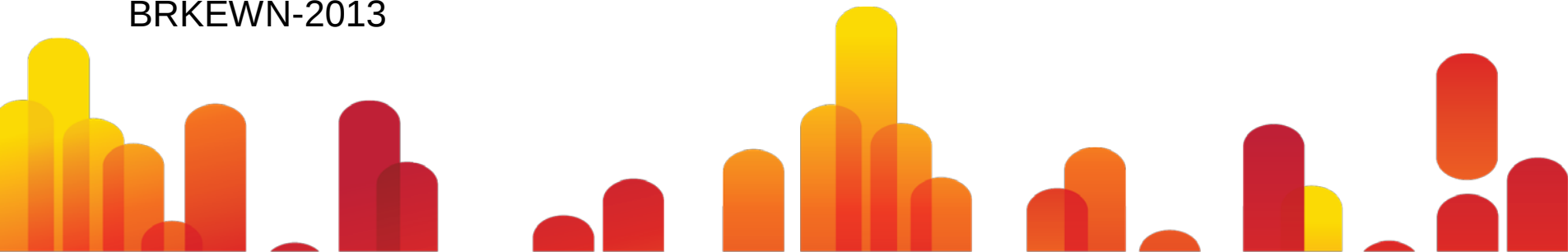




Understanding CleanAir Technology to Improve Wlan Spectrum Management

BRKEWN-2013



Housekeeping

- We value your feedback- don't forget to complete your online session evaluations after each session & complete the Overall Conference Evaluation which will be available online from Thursday
- Visit the World of Solutions
- Please remember this is a 'non-smoking' venue!
- Please switch off your mobile phones
- Please make use of the recycling bins provided
- Please remember to wear your badge at all times

Agenda

- Why does interference matter?
- CSMA-CA and Duty Cycle?
- AP modes of Operation
- Technical Details
 - Interference Detection
 - Interference Mitigation
 - CleanAir Monitoring
 - Spectrum Expert Mode
- Configuration Essentials

RF terms and Wi-Fi behavior basics



The Impact of a Crowded Spectrum

Performance At Risk in Unprotected Networks



End User Impact

- Reduced network capacity and coverage
- Poor quality voice and video
- Potential complete link failure

IT Manager Impact

- Potential security breaches
- Support calls
- Increased cost of operation

Interference Type		Throughput Reduction	
		Near (25 ft)	Far (75 ft)
2.4 or 5 GHz Cordless Phones		100%	100%
Video Camera		100%	57%
Wi-Fi (busy neighbor)		90%	75%
Microwave Oven		63%	53%
Bluetooth Headset		20%	17%
DECT Phone		18%	10%

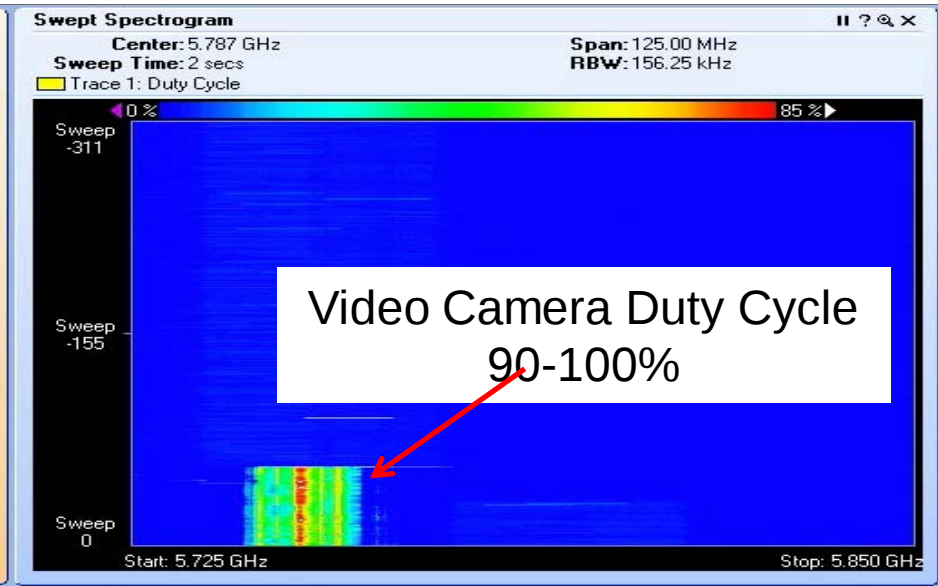
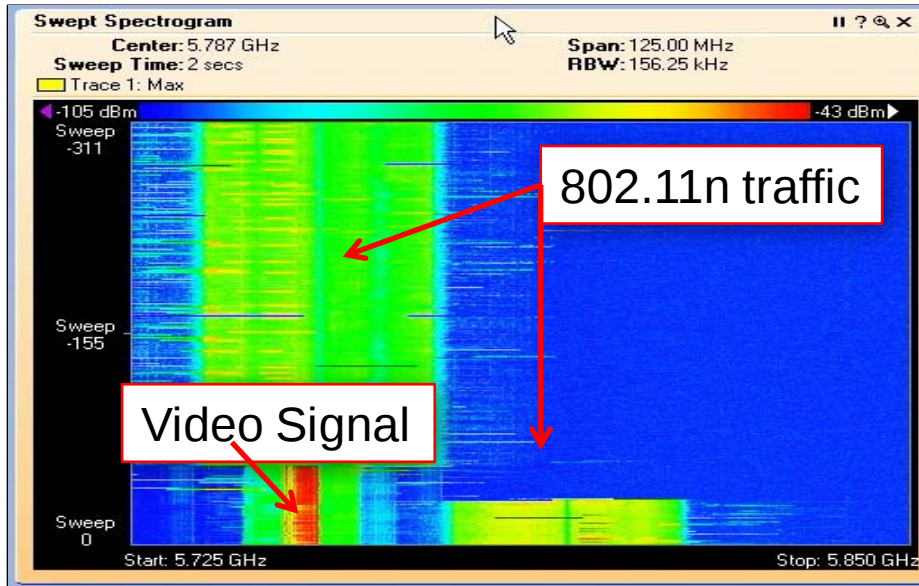
Source: FarPoint Group

How does Interference impact Wi-Fi?

Separating the FUD from the Fact's

- 802.11a/b/g/n - CSMA/CA or LBT (listen Before Talk)
- Collision Avoidance – 802.11 very very polite – by design
 - CCA
 - Collisions
 - SNR
- CCA – Clear Channel Assessment
 - ED – quick – low power - prone to false positives
 - Preamble – takes time – power – less prone to false
- CCA threshold for 802.11b/g is -65 dBm
- CCA for 802.11a is different -65 dBm ED, if true then 20 dB lower for Preamble interrogation needs to be processed -85 dBm

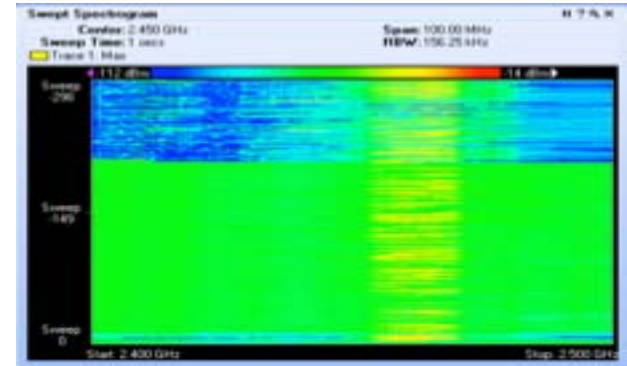
CCA Blocked or High



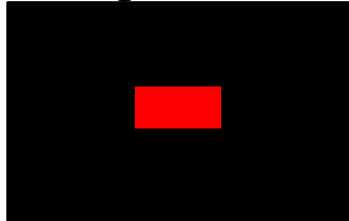
How does Interference impact Wi-Fi?

Separating the FUD from the Fact's

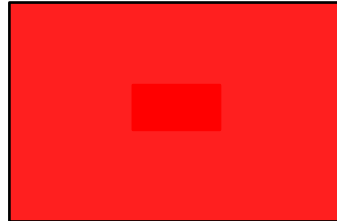
- Collisions - Non Wi-Fi devices do not participate in our CA mechanism – they have their own
- No respect for Wi-Fi – results in:
 - Corrupted packets
 - Increased retransmissions
 - Increased Duty Cycle
 - Less available bandwidth
- SNR – Signal to Noise ratio



High SNR



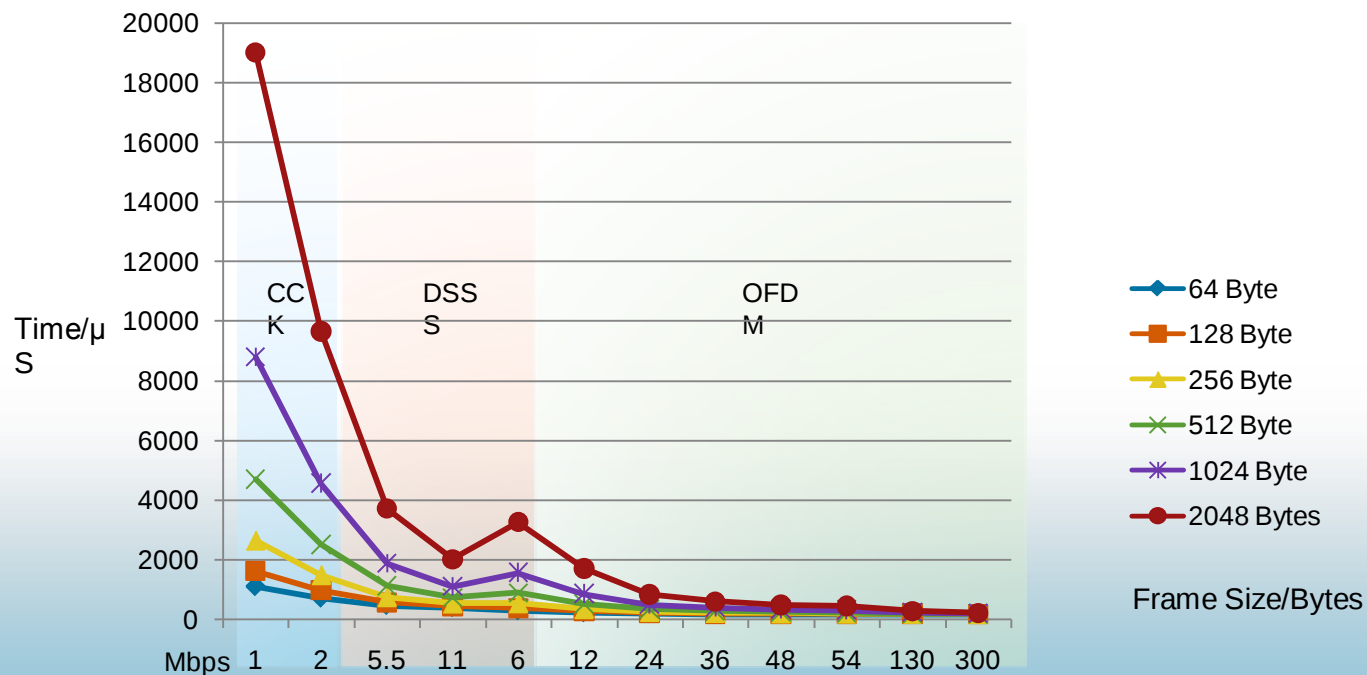
Low SNR



802.11 and Duty Cycle – Channel Utilization

- Retransmit a packet
- Duty Cycle of interference is directly proportionate to channel time available
- Busy network – less interference tolerance
- Less busy – might not even notice low levels of interference
- Bandwidth is like Money – the more you get the more you spend

Understand Protocol Selection 802.11 b/g/a/n and Duty Cycle—Important? Why?

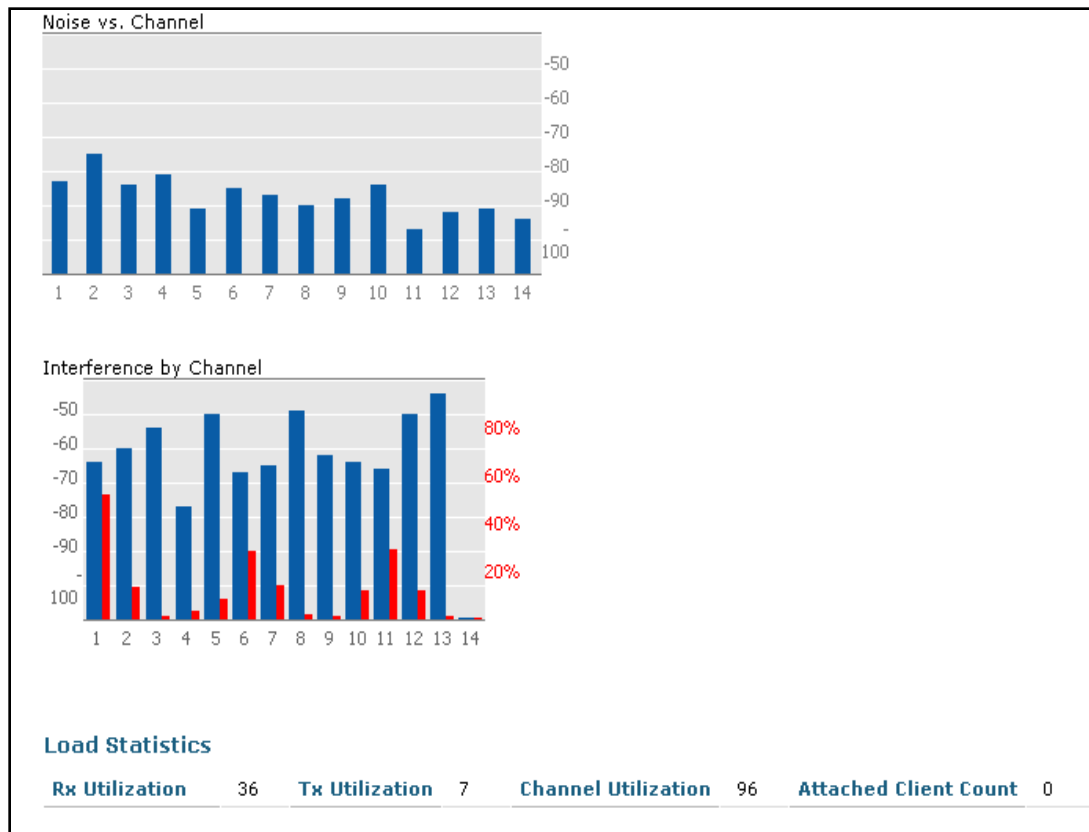


Spectrum is a Shared Finite Resource

Cisco Access Points – Modes of Operation



Any Cisco Access point already sees and reports noise and interference per Channel



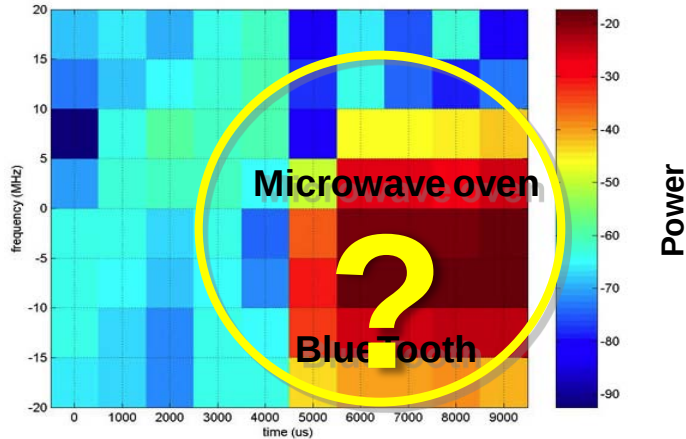
Wi-Fi and Spectrum Knowledge – Why is silicon important?

- A Wi-Fi chip is a communications processor – a MODEM
- It only knows
 - Energy that can be demodulated = Wi-Fi
 - Energy that can not be demodulated = Noise
- Noise is complicated –
 - Collisions, fragments, corruption
 - Wi-Fi that is below sensitivity threshold of the receiver
- Peaks in Wi-Fi activity can cause all of the above to occur

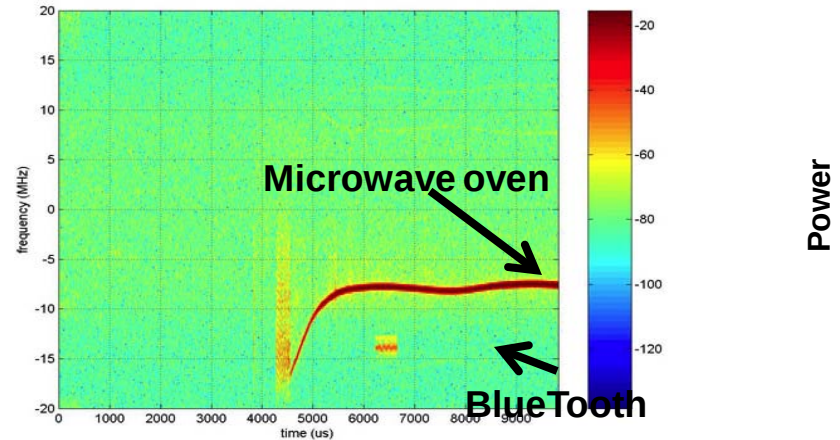
High Resolution Spectral Advantage

The Industry's ONLY in-line high-resolution spectrum analyzer

Typical Wi-Fi chipset
Spectral Resolution at 5 MHz



Cisco CleanAir Wi-Fi chipset
Spectral Resolution at 78 to 156 KHz



‘Chip View Visualization’ of Microwave oven and BlueTooth Interference

The Value of ASIC Based Intelligence

Troubleshooting Workflow	Response A: CleanAir Technology	Response B: Software-only Solution
Event: SpyCam and Microwave causing strong interference		
Detect presence of interference	Two unique sources detected by all APs	Energy detected by all APs
Classify source of interference	Spycam and microwave uniquely identified	Inability to differentiate between multiple sources of interference
Correlate interference events across APs	Interference correlated across all APs as two events	None – seen as unique event by each AP
Assess impact to AP and network	Severity and impact of each interferer measured	Total Interference measured only
Alert to IT	Intelligent alert on sources and impact	One alert per AP on “interference detect”
Physically locate SpyCam and Microwave	Interferers precisely located on floor map	Unable to locate automatically, manual search for both
Mitigate impact of interference	Intelligent and automatic channel change	Manual changes based on limited data
Air Quality Report	Network-wide view of Wi-Fi health by AP	None

Enterprise Wireless Evolution

From Best Effort to Mission Critical

2005

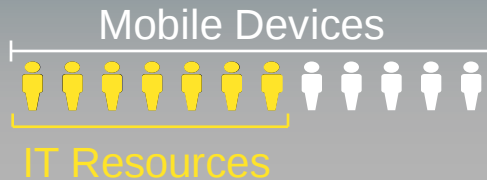
2011



Market Transitions

Mobility

1.3 Billion new Networked Mobile Devices in the Next Three Years



Workplace Experience

Blurring the Borders:

Consumer ↔ Workforce
Employee ↔ Partner

Anyone, Anything,
Anywhere, Anytime



Video

50% of all Cisco Network Traffic Today Is Video



“When the students returned this year, if you asked me what percentage of students are using the Wi-Fi network – I would have told you 40%. I was shocked to see 85% of them using the Wi-Fi network”

Scott Ksander – September 2009 – Cisco Education TAB
Purdue University



Influx of Mobile Devices Creates IT Challenge

IT Consumerization: Now a Reality

Smartphone adoption is growing at 50%+ annually

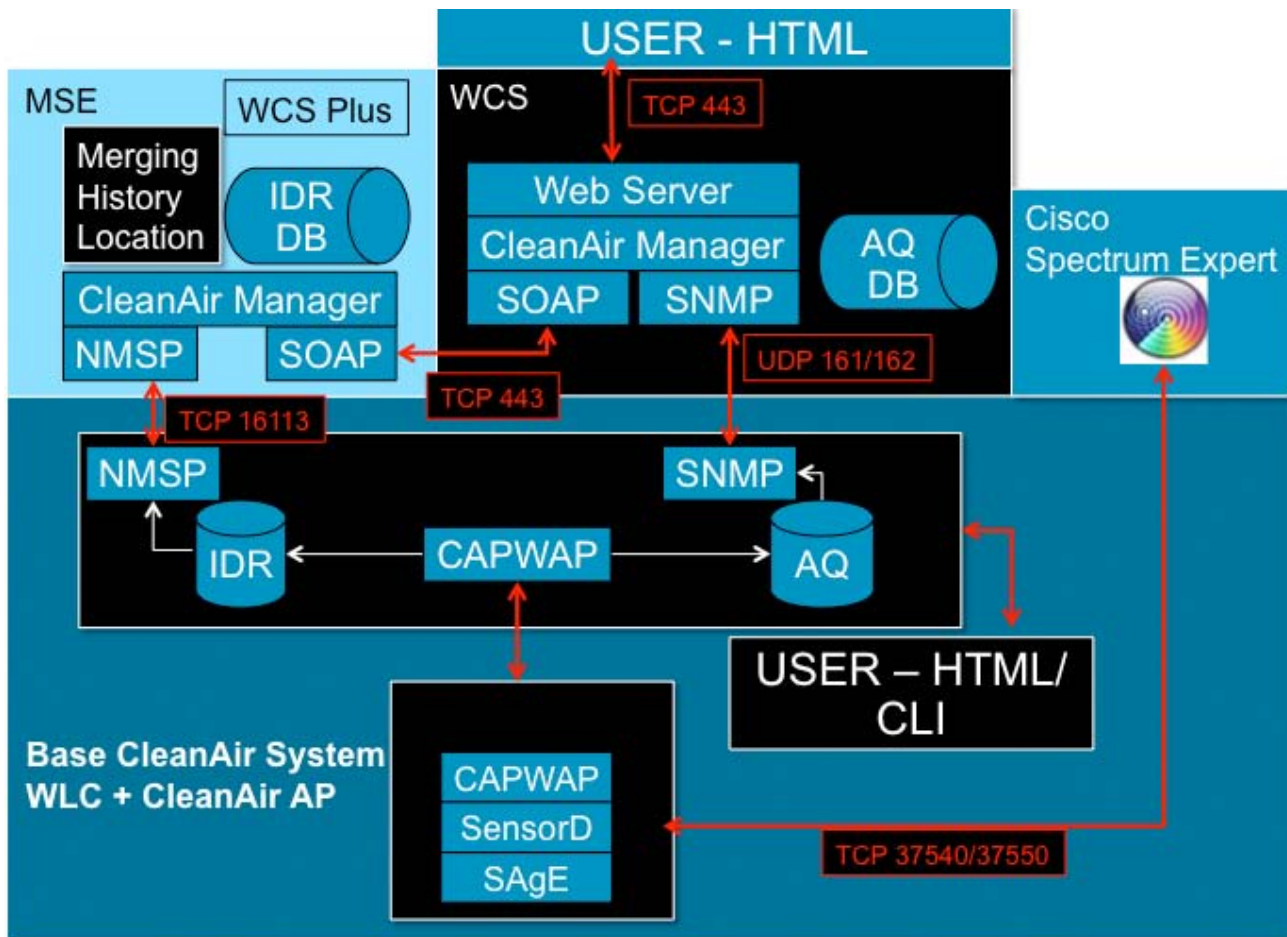
A Smartphone can use as much bandwidth as 200 legacy phones

ENTERPRISE



TIME

CleanAir Technical Details



CleanAir Specific Acronyms

- AQI – Air Quality Index – also seen as AQ
- IDR – Interference Device Report
- PMAC – Pseudo MAC
- Merge – Correlation of IDR's based on PMAC
- ZOI – Zone of Impact
- LMAP – Local Mode AP – AP serving clients
- MMAP – Monitor Mode AP – AP scanning all bands

Key Components Interaction

- Information is driven in two ways
 - AQI – Air Quality index reporting
 - IDR – Interference device report
- Air Quality – Is derived by the AP's, Stored on WLC, and polled by WCS
- Interference Device Reports – are reported to WLC
 - WLC will merge multiple IDR's
 - Keep a limited Database (single reporting period)
 - Forward NMSP notification message with IDR payload to MSE

Non Wi-Fi Interference Detection



The CleanAir AP

- Built into the silicon of the Wi-Fi chip is an additional 500K logic gates that house the SAgE logic.
- SAgE is the spectrum analyzer that was used on the Spectrum Expert Cards (Spectrum Analysis Engine)
- Controlling the SAgE hardware is a software known as SensorD – where all measurements are gathered and reported to and from the AP
- SensorD does all classification of devices and calculations required to populate upstream information stores and handles interfacing to CAPWAP

Information passed from the AP to controllers is minimal. No off platform calculations are performed: it all happens on the AP

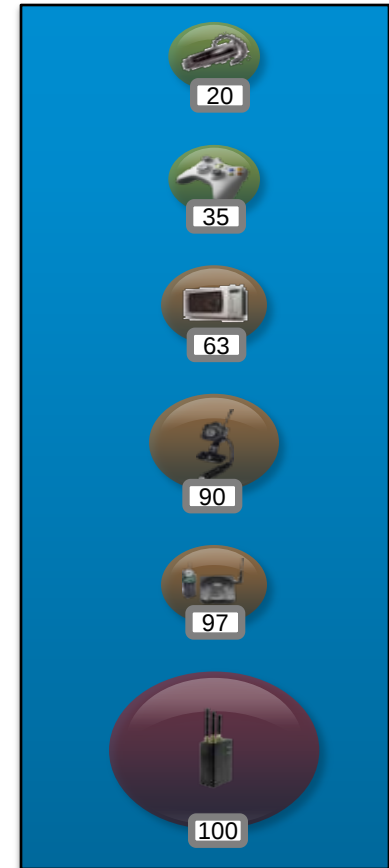
Air Quality Index - AQI

- Air Quality is a measurement of non-wifi and adjacent channel interference
- All Individual devices when Classified are assigned a Severity Value
- Air Quality is a measure of all Devices/Severities within a Radio, Floor, Building, or Campus



Air Quality and Severity

- For each Classified Device – a Severity Value is calculated
- Severity of 0 is not Severe – a Severity of 100 is very severe.
- Severity is a local opinion of the reporting AP and takes into account the type of device, Duty Cycle (persistence) and Power as measured by the AP.
- For the same device – severity will differ on each reporting AP because of the AP's RF relationship to that device.





Supported Interferers

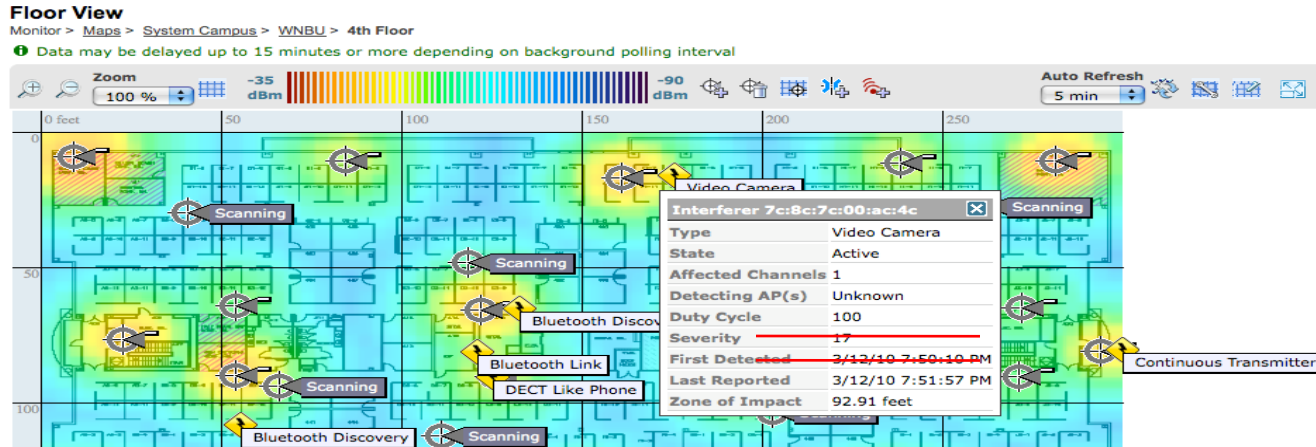
Cisco Unified Wireless Network 7.0 Release

- 2.4 GHz only
 - Bluetooth Link
 - Bluetooth Discovery
 - 802.11FH
 - Microwave Oven
 - Industrial wireless/802.15.4
 - Xbox
- 5 GHz only
 - Radar
 - WiMAX Mobile
 - WiMAX Fixed
- 2.4 or 5 GHz
 - Jammer
 - WiFi Inverted
 - WiFi Invalid Channel
 - Continuous Transmitter
 - Video Camera
 - SuperAG
 - Canopy
 - Other (i.e. unclassified devices)
 - TDD Transmitter
 - DECT-like Phone

1. Classifiers are expandable over time with software upgrade.
2. All third party trademarks are the property of their respective

- Definite Security Threat Devices
- Potential Security Threat Devices
- Performance Impacting Devices

Air Quality and Severity



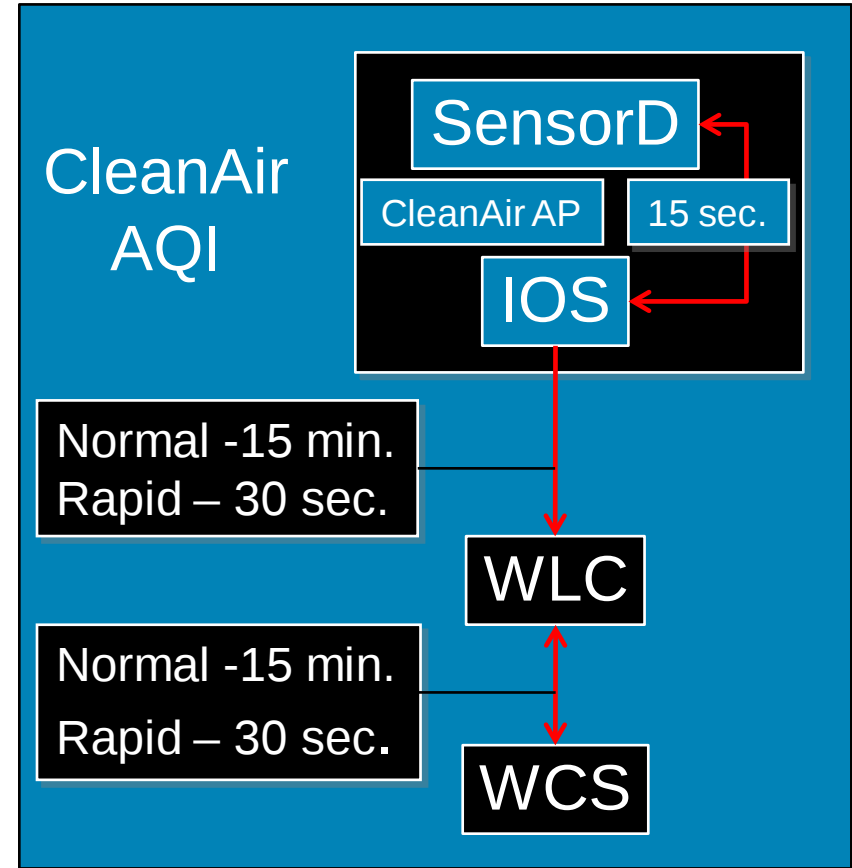
- Severity is used to understand the potential impact to a Wi-Fi network
- The RSSI at the AP for this interferer (-78) is well below CCA threshold (Clear Channel Assessment)
- Even with duty cycle of 100% - the severity here is 17 – if it was closer to us, the severity would be much higher

Air Quality and Severity

- Severity is calculated for a single device
- All devices affecting a radio/channel are added together and subtracted from Air Quality for that for that radio/ served channel
- Separate AQ metrics exist per band
- Air Quality is observable at the Radio/channel level, or averaged together for a Floor, Building, Campus in a hierarchical fashion.

AQ Detail

- AP manages AQI data – averaging period is decided by WCS/WLC, and configured on AP by WLC
- Default AQ Averaging periods are
 - 15 min. default (up to 1 hour)
 - Rapid Update Mode – 30 seconds
- AP-SensorD reports AQ information every 15 seconds to IOS



AQI In-Depth

- Each AQ report contains the average, and the minimum observed AQ during the period
- Each CleanAir Radio sends AQ reports independently to the WLC for the channel it is serving (15 Minutes by default) or all channels if in Monitor Mode (MMAP)
- WLC Maintains last normal AQ report for each radio until update is received
- WCS polls each WLC at predetermined (normal or rapid) intervals (Normal 15 minutes, Rapid 30 second)

AQI Summary

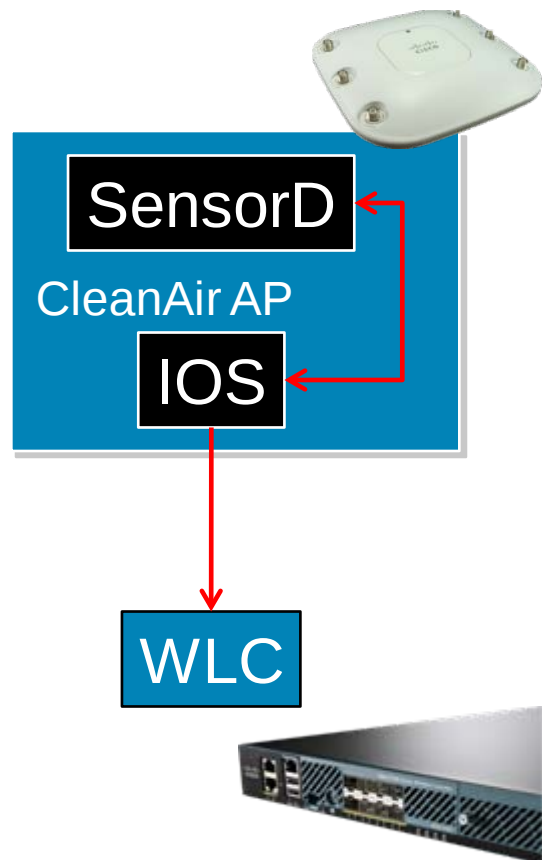
- AQ reports drive the AQI
- AQ is good at 100 and bad at 0
- ED-RRM feature is driven by AQ directly from the AP – independent of the controller or RRM
- Air Quality is a measure of NON Wi-Fi interference and Adjacent Channel Wi-Fi only
- All on channel Wi-Fi is monitored by the Wi-Fi chip, CleanAir is locked out.

Interference Device Report

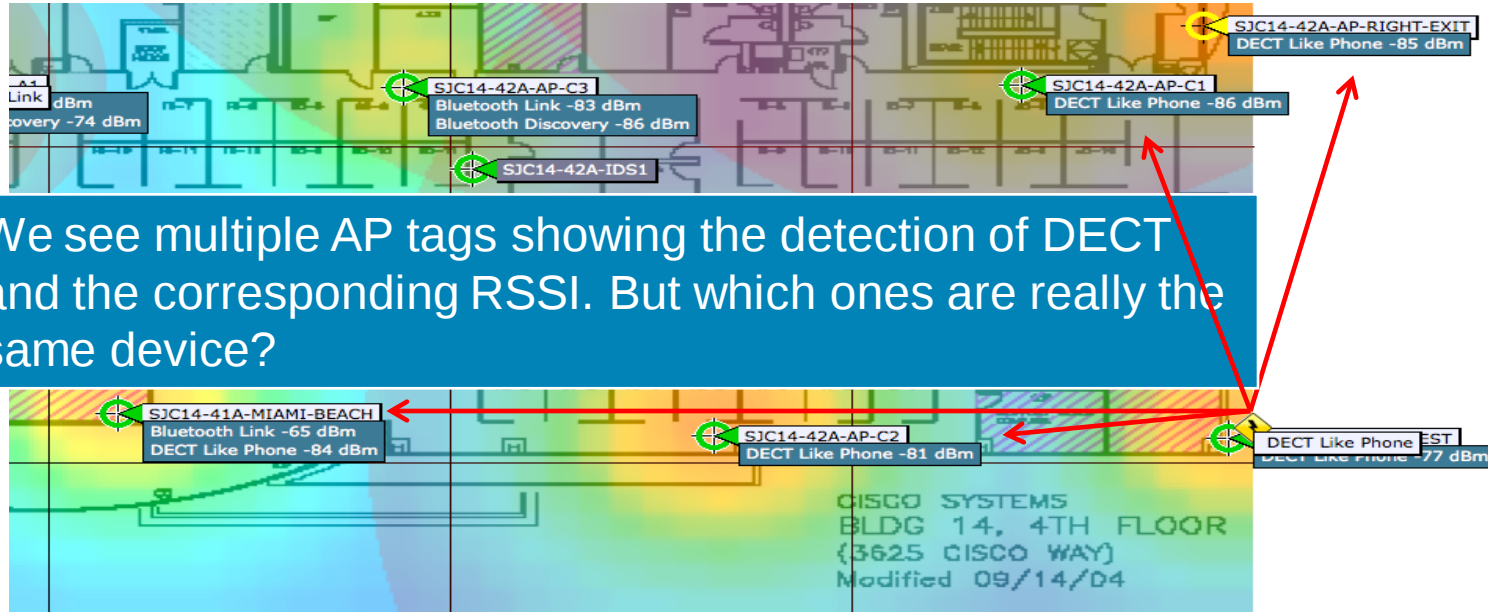
IDR and The AP

- IDR's are reports of devices classified by SensorD
- Top 10, by severity are reported to WLC
- A Security IDR will always be reported regardless of severity
- IDR up/down reporting is near real time
- AP tracks all IDR's not reported to WLC

TYPE	SEV	WLC
SEC	1	*
INT	20	*
INT	9	*
INT	2	*
INT	2	*
INT	1	*
INT	1	*
INT	1	*
INT	1	*
INT	1	
INT	1	
INT	1	



Multiple AP's = Multiple Sensors

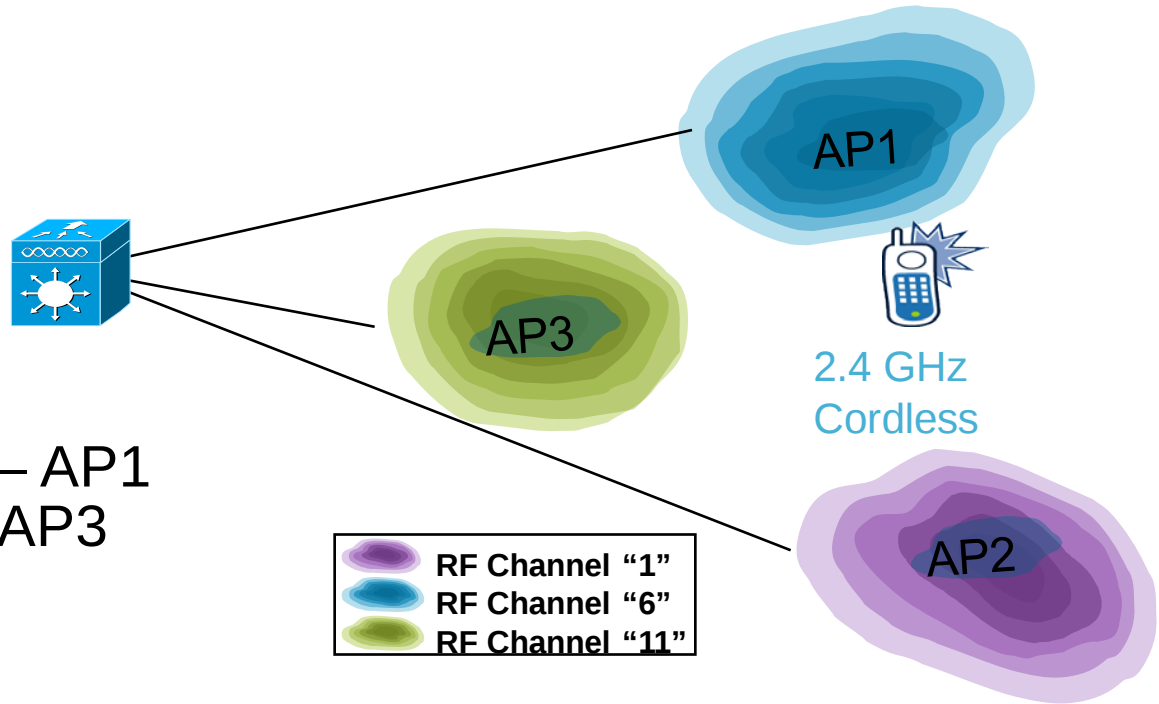


IDR In-Depth – The AP - PMAC

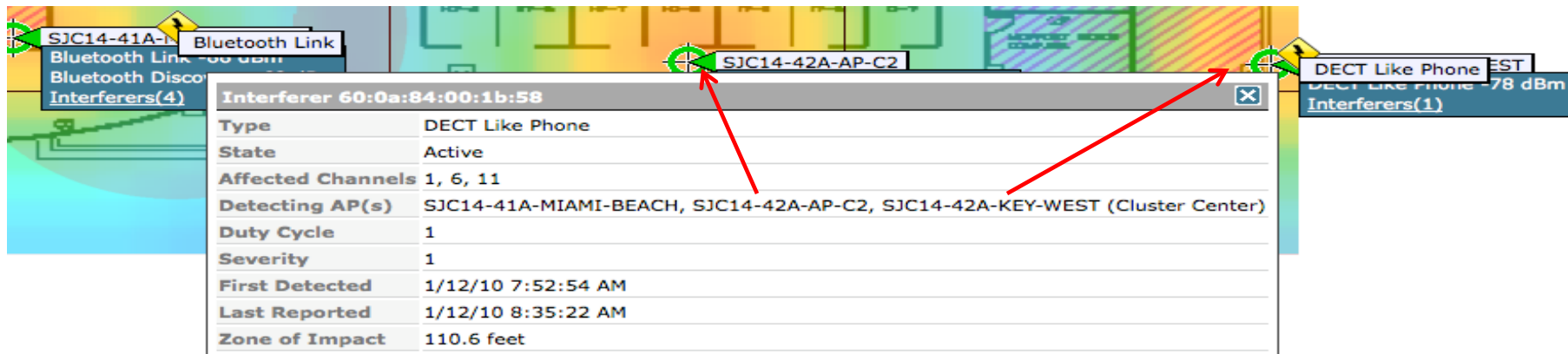
- Pseudo – MAC applied to analog device signatures
- PMAC will never calculate exactly the same on all AP's detecting the same device – but rather similar
- PMAC will change overtime for a given device
 - Battery operated devices – voltage drop – temp variations
 - Measurement accuracy – or inaccuracy
- The AP will combine devices that can not reliably be merged with devices seen by another AP

WLC Merging – and PMAC “The Cluster”

- IDR-DECT – ap1
- IDR-DECT – ap2
- IDR-DECT – ap3
- Merged IDR = DECT – AP1 (cluster center), AP2, AP3



PMAC Merge



- Once the PMAC Signatures are merged – we can identify which AP's are hearing the same device
- Notice the Cluster Center – this is the closest AP to the device

WLC and PMAC Merging

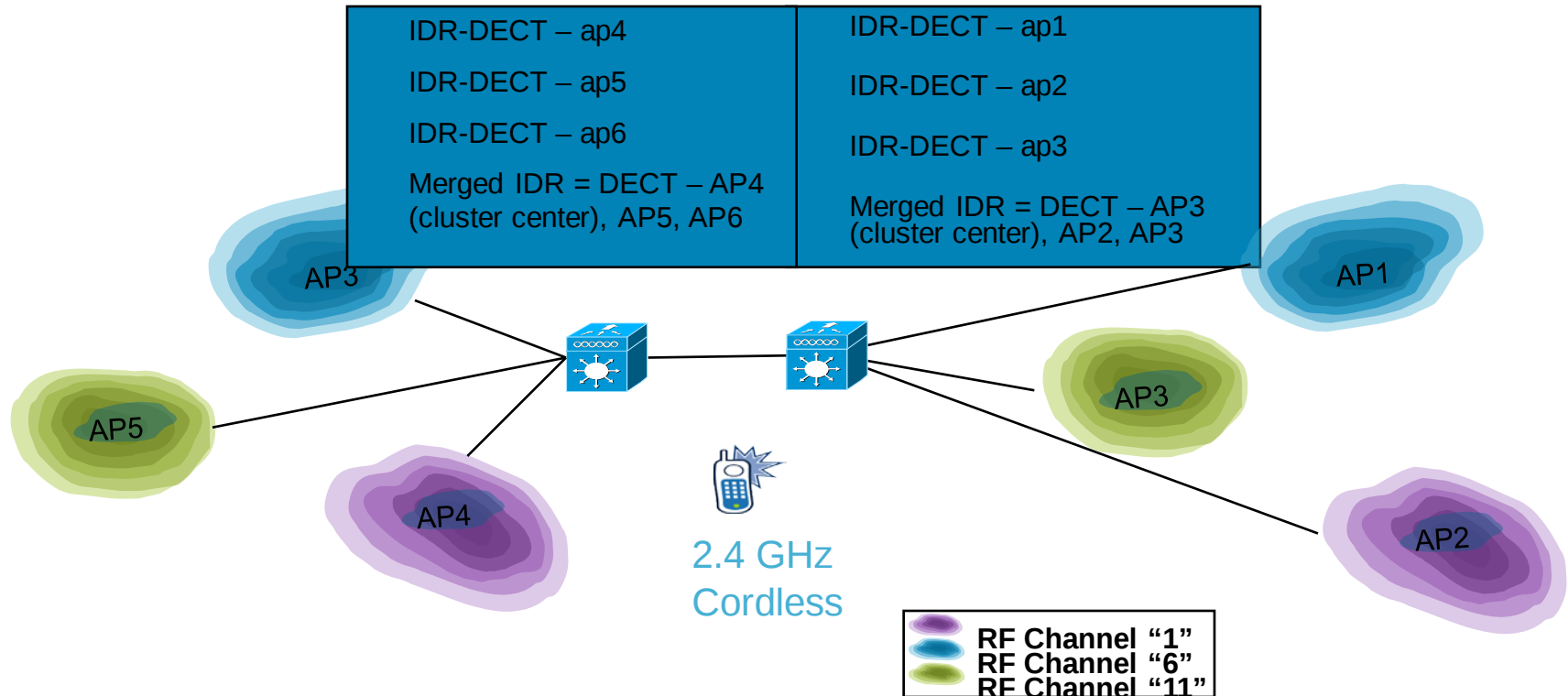
- WLC performs comparison function on received IDR's PMAC
- WLC can merge devices for AP's physically connected to it
- WLC merge results are only viewable in IDR traps sent to trap receiver (WCS)
- No Location is performed on WLC merged interferers
- The result of a WLC merge is forwarded to the MSE (If present) along with all of the supporting IDR's

The MSE

- All IDR's received by a WLC are sent to MSE via NMSP notify with IDR payload
- NMSP message includes the merged IDR and the individual IDR's used for that conclusion
- IDR's are re-merged at the MSE, this accommodates multiple WLC systems
- A tracked Interferer is equal to a client for CAS license purpose – each active merged interferer will consume 1 seat

MSE Merging – LMAP X-WLC

MSE Merge



MSE – WLC Merging and Location

- MSE and the WLC rely 1st on RF Neighbor lists to establish spatial probability in a merge
- LMAP AP's are active and send neighbor messages as part of normal RRM operation
- Changing Neighbor message defaults will affect merging
- MMAP AP's are passive devices and do not send neighbor messages

CleanAir Mitigation Modes



Interference Mitigation Features

- Persistent Device Avoidance – PDA

- Operates on Classification – IDR on a per AP basis

- Once set – biases DCA against the PDA channel for the detecting AP only

- Remembers interference and avoids placing the AP back on the same channel

- Energy Detect – RRM or ED-RRM

- Fast acting (≤ 30 seconds)

- Works on AQI on a per AP basis

- Designed to prevent catastrophic interference from disrupting channel/clients

NOTE: Only Available with full CleanAir enabled installation – not overlay

PDA - configuration

Wireless

Access Points

- All APs
- Radios
 - 802.11a/n
 - 802.11b/g/n
 - Global Configuration
- Advanced**
- Mesh**
- HREAP Groups**
- 802.11a/n**
- 802.11b/g/n**
 - Network
 - RRM
 - RF Grouping
 - TPC
 - DCA
 - Coverage
 - General
 - Client Roaming
 - Media
 - EDCA Parameters
 - High Throughput (802.11n)
 - CleanAir
- Media Stream**
- Country**
- Timers**
- QoS**

802.11b > RRM > Dynamic Channel Assignment (DCA)

Dynamic Channel Assignment Algorithm

Channel Assignment Method: ☒ Automatic ☐ Freeze ☐ OFF Interval: 10 minutes AnchorTime: 0

Avoid Foreign AP Interference: ☒ Enabled

Avoid Cisco AP load: ☐ Enabled

Avoid non-802.11b noise: ☒ Enabled

non-WiFi Device Avoidance: ☐ Enabled

Channel Assignment Leader: 00:24:97:69:9a:60

Last Auto Channel Assignment: 185 secs ago

DCA Channel Sensitivity: Medium (10 dB)

DCA Channel List

DCA Channels: 1, 6, 11

Select	Channel
☒	1
☐	2
☐	3
☐	4
☐	5

Event Driven RRM

EDRRM: ☒ Enabled

Sensitivity Threshold: Medium

Enabled Per Band
Same on WCS or WLC
EDRRM has threshold variable

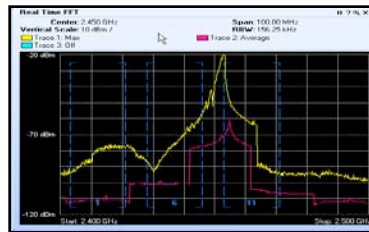
WLC GUI - Wireless=>802.11a/b=>RRM=>DCA

WCS - Configure=>controllers=>802.11a/b=>RRM=>DCA

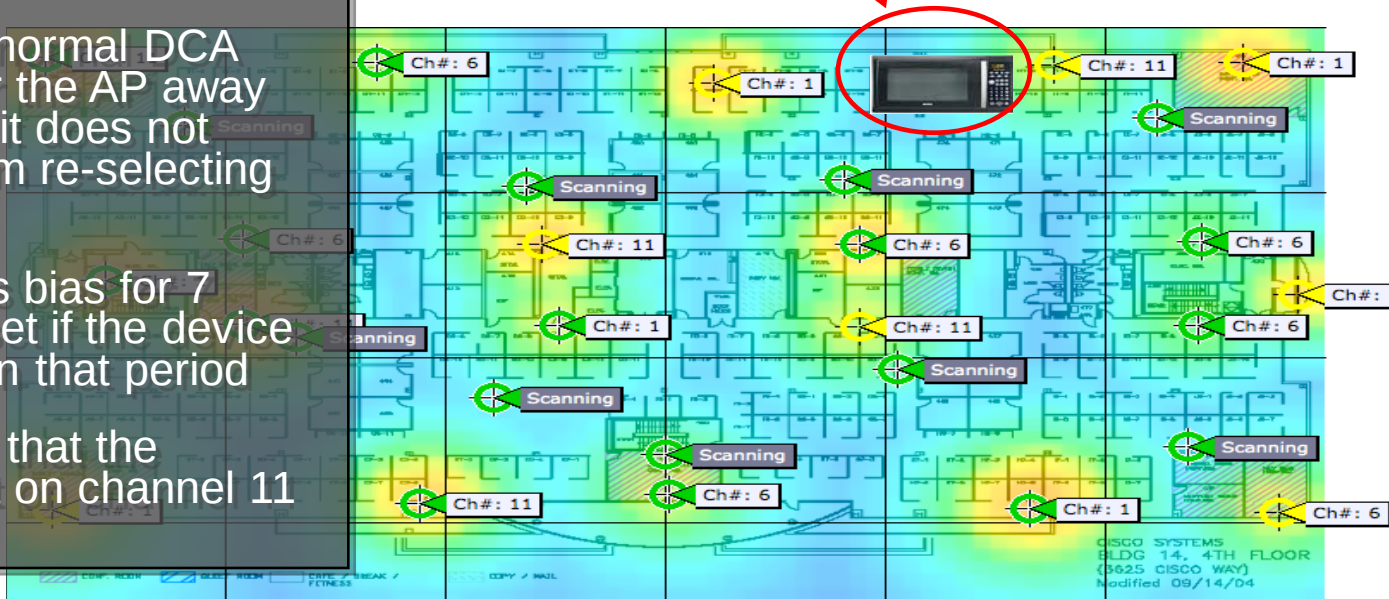
ED-RRM AQI thresholds:
Low - 35
Medium (default) - 50
High - 60

PDA – Use case

- PDA logs the device for this AP.
- A CM bias is added to this AP's channel 11 only
- The bias works in normal DCA operations to steer the AP away from channel 11 – it does not prevent the AP from re-selecting this channel
- AP remembers this bias for 7 days, which is re-set if the device is seen again within that period
- If DCA determines that the affected AP is best on channel 11 it will be assigned



Microwave Oven detected
Channel 11 – highest
Impact.



PDA Operation

- If channel change is caused by PDA event – it will be logged in WCS – Monitor=>RRM
- PDA event is viewable on WLC=>wireless=>Access Points=>Radios=>802.11a/b=>CleanAir RRM
- Only available with full LMAP deployment
- Microwave Oven, Video Camera, Canopy, Fixed Wi-Fi are all persistent devices

AP Name	Radio Slot#	Base Radio MAC	Admin Status	Operational Status	Channel	Clean-Air Admin Status	Clean-Air Oper Status	Power Level	Antenna
AP0022.bd18.a642	0	00:22:bd:cc:d4:20	Enable	UP	1	Enable	UP	7	Configure
AP0022.bd18.da96	0	00:22:bd:cc:e5:d0	Enable	UP	6 *	Enable	UP	8	Details
AP0022.bd18.ab11	0	00:22:bd:cc:de:b0	Enable	UP	11 *	Enable	UP	3	802.11b/gTSM
cisco_1250	0	00:17:df:a6:84:30	Disable	DOWN	1	NA	NA	5	CleanAir-RRM
AP001b.d513.1652	0	00:17:df:a6:e9:70	Disable	DOWN	6 *	NA	NA	8	External
c1130_3	0	00:1a:a2:fa:2e:40	Disable	DOWN	6	NA	NA	8	Internal

802.11b/g/n Cisco APs > AP0022.bd18.ab11 > Persistent Devices

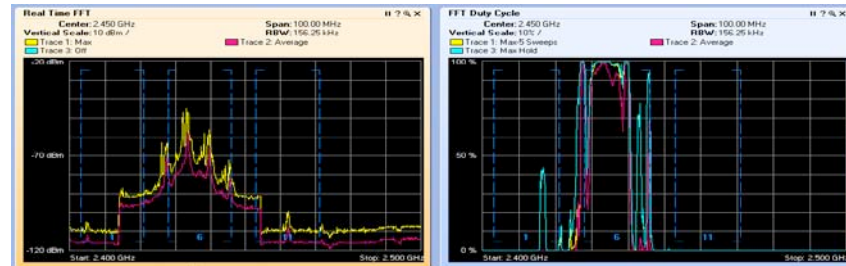
Class Type	Channel	DC(%)	RSSI(dBm)	Last Seen Time
Video Camera	11	100	-64	Tue Mar 16 15:28:10 2010

ED-RRM Operation

- ED-RRM operates based on Air Quality (AQ)
- Each AP measures AQ over a 15 second period and reports it to the controller in as little as 30 second increments (rapid update mode)
- ED-RRM is designed to instantly sense a catastrophic interference source defined as a high duty cycle interferer – and if the AQI drops perilously – immediately change the AP's channel independent of RRM.
- ED-RRM prevents the AP from returning to the original channel for 3 hours after the event.
- Channel Change reason is logged in Monitor RRM as catastrophic AQI event

ED-RRM Use Case

Video camera produces 100% DC
If seen at an AP above CCA threshold
the AP will stop beaconing, clients
will not attempt to associate



- The AP reacts almost instantly (within 30 seconds)
- Clients that have decent roaming capabilities will reconnect
- ED-RRM AQI thresholds are:
 - Low – 35
 - Medium (default) – 50
 - High - 60

Spectrum Monitoring



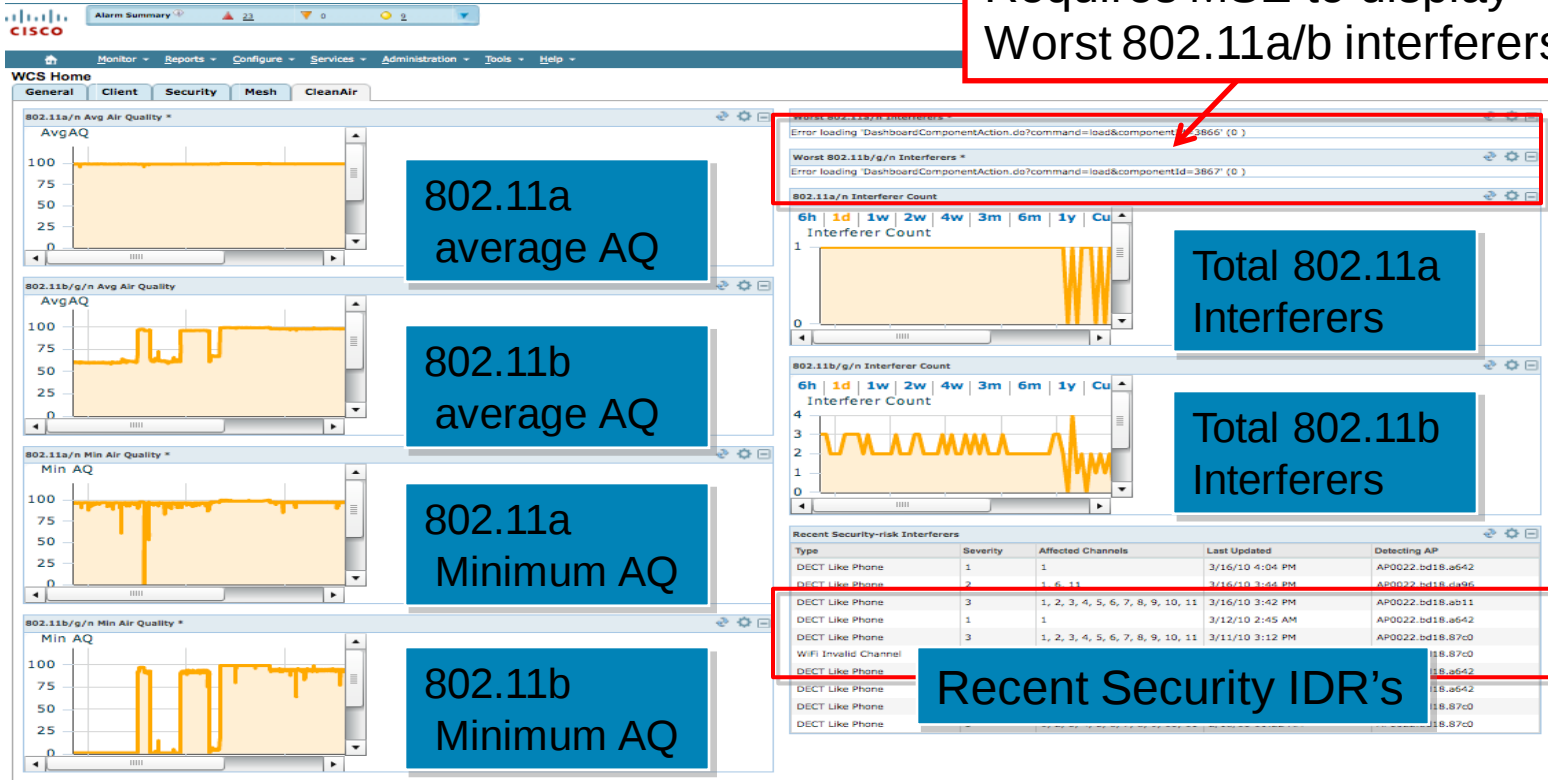
WCS - Home



- WCS version 7.0.x includes the CleanAir information Tab
- The Alarm Summary Panel will display both AQ alerts under Performance and Security Alerts under Security
- Advanced Search function includes Interference – rich interface for searches

WCS – CleanAir TAB

Requires MSE to display
Worst 802.11a/b interferers



WCS – Alarm Summary

The screenshot shows the Cisco Wireless Control System (WCS) interface. On the left, the 'Alarm Summary' menu is expanded, showing a total of 25 alarms. The main panel displays a table of alarms, including severity, failure source, owner, date/time, message, and acknowledged status.

Severity	Failure Source	Owner	Date/Time	Message	Acknowledged
Warning	AP AP0022.b018.a011, Interface 802.11b/g/n		1/19/10 8:36:19 AM	Air Quality Index on Channel '6' is '92' (Threshold: '85').	No
Warning	AP AP0022.b018.a042, Interface 802.11b/g/n		1/19/10 8:35:22 AM	Air Quality Index on Channel '1' is '46' (Threshold: '85').	No
Warning	AP AP0022.b018.a046, Interface 802.11b/g/n		1/19/10 8:24:20 AM	Air Quality Index on Channel '1' is '35' (Threshold: '85').	No
Warning	AP AP0022.b018.a011, Interface 802.11b/g/n		1/19/10 6:49:35 AM	Air Quality Index on Channel '1' is '7' (Threshold: '85').	No
Warning	AP AP0022.b018.87d0, Interface 802.11b/g/n		1/18/10 3:51:19 PM	Air Quality Index on Channel '6' is '79' (Threshold: '85').	No
Warning	AP AP0022.b018.87d0, Interface 802.11b/g/n		1/18/10 2:20:02 PM	Air Quality Index on Channel '1' is '33' (Threshold: '85').	No
Warning	AP AP0022.b018.87d0, Interface 802.11b/g/n		1/17/10 8:01:45 PM	Air Quality Index on Channel '11' is '95' (Threshold: '85').	No
Warning	AP AP0022.b018.87d0, Interface 802.11a/n		1/17/10 2:16:56 AM	Air Quality Index on Channel '157' is '98' (Threshold: '85').	No

- Performance alarms report AQ threshold violations
- Security Alarms Report security IDR instances
- CleanAir Alarms and Traps configured from
Configure=>Controllers=>802.11a/b=>CleanAir

CleanAir

SNMP Trap Settings/controls

- Select trap configurations per band
- Select which interference
- Enable/Disable AQ threshold alert
- Select Interference types for Security alert trap

The screenshot shows the Cisco CleanAir configuration interface for the 802.11b/g/n band. The left sidebar contains a navigation tree with categories like Access Points, Advanced, Mesh, HREAP Groups, 802.11a/n, 802.11b/g/n, Network, RRM, RF Grouping, TPC, ECA, Coverage, General, Client Roaming, Media, EDCA Parameters, High Throughput, QoS, Media Stream, Country, Timers, and QoS. The main content area is titled '802.11b > CleanAir' and contains several sections: 'CleanAir Parameters' with checkboxes for 'CleanAir' and 'Report Interferers' (both enabled); 'Interferences to Detect' and 'Interferences to Ignore' lists; 'Trap Configurations' with checkboxes for 'Enable AQI (Air Quality Index) Trap', 'AQI Alarm Threshold (1 to 100)' (set to 85), and 'Enable Interference Type Trap' (all enabled); 'Trap on these types' and 'Do not trap on these types' lists; and 'Event Driven RRM' settings (EDRRM enabled, Sensitivity Threshold set to Medium). Red arrows point from the list items to specific configuration elements: 'Select trap configurations per band' points to the 'Trap Configurations' section; 'Select which interference' points to the 'Interferences to Detect' list; 'Enable/Disable AQ threshold alert' points to the 'Enable AQI (Air Quality Index) Trap' checkbox; and 'Select Interference types for Security alert trap' points to the 'Trap on these types' list.

Wireless

802.11b > CleanAir

CleanAir Parameters

CleanAir ☒ Enabled

Report Interferers ☒ Enabled

Interferences to Detect

Bluetooth Sco Acl
Microwave
Spectrum 802 11 FH
Bluetooth Paging Inquiry
Generic TDD

Interferences to Ignore

Trap Configurations

Enable AQI (Air Quality Index) Trap ☒ Enabled

AQI Alarm Threshold (1 to 100)

Enable Interference Type Trap ☒ Enabled

Trap on these types

Jammer
Spectrum 802.11 inverted
Spectrum 802.11 non std channel

Do not trap on these types

Bluetooth Sco Acl
Microwave
Spectrum 802 11 FH
Bluetooth Paging Inquiry
Generic TDD

Event Driven RRM [\(Change Settings\)](#)

EDRRM Enabled

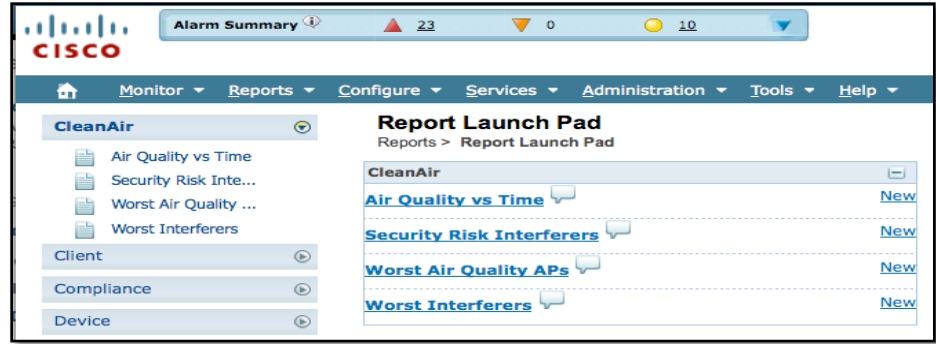
Sensitivity Threshold Medium

(1) Device Security alarms, Event Driven RRM and Persistence Device Avoidance algorithm will not work if Interferers reporting is disabled.
(2) AQI value 100 is best and 1 is worst

Granular control over trap messages for performance thresholds as well as security concerns

WCS CleanAir reports

- CleanAir reports allow configuration by floor-controller-AP and radio
- Air Quality and Security Risk Reports are all functional without MSE
- Worst Interference report requires MSE



WCS CleanAir Maps

The screenshot shows the Cisco Wireless Control System (WCS) interface. The left sidebar displays a tree view of the network hierarchy: Maps (Root Area) > System Campus > Home > 1st > 2nd > basement. The main content area shows a table of air quality data for the selected location. The table has columns for Name, Type, Total APs, a/n Radios, b/g/n Radios, Critical Radio Alarms, Clients, Status, a/n Avg Air Quality, a/n Min Air Quality, b/g/n Avg Air Quality, and b/g/n Min Air Quality. The data is filtered to show 5 entries. A callout box highlights the last four columns of the table.

Name	Type	Total APs	a/n Radios	b/g/n Radios	Critical Radio Alarms	Clients	Status	a/n Avg Air Quality	a/n Min Air Quality	b/g/n Avg Air Quality	b/g/n Min Air Quality
System Campus	Campus	5	5	5	0	3	99	98	97	97	97
System Campus > Home	Building	5	5	5	0	3	99	98	97	97	97
System Campus > Home > 1st	Floor Area	0	0	0	0	0	Not Available	Not Available	Not Available	Not Available	Not Available
System Campus > Home > 2nd	Floor Area	0	0	0	0	0	Not Available	Not Available	Not Available	Not Available	Not Available
System Campus > Home > basement	Floor Area	5	5	5	0	3	99	98	97	97	97

<u>a/n Avg Air Quality</u>	<u>a/n Min Air Quality</u>	<u>b/g/n Avg Air Quality</u>	<u>b/g/n Min Air Quality</u>
99	98	97	97
99	98	97	97
Not Available	Not Available	Not Available	Not Available
Not Available	Not Available	Not Available	Not Available
99	98	97	97

CleanAir Air Quality reports per radio and is averaged up:
By AP, By Floor, By Building, and by Campus

Select Edit View to add CleanAir Average and Minimum readings to the Maps View

WCS CleanAir Maps

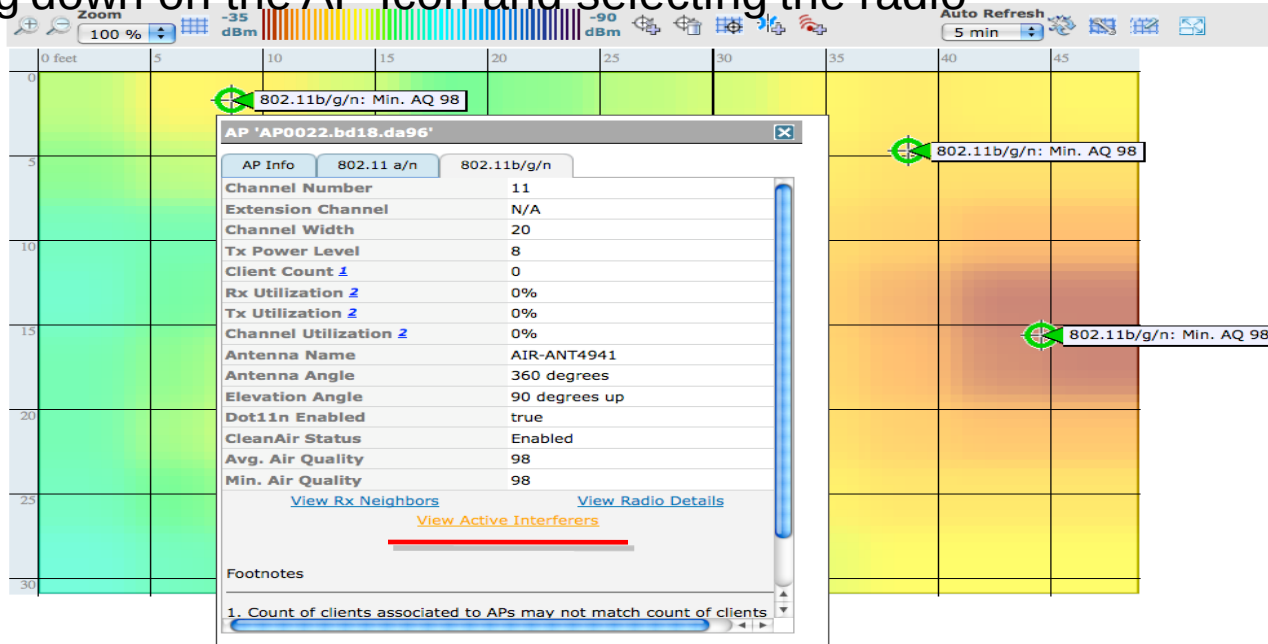
Selecting a map for a given floor provides detail relevant to the selected floor. You can change the AP tags to display CleanAir information such as CleanAir Status (shows which AP's are capable), Min or average AQ values, or Average and Minimum values. The values are relevant to the band selected.

The screenshot displays the WCS CleanAir Maps interface. On the left, a sidebar contains a 'Maps Tree View' and 'Floor Settings'. The 'Floor Settings' section includes checkboxes for 'Access Points', 'AP Heatmaps', 'Clients', '802.11 Tags', 'Rogue APs', 'Rogue Adhocs', 'Rogue Clients', 'coverageAreas', 'Location Regions', 'Ralls', 'Markers', 'Chokepoints', 'Wifi TDOA Receiver', and 'Interferers'. Below this, there is a 'Display MSE data within last' dropdown set to '2 Minutes' and a 'Save Settings' button. The main area shows a heatmap of a floor plan. Overlaid on this is an 'AP Filter' dialog box. The dialog box has a title bar with a close button. It displays 'Total APs: 4'. Under 'Show', the 'Radio Status' radio button is selected. The 'Protocol' is set to '802.11b/g/n'. The 'Display' dropdown is set to 'Min. Air Quality'. The 'RSSI Cutoff' is set to '-75 dBm'. The 'Show Detected Interferers' checkbox is checked. The 'Max. Interferers / label' is set to '3'. There are 'OK' and 'Cancel' buttons at the bottom. A red arrow points from the 'Show Detected Interferers' checkbox to a heatmap label. The heatmap label reads: '802.11b/g/n: Min. AQ 97', 'DECT Like Phone -46 dBm', 'DECT Like Phone -89 dBm', and 'Interferers(2)'. Another heatmap label to the right reads: '802.11b/g/n: Min. AQ 98', 'DECT Like Phone -37 dBm', and 'Interferers(1)'. The heatmap itself shows a color gradient from green to yellow to orange, representing different signal quality levels.

Interferers displayed in this way do not require MSE – However they are Raw and not coordinated to eliminate duplicates

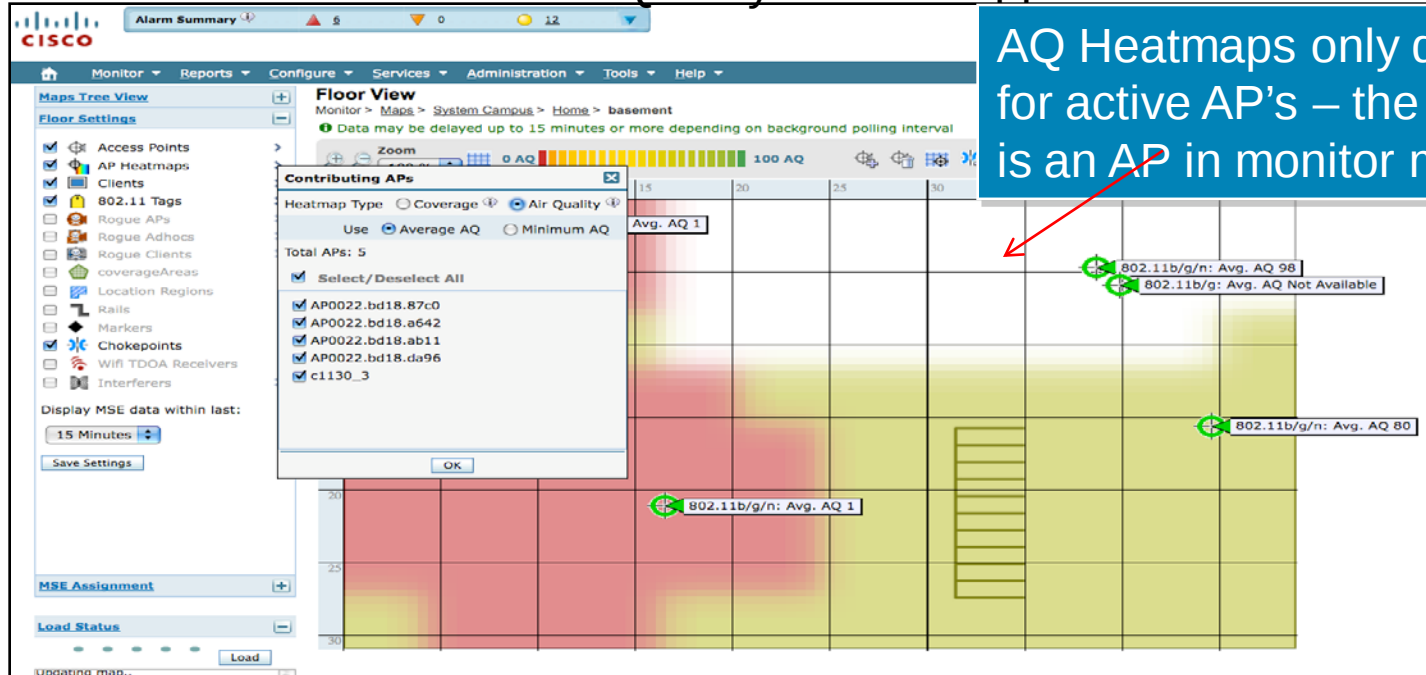
WCS CleanAir Maps

You can also view interference information being seen on any radio interface by drilling down on the AP Icon and selecting the radio



WCS CleanAir Maps

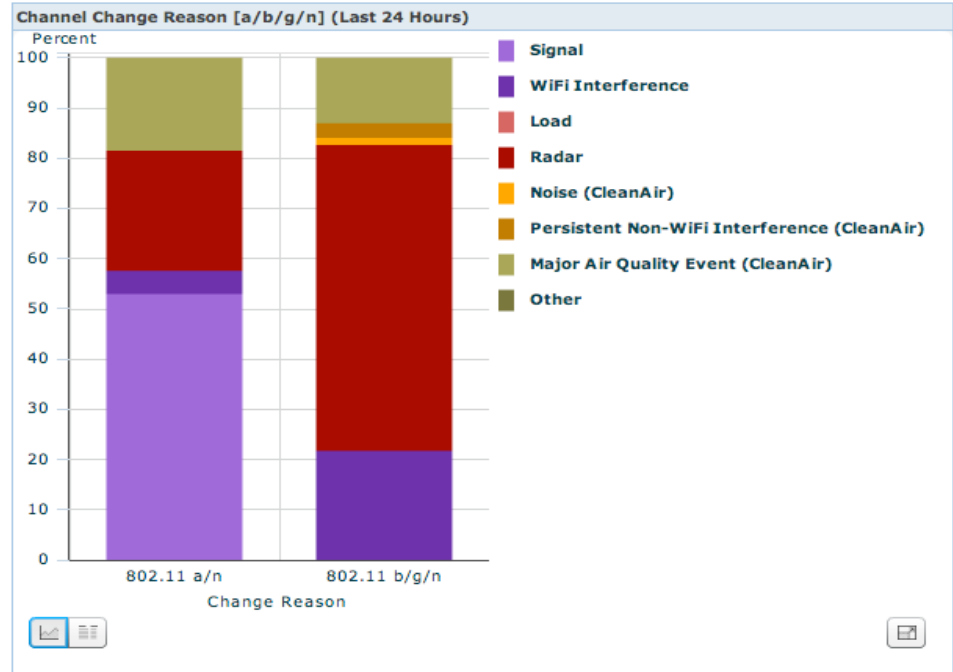
Air Quality heatmaps can be selected to represent average or minimum AQ and Provide a visualization of the Air Quality over a mapped area.



AQ Heatmaps only display for active AP's – the white area is an AP in monitor mode

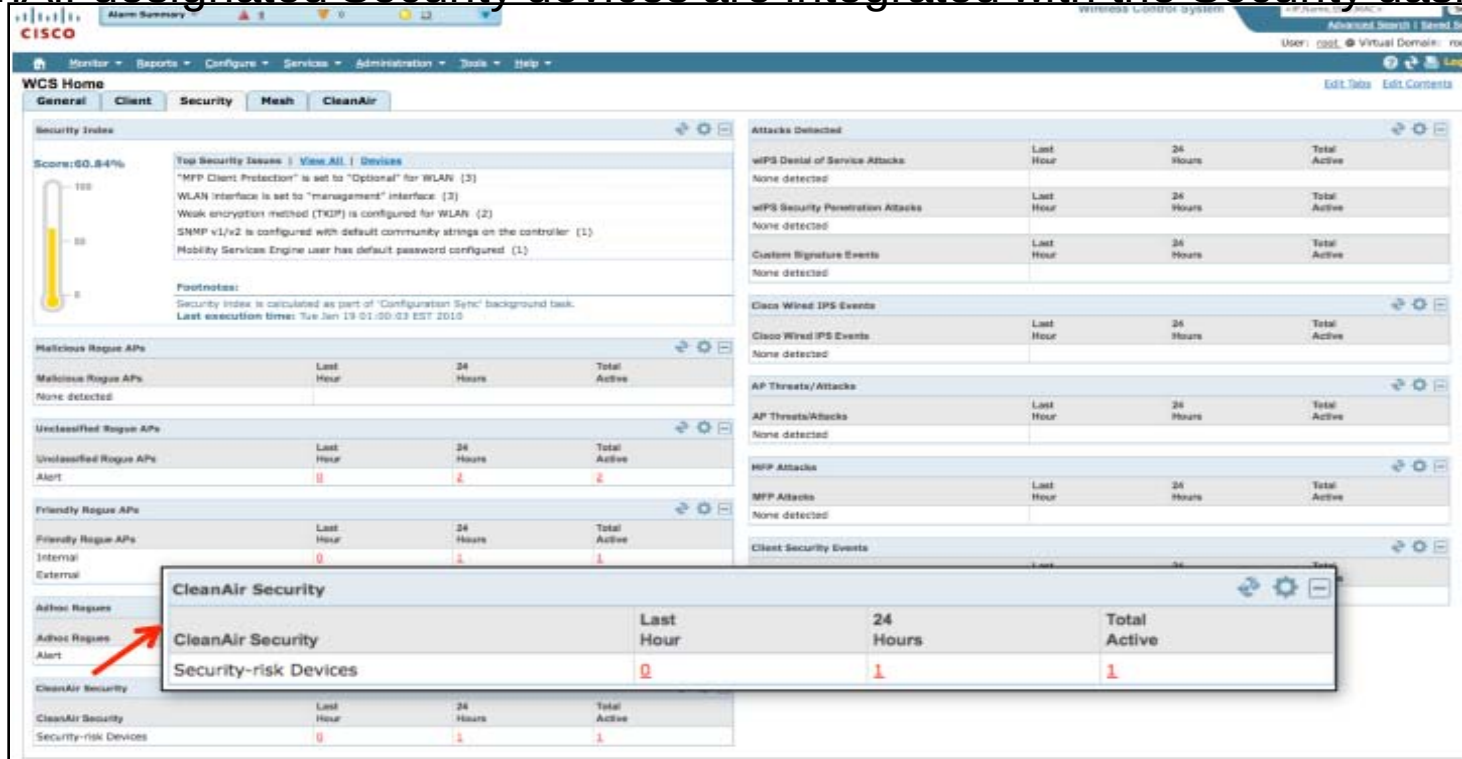
WCS – RRM Dashboard

- RRM Dashboard has been modified to capture CleanAir metrics
- Persistent device (PDA)
- Major Air Quality (ED-RRM)
- Noise



WCS CleanAir enabled Security Dashboard

CleanAir designated Security devices are integrated with the Security dashboard

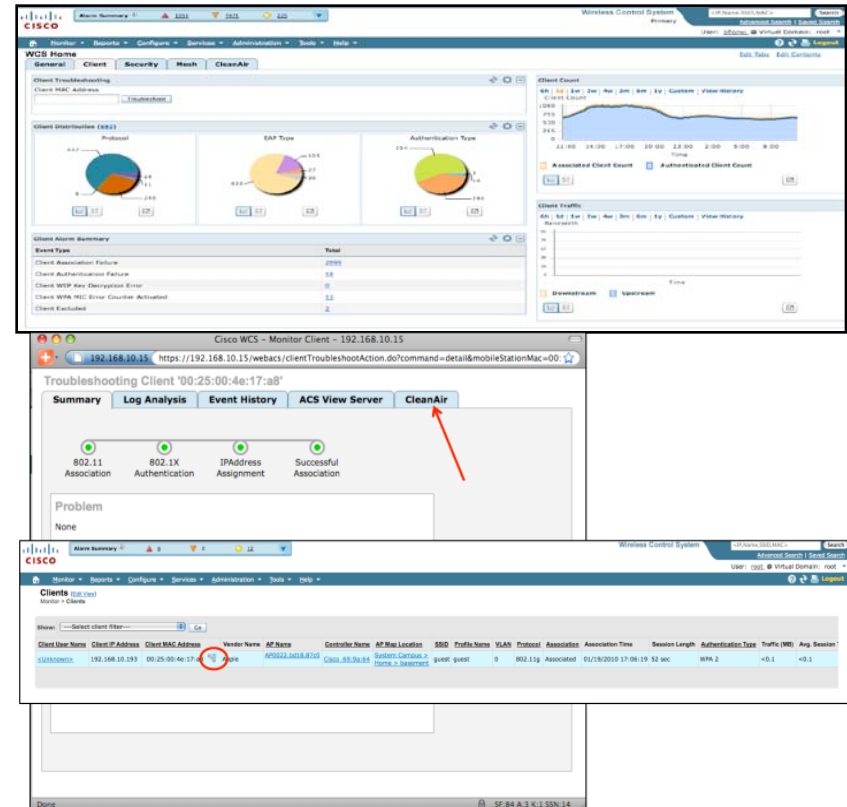


WCS CleanAir Security

- There are three devices enabled by Default for security – And not a single WIDs/WIPs solution on the market can see them
- The customer can also add any other device that they deem appropriate
 - Jammer
 - Wi-Fi Inverted
 - Wi-Fi Invalid channel
- Jammers – are self explanatory – and readily available online
- Wi-Fi inverted is simply inverting the I and the Q of the RF signal – very effective
- Off Channel is a fairly easy hack with DD-WRT – simply moving the center frequency by a few KHz will render it invisible.

WCS CleanAir Client Troubleshooting integration

- CleanAir information is also coordinated into the client troubleshooting dashboard
- Selecting a client – and launching the client TS dashboard now adds a CleanAir tab
- The TAB displays any interference source that is currently being detected by the AP the client is attached to



WCS CleanAir Client TS integration

The screenshot shows the Cisco WCS Monitor Client interface for a client with MAC address 00:25:00:4e:17:a8. The interface has several tabs: Summary, Log Analysis, Event History, ACS View Server, and CleanAir. The CleanAir tab is active, displaying a table of client details and a table of interferers.

Troubleshooting Client '00:25:00:4e:17:a8'

Summary		CleanAir	
AP Name	AP0022.bd18.87c0	Channel	11
AP Base Radio MAC	00:22:bd:cc:d5:70	Extension Channel	N/A
Radio	802.11b/g/n	Channel Width	20 MHz
CleanAir Capable	Yes	Power Level	2
CleanAir Enabled	Yes	Average AQ Index	99
Admin Status	Enabled	Minimum AQ Index	99
Operational Status	Up		

Interferer Name	Affected Channels	Detected Time	Severity	Duty Cycle (%)	RSSI (dBm)
DECT Like Phone	11	01/19/2010 17:05:23 PM	1	1	-47

[CleanAir Details](#)

CleanAir Configuration



CleanAir WLC enable (WCS identical under Configure=>Controllers)

The screenshot displays the Cisco WLC configuration page for CleanAir. The left sidebar shows the navigation tree with 'Wireless' expanded, leading to 'Access Points' and then 'Radios'. The 'Radios' section is further expanded to show '802.11a/n', '802.11b/g/n', and 'Global Configuration'. The '802.11b/g/n' radio is selected, and the 'CleanAir' tab is active. The main content area shows the 'CleanAir Parameters' section, which includes a 'CleanAir' checkbox (checked) and a 'Report Interferers' checkbox (checked). Below this, the 'Interferences to Detect' list includes 'Bluetooth Sco Acl', 'Microwave', 'Spectrum 802.11 FH', 'Bluetooth Paging Inquiry', and 'Generic TDD'. The 'Interferences to Ignore' list is empty. The 'Trap Configurations' section includes 'Enable AQI(Air Quality Index) Trap' (checked), 'AQI Alarm Threshold (1 to 100)' (set to 85), and 'Enable Interference Type Trap' (checked). The 'Trap on these types' list includes 'Jammer', 'Spectrum 802.11 inverted', and 'Spectrum 802.11 non std channel'. The 'Do not trap on these types' list includes 'Bluetooth Sco Acl', 'Microwave', 'Spectrum 802.11 FH', 'Bluetooth Paging Inquiry', and 'Generic TDD'.

Wireless=>802.11a/b=>CleanAir

CleanAir is enabled by Default on the AP Interface
it is disabled Globally by default on the controller.

WLC CLI
(Cisco Controller) >config 802.11a/b cleanair enable

(2)AQI value 100 is best and 1 is worst

Per AP radio CleanAir Feature Enable

- Enabled by default – but the first place to check -

The screenshot shows the Cisco Wireless Configuration interface for 802.11a/n Cisco APs. The 'CleanAir' section is highlighted with a red box, indicating the status of the CleanAir feature. The 'CleanAir Status' is set to 'Enable'.

General

AP Name	AP0022.bd18.ab11
Admin Status	Enable
Operational Status	UP
Slot #	1

11n Parameters

11n Supported	Yes
ClientLink	☒

CleanAir

CleanAir Capable	Yes
CleanAir Status	Enable
Number of Spectrum Expert connections	0

Antenna Parameters

Antenna Type	External									
Antenna	<table><tr><td>A</td><td>☒</td><td>☒</td></tr><tr><td>B</td><td>☒</td><td>☒</td></tr><tr><td>C</td><td>☒</td><td>☒</td></tr></table>	A	☒	☒	B	☒	☒	C	☒	☒
A	☒	☒								
B	☒	☒								
C	☒	☒								
Antenna Gain	7 x 0.5 dBi									

RF Channel Assignment

Current Channel	153 (Extension : 149)
Channel Width*	40 MHz
Assignment Method	Custom 153

Tx Power Level Assignment

Current Tx Power Level	1
Assignment Method	Global

Performance Profile

View and edit Performance Profile for this AP.

Note: Changing any of the parameters causes the Radio to be temporarily disabled and thus may result in loss of connectivity for some clients.

WCS CleanAir Status

Alarm Summary 22 0 10

Wireless Control System

Search IP Name, SSID, MAC

Advanced Search | Saved Search

User: root Virtual Domain: root Logout

Monitor Reports Configure Services Administration Tools Help

Access Points (Edit View)

Monitor > Access Points

Generate report for selected APs Select a report Go

Entries 1 - 14 of 14

AP Name	Ethernet MAC	IP Address	Radio	Map Location	Controller	Client Count	Admin Status	AP Mode	Oper Status	Alarm Status	CleanAir Capable	Channel Number	CleanAir Sensor Status	CleanAir Status
☐ AP0022-bd18-87c0	00:22:bd:18:87:c0	192.168.10.89	802.11b/g/n	System Campus > Home > basement	192.168.10.8	1	Enabled	Local	Up	Up	Yes	11	Up	Enabled
☐ AP0022-bd18-87c0	00:22:bd:18:87:c0	192.168.10.89	802.11a/n	System Campus > Home > basement	192.168.10.8	1	Enabled	Local	Up	Up	Yes	64	Up	Enabled
☐ AP0022-bd18-ab11	00:22:bd:18:ab:11	192.168.10.88	802.11b/g/n	System Campus > Home > basement	192.168.10.8	0	Enabled	Local	Up	Up	Yes	11	Up	Enabled
☐ AP0022-bd18-ab11	00:22:bd:18:ab:11	192.168.10.88	802.11a/n	System Campus > Home > basement	192.168.10.8	0	Enabled	Local	Up	Up	Yes	153	Up	Enabled
☐ AP0022-bd18-a642	00:22:bd:18:a6:42	192.168.10.67	802.11b/g/n	System Campus > Home > basement	192.168.10.8	0	Enabled	Local	Up	Up	Yes	1	Up	Enabled
☐ AP0022-bd18-a642	00:22:bd:18:a6:42	192.168.10.67	802.11a/n	System Campus > Home > basement	192.168.10.8	0	Enabled	Local	Up	Up	Yes	48	Up	Enabled
☐ c1130_3	00:1b:0c:92:b1:2c	192.168.10.68	802.11b/g	System Campus > Home > basement	192.168.10.8	0	Disabled	Local	Down	Up	No	6	N/A	N/A
☐ c1130_3	00:1b:0c:92:b1:2c	192.168.10.68	802.11a	System Campus > Home > basement	192.168.10.8	0	Disabled	Local	Down	Up	No	64	N/A	N/A
☐ AP001b-d513-1652	00:1b:d5:13:16:52	192.168.10.79	802.11b/g/n	Unassigned	192.168.10.8	0	Disabled	Local	Down	Up	No	6	N/A	N/A
☐ AP001b-d513-1652	00:1b:d5:13:16:52	192.168.10.79	802.11a/n	Unassigned	192.168.10.8	0	Disabled	Local	Down	Up	No	153	N/A	N/A
☐ AP0022-bd18-da96	00:22:bd:18:da:96	192.168.10.50	802.11b/g/n	System Campus > Home > basement	192.168.10.8	0	Enabled	Local	Up	Up	Yes	6	Up	Enabled
☐ AP0022-bd18-da96	00:22:bd:18:da:96	192.168.10.50	802.11a/n	System Campus > Home > basement	192.168.10.8	0	Enabled	Local	Up	Up	Yes	36	Up	Enabled
☐ csc0_1250	00:1b:d5:13:1a:96	192.168.10.97	802.11b/g/n	Unassigned	192.168.10.8	0	Disabled	Local	Down	Up	No	1	N/A	N/A
☐ csc0_1250	00:1b:d5:13:1a:96	192.168.10.97	802.11a/n	Unassigned	192.168.10.8	0	Disabled	Local	Down	Up	No	64	N/A	N/A

This is a dissociated AP. All of the data presented on this page is from WCS database.

Entries 1 - 14 of 14

- Monitor=>Access Points
- Edit View – add CleanAir Status and CleanAir Capable
- CleanAir sensor status –

MSE – Context Aware

WCS=>Services=>MSE=>Context Aware Service=>Administration=>tracking parameters

Alarm Summary 2 0 15

Wireless Control System <IP,Name,SSID,MAC> Search

Advanced Search | Saved Search

User: root @ Virtual Domain: root Logout

Monitor Reports Configure Services Administration Tools Help

System

Context Aware Service

General

Administration

Tracking Parameters

Filtering Parameters

History Parameters

Presence Parameters

Import Asset

Information

Export Asset

Information

Wired

Advanced

Partner Engine

Notification Statistics

Tracking Parameters: mse

Services > Mobility Services > mse > Context Aware Service > Administration > Tracking Parameters

The SNMP parameters and Polling Interval are applicable for Controller version 4.1 or below

Tracking Parameters

Network Location Service Elements: Licensed Limit = 1000

Enable	Tracking Parameters	Enable Limiting	Limit Value	Active Value
☒	Wired Clients	☐	0	0
☒	Wireless Clients	☐	0	10
☐	Rogue Clients and AccessPoints	☐	0	0
☐	Exclude Admin Rogue APs	☐	0	0
☒	Interferers	☐	0	2

Asset Tracking Elements: Licensed Limit = 100

Enable	Tracking Parameters	Active Value	Not Tracked
☒	Active RFID Tags	0	0

SNMP Parameters

SNMP Retry Count 3 0 - 99999

SNMP Timeout 5 0 - 99999 secs

SNMP Polling Interval

Client Stations 300 1 - 99999 secs

Active RFID Tags 600 1 - 99999 secs

Rogue Clients and AccessPoints 600 1 - 99999 secs

Statistics 900 1 - 99999 secs

Save Cancel

Disabled by Default

MSE – Context Aware - History

WCS=>Services=>MSE=>Context Aware Service=>Administration=>History Parameters

The screenshot shows the Cisco WCS Administration interface. The breadcrumb path is: Services > Mobility Services > mse > Context Aware Service > Administration > History Parameters. The left sidebar shows the navigation tree with 'History Parameters' selected under 'Context Aware Service Administration'. The main content area is titled 'History Parameters: mse' and contains the following settings:

- Archive for: 30 days
- Prune data starting at: 23 hours 50 minutes and also every 1440 minutes
- Enable History Logging of Location Transitions for:
 - ☒ Client Stations
 - ☐ Wired Stations
 - ☐ Asset Tags
 - ☐ Rogue Clients and Access Points
 - ☒ Interferers

Two red boxes highlight the 'Enable History Logging of Location Transitions for' section and the 'Interferers' checkbox. A callout box with an arrow pointing to the 'Interferers' checkbox contains the text 'Disabled by Default'.

- Cisco CleanAir design Guide
 - http://www.cisco.com/en/US/products/ps10315/products_tech_note09186a0080b4bdc1.shtml
- Cisco CleanAir – White Papers
 - http://www.cisco.com/en/US/netsol/ns1070/networking_solutions_white_papers_list.html
- CleanAir TechWise TV Broadcast
 - http://www.cisco.com/en/US/solutions/ns340/ns339/ns638/ns914/html_TWT_V/twtv_episode_67.html
- Cisco AP3500 – CleanAir
 - <http://www.cisco.com/en/US/products/ps10981/index.html>

