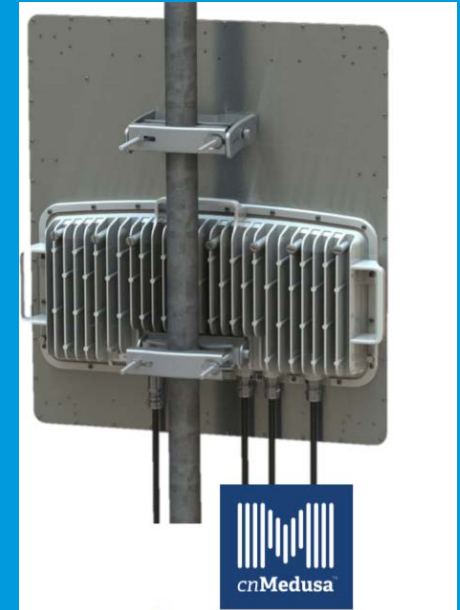


PMP 450 Release 16.1



Supported products

- Release 16.1 is supported by the following products:
 - PMP/PTP 450, 450i, 450m and 450b
- Release 16.1 terminates support for the PMP 430 SM: PMP 430 SMs will not connect to APs running Release 16.1 or later
- SMs at Release 15.1.5 or earlier will not connect to APs at Release 16.1 or later

New features

- Release 16.1 introduces the following new features:
 - Auto Contention
 - Proportional Scheduler
 - Last Known AP and Follow Me feature
 - EVM calculations
 - EVM-based LQI
 - 802.1X Proxy
 - Layer 3 PVID mapping
 - Custom DHCP Option 82

Auto Contention (1)

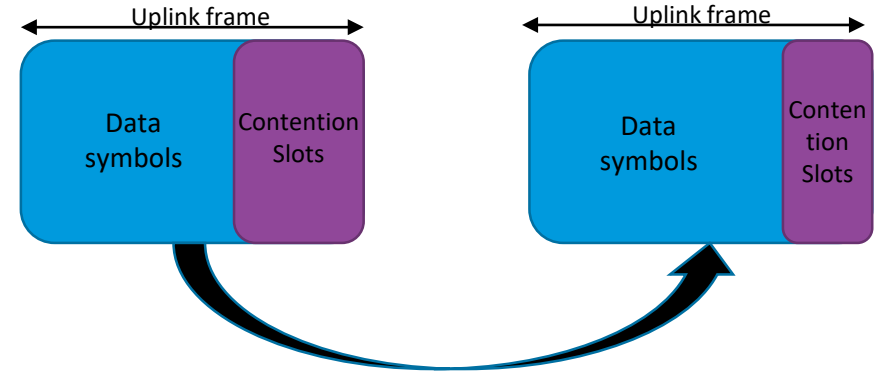
- Contention slots
 - Reserved symbols at the end of the uplink for transmitting unscheduled messages (registration requests and bandwidth requests)
 - Used to calculate the frame structure (downlink and uplink time)
 - Previous guidance on how to configure: increase the number if the sector has many SMs and a lot of traffic – not easy to optimize
 - Configured in Configuration → Radio → Frame Configuration



Frame Configuration	
Max Range :	<input type="text" value="1"/> miles (Range: 1 — 40 miles / 64 km)
Downlink Data :	<input type="text" value="50"/> % (Range: 15 — 85 %)
Contention Slots :	<input type="text" value="3"/> (Range: 1 — 15)
Auto Contention :	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled
Broadcast Repeat Count :	<input type="text" value="0"/> (Range: 0 — 2)

Auto Contention (2)

- In R16.1, the AP adjusts the number of contention slots dynamically based on the current percentage of successfully received BW requests
- The total number of uplink symbols does not change
 - Reducing the number of reserved contention symbols increases the number of uplink data symbols
 - Increasing the number of reserved contention symbols reduces the number of uplink data symbols
- The number of contention symbols still needs to be configured in the Configuration → Radio page for co-location purposes
- The Auto Contention feature can be Enabled/Disabled
- Not supported by PMP 450m in Release 16.1 – planned for a future release



Frame Configuration	
Max Range :	1 miles (Range: 1 — 40 miles / 64 km)
Downlink Data :	50 % (Range: 15 — 85 %)
Contention Slots :	3 (Range: 1 — 15)
Auto Contention :	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled
Broadcast Repeat Count :	0 (Range: 0 — 2)

Auto Contention (3)

- Auto Contention Statistics available in Statistics → Frame Utilization → Uplink Counts

Uplink Counts	
Total :	1329
Per Frame Average :	0
Low Priority :	0
Medium Priority :	0
High Priority :	605
Ultra High Priority :	0
Authentication and Configuration Messages :	0
Canopy MAC Acknowledgments :	724
Contention Slots :	550671
Contention Slots Average Per Frame :	23
Reserved Contention Slots Average Per Frame :	12
Bandwidth Requests Received :	205
Bandwidth Requests Missed :	0

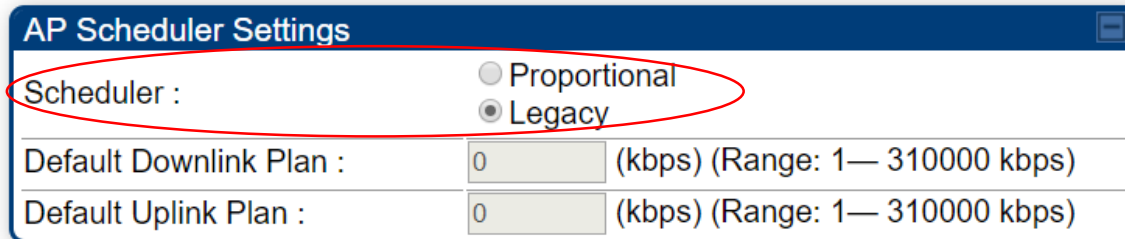
Contention Slots: Total number of contention slots used during current time interval.

Contention Slots Average Per Frame: Average number of contention slots used per frame during current time interval.

Reserved Contention Slots Average Per Frame: Average number of contention slots reserved per frame by Auto Contention during current time interval.

Proportional scheduler (1)

- In R16.1, the AP supports two schedulers: proportional and legacy
- Scheduler type is selected in the AP Configuration → Quality of Service (QoS) page
- The legacy scheduler maintains the behavior of pre-R16.1 releases
- The Proportional scheduler maintains the proportions of the SMs' plans when the sector is congested (see next slide for SM plan configuration)
- The Default Downlink/Uplink Plan are applicable to the Proportional scheduler only. They are used in case an SM is not configured with a plan (for example, the SM is not upgraded to R16.1 yet)
- The proportional scheduler works in conjunction with the Weighted Fair Queuing feature (in the products that support it), but preserving the plans ratios takes precedence in the scheduler decisions over honoring the WFQ percentages
- When selecting the Proportional scheduler, CIR is no longer applicable



AP Scheduler Settings		
Scheduler :	<input type="radio"/> Proportional	
	<input checked="" type="radio"/> Legacy	
Default Downlink Plan :	<input type="text" value="0"/>	(kbps) (Range: 1— 310000 kbps)
Default Uplink Plan :	<input type="text" value="0"/>	(kbps) (Range: 1— 310000 kbps)

Proportional Scheduled (2)

- In R16.1, the SM supports a Proportional Scheduler setting section in the Configuration → Quality of Service (QoS) page. These settings are applicable only if the AP is configured to use the Proportional scheduler
- Downlink/Uplink Plan: plan (in kbps) for the SM
 - The plan value aggregates throughput to all QoS levels, if multiple are configured
 - The plan value does not limit the maximum throughput
The Downlink/Uplink MIR can still be configured separately
- Weight: scaling factor to be applied to the DL and UL plans. If plans do not need to be prioritized, use the default value of 1.0 for all plans

Proportional Scheduler settings	
Downlink Plan :	<input type="text" value="0"/> (kbps) (Range: 1— 4000 kbps)
Uplink Plan :	<input type="text" value="0"/> (kbps) (Range: 1— 4000 kbps)
Weight :	<input type="text" value="1.0"/> (Range: 0.1—9.9)
User Lock Modulation :	Disable ▾
Locked Modulation :	8x ▾
Threshold Modulation :	8x ▾

Proportional Scheduled (3)

- User Lock Modulation: Disable, Enable, Enable below Threshold
 - Disable: the plan proportions are honored regardless of changes in the SM's modulation
 - Enable: the plan proportions are honored at a specific modulation level, configured in the Locked Modulation field
If the modulation level changes, the plan is scaled proportionally to the modulation
This avoids the case of one SM with degrading channel quality affecting the other SMs
 - Enable below Threshold: the plan proportions are honored regardless of changes in the SM's modulation, unless the modulation goes below the configured Threshold Modulation. If the modulation is below the threshold, the scheduler behaves as in the User Lock Modulation "Enable" case

Proportional Scheduler settings	
Downlink Plan :	0 (kbps) (Range: 1— 4000 kbps)
Uplink Plan :	0 (kbps) (Range: 1— 4000 kbps)
Weight :	1.0 (Range: 0.1—9.9)
User Lock Modulation :	Disable ▼
Locked Modulation :	8x ▼
Threshold Modulation :	8x ▼

Proportional Scheduler (4)

- New statistics added in the Proportional Scheduler tab
 - Configuration (Lock Modulation, Modulation, Weight): as configured at the SM
 - DL/UL Rate plan: as configured at the SM
 - Current Modulation: latest modulation used by the link
 - DL/UL Slots Percentage: percentage of resources needed to meet the SM's plan
 - DL/UL Instantaneous Max Possible Throughput: throughput that can be sustained by the SM considering the percentage of resources and the current modulation level
 - DL/UL Sustained Data Rate: configured MIR

Proportional Scheduler Stats														
Subscriber	LUID	Configuration			Downlink Statistics				Uplink Statistics					
		Lock Modulation	Modulation	Weight	Rate Plan (Kbps)	Current Modulation	Slots Percentage	Guaranteed Minimum Throughput(Kbps)	Sustained Data Rate (Kbps)	Rate Plan (Kbps)	Current Modulation	Slots Percentage	Guaranteed Minimum Throughput(Kbps)	Sustained Data Rate (Kbps)
Broadcast	255	Disable		1.0	1000	1X	3.5%	128	NA	NA	NA	NA	NA	NA
SM11 - SF4	002	Disable		1.0	10000	8X	4.3%	1270	155000	10000	8X	4.5%	1393	155000
SM3 - SF1	003	Enable Below Threshold	4X	1.0	20000	2X	17.5%	1290	155000	20000	2X	18.2%	1413	155000
SM10 - SF4	004	Disable		1.0	20000	8X	8.8%	2580	155000	20000	8X	9.1%	2826	155000
SM8 - SF3	005	Disable		1.0	10000	8X	4.3%	1270	155000	10000	8X	4.5%	1393	155000
SM9 - SF3	006	Disable		1.0	10000	8X	4.3%	1270	155000	10000	8X	4.5%	1393	155000
SM7 - SF3	007	Disable		1.0	20000	8X	8.8%	2580	155000	20000	8X	9.1%	2826	155000
SM12 - SF4	008	Disable		1.0	10000	8X	4.3%	1270	155000	10000	8X	4.5%	1393	155000
SM5 - SF2	009	Disable		1.0	20000	8X	8.8%	2580	155000	20000	8X	9.1%	2826	155000
SM2 SF1	010	Disable		1.0	10000	4X	8.8%	1290	155000	10000	4X	9.1%	1413	155000
SM4 SF2	011	Disable		1.0	10000	8X	4.3%	1270	155000	10000	8X	4.5%	1393	155000
SM6 - SF2	012	Disable		1.0	10000	8X	4.3%	1270	155000	10000	8X	4.5%	1393	155000
SM1 SF1	013	Disable		1.0	20000	4X	17.5%	2580	155000	20000	4X	18.2%	2826	155000
Total					171000		99.5%	20648	1860000	170000		99.8%	22488	1860000

Proportional scheduler – Example 1

- Configuration

Subscriber	Plan	Weight	Modulation Lock	Current modulation
SM1	20 Mbps	1.0	Disabled	8x
SM2	10 Mbps	1.0	Disabled	8x
SM3	20 Mbps	1.0	Disabled	8x
SM4	10 Mbps	1.0	Disabled	8x

- Test Results

- SM1: 15.6 Mbps
- SM2: 7.6 Mbps
- SM3: 15.6 Mbps
- SM4: 7.6 Mbps

- Comments

- SM1 and SM3 achieve 2x the throughput of SM2 and SM4

Proportional scheduler – Example 2

- Configuration

Subscriber	Plan	Weight	Modulation Lock	Current modulation
SM1	20 Mbps	1.0	Disabled	8x
SM2	10 Mbps	0.5	Disabled	8x
SM3	20 Mbps	1.0	Disabled	8x
SM4	10 Mbps	1.0	Disabled	8x

- Test Results

- SM1: 16.6 Mbps; SM2: 4.1 Mbps
- SM3: 16.7 Mbps; SM4: 8.3 Mbps

- Comments

- SM1 and SM3 achieve 2x the throughput of SM4
- SM2 achieves half the throughput of SM4 because they have the same plan but the weight of SM2 is half

Proportional scheduler – Example 3

- Configuration

Subscriber	Plan	Weight	Modulation Lock	Current modulation
SM1	20 Mbps	1.0	Enabled at 8x	4x
SM2	10 Mbps	1.0	Disabled	8x
SM3	20 Mbps	1.0	Disabled	8x
SM4	10 Mbps	1.0	Disabled	8x

- Test Results

- SM1: 7.6 Mbps; SM2: 7.7 Mbps
- SM3: 15.3 Mbps; SM4: 7.6 Mbps

- Comments

- SM3 achieves 2x the throughput of SM2 and SM4
- SM1 achieves half the throughput of SM3 because they have the same plan but SM1's modulation is half the locked modulation

Which scheduler is better for me?

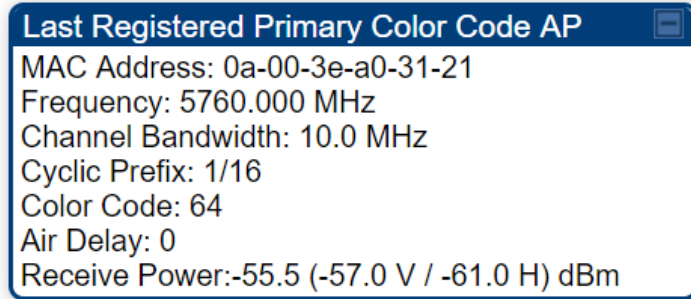
- How do you choose between the legacy scheduler and the proportional scheduler?
- Example: assume all SMs have the same plan configuration
- Resource allocation
 - The legacy scheduler gives equal scheduling opportunities to each SM. SMs with higher modulation will be capable of receiving more data than SMs with lower modulations due to their higher spectral efficiency. No attempt is made to regulate any SM's resource allocation.
 - The proportional scheduler allocates equal throughput to each SM. SM's with lower spectral efficiency will require more air time to achieve the same throughput as SM's with higher spectral efficiency. Resource allocations are regulated to achieve equal throughput.
- Sector throughput
 - The legacy scheduler has higher total throughput in this case because more data is sent to SMs with higher modulation
 - The proportional scheduler can be configured to achieve the same effect, by using the lock modulation parameter set to the higher modulation: this locks the air time used for SMs at lower modulation and achieves the same throughput as the legacy scheduler

Last known AP and Follow me feature (1)

- In Releases pre-16.1, when an SM searches for an AP to connect to, it scans with all the configured frequencies and BWs → if many are selected, it may take a long time to find the AP
- Last known Primary AP: the SM stores the information (frequency, channel BW) of the last primary AP it connected to. If the AP or SM reboots, it looks for the saved primary AP first
- Follow me feature: if the AP switches frequency and/or channel BW, it first sends a message to all SMs with the new operational parameters
If these operational parameters are not present in the SM radio configuration, they are automatically added
When the SM starts scanning, it first tries the parameters indicated by the AP
- In both cases the scan time is significantly shortened
- In both cases, if the AP is not found the SM performs a full scan
- Additionally notes:
 - PMP/PTP 450, 450i, 450b AP and BHM's no longer require reboot when frequency and/or channel bandwidth settings are changed
 - PMP 450m no longer requires a reboot when the frequency setting is changed (but it still does when the channel BW is changed)
 - The SM also remembers the last Air Delay. When sending a registration request, the SM attempts to use the saved Air Delay first, reducing the registration time
 - If radar is detected, the Follow Me message is also used to switch to one of the configured alternate frequencies

Last known AP and Follow me feature (2)


- At the SM, the Tools → AP Evaluation tab shows the Last Known AP



Last Registered Primary Color Code AP

MAC Address: 0a-00-3e-a0-31-21
Frequency: 5760.000 MHz
Channel Bandwidth: 10.0 MHz
Cyclic Prefix: 1/16
Color Code: 64
Air Delay: 0
Receive Power: -55.5 (-57.0 V / -61.0 H) dBm

- The same tab offers the *Rescan APs* option that causes the SM to perform a full scan



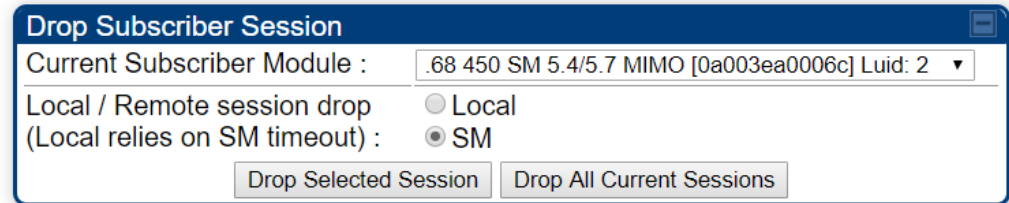
AP List

AP Selection Method used: Optimize for Throughput
Current entry index: 0 Session Status: REGISTERED (via Primary Color Code 64)

Index: 0 Frequency: 5760.000 MHz Channel Bandwidth: 10.0 MHz Cyclic Prefix: 1/16
ESN: 0a-00-3e-a0-31-21 Region: Other
Beacon Receive Power: -55.5 (-57.0 V / -61.0 H) dBm Beacon Count: 9 FECN: 1
Type: Multipoint Avail: 1 Age: 0 Scans Seen: 1 Lockout: 0 RegFail 0 Range: 0 feet MaxRange: 1
miles TxBER: 1 EBcast: 0 AES256Rdy: 0
Session Count: 1 NoULIDs: 0 OutOfRange: 0 AuthFail: 0 EncryptFail: 0 Rescan Req: 0
SMLimitReached: 0
NoVC's: 0 VCRsv/430smFail: 0 VCAcFail: 0 UnsupportedULMap: 0 Air Delay: 50
AP Gain: 9 cBm AP RevT: -58 dBm Color Code: 64 BeaconVersion: 1 SectorUserCount: 4
SyncSrc: 1
NumULSlots: 9 NumDLSlots: 26 NumULContSlots: 4
WhiteSched: 0 ICC: 1 Authentication: Disabled
SM PPPoE: Supported
AckBeforeMap: Enabled
Frame Period: 2.5 ms

Rescan APs

- At the AP, the Tools → Sessions tab offers the option to send a message to all SMs to forget the last known AP and start a full scan

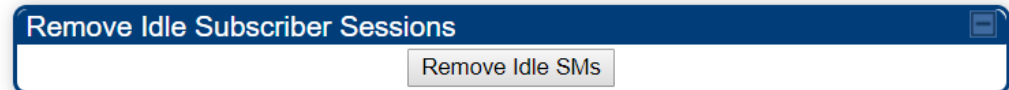


Drop Subscriber Session

Current Subscriber Module : .68 450 SM 5.4/5.7 MIMO [0a003ea0006c] Luid: 2


Local / Remote session drop Local
(Local relies on SM timeout) : SM

Drop Selected Session Drop All Current Sessions



Remove Idle Subscriber Sessions

Remove Idle SMS



Remove Last Known Primary AP from SM

Remove Last Known Primary AP and Rescan

EVM Calculations

- The DL and UL Average EVM per branch (in dB) is shown in the Tools → Link Status page and it is available via SNMP
- DL EVM reported only by SMs at Release 16.1 or later

Link Status

Due to current system load, Downlink Statistics will only be updated at most every 5 seconds.

Note: To measure the receive modulation of every fragment, Receive Quality Debug must be enabled.

■ MIMO-B:2X MIMO-A/SISO:1X
 ■ MIMO-B:4X MIMO-A/SISO:2X
 ■ MIMO-B:6X MIMO-A/SISO:3X
 ■ MIMO-B:8X MIMO-A/SISO:4X

Subscriber	LUID	Downlink Statistics						Uplink Statistics						
		Beacon % Received Curr/Min/Avg/Max	Power Level dBm: Signal Strength Ratio (dB V - H)	Signal to Noise Ratio (dB)	Average EVM (dB)	Link Test Efficiency	Rate	Power Level dBm: Signal Strength Ratio (dB V - H)	Fragments Modulation	Link Quality	Signal to Noise Ratio (dB)	Average EVM (dB)	Link Test Efficiency	Rate
.68.450 SM 5.4/5.7 MIMO- [0a-00-3e- a0-00-6c]	002	100/100/100/100	-56.5 (-58.0 V / -62.0 H):4.0	32 V / 33 H	-29 V / -27 H	NA	8X/8X MIMO- B	-55.7 (-60.4 V / -57.5 H):-2.9	Path V:QPSK:30% 16-QAM:24% 64-QAM:26% 256- QAM:20% Path H:QPSK:28% 16-QAM:25% 64-QAM:23% 256- QAM:23%	Path V:QPSK:2.303 16-QAM:3.461 64-QAM:2.642 256- QAM:4.227 Path H:QPSK:4.000 16-QAM:4.344 64-QAM:5.629 256- QAM:4.518	34 V / 35 H	-28 V / -27 H	NA	8X/8X MIMO- B

EVM-based LQI (1)

- R16.1 calculates the Link Quality Indicator (LQI) either using the modulation (rate) or the EVM
- The option can be found in the AP's Home → Session Status tab
- The Session List Tools section offers a button to set the Reference EVM on all SMs to the current EVM
- The Reference EVM setting option can be:
 - Set Reference EVM only if it is not already set: only SMs without a reference EVM will save the current EVM as reference
 - Always override: all SMs will save the current EVM as reference, even if they already had a reference

Session Status Configuration	
Show Idle Sessions :	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled
Link Quality Update Interval :	1 minute ▾
Link Quality Metric :	Rate ▾
	Rate
	EVM

Session List Tools	
	EVM

Reference EVM setting option : Set Reference EVM only if it is not already set
 Always override

Set Reference EVM on all SMs to current EVM

EVM-based LQI (2)

- The SM Reference EVM is configured in the SM's Configuration → Radio → LQI Reference EVM section
- Reference EVM is entered both for the DL and the UL
- The values can be manually entered, or they can be automatically populated by clicking the Populate EVM button

LQI Reference EVM	
Reference Downlink EVM :	<input type="text" value="-26.9"/> dB
Current Downlink EVM :	-32.1 dB
Reference Uplink EVM :	<input type="text" value="-28.6"/> dB
Current Uplink EVM :	-36.2 dB
Access Point MAC Address :	0a-00-3e-60-34-c8
Channel Frequency :	5745.0 MHz
Channel Bandwidth :	40.0 MHz
<input type="button" value="Populate EVM"/>	

EVM-based LQI (3)

- The Link Quality table is shown in the Session Status List section
- The Downlink LQI is calculated using
 - Comparison of Expected EVM and Actual Average EVM
 - Percentage of received beacons
- The Uplink LQI is calculated using
 - Comparison of Expected and Actual EVM
- The total LQI is calculated using
 - Downlink LQI
 - Uplink LQI
 - Number of re-registrations

Session Status List

Data : [SessionStatus.xml](#)

Encryption Information : Encryption is disabled on this radio

Device Session Power Configuration **Link Quality**

Subscriber	LUID	Link Quality Indicator	Downlink					Uplink			Re-Reg		Uptime	
			Quality Index	Actual Average EVM	Expected EVM	Beacon Quality Index	Beacon %	Quality Index	Actual Average EVM	Expected EVM	Quality Index	Count		
.66 450 SM 5.4/5.7 MIMO [0a-00-3e-a0-00-66]	008	100	100%	-28.4	-28.5	100%	100%	100%	100%	-27.0	-26.8	100%	0	4 days, 12:56:20
.67 450 SM 5.4/5.7 MIMO [0a-00-3e-0a-00-6a]	010	100	100%	-28.7	-28.7	100%	100%	100%	100%	-27.8	-27.6	100%	0	4 days, 12:56:39
.68 450 SM 5.4/5.7 MIMO [0a-00-3e-a0-00-6c]	002	100	100%	-27.8	-27.7	100%	100%	100%	100%	-27.8	-27.6	100%	0	4 days, 12:56:05
.70 450 SM 5.4/5.7 MIMO [0a-00-3e-a0-00-7d]	009	100	100%	-28.5	-28.5	100%	100%	100%	100%	-27.9	-27.8	100%	0	4 days, 12:56:34

EVM-based LQI (4)

- The AP can raise SNMP traps when the UL or DL LQI falls below the thresholds configured in the Configuration → SNMP → LQI Traps section
- This functionality can be Enabled/Disabled
- LQI threshold to raise trap (delta from reference LQI value): if the LQI value is at least this amount lower than the reference value, then the trap is raised
- LQI threshold to clear trap (delta from reference LQI value): if a trap was raised, and the LQI value is now less than this amount lower than the reference value, then the trap is cleared
- Minimum observation period: Minimum time before the trap is raised/cleared

LQI Traps		
LQI Traps :	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled	
LQI threshold to raise trap (delta from reference LQI value) :	30	
LQI threshold to clear trap (delta from reference LQI value) :	25	
Minimum observation period :	2	Minutes (Range : 1 — 15 Minutes)

802.1X Proxy (1)

- Client and server-based access control and authentication protocol that restricts unauthorized clients from connecting to a LAN through publicly accessible ports
- Until the client is authenticated, 802.1X access control allows only Extensible Authentication Protocol over LAN (EAPoL) traffic through the port to which the client is connected.
After authentication is successful, normal traffic can pass through the port.
- Two types of authentication mode are supported
 1. Port based authentication: This mode should be used when single host is connected to the SM. If the authentication is successful by the host connected to the SM, SM port is enabled and all traffic will pass through.
 2. MAC Address Based Authentication: This mode should be used when multiple hosts are connected to the SM. Each host needs to be authenticated by 802.1x protocol to access the network. The traffic is filtered based on the source MAC Address of the host, only the traffic from authenticated host will be allowed to access the network.

802.1X Proxy (2)

- AP configuration is in the Configuration → 802.1X Authentication tab

The screenshot shows the configuration page for 802.1X Authentication on a PMP 450i device. The page title is "Configuration → 802.1X Authentication". The device ID is "PMP 450i" and the MAC address is "0a-00-3e-bb-6f-40". There are "Save Changes" and "Reboot" buttons. A pop-up window titled "802.1X Authentication Configuration" is open, showing the following settings:

802.1X Authentication :	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled
802.1X Authentication Server DNS Usage :	<input checked="" type="radio"/> Append DNS Domain Name <input type="radio"/> Disable DNS Domain Name
802.1X Authentication Server :	***** Shared Secret aaaserver .example.com

Below the pop-up window, there are "Save Changes" and "Reboot" buttons.

- 802.1X Authentication: by default, this feature is Disabled
- 802.1x Authentication Server DNS Usage: Enable this if server address is in Fully Qualified Domain Name format
- Shared Secret: Maximum length is 32 characters.
Enter the shared secret that is configured for this client on RADIUS server
- Authentication server: Either in dotted decimal notation or Fully Qualified Domain Name.
Maximum length is 256 characters

802.1X Proxy (3)

- SM configuration is in the Configuration → Security tab

802.1x	
802.1x Bridging Mode :	Require 802.1x for all non-management traffic ▼
802.1x Authentication Mode :	Mac Based Authentication ▼
802.1x VLAN (Range : 1 — 4094) :	1

- 802.1x Bridging Mode:
 - Disable 802.1x: By default this feature is disabled
 - Require 802.1x for all traffic: 802.1x Authentication should be successful for any traffic to pass through the SM (i.e. Authenticator)
 - Require 802.1x for all non-management traffic: Management traffic will be allowed to pass through the SM without 802.1x Authentication.
- 802.1x Authentication Mode:
 - Port Based Authentication: SM port is activated once the 802.1x authentication is successful. This configuration should be used typically when single host is connected behind SM. If the authentication is successful, SM port is enabled and all traffic will pass through.
 - MAC Address Based Authentication: This option should be used typically when multiple host are connected behind the SM. Each host needs to be authenticated by 802.1x protocol to access the network. The traffic is filtered based on the source MAC address of the host, only the traffic from authenticated host will be allowed to access the network.
- 802.1x VLAN:
 - VLAN configuration used for sending the 802.1x packet on the configured VLAN. If a customer expects EAPoL packets on a particular VLAN, customer needs to configure the VLAN. Once the VLAN is configured, all EAPoL packets are exchanged on the configured VLAN. VLAN 1 is the default configuration, this is equivalent to untagged traffic.

Layer 3 PVID Mapping

- Allows the user to tag an untagged packet that ingresses at SM's Ethernet port with a VID other than "Default Port VID" based on the IP Address
The IP address can be either source IP Address or destination IP Address
- Configured in the Configuration -> VLAN tab of the SM in the L3 Port VID Map section

L3 Port VID Map

L3 Port VID Map look-up key : Use Source IP Use Destination IP

IP Address / Subnet Mask : 10.20.30.1 / 24

VID : 200

Priority Mode : Promote IPv4/IPv6 priority ▼

Priority : 0

L3 Port VID Map

Map Key	IP Address/ NetMask	VID	Priority Mode	Priority	Hash Key
Dst Ip	192.168.1.20/ 32	20	Define Priority	3	7d
Src Ip	10.10.10.1/ 32	100	Promote IPv4/IPv6 priority	0	b
Dst Ip	10.20.30.1/ 24	200	Promote IPv4/IPv6 priority	0	0

- L3 Port VID Map look-up key:
 - Use Source IP: Mapping is done based on the source IP of the incoming packet.
 - Use Destination IP: Mapping is done based on the Destination IP of the incoming packet.
- IP Address / Subnet Mask: IP Address and the Subnet Mask to be matched
- VID: VLAN ID the packet will be tagged with
- Priority Mode: Priority Precedence - to decide if 802.1p or DSCP Priority bits must be used when making priority decisions
- Priority: 802.1p Priority bits in the VLAN tag

Custom DHCP Option 82 (1)

- In pre-16.1 releases, the sub-options for DHCP Option 82 are interpreted in the Canopy PMP systems as follows:
 - Circuit ID - AP MAC Address (ESN) in hexadecimal format with no delimiters (e.g. 0a003e112233)
 - Remote ID - SM MAC Address (ESN) in hexadecimal format with no delimiters (e.g. 0a003e445566)
 - Vendor Specific ID - SMs VID in use (which can vary based on Port VID Mapping Configuration at the SM), in hexadecimal format in 2 bytes (e.g. 0001)
- The Custom DHCP Option 82 feature gives the flexibility to customize the sub-options of DHCP Option 82
Users can specify the Options 82 data in ASCII format with wildcards
A wildcard is noted by a leading and ending \$ symbol
- The \$ symbol can be used in the string by using \$ as the escape character (e.g. "\$\$" results in "\$")
- List of supported wildcards.
 - * \$apmac\$ - AP's MAC address in ASCII form (string)
 - * \$apmacbi\$ - AP's MAC address in hex form (binary)
 - * \$smmac\$ - SM's MAC address in ASCII form (string)
 - * \$smmacbi\$ - SM's MAC address in hex form
 - * \$apasn\$ - AP's Site Name, truncated to 32 characters
 - * \$smsn\$ - SM's Site Name, truncated to 32 characters
 - * \$smvid\$ - SM's Port VID
 - * \$smuid\$ - SM's LUID
 - * \$smvid\$ - SM's VID in ASCII format, leading 0's included, 4 chars long- this is a dynamic entry and will be determined per DHCP request
 - * \$smvidbi\$ - SM's VID in binary format - 2 bytes - this is a dynamic entry and will be determined per DHCP request



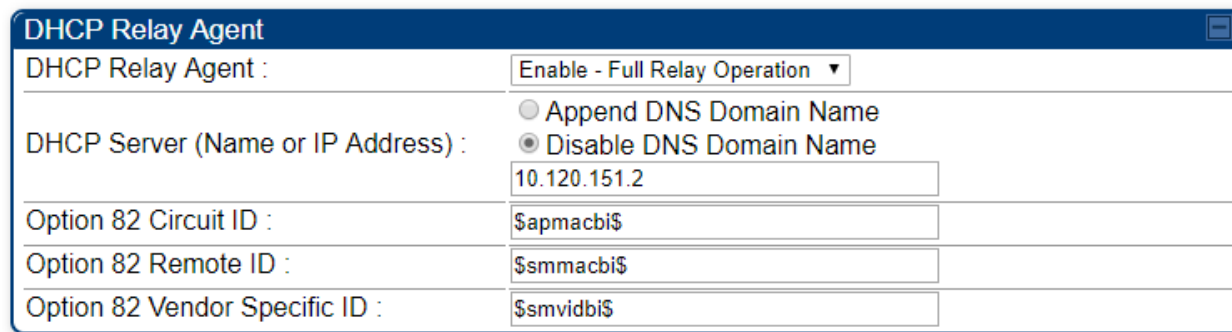
Custom DHCP Option 82 (2)

- Three suboptions: Circuit ID, Remote ID and Vendor Specific ID
- Format:
 - Option Value - 1 byte - this is 82 (0x52) for DHCP Option 82
 - Option Length - 1 byte - value varies depending on overall length of Option 82 data
 - Option Data - Variable length, max length 255 bytes
- Circuit ID: Option Value is 1
- Remote ID: Option Value is 2
- Vendor Specific ID: Option Value is 9
- The suboptions follow that same format within the top level Option 82's "Option Data" field
- Within the Vendor Specific ID suboption, there is further top level information required:
 - Option Value - 1 byte - this is 9 for Vendor Specific ID per RFC4243
 - Option Length - 1 byte (value varies depending on total length of option)
 - Enterprise Number - 4 bytes (this is 161 (0xa1), which is Motorola's IANA for historical reasons)
 - Suboption Value - 1 byte – this is "6" for historical reasons (whispROOT, same as MIB)
 - Suboption Size - 1 byte (value varies depending on length of suboption)
 - Suboption Option Value - 1 byte - Currently only support value of 1 here.
 - Suboption Option Size - 1 byte - value varies depending on length of data
 - Suboption Option Data - Contents of Vendor Specific ID string as configured. Default is 2 bytes, hex representation of SM VID (e.g. 000a for VID 10).



Custom DHCP Option 82 (3)

- Configuration
 - User can configure the suboptions in "Configuration -> General page, under "DHCP Relay Agent" section.
 - There are 3 text boxes, one for each Option 82 suboption, which can be populated with an ASCII string including the wildcards if desired.
 - Each suboption has a max length of 255 bytes and the overall Option 82 data (including all 3 suboptions) itself has a max length of 255 bytes.



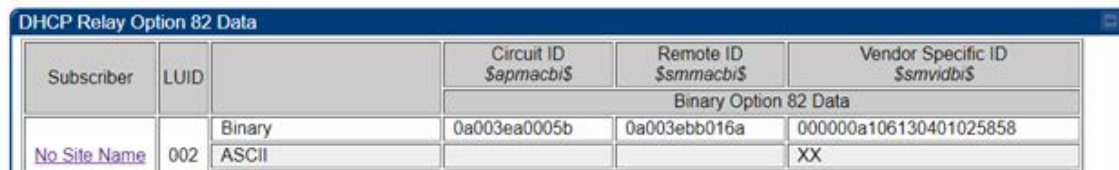
The screenshot shows a configuration window titled "DHCP Relay Agent". It contains the following fields and options:

DHCP Relay Agent :	Enable - Full Relay Operation ▾
DHCP Server (Name or IP Address) :	<input type="radio"/> Append DNS Domain Name <input checked="" type="radio"/> Disable DNS Domain Name
	<input type="text" value="10.120.151.2"/>
Option 82 Circuit ID :	<input type="text" value="\$apmacbi\$"/>
Option 82 Remote ID :	<input type="text" value="\$smmacbi\$"/>
Option 82 Vendor Specific ID :	<input type="text" value="\$smvidbi\$"/>

Custom DHCP Option 82 (4)

- Statistics

- A new section in "Stats -> DHCP Relay" Page, "DHCP Relay Option 82 Data", shows the contents of each SM's option 82 data
- This screenshot shows "DHCP Relay Option 82 Data", with default configuration



The screenshot shows a table titled "DHCP Relay Option 82 Data". The table has columns for Subscriber, LUID, Circuit ID (\$apmacb1\$), Remote ID (\$smmacb1\$), and Vendor Specific ID (\$smvidb1\$). Below these columns, there is a section for "Binary Option 82 Data" with two rows: "Binary" and "ASCII". The "Binary" row shows the expanded data for the Circuit ID, Remote ID, and Vendor Specific ID. The "ASCII" row shows the notation for the dynamic wildcard field.

Subscriber	LUID		Circuit ID \$apmacb1\$	Remote ID \$smmacb1\$	Vendor Specific ID \$smvidb1\$
Binary Option 82 Data					
		Binary	0a003ea0005b	0a003ebb016a	000000a106130401025858
No_Site_Name	002	ASCII			XX

- The table header shows the configured string for each suboption
- The entries in the table show how the string has been expanded
Since, both ASCII and binary formats are supported, this table shows both interpretations.
- This is an example of binary version of AP and SM MAC. There is nothing in the ASCII rows, but Binary row shows the MAC addresses of AP and SM.
- The Vendor Specific ID has a special format (described before), and 'XX' is the notation for the dynamic wildcard field for on-the-fly replacement when a DHCP request is processed

Quiz

In this section you will have an opportunity to validate what you have learned.

Please click next when you are ready to begin the quiz.



Quiz Questions

1. Does Release 16.1 support the PMP 430 SMs?
 - A. Yes
 - B. No (*)

2. If the Auto-Contention feature is Enabled, why does the Contention Slots parameter still need to be configured?
 - A. To guarantee a minimum number of reserved contention slots
 - B. To allow co-location with other sectors (*)
 - C. To cap the maximum number of reserved contention slots
 - D. It does not need to be configured

3. Which of these statements is false about the Auto-Contention feature?
 - A. The AP automatically increases the number of reserved contention symbols if the percentage of missed BW requests increases above a threshold
 - B. The total number of uplink symbols (data + contention) does not change when Auto-Contention is enabled
 - C. If the AP increases the number of reserved contention slots, the uplink time also increases (*)
 - D. The configured number of Contention Slots is used to calculate the DL and UL frame times

Quiz Questions

4. Which of these statements is true about the SM configuration of the proportional scheduler?
- A. If the Lock Modulation is set as Disabled, the plans' proportions scale according to the current modulation level.
 - B. If the Lock Modulation is set as Enable below Threshold, the user does not need to configure a modulation level
 - C. If SM1 and SM2 have the same plan, the same Modulation Lock configuration and the same modulation, and SM1 has higher weight, SM1 plan has a larger proportion (*)
 - D. The Weight is configured only if legacy scheduler is selected
5. The AP at Release 16.1 cannot enable the proportional scheduler if there are SMs in the sector at a pre-16.1 release.
- A. True
 - B. False (*)
6. Which of these statements is false about the proportional scheduler?
- A. It works in conjunction with WFQ (in the products that support it)
 - B. It does not work in conjunction with CIR
 - C. The SM plan is also used as MIR (*)
 - D. It can be disabled at the AP (switching to the legacy scheduler)

Quiz Questions

7. What is the main advantage of the Last Known AP feature?
- A. It forces the SM to connect to only one AP
 - B. It prevents the SM to connect to blacklisted APs
 - C. It shortens the time the SM needs to reconnect to the AP (*)
 - D. It allows the SM to only scan certain center frequencies and channel BWs
8. When is the Follow me message sent?
- A. It is sent by the AP when it is being relocated to another site
 - B. It is sent by the AP when it is switching center frequency or channel BW (*)
 - C. It is sent by the SM when it can no longer see the AP it was connected to
 - D. It is sent by the SM when switching to the AP matching the secondary color code
9. Which of the following statements is false about the EVM-based LQI?
- A. It calculates values also for pre-16.1 SMs (*)
 - B. It uses a reference EVM for each direction
 - C. It supports configurable thresholds to raise/clear traps
 - D. It uses the information on number of re-registrations and beacon %, as the rate-based LQI

Quiz Questions

10. Which of these statements is false about 802.1X Proxy?

- A. It is an authentication protocol that restricts unauthorized clients from connecting to a LAN through publicly accessible ports
- B. 802.1X does not allow Extensible Authentication Protocol over LAN (EAPoL) traffic, Until the client is authenticated. (*)
- C. In Port based authentication single host is connected to the SM
- D. In MAC Address Based Authentication multiple hosts are connected to the SM

11. L3 Port VID Mapping can only be done based on source IP Address?

- A. True
- B. False (*)