CLI) >config time manual <MM/DD/YY> <HH:MM:SS>`
- Or, use NTP:
  - `(WLC_CLI) >config time ntp server <Index> <IP Address>`
  - `(WLC_CLI) >config time ntp interval <3600 - 604800 sec>`

Does Regulatory Domain Matter? Yes!

(WLC_CLI) >debug mac addr 00:12:80:ad:7a:9c

(WLC_CLI) >debug capwap events enable

[TIME]: * spamVerifyRegDomain:6202 AP 00:12:80:ad:7a:9c 80211bg Regulatory Domain (-A) does not match with country (BE) reg. domain -BE for slot 0

[TIME]: DEBU CTRLR spamVerifyRegDomain:6167 spamVerifyRegDomain RegDomain set for slot 1 code 0 regstring -A regDfromCb -E

[TIME]: * spamVerifyRegDomain:6202 AP 00:12:80:ad:7a:9c 80211a Regulatory Domain (-A) does not match with country (BE) reg. domain -BE for slot 1

[TIME]: DEBU CTRLR spamVerifyRegDomain:6210 spamVerifyRegDomain AP RegDomain check for the country BE failed

[TIME]: * spamProcessConfigRequest:1730 AP 00:12:80:ad:7a:9c: Regulatory Domain check Completely FAILED. The AP will not be allowed to join.

- The fix?

  Make sure you match your APs' **regulatory domain with your WLCs**.
  RRM will use the lowest common denominator for channels

- How do you know how to make sure you do?

  Search CCO for **Wireless LAN Compliance Status**

CAPWAP Troubleshooting

- WLC side debug commands:

```
(Cisco Controller) >debug capwap ?

events          Configures debug of CAPWAP events and state
errors          Configures debug of CAPWAP errors
detail          Configures debug of CAPWAP detail
info            Configures debug of CAPWAP info
packet          Configures debug of CAPWAP packet
payload         Configures debug of CAPWAP payloads
hexdump         Configures debug of CAPWAP payloads
```

CAPWAP Troubleshooting

- Useful CAPWAP join debugs:
  - **`debug dhcp`**
  - **`debug ip udp`**
  - **`debug capwap client {config, error, event, detail, packet}`**
  - **`debug dtls client {error, event}`**

CAPWAP Join

(Cisco Controller) >debug capwap events enable

*Jan 09 05:02:07.952: 00:17:df:a8:bf:00 Discovery Request from 192.168.100.103:41824

*Jan 09 05:02:07.952: 00:17:df:a8:bf:00 Join Priority Processing status = 0, Incoming Ap's Priority 1, MaxLrads = 6, joined Aps =0

*Jan 09 05:02:07.952: 00:17:df:a8:bf:00 Discovery Response sent to 192.168.100.103:41824

*Jan 09 05:02:18.949: DTLS connection not found, creating new connection for 192:168:100:103 (41824) 192:168:100:4 (5246)

*Jan 09 05:02:19.881: DTLS connection established

*Jan 09 05:02:19.881: DTLS Session established server (192.168.100.4:5246), client (192.168.100.103:41824)

*Jan 09 05:02:19.881: Starting wait join timer for DTLS connection 0xc332dbc!, AP: 192.168.100.103:41824

*Jan 09 05:02:19.884: 00:17:df:a8:bf:00 Join Request from 192.168.100.103:41824

*Jan 09 05:02:19.884: DTL Adding AP 3 - 192.168.100.103

*Jan 09 05:02:19.884: Join Version: = 84057344

*Jan 09 05:02:19.885: Join resp: CAPWAP Maximum Msg element len = 91

*Jan 09 05:02:19.885: CAPWAP State: Configure

CAPWAP Failure

*Jan 09 07:44:45.781: 00:17:df:a8:bf:00 Discovery Request from 192.168.100.104:41825
*Jan 09 07:44:45.781: 00:17:df:a8:bf:00 Join Priority Processing status = 0, Incoming Ap's Priority 1, MaxLrads = 6, joined Aps =0
*Jan 09 07:44:45.781: 00:17:df:a8:bf:00 Discovery Response sent to 192.168.100.104:41825
*Jan 09 07:44:55.779: DTLS connection not found, creating new connection for 192:168:100:104 (41825) 192:168:100:4 (5246)
*Jan 09 07:44:56.710: DTLS connection established
*Jan 09 07:44:56.710: DTLS Session established server (192.168.100.4:5246), client (192.168.100.104:41825)
*Jan 09 07:44:56.710: Starting wait join timer for DTLS connection 0xc332dbc!, AP: 192.168.100.104:41825
*Jan 09 07:44:56.713: 00:17:df:a8:bf:00 Join Request from 192.168.100.104:41825
*Jan 09 07:44:56.714: 00:17:df:a8:bf:00 In AAA state 'Idle' for AP 00:17:df:a8:bf:00
*Jan 09 07:44:56.714: 00:17:df:a8:bf:00 State machine handler: Failed to process msg type = 3 state = 0 from 192.168.100.104:41825
*Jan 09 07:44:56.714: Failed to process CAPWAP packet from 192.168.100.104:41825
*Jan 09 07:44:56.715: Disconnecting DTLS session 0xc332dbc for AP 00:17:df:a8:bf:00 (192:168:100:104/41825)
*Jan 09 07:44:56.715: CAPWAP State: Dtls tear down

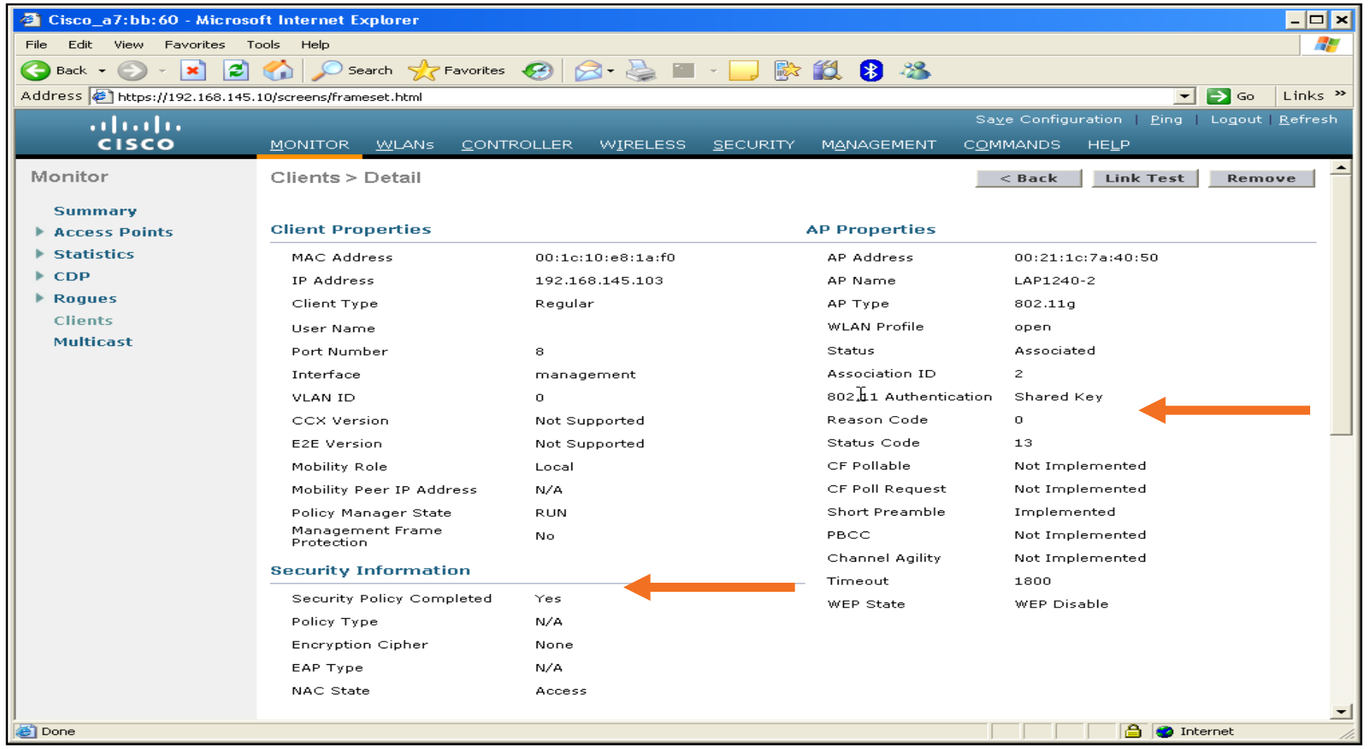
Troubleshooting Clients

Troubleshooting Clients

- Connectivity issues
- Logs/Debugs
- Wireless/Wired Sniff
- Spectrum Analysis
- Each Step Explained

Connectivity Issues

- Typical problem: client(s) can not connect to the network
- Where to look (assuming basic steps were already taken): policy manager state and status

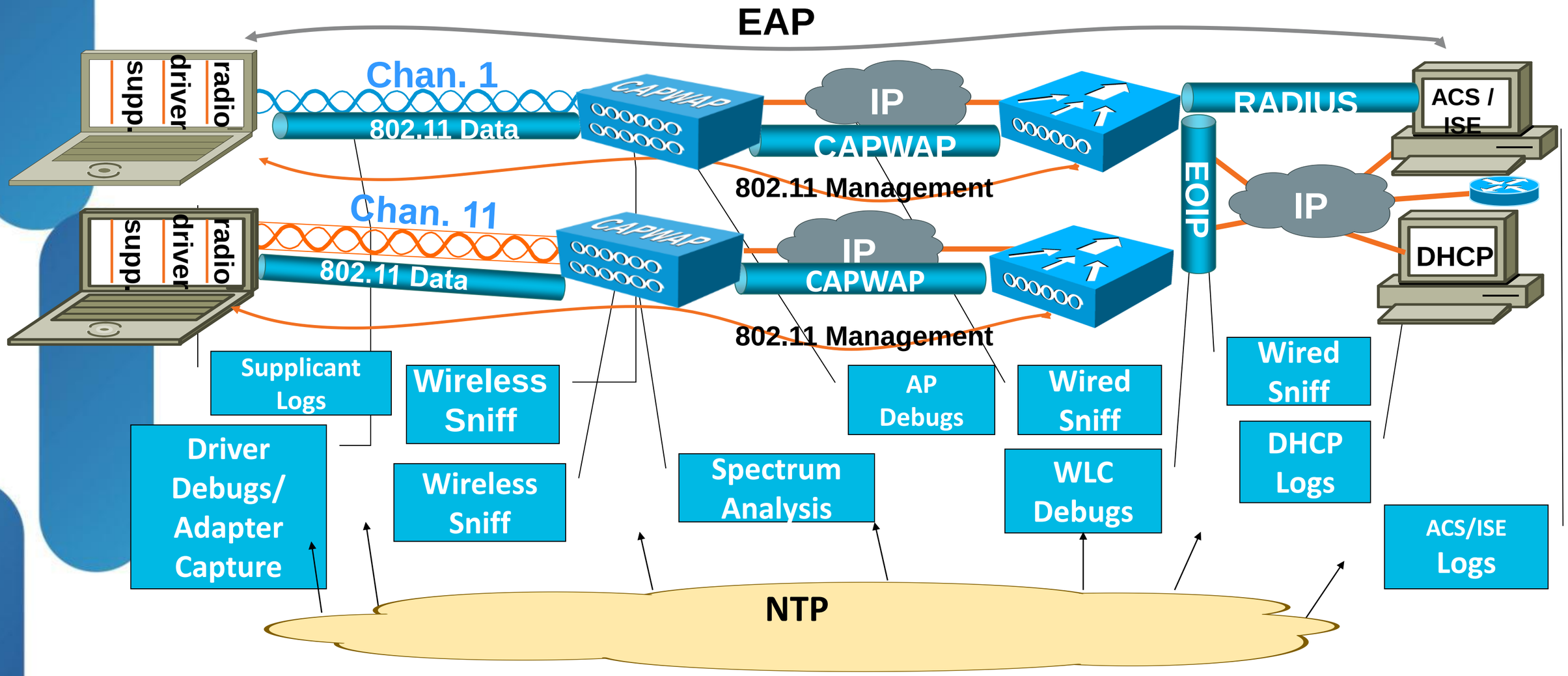


CLI: **`show client detail <MAC>`**

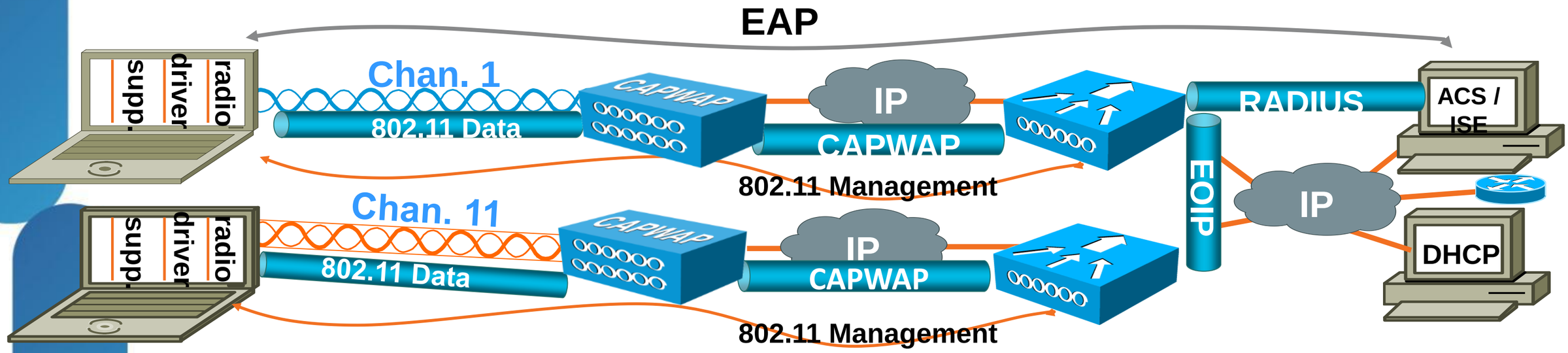
Client Connectivity

- Unified Wireless Network: Troubleshoot Client Issues Document ID: 107585
- Configuration Issues
  - SSID/Security Mismatch
  - Disabled WLAN
  - Unsupported Data-Rates
  - Disabled Clients
  - Radio Preambles
- Cisco Features - Issues with Third Party Clients
  - Aironet IE, MFP

Complexity of a Wireless Network



Supplicant logs



–WZC supplicant log:

`netsh ras set tracing * enabled` —logs in c:\windows\tracing

see http://www.microsoft.com/technet/network/wifi/wlansupp.mspx

–PROSet supplicant log: under hklm\software\intel\wireless\settings

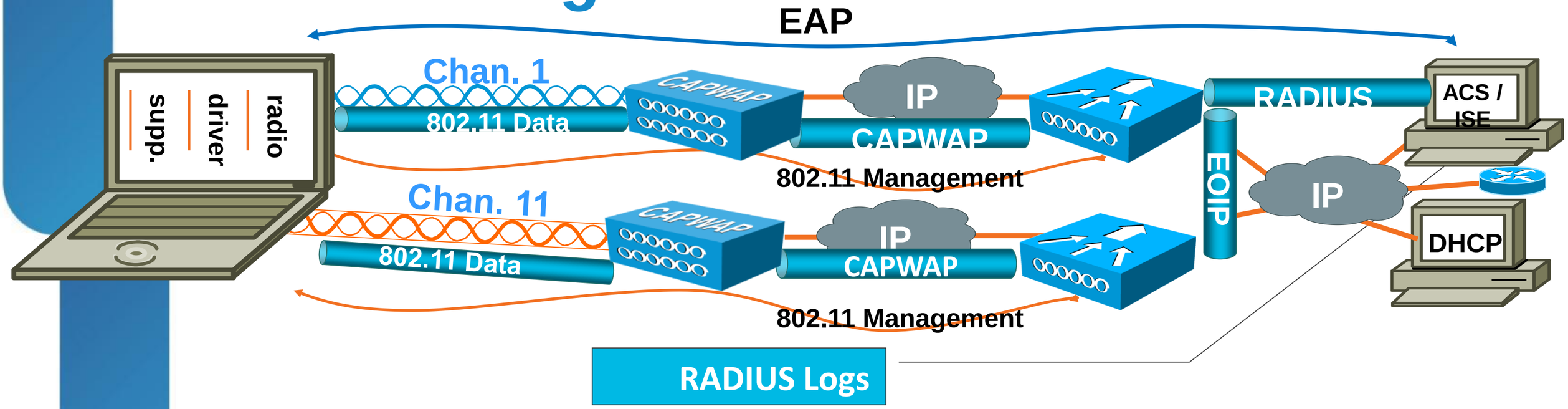
1xconfigdbg=wwxyz; 1xDebugLevel=dword:0x18;1xLogLevel=dword:0x18

logs in c:\ (subject to change without warning)

–ADU: see CSCsi16921

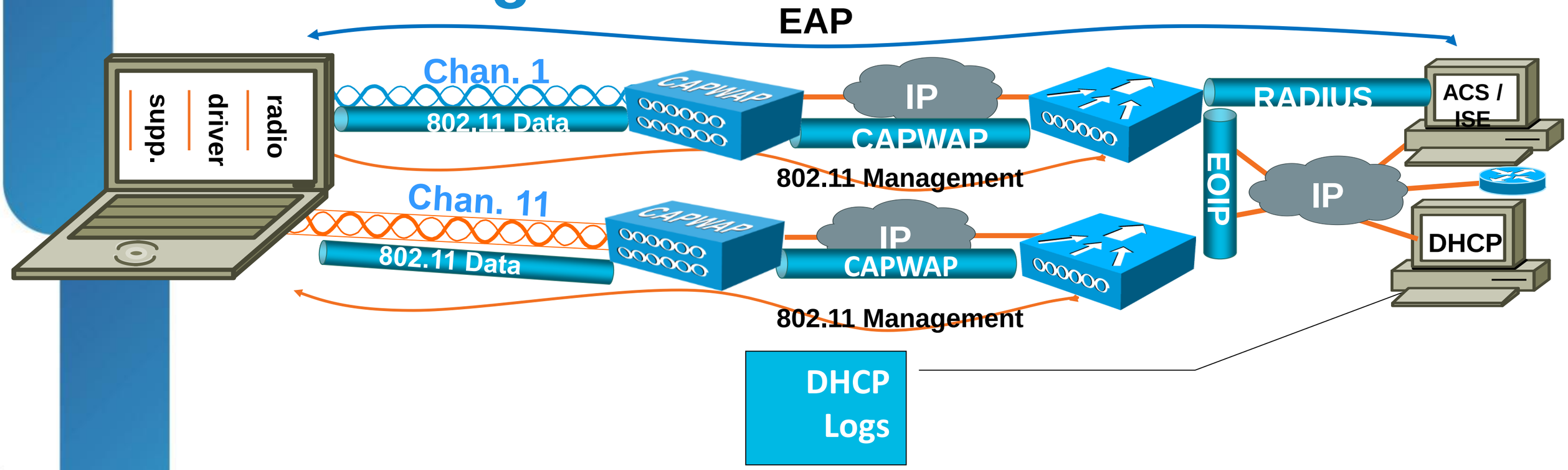
–CSSC/AnyConnect: see Log Packager utility on cisco.com

RADIUS Logs



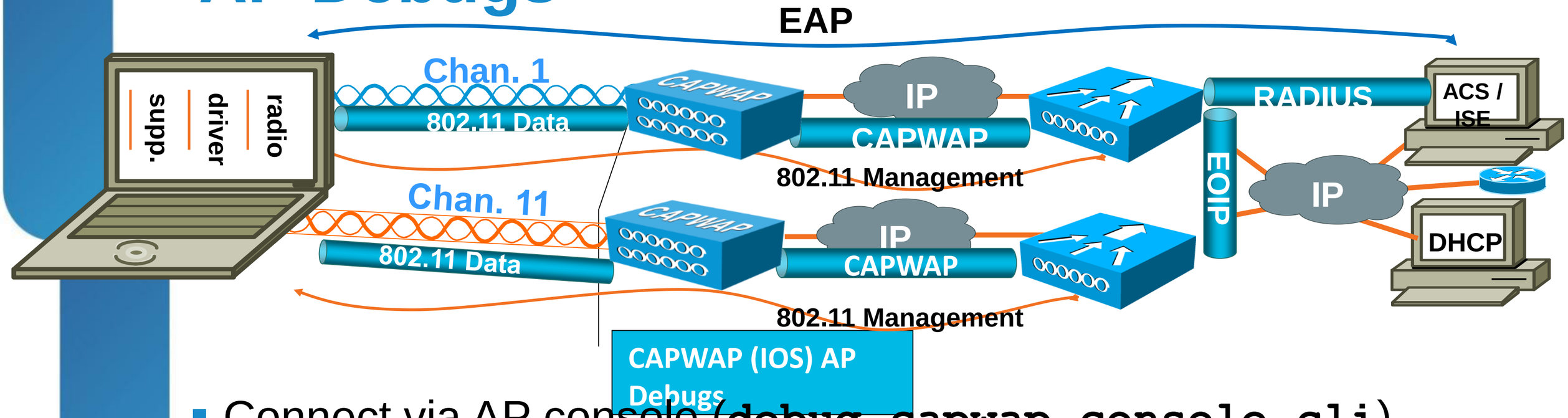
- See **Monitoring and Reporting** section on ACS 5.x or ISE
- **NTP sync your ACS/ISE!**

DHCP Logs



- Cisco IOS DHCP server:
  - `debug ip dhcp server events`
    `debug ip dhcp server packet`

AP Debugs



- Connect via AP console (**`debug capwap console cli`**)
- From WLC CLI, use:
  - **`debug ap enable`** ***`APname`***
  - **`debug ap command`** ***`"debug command" APname`***
- 5.x+ can use Telnet/SSH to connect to APs

AP Debugs

- By default, radio debugs appear only on the console.
  To see radio debugs in your telnet/ssh/WLC CLI session, use the command

  `debug dot11 dot11radiox print printf`

  where x is 0 or 1
- Useful radio debugs:

  `debug dot11 dot11radiox trace print {mgmt, keys, client, beacon, rcv, xmt}`

  (beacon, rcv & xmt can be extremely verbose!)

Client Debug

debug client <mac address>

(Cisco Controller) >**debug client 00:16:EA:B2:04:36**

(Cisco Controller) >show debug

MAC address 00:16:ea:b2:04:36

Debug Flags Enabled:

dhcp packet enabled

dot11 mobile enabled

dot11 state enabled

dot1x events enabled

dot1x states enabled

pem events enabled

pem state enabled

CCKM client debug enabled

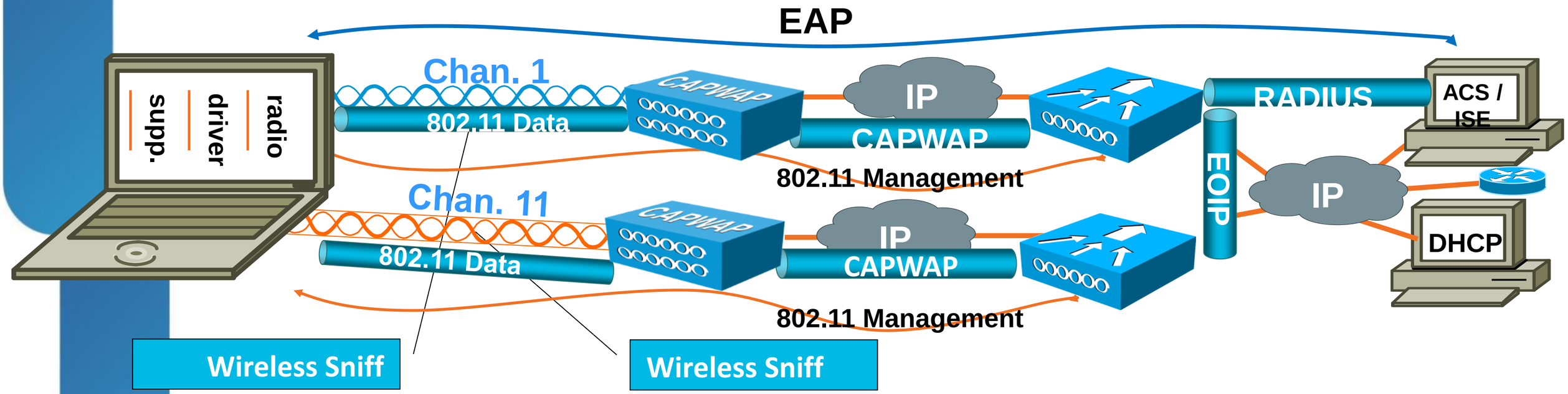
WLC Debugs

- More general client debugging options:

```
debug dot11
debug dot1x
debug aaa <= use for RADIUS troubleshooting
debug pem
debug mobility handoff <= roaming
debug dhcp
```

- Use **`debug client`** <***`MACaddr`***> to filter on a single client

Wireless Sniff

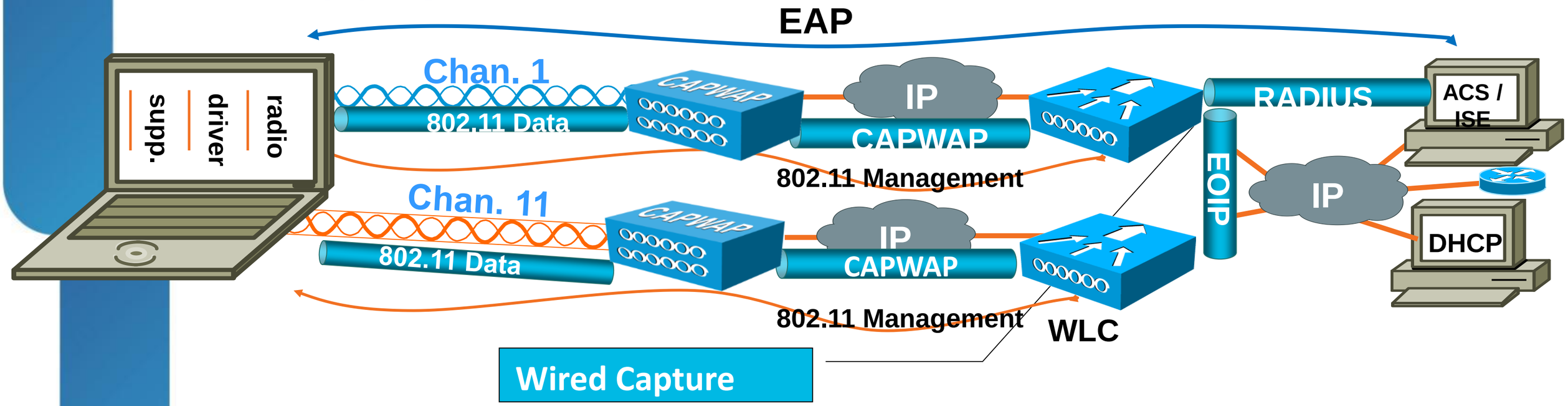


- Good options (Windows PCs):
  - –Omnipeek from Wildpackets (Linksys WUSB600N, CB21AG,..)
  - –Wireshark with CACE Technologies AirPcap adapters
    USB adapters nice for multichannel sniff
  - –AirMagnet

Wireless Sniff - Some Tips

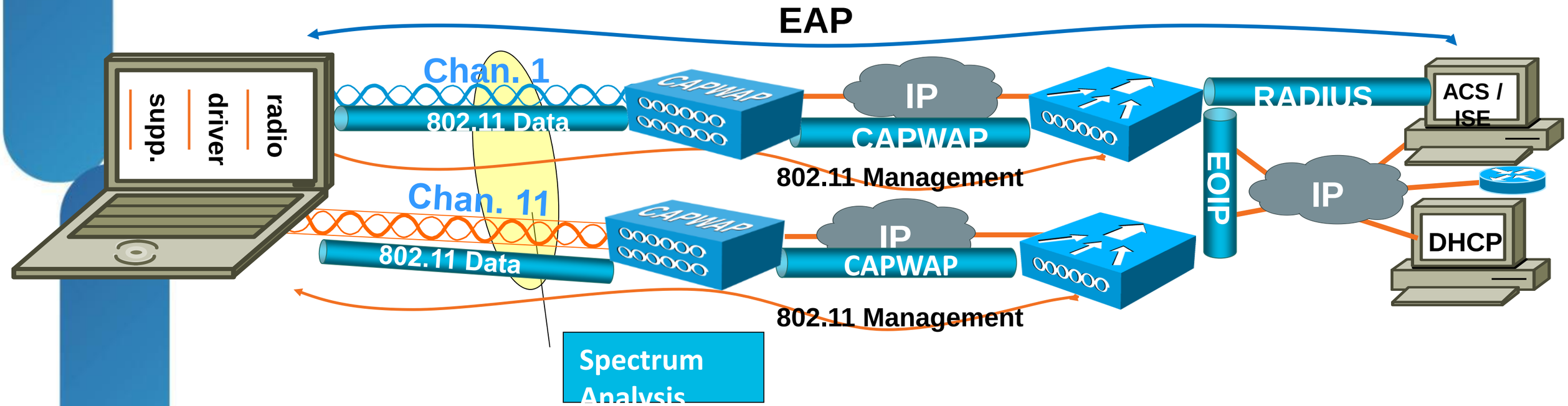
- One packet capture per wireless channel
- Multi-channel capture using multiple adapters
- Take **unfiltered** captures
- Cut a new file every 20–30 MB
- Do not display updated packet during capture
- **NTP sync everything**

Wired Sniff



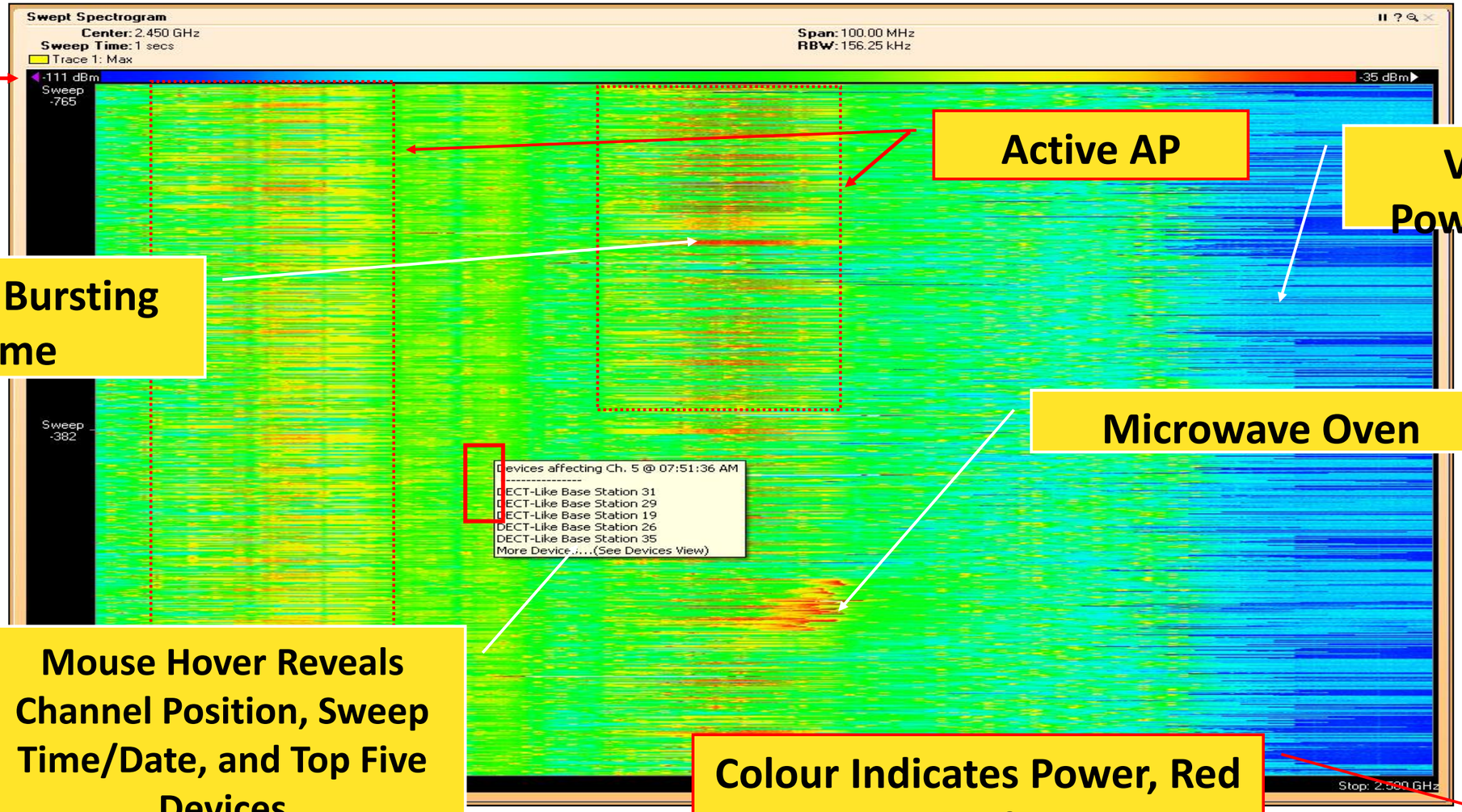
- When capturing from trunk ports, best to capture with 802.1q tags (watch out for packets in the wrong VLANs). You may need to touch driver config to see the VLAN information
- Cut new file every 20/30 MB; don't display packet updates in real time
- **NTP sync your sniffers!**

Spectrum Analysis



- Use spectrum analysis to capture RF spectrum behaviour—necessary to identify/track down non-802.11 interference sources
- Cisco's product: **Spectrum Expert** (Standalone or CleanAir AP in SE-Mode)

SpEx Spectrogram



Active AP

Very Low Power/Activity

High Power, Bursting over Time

Microwave Oven

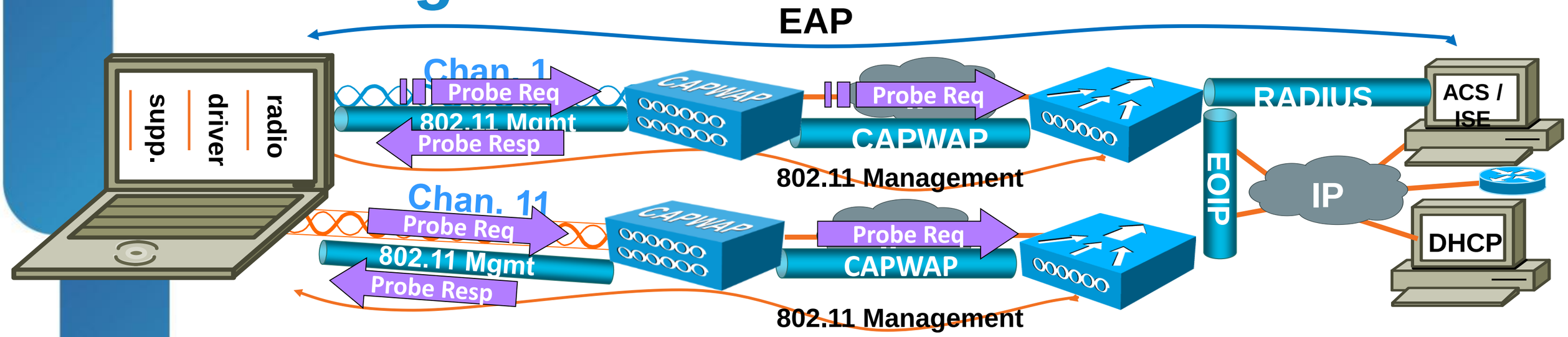
Mouse Hover Reveals Channel Position, Sweep Time/Date, and Top Five Devices

Colour Indicates Power, Red = –35 dBm

SpEx Tips

- When capturing, be sure to have an 802.11 adapter installed, enabled, but configured not to associate to a WLAN
  - Spectrum expert cannot identify 802.11 devices (MAC address, etc.) without an 802.11 adapter's aid
- **NTP sync your Spectrum Expert host!**
- **Always use external antenna**
- **If searching for Interferers, good idea to turn off your wireless network**

Probing



1. Client probes for the SSID
2. Client authenticates/associates in 802.11 to an AP
3. EAP takes place
   - 3.1 EAP dialog between client and authenticator
   - 3.2 Authenticator (radius) dialog to end-user DB
4. DHCP address negotiation
5. Client reaches RUN state

PEM State:

START

PROBING

Probing

	Source	Destination	Protocol	Info	Size	RSSI	Rate
:37.815670013	Cisco_92	Broadcast	IEEE 802	Probe Request, SN=138, FN=0, SSID: "	45	58	6.0
:37.816028594	Cisco_8e	Cisco_92	IEEE 802	Probe Response, SN=2629, FN=0, BI=100, SSID: ",	209	52	6.0

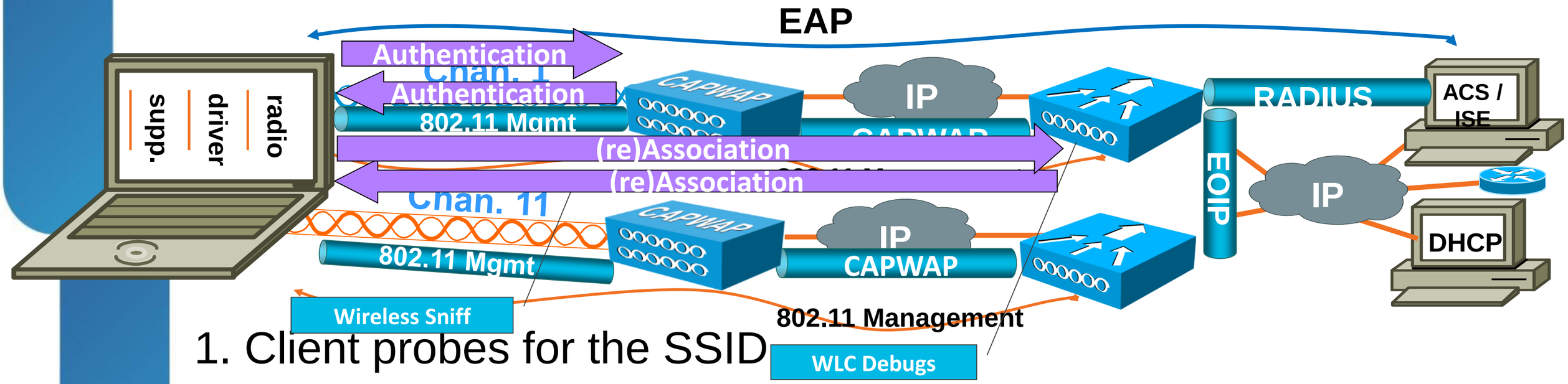
- Clients broadcasts a probe for the SSID of interest
- AP unicasts back a probe response
- Probe response includes interesting facts (information elements) about the service

```
⊟ Tagged parameters (169 bytes)
  ⊞ SSID parameter set: "
  ⊞ Supported Rates: 6.0(B) 9.0 12.0(B) 18.0 24.0(B) 36.0 48.0 54.0
  ⊞ Country Information: Country Code: US, Any Environment
  ⊞ QBSS Load Element
  ⊞ Cisco Unknown 1 + Device Name
  ⊞ Reserved tag number: Tag 150 Len 6
  ⊞ Vendor Specific: WPA
  ⊞ Vendor Specific: Aironet Unknown
```

Problems at Probing Stage

- What if the client never sends out a probe?
  - Is it configured for the SSID of interest?
- What if the AP doesn’t send back the probe response?
  - Is it (WLC) configured for the SSID of interest?
  - Do you have RF coverage from this AP? (can you see beacons from it?)
- What if the client never moves beyond probing?
  - Does it like the IEs that the AP is sending out?
  - Try different crypto settings; disable Aironet extensions;
  - try different basic rates; etc.

802.11 Auth/Assoc



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4. DHCP address negotiation
5. Client reaches RUN state

PEM State:

ASSOCIATED

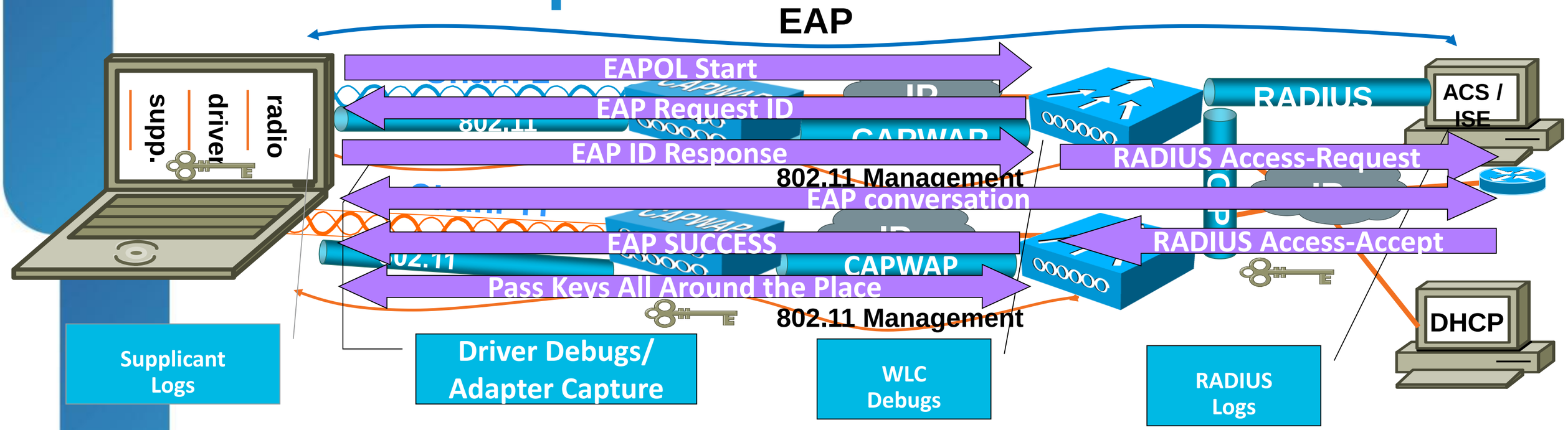
8021X_REQD

802.11 Auth/Assoc

```
25 05:30:36 IntelCor_7 Cisco_83:5 IEEE 802 Authentication, SN=209, FN=0                          30 63   1.0
26 05:30:36 IntelCor_7 Cisco_83:5 IEEE 802 Authentication, SN=209, FN=0                          30 62   1.0
27 05:30:36 IntelCor_7 Cisco_83:5 IEEE 802 Association Request, SN=210, FN=0, SSID: "[redacted]", Name:   91 62   1.0
28 05:30:36 Cisco_83:5 IntelCor_7 IEEE 802 Association Response, SN=3262, FN=0, Name: "[redacted]:   123 33   11.0
```

- Client and AP authenticate to each other (normally just open authentication nowadays, some devices don't even do this)
- Client tries to associate to the AP, hopefully gets a status=0 (successful) response
- What if unsuccessful?
  - –Check status code
  - –Run debugs on WLC

EAP takes place



3. EAP takes place

3.1 EAP dialog between client and authenticator

3.2 Authenticator (radius) dialog to end-user DB

PEM State:

8021X_REQD

DHCP_REQD

Wireshark Capture of MS-PEAP (WPA2)

#	Time	Source	Destination	Protocol	Info	Size	RSS
1	11:16:26.547979	Cisco_36	IntelCor_3e:	EAP	Request, Identity [RFC3748]	71	
2	11:16:26.945640	IntelCor	Cisco_36:a2:	EAP	Response, Identity [RFC3748]	60	
3	11:16:26.961292	Cisco_36	IntelCor_3e:	EAP	Request, PEAP [Palekar]	24	
4	11:16:27.574427	IntelCor	Cisco_36:a2:	SSL	Client Hello	128	
5	11:16:27.579089	Cisco_36	IntelCor_3e:	EAP	Request, PEAP [Palekar]	1030	
6	11:16:27.599226	IntelCor	Cisco_36:a2:	EAP	Response, PEAP [Palekar]	60	
7	11:16:27.603239	Cisco_36	IntelCor_3e:	TLSv1	Server Hello, Certificate, Server Hello Done	945	
8	11:16:27.773854	IntelCor	Cisco_36:a2:	TLSv1	Client Key Exchange, Change Cipher Spec, Encrypted Handsh	354	
9	11:16:27.805694	Cisco_36	IntelCor_3e:	TLSv1	Change Cipher Spec, Encrypted Handshake Message	87	
10	11:16:27.848802	IntelCor	Cisco_36:a2:	EAP	Response, PEAP [Palekar]	60	
11	11:16:27.852007	Cisco_36	IntelCor_3e:	TLSv1	Application Data	77	
12	11:16:27.951994	IntelCor	Cisco_36:a2:	TLSv1	Application Data, Application Data	114	
13	11:16:27.955152	Cisco_36	IntelCor_3e:	TLSv1	Application Data	93	
14	11:16:28.088598	IntelCor	Cisco_36:a2:	TLSv1	Application Data, Application Data	162	
15	11:16:28.110353	Cisco_36	IntelCor_3e:	TLSv1	Application Data	109	
16	11:16:28.151837	IntelCor	Cisco_36:a2:	TLSv1	Application Data, Application Data	98	
17	11:16:28.154869	Cisco_36	IntelCor_3e:	TLSv1	Application Data	61	
18	11:16:28.189439	IntelCor	Cisco_36:a2:	TLSv1	Application Data, Application Data	98	
19	11:16:28.194497	Cisco_36	IntelCor_3e:	EAP	Success	22	
20	11:16:28.194909	Cisco_36	IntelCor_3e:	EAPOL	Key	135	
21	11:16:28.294394	IntelCor	Cisco_36:a2:	EAPOL	Key	133	
22	11:16:28.297998	Cisco_36	IntelCor_3e:	EAPOL	Key	193	
23	11:16:28.312797	IntelCor	Cisco_36:a2:	EAPOL	Key	113	
24	11:16:28.435178	0.0.0.0	255.255.255.	DHCP	DHCP Request - Transaction ID 0x56fe92f0	378	

Failed 802.1X Client Authentication

debug dot1x events—Username/Password Failure

(WLC_CLI) >debug mac addr 00:13:ce:57:2b:84

(WLC_CLI) >debug dot1x events enable

[TIME]: * dot1x_auth_txReqId:2827 Sending EAP-Request/Identity to mobile 00:13:ce:57:2b:84 (EAP Id 1)

[TIME]: * dot1x_authsm_capture_supp:675 Received EAPOL START from mobile 00:13:ce:57:2b:84

[TIME]: * dot1x_handle_eapsupp:1962 Received Identity Response (count=*n*) from mobile 00:13:ce:57:2b:84

<SNIP> Series of 802.1X EAP Requests/Responses </SNIP>

[TIME]: * dot1x_process_aaa:898 Processing Access-Challenge for mobile 00:13:ce:57:2b:84

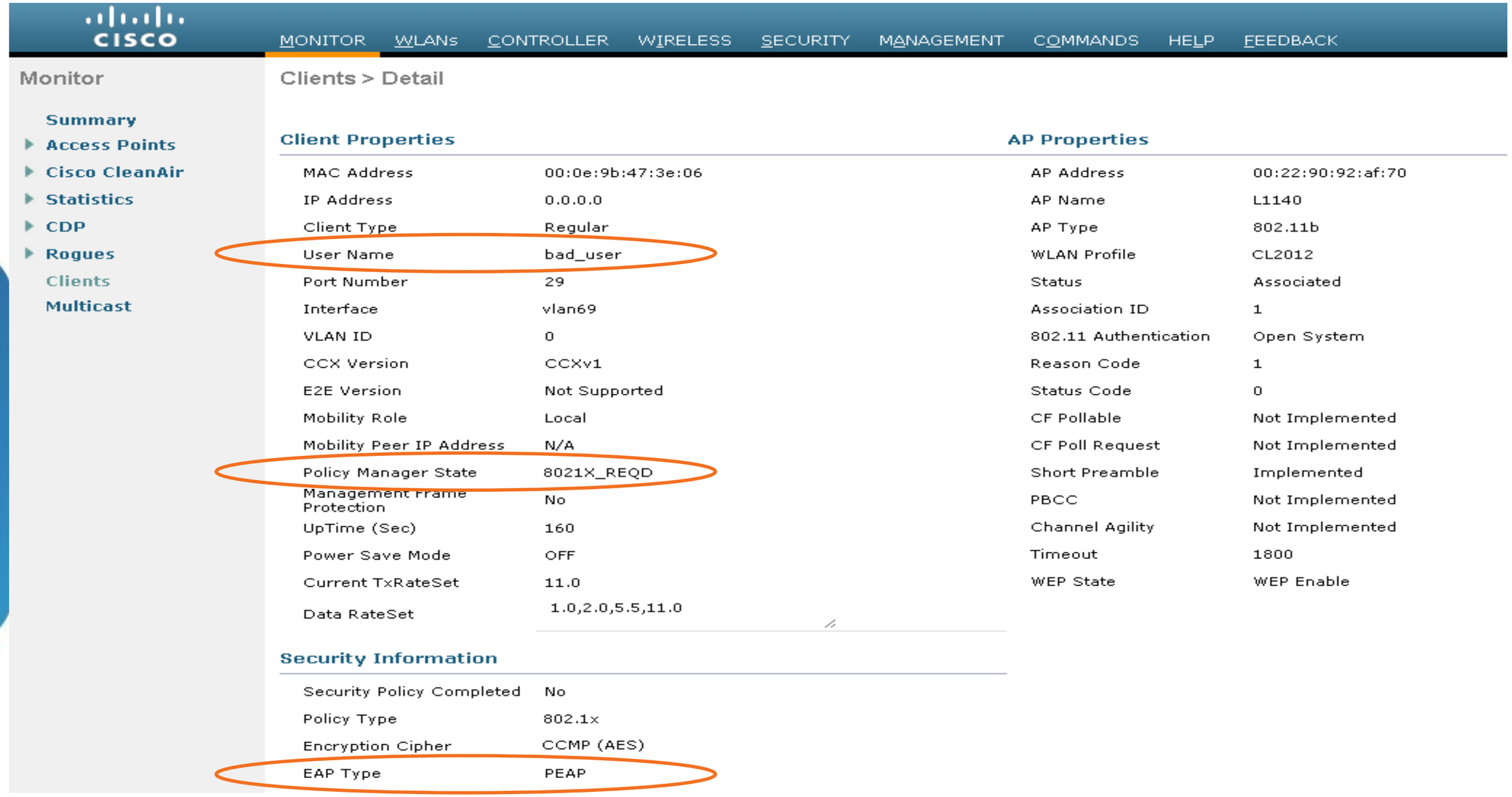
[TIME]: * dot1x_bauthsm_txReq:465 Sending EAP Request from AAA to mobile 00:13:ce:57:2b:84 (EAP Id 14)

[TIME]: * dot1x_handle_eapsupp:1997 Received EAP Response from mobile 00:13:ce:57:2b:84 (EAP Id 14, EAP Type 25)

[TIME]: * dot1x_process_aaa:928 Processing Access-Reject for mobile 00:13:ce:57:2b:84

[TIME]: * dot1x_auth_txCannedFail:2865 Sending EAP-Failure to mobile 00:13:ce:57:2b:84 (EAP Id 14)

Check Client Record for Details



In the WLC GUI, Go to: Monitor | Clients and Select Details for the Client of Choice

Successful 802.1X Client Authentication

debug aaa events

(WLC_CLI) >debug mac addr 00:13:ce:57:2b:84

(WLC_CLI) >debug aaa events enable

[TIME]: * sendRadiusMessage:2494 Successful transmission of Authentication Packet (id 49) to 10.48.76.71:1812, proxy state 00:13:ce:57:2b:84-ce:57

[TIME]: DEBU CTRLR processIncomingMessages:3480 ****Enter processIncomingMessages: response code=11

[TIME]: DEBU CTRLR processRadiusResponse:3053 ****Enter processRadiusResponse: response code=11

[TIME]: * processRadiusResponse:3325 Access-Challenge received from RADIUS server 10.48.76.71 for mobile 00:13:ce:57:2b:84 receiveId = 2

[TIME]: * sendRadiusMessage:2494 Successful transmission of Authentication Packet (id 59) to 10.48.76.71:1812, proxy state 00:13:ce:57:2b:84-ce:57

[TIME]: DEBU CTRLR processIncomingMessages:3480 ****Enter processIncomingMessages: response code=2

[TIME]: DEBU CTRLR processRadiusResponse:3053 ****Enter processRadiusResponse: response code=2

[TIME]: * processRadiusResponse:3325 Access-Accept received from RADIUS server 10.48.76.71 for mobile 00:13:ce:57:2b:84 receiveId = 2

Failed 802.1X Client Authentication

debug aaa events - AAA Server Unreachable

```
(Cisco Controller) >debug mac addr 00:13:ce:57:2b:84
(Cisco Controller) >debug aaa events enable
[TIME]: * sendRadiusMessage:2494 Successful transmission of Authentication Packet (id 66) to 10.48.76.71:1812, proxy state 00:13:ce:57:2b:84-ce:57
[TIME]: * sendRadiusMessage:2494 Successful transmission of Authentication Packet (id 66) to 10.48.76.71:1812, proxy state 00:13:ce:57:2b:84-ce:57
[TIME]: * sendRadiusMessage:2494 Successful transmission of Authentication Packet (id 66) to 10.48.76.71:1812, proxy state 00:13:ce:57:2b:84-ce:57
[TIME]: * sendRadiusMessage:2494 Successful transmission of Authentication Packet (id 66) to 10.48.76.71:1812, proxy state 00:13:ce:57:2b:84-ce:57
[TIME]: * sendRadiusMessage:2494 Successful transmission of Authentication Packet (id 66) to 10.48.76.71:1812, proxy state 00:13:ce:57:2b:84-ce:57
[TIME]: * sendRadiusMessage:2494 Successful transmission of Authentication Packet (id 66) to 10.48.76.71:1812, proxy state 00:13:ce:57:2b:84-ce:57
[TIME]: * radiusProcessQueue:2735 Max retransmission of Access-Request (id 66) to 10.48.76.71 reached for mobile 00:13:ce:57:2b:84
[TIME]: * sendAAAError:323 Returning AAA Error 'Timeout' (-5) for mobile 00:13:ce:57:2b:84
```

- AAA connectivity failure will generate an SNMP trap

218	Thu Jan 5 13:47:33 2012	RADIUS server 10.48.76.71:1812 deactivated in global list
219	Thu Jan 5 13:47:33 2012	RADIUS server 10.48.76.71:1812 failed to respond to request (ID 14) for client 00:00:00:3d:00:00 / user 'unknown'

In the WLC GUI, Go to: Management | SNMP ↳Trap Logs

Verify Complete 802.11/ 802.1X Connectivity

debug pem state

```
(WLC_CLI) >debug mac addr 00:13:ce:57:2b:84
(WLC_CLI) >debug pem state enable
[TIME]: pem_api.c:1780 - State Update 00:13:ce:57:2b:84 from RUN (20) to START (0)
[TIME]: pem_api.c:1836 - State Update 00:13:ce:57:2b:84 from START (0) to AUTHCHECK (2)
[TIME]: pem_api.c:1859 - State Update 00:13:ce:57:2b:84 from AUTHCHECK (2) to 8021X_REQD (3)
[TIME]: pem_api.c:3977 - State Update 00:13:ce:57:2b:84 from 8021X_REQD (3) to L2AUTHCOMPLETE (4)
[TIME]: pem_api.c:4152 - State Update 00:13:ce:57:2b:84 from L2AUTHCOMPLETE (4) to RUN (20)
```

Troubleshooting 802.1X

- Make sure the RADIUS server is properly configured

RADIUS Authentication Servers > Edit

Server Index	1
Server Address	10.48.76.71
Shared Secret Format	ASCII
Shared Secret	***
Confirm Shared Secret	***
Key Wrap	(Designed for FIPS customers
Port Number	1812
Server Status	Enabled
Support for RFC 3576	Enabled
Server Timeout	2 seconds
Network User	Enable
Management	Enable
IPSec	Enable

Make Sure the Correct Shared Secret Is Input

Select the Correct RADIUS Port (Common Ports Are 1812 and 1645)

Status Must Be Enabled

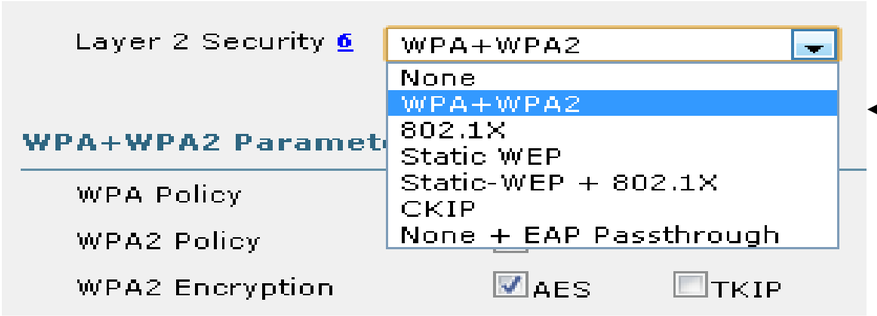
Timeout May Be too Short

Network User Auth Has to Be Enabled for This AAA Server to Be Used Globally, Otherwise, Select on WLAN

In the WLC GUI, Go to: Security | AAA | RADIUS Authentication and Then Select Edit or New

Troubleshooting 802.1X

- Make sure the proper security policy is enabled for both encryption and authentication



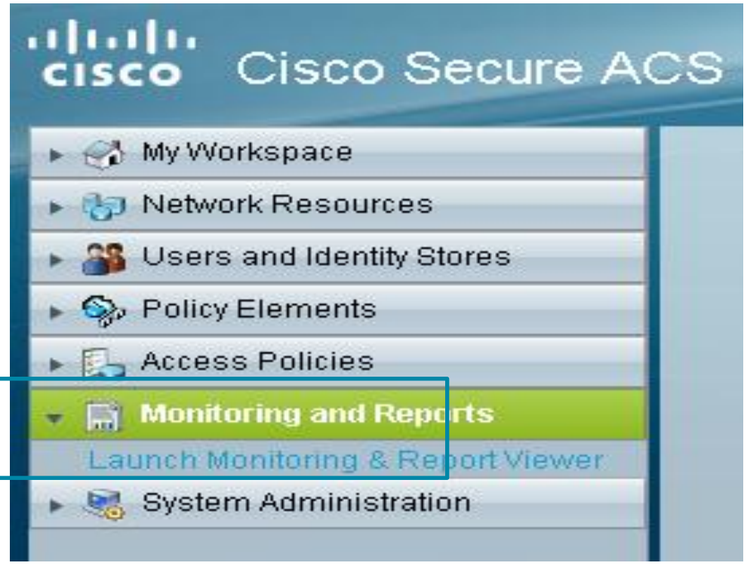
Step (1): Select the Desired Layer 2 Security Configuration

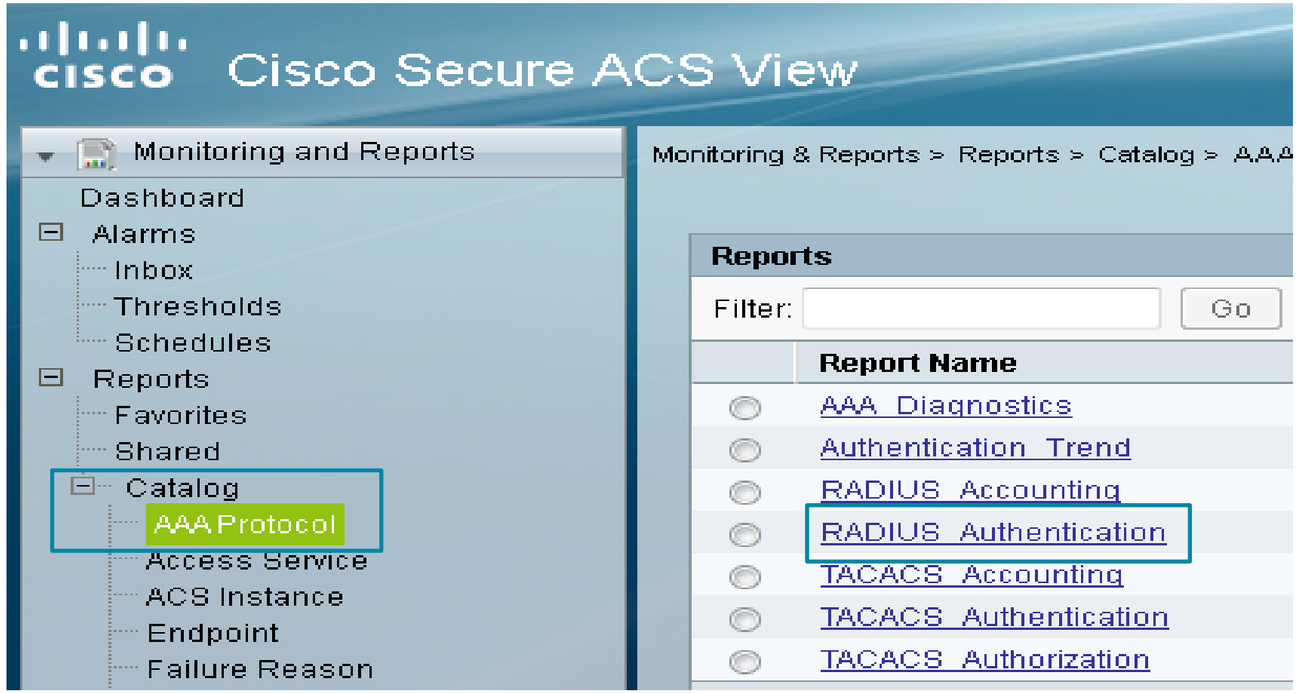
Step (2): Check Radius list per WLAN or Use Global list

In the WLC GUI, Go to: WLANs | WLANs | WLANs and Then Select Edit for the WLAN of Interest

Troubleshooting 802.1X – ACS 5.x

- Enabled Logging in your ACS 5.x server to identify where issues might lie with backend authentication





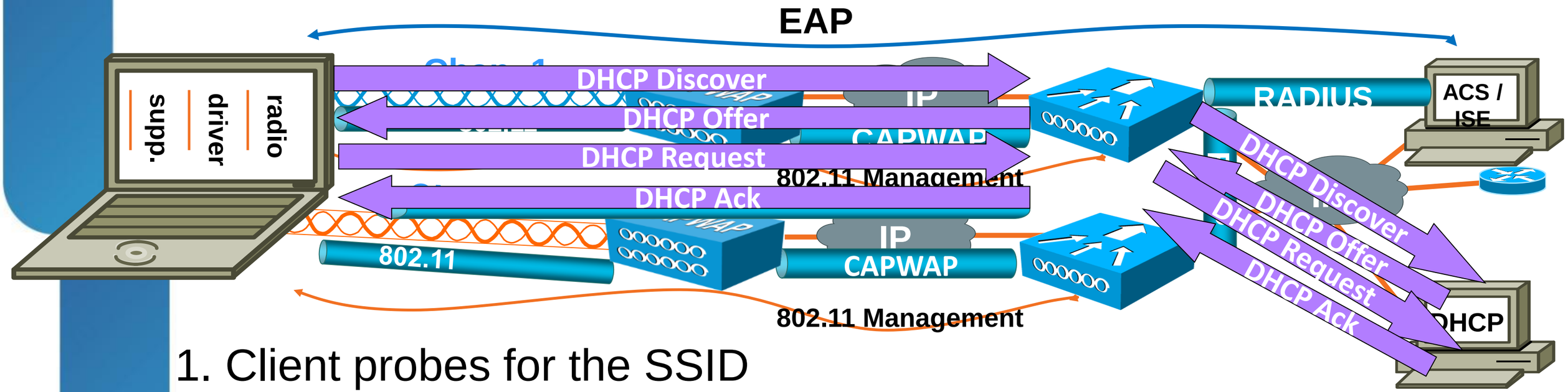
802.1X – Common issues

- **SSL Handshake failure** (e.g. PEAP, EAP-TLS)
  - Verify the certificate trust settings on the client side
  - For EAP-TLS, the ACS must also trust the client certificate
- **User unknown or wrong password / unsupported auth method**
  - Correct Access-Service / Identity Store?

802.1X – Common issues

- **Unknown NAS**
  - ACS ignores RADIUS requests coming from non configured AAA clients
  - What is the source IP address of the RADIUS traffic sent by the WLC?
  - Static routes on WLC? → Service Port

DHCP Succeeds



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2. Client authenticates/associates in 802.11 to an AP
3. EAP takes place
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4. DHCP address negotiation
5. Client reaches RUN state

PEM State:

DHCP_REQD

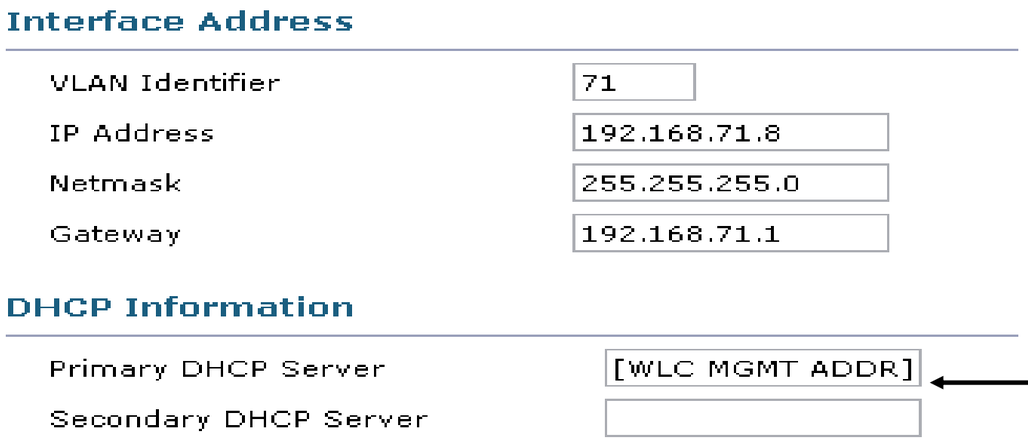
RUN

Troubleshooting DHCP

If Clients Aren't Getting Addresses Properly via DHCP, Ensure:

- Clients are not configured for static addressing
- DHCP scopes are properly configured (either external or internal DHCP)
- External servers: need to support DHCP proxy—if they don't, turn on DHCP bridging:
  - `(WLC_CLI) >config dhcp proxy disable`
- Internal DHCP server: after properly configuring the WLC's scopes, each interface needs to have the WLC's management IP as its DHCP server IP address, as below:

In the WLC GUI, Go to: Controller | Interfaces and Select Edit for the Interface of Choice



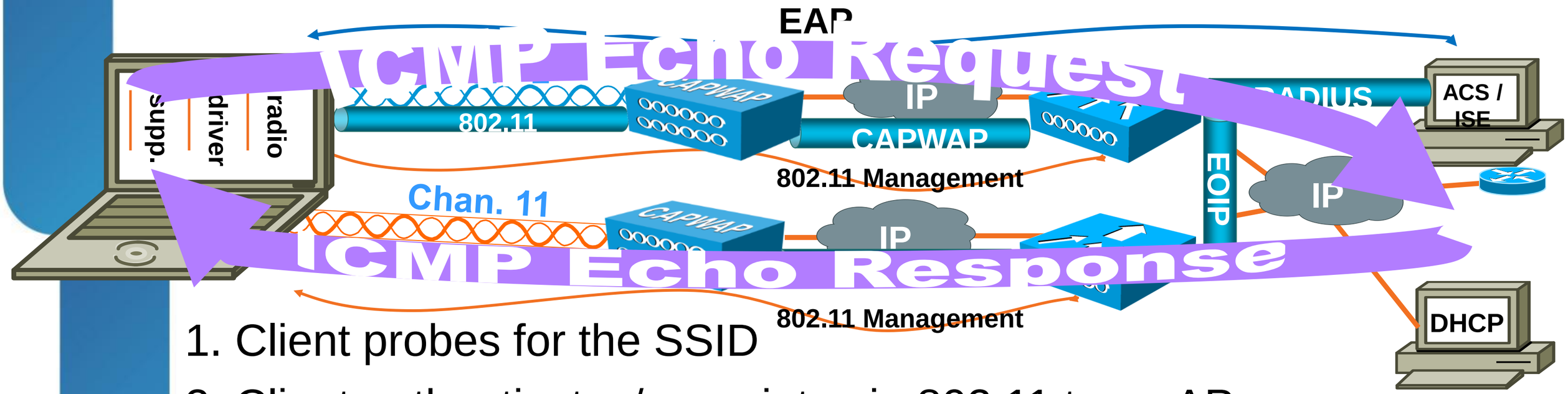
For Internal DHCP, Input the WLC's Management IP Address Here

Client IP Provisioning via DHCP

debug dhcp message

```
(WLC_CLI) >debug mac addr 00:13:ce:57:2b:84
(WLC_CLI) >debug dhcp message enable
[TIME]: dhcp option: received DHCP DISCOVER msg
[TIME]: Forwarding DHCP packet (332 octets) from 00:13:ce:57:2b:84
                    -- packet received on direct-connect port requires forwarding to external DHCP server. Next-hop is 20.20.20.1
[TIME]: dhcp option: received DHCP OFFER msg
[TIME]: dhcp option: server id = 20.20.20.1
[TIME]: dhcp option: netmask = 255.255.255.0
[TIME]: dhcp option: gateway = 20.20.20.1
[TIME]: dhcp option: received DHCP REQUEST msg
[TIME]: dhcp option: requested ip = 20.20.20.113
[TIME]: dhcp option: server id = 1.1.1.1
[TIME]: Forwarding DHCP packet (340 octets) from 00:13:ce:57:2b:84
                    -- packet received on direct-connect port requires forwarding to external DHCP server. Next-hop is 20.20.20.1
[TIME]: dhcp option: received DHCP ACK msg
```

PING Succeeds!!



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PEM State:

RUN

802.11n Speeds

- Troubleshoot 802.11n Speeds Document ID: 112055
- Configuration Issues
  - 11n Support Enabled
  - WMM is Allowed or Required
  - Open or WPA2-AES
  - 5Ghz Channel Width
  - 2.4Ghz does not support 40-Mhz Channels

Voice over WiFi

VoWiFi

- Wireless IP Phone Deployment Guide
  - http://www.cisco.com/en/US/docs/voice_ip_comm/cuipph/7925g/7_0/english/deployment/guide/7925dply.pdf
- Best Practices
  - -67 dBm signal with 20-30% cell overlap
  - 802.11A
  - CCKM for Fastest Roaming
  - Avoid designs where AP is seen at superb signal, but drops off instantly

VoWiFi - Troubleshooting

- Must know if problem occurs during roaming events or when no association change takes place
- If no change in connection
  - Interference, coverage loss, end to end QOS missing/issue
- If during roaming event
  - How long did the roam take?
  - Does the client associate to another AP again within seconds?
  - Does the client associate to the same AP again?

VoWiFi - Troubleshooting

- Define a reproducible area where you believe you have perfect voice coverage but have problems
- Place phone in Neighbour List Mode (On a call)
  - Real Time current AP RSSI and candidate list
  - Confirm AP as next best candidate is realistically a good candidate
  - Confirm devices roams to correct candidate where the intended design specifies
- Watch out for sudden drops in coverage

VoWiFi - Debugs

- Phone can Trace (debug) to file or syslog
  - Recommend USB Connection and SYSLOG
  - Configured via GUI
  - Enable Debug level for Kernel, WLAN MGR, WLAN Driver
- WLC Debugs
  - Debug client <mac>
  - Debug cac all enable
- Wireless Packet Captures

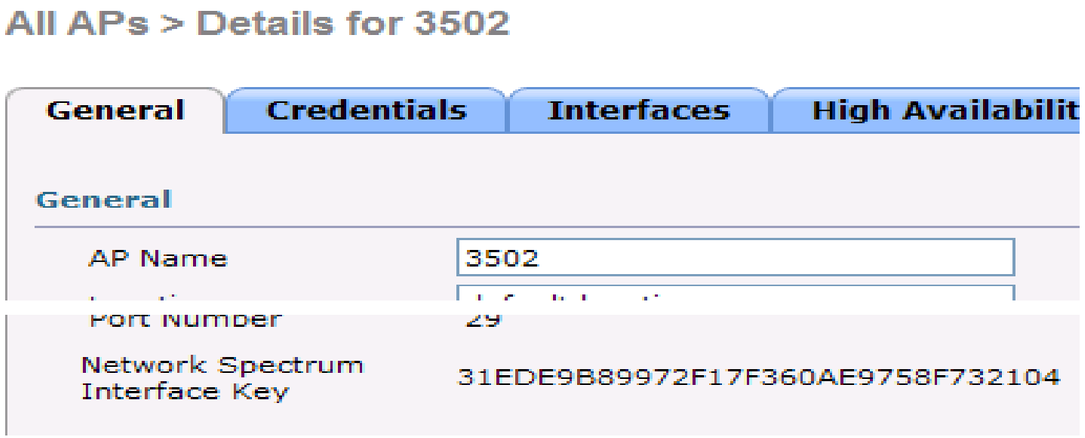
SE-Connect - Clean Air

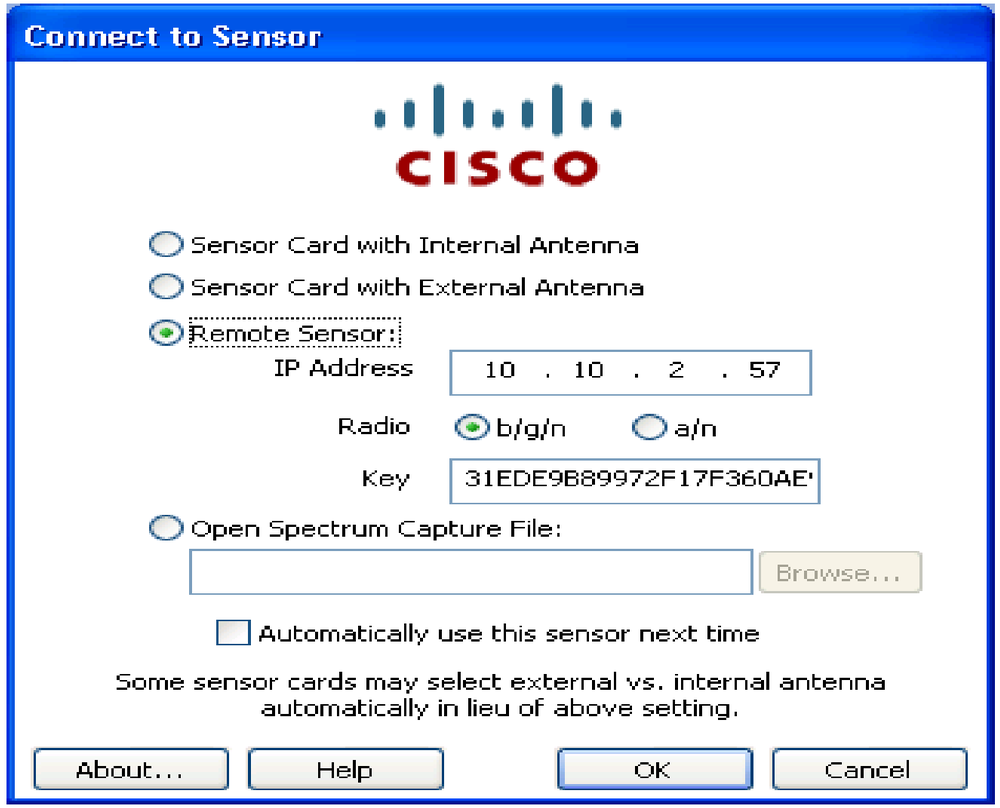
SE-Connect

- Clean Air APs can be used in lieu of Spectrum Card for Spectrum Analysis
  - AP can be placed in SE-Connect mode for full functionality
  - AP in local mode can be used now for Spectrum Analysis of current channel

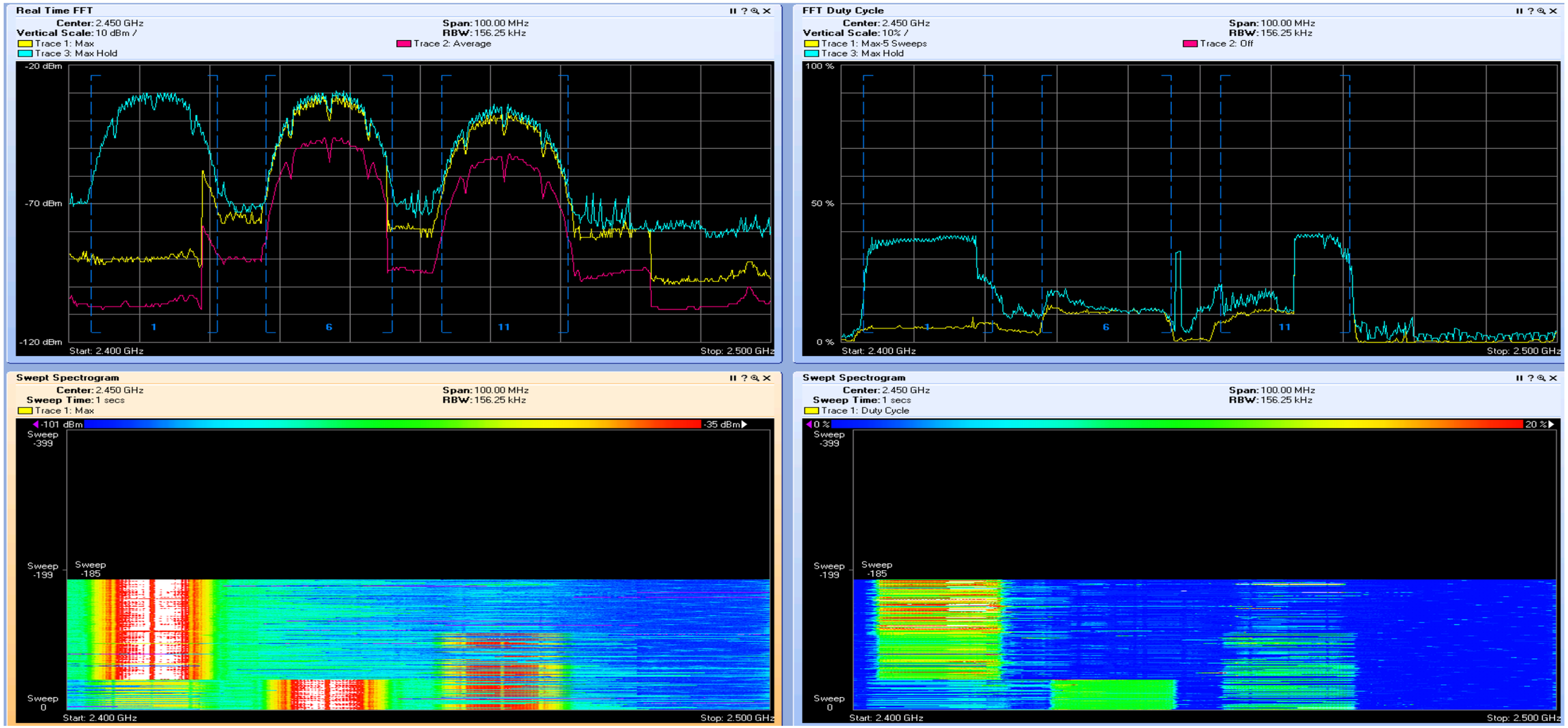
Spectrum Expert with Clean Air

- Obtain Spectrum Key
- Connect to Remote Sensor





Spectrum Expert with Clean Air



Summary

- Basic Concepts
- Best Practices
- Supportability
- AP Troubleshooting
- Troubleshooting Clients
- Voice over WiFi
- SE-Connect - Clean Air

Q & A

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