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Design & Deployment of Outdoor Mesh Wireless Networks

BRKEWN-2027

Brian Levin – Technical Marketing
ENG

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Session Abstract

- This intermediate session will describe the Outdoor wireless products involved in delivering outdoor broadband wireless services for Service Providers, Municipalities, Transportation and other end user customers.
- The Cisco Outdoor Wireless Bridging and MESH Technologies will be discussed in detail. The session is intended for wireless network architects, network designers, network planners working in Service Providers, Systems Integrators, small providers and enterprise customers.
- Attendees should have some base knowledge in configuration of IP routers, Wi-Fi access points, and policy management. Basic understanding of Controller Architecture and Service Provider networks and services is required.

Session Agenda

- Discuss Outdoor wireless trends
- Address how Outdoor Wireless can meet your business needs
- Overview of Cisco's Outdoor Wireless Solution
- Pre-planning for a large scale deployment
- Design and planning recommendations / best practices
- Cisco Outdoor Product Roadmap

What is Outdoor Wireless all About?

End user devices

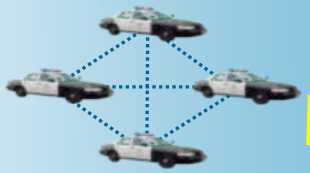
Broadband Tech

WiFi, HSxPA, HiperLan
MaNet, LTE…



What is outdoor wireless?

Mobility


Applications



Cisco Wi-Fi and Wi-Fi Mesh is Ready for Outdoors

Cost effective

- No licenses
- Large ecosystem of suppliers
- Availability of client devices
- Zero on-going communication costs

Standard

- CPE and client devices interoperability
- Attention from the industry (ex. Security)
- It's global. Same frequencies everywhere

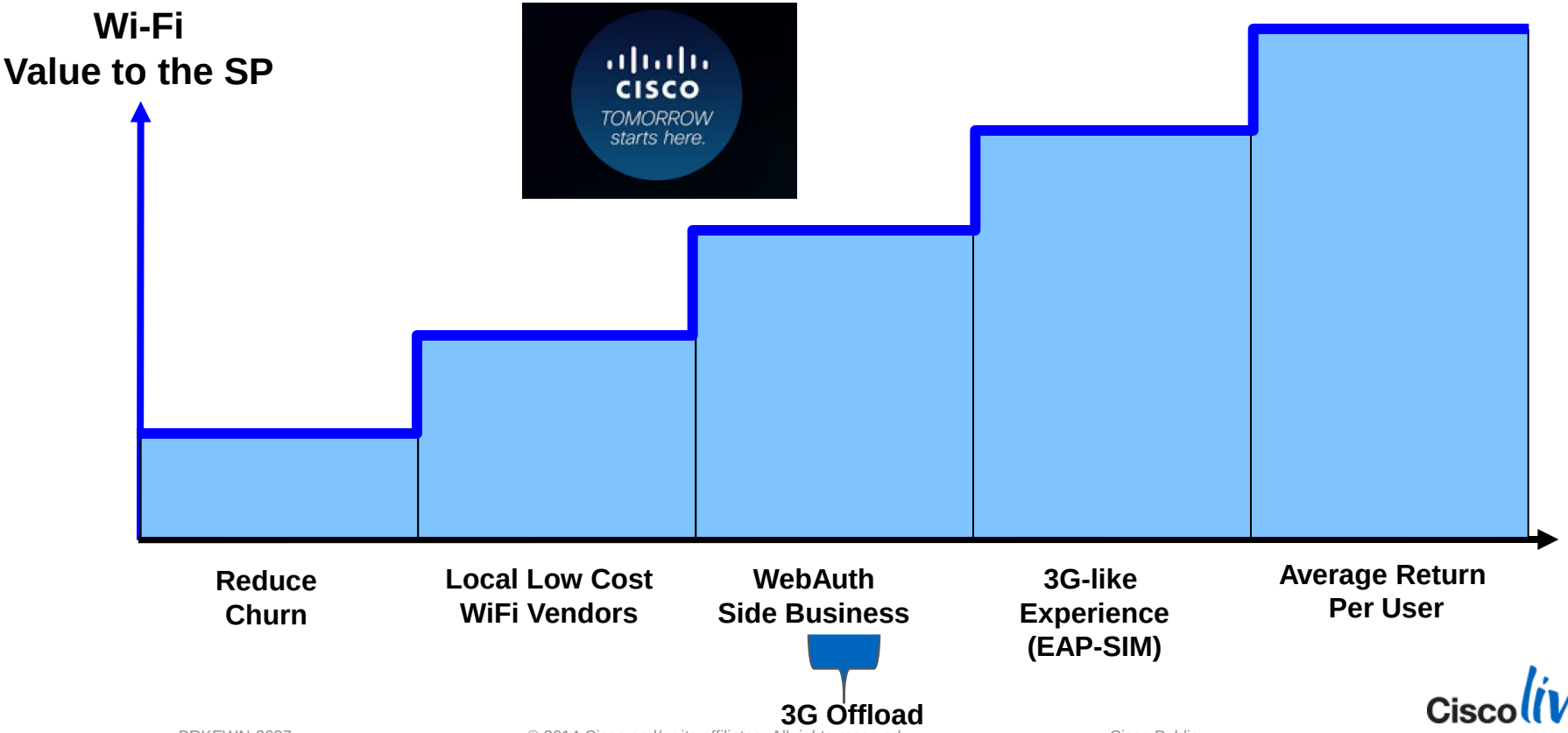
Mature technology

- Can mitigate interferences
- Large unlicensed spectrum (> 300 MHz)
- Can deliver throughput where you want it

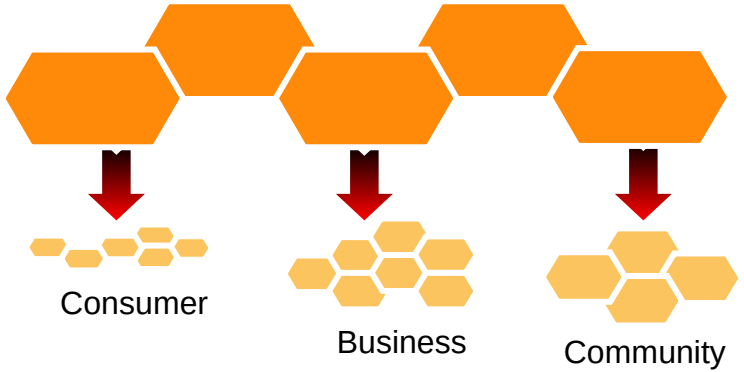
Scalability & Ease of use

- Just keep on adding nodes
- Low impact for new sites
- Outdoor extension of the indoor Wireless LAN

Service Provider Wi-Fi Levels of Adoption



Small Cells Increase Existing Capacity



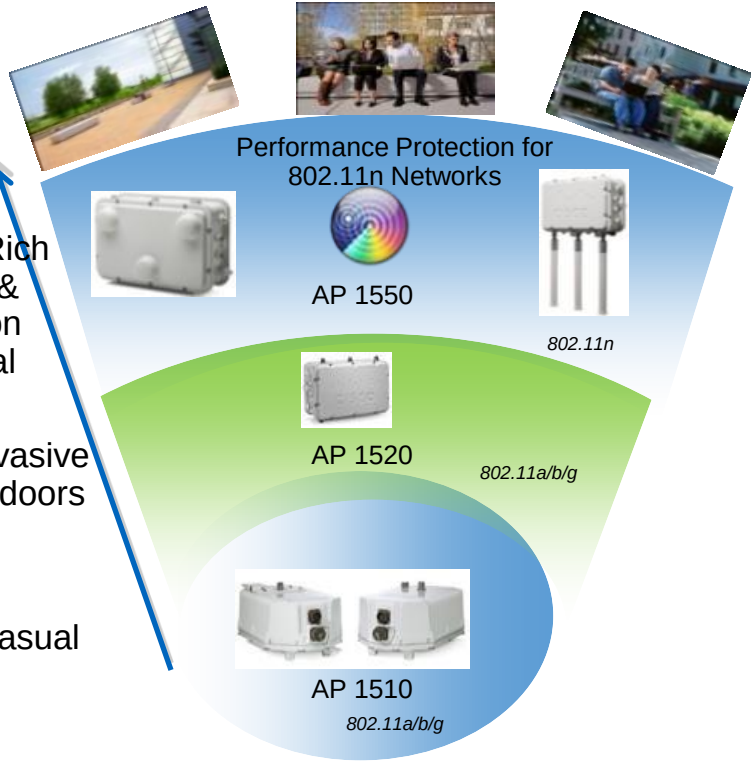
- Hierarchical Networks are the best solutions
- Spectrum Allocation is not increasing significantly
- Small Cells are the only answers to exponential growth in Data Traffic

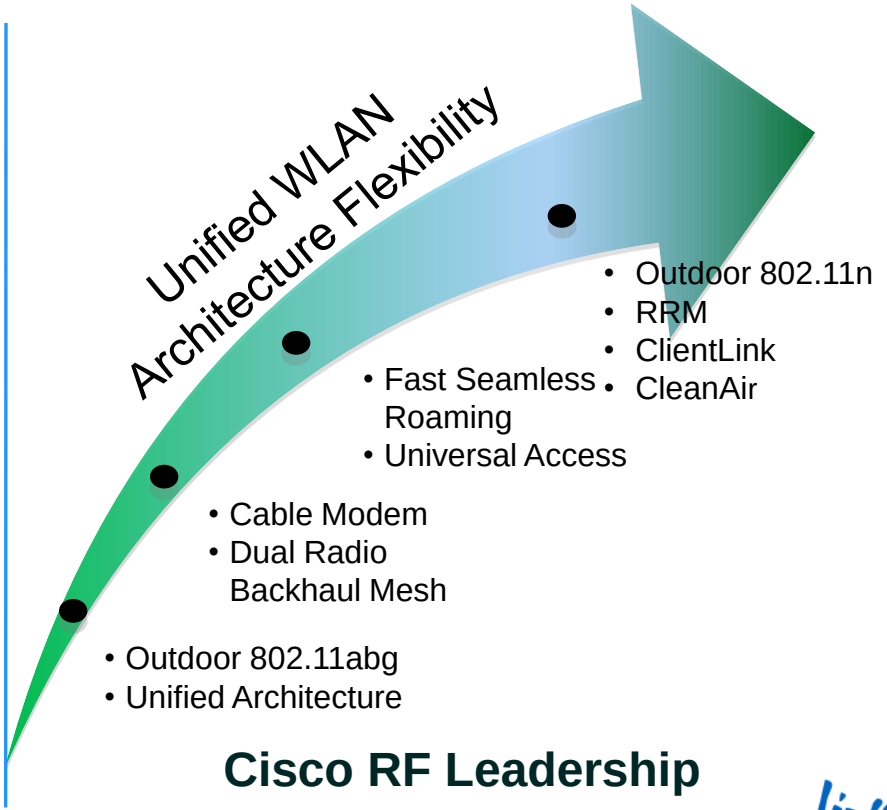
Mobile Network Operators (MNO)

Cable Operators (MSO)

Future networks supporting the mobile Internet will need to seamlessly integrate a lot more smaller cells

Enterprise/SP Outdoor Wireless Evolution



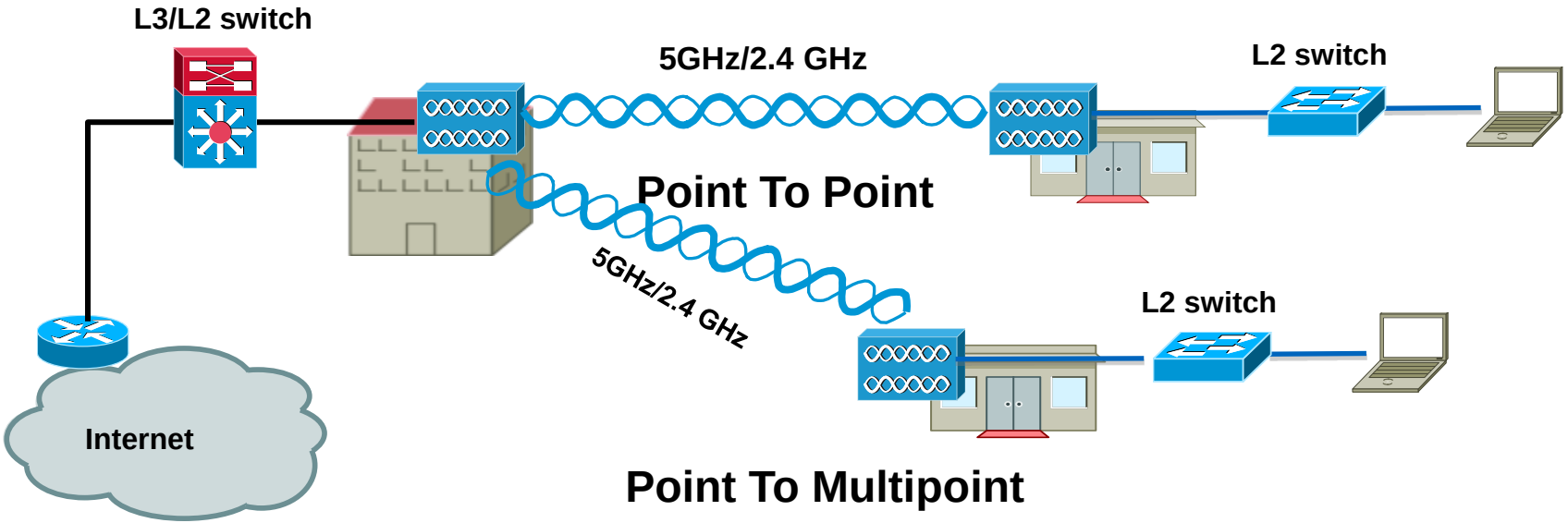


Cisco RF Leadership

Cisco Outdoor Mesh Architecture Overview

Cisco Outdoor Mesh Architecture Overview

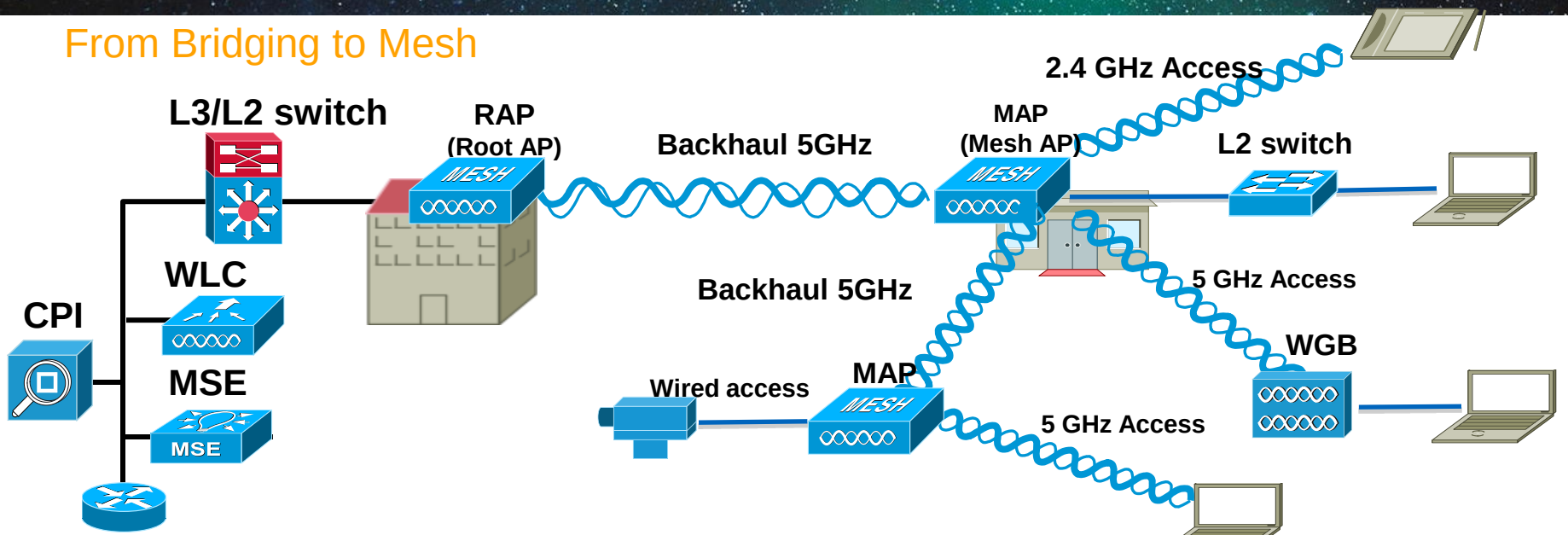
Bridging



Bridging: basic LAN to LAN wireless connectivity

Cisco Outdoor Mesh Architecture Overview

From Bridging to Mesh

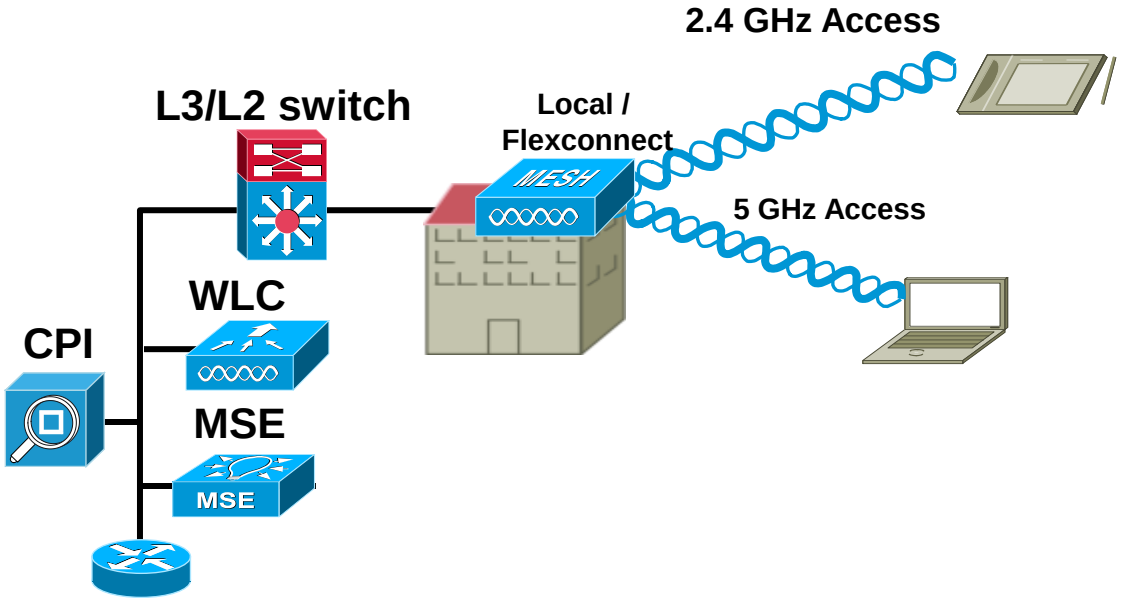


Mesh Deployment Flexibility:

- LAN-to-LAN connectivity
- Multiple hop backhaul
- 2.4 GHz and 5GHz wireless client access
- Ethernet Access to wired clients
- LAN-to-LAN in motion with Work Group Bridge (WGB)

Cisco Outdoor Mesh Architecture Overview

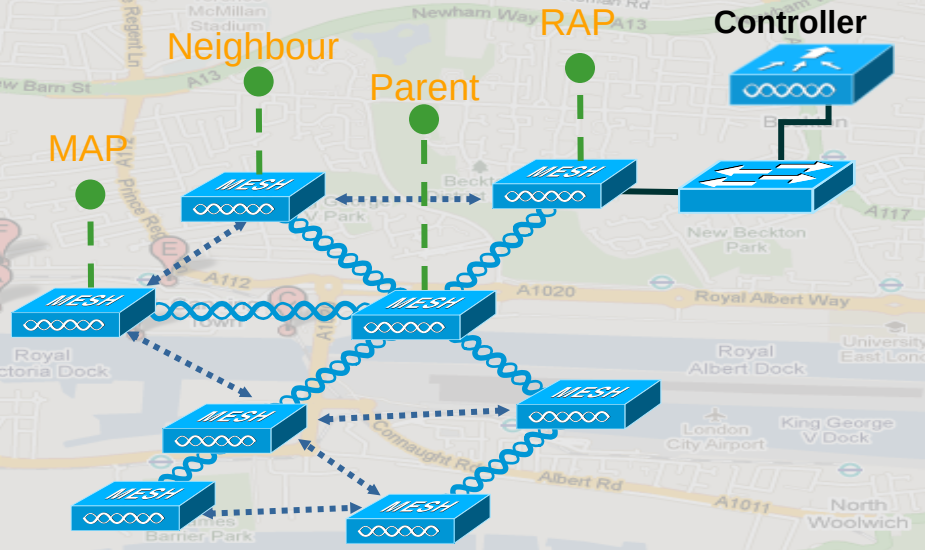
Outdoor AP in Local / Flexconnect mode



Cisco Outdoor Mesh Architecture Overview

Self-configuring, Self-healing Mesh

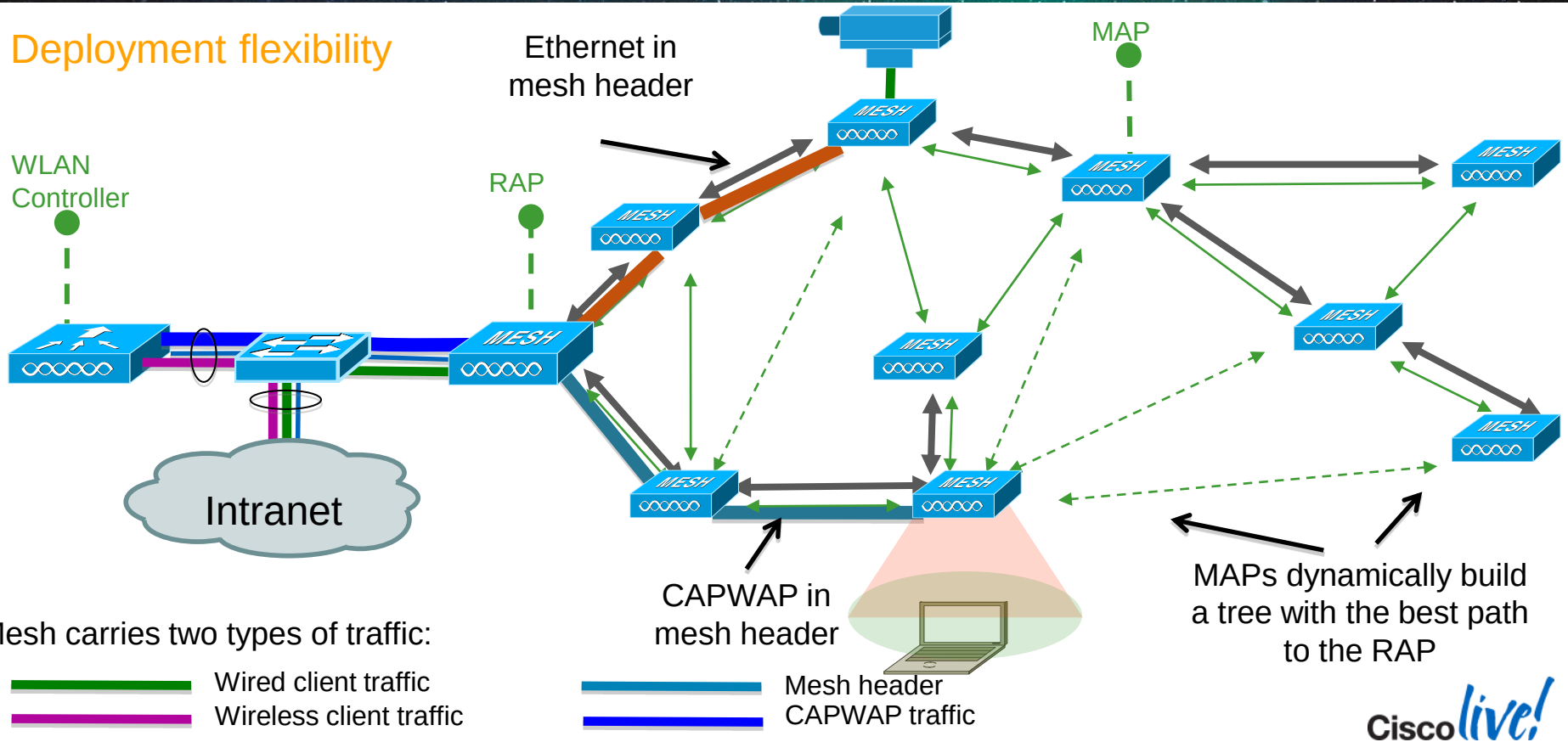
- Optimal parent selection selects the path “ease” across each available backhaul
- Ease based on number of hops and link SNR (Signal Noise Ratio)
- AWPP uses a “Parent Stickiness” value to mitigate Route Flaps
- AWPP integrates 802.11h DFS (Dynamic Frequency Selection) for radar detection and avoidance
- From release 7.0.116 preferred parent can be configured



Adaptive Wireless Path Protocol (AWPP)
establishes the best path to the Root

Cisco Outdoor Mesh Architecture Overview

Deployment flexibility



Cisco Outdoor Mesh Architecture Overview

Scalability at different layers

Access Point

32 MAPs per RAP (20 recommended)

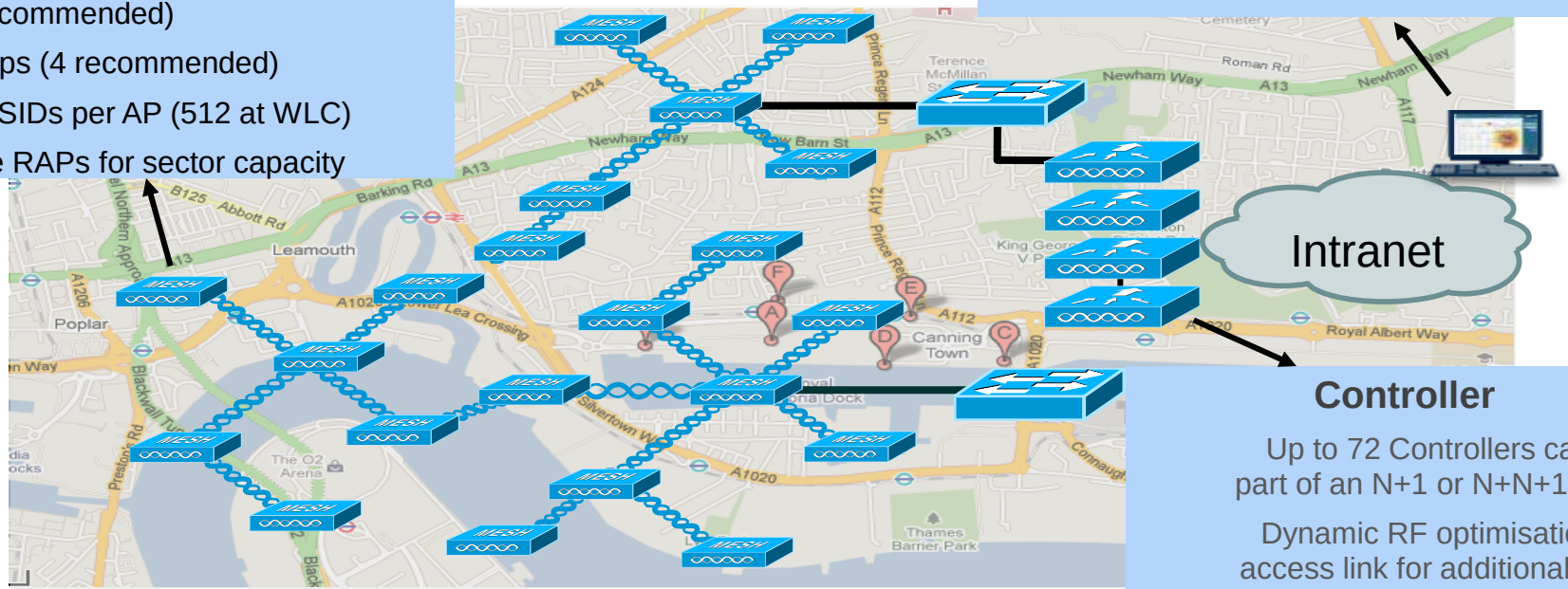
8 Hops (4 recommended)

16 SSIDs per AP (512 at WLC)

More RAPs for sector capacity

Management

Prime manages up to 15000 APs



Controller

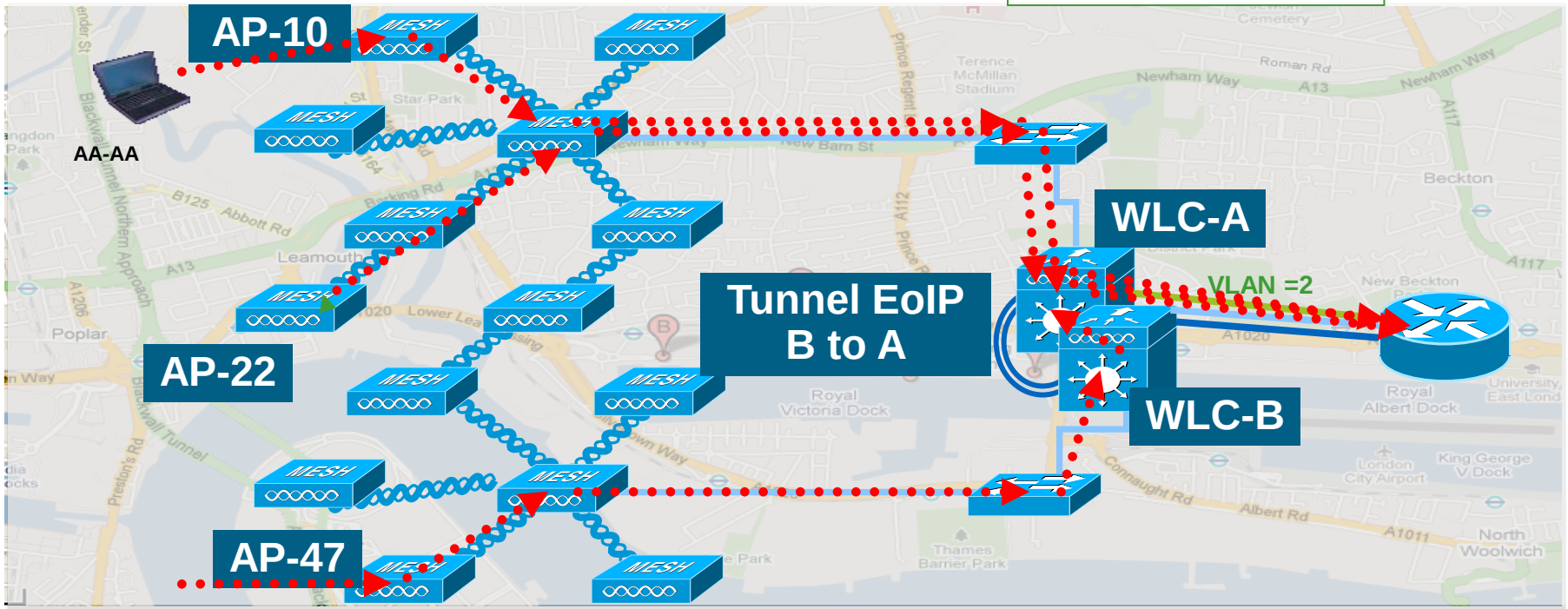
Up to 72 Controllers can be part of an N+1 or N+N+1 cluster

Dynamic RF optimisation on access link for additional radios

Cisco Outdoor Mesh Architecture Overview

Seamless user mobility

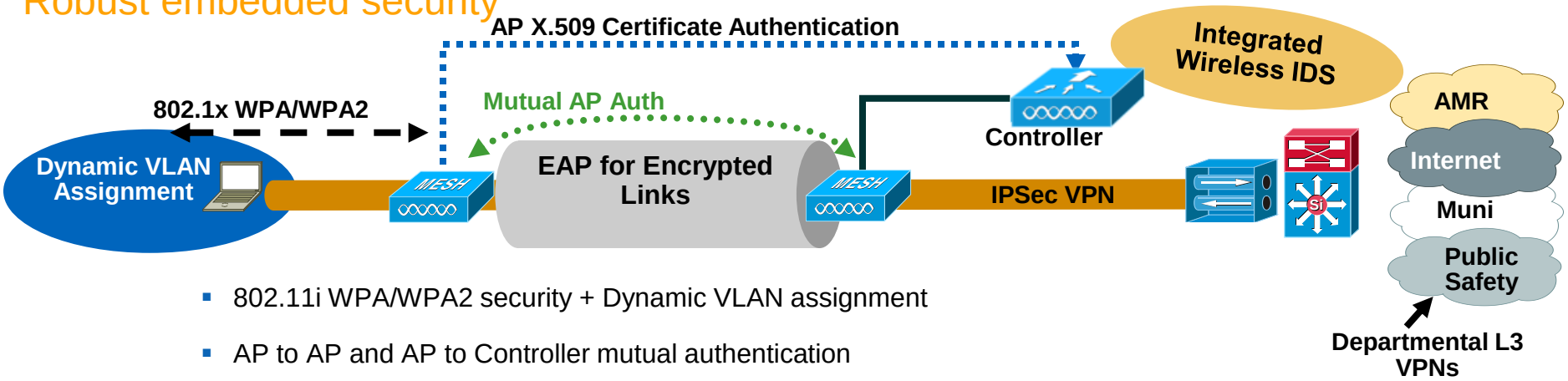
Intra-controller Roaming



MAC	SSID	AP	WLAN	WLC	VLAN	IP
AA-AA	**OpenWiFi**	**47**	**2**	**B-A**	**2**	**10.10.10.2**

Cisco Outdoor Mesh Architecture Overview

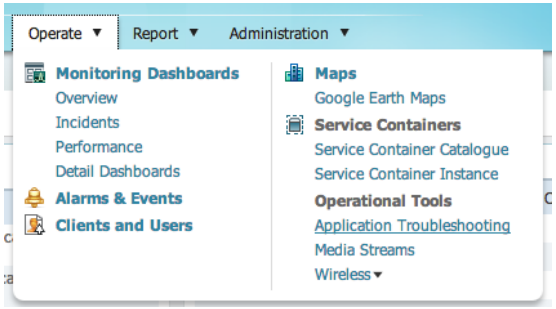
Robust embedded security

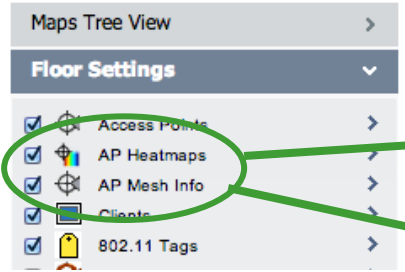


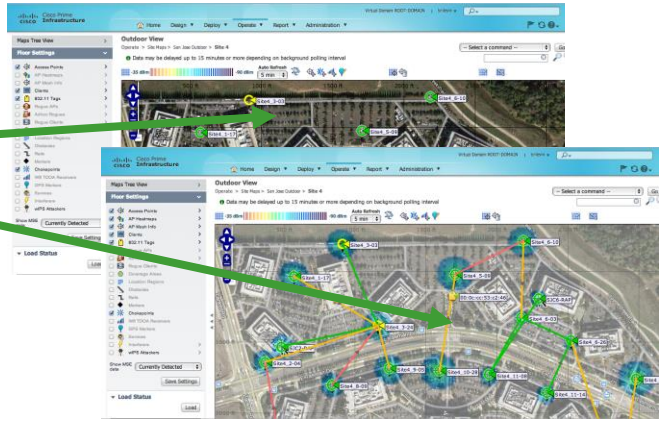
- 802.11i WPA/WPA2 security + Dynamic VLAN assignment
- AP to AP and AP to Controller mutual authentication
- EAP authenticated and AES-based encrypted backhaul mesh links
- Encrypted control traffic between AP and Controller
- Rogue AP detection and blacklisting
- Integrated Wireless IDS and Attack correlation software
- Mobile L3 VPNs for “confidential” client traffic

  Cisco’s AnyConnectVPN Client uninterrupted L3 roaming between Wi-Fi, cellular, etc. networks

Prime Infrastructure: Tracking Mesh APs / Clients



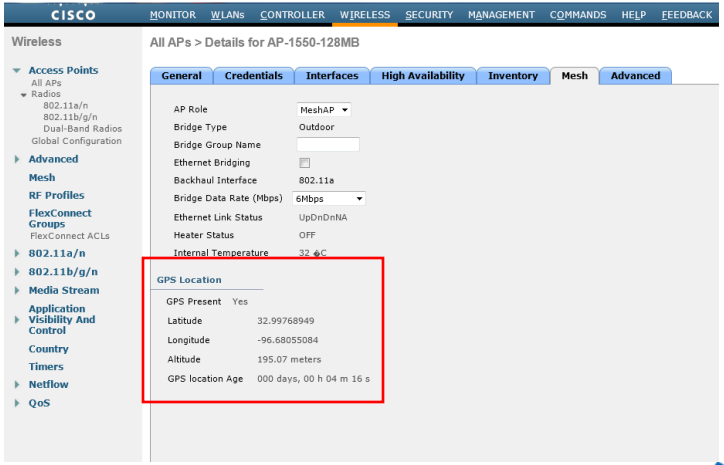




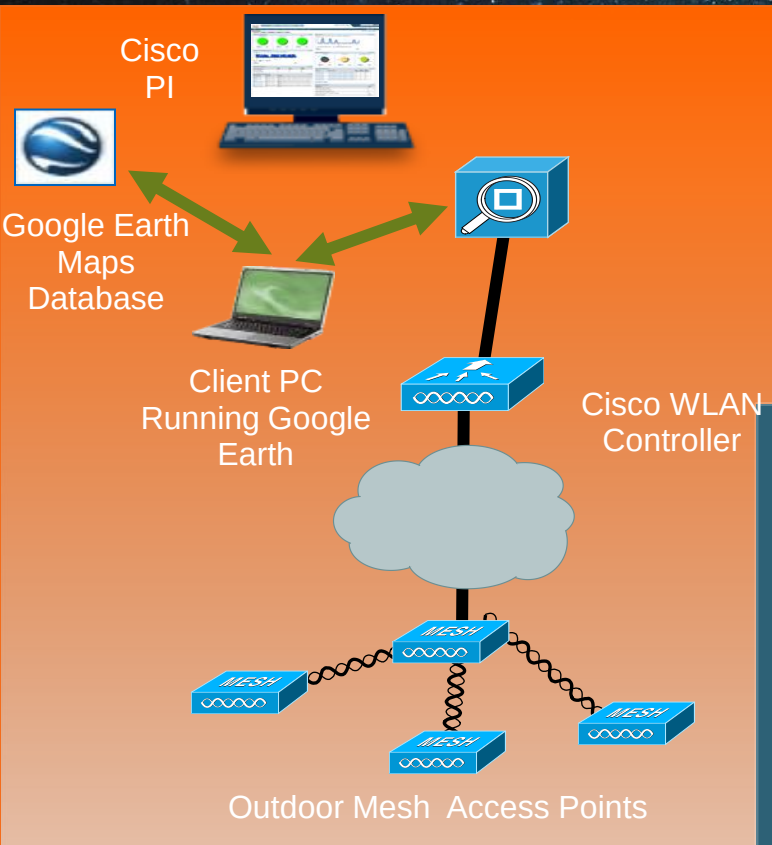
GPS status is visible on controller via following CLI commands.

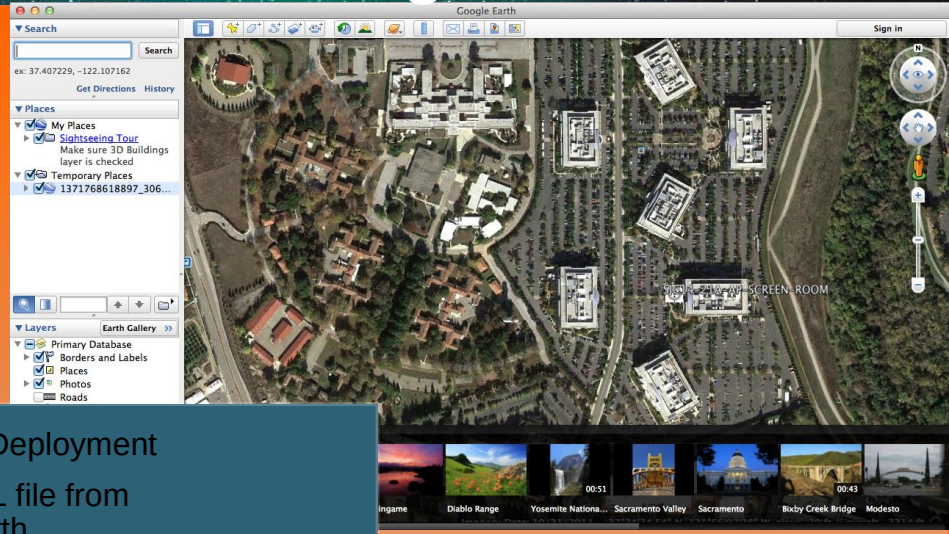
(Cisco Controller) >show mesh gps location summary

AP Name	GPS Present	Latitude	Longitude	Altitude	GPS location Age
AP-1520	NO	N/A	N/A	N/A	N/A
AP-1550	YES	32.99876807	-96.68068025	46.21 meters	000 days, 00 h 03 m 22 s



Prime Infrastructure: Google Earth Integration

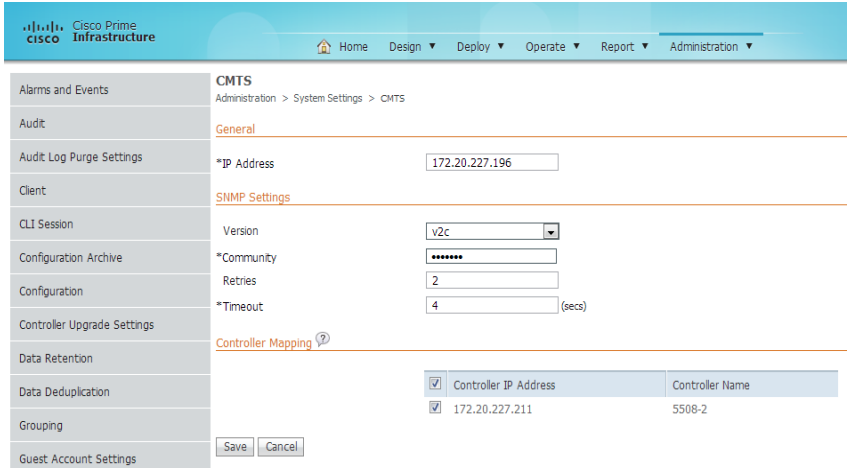




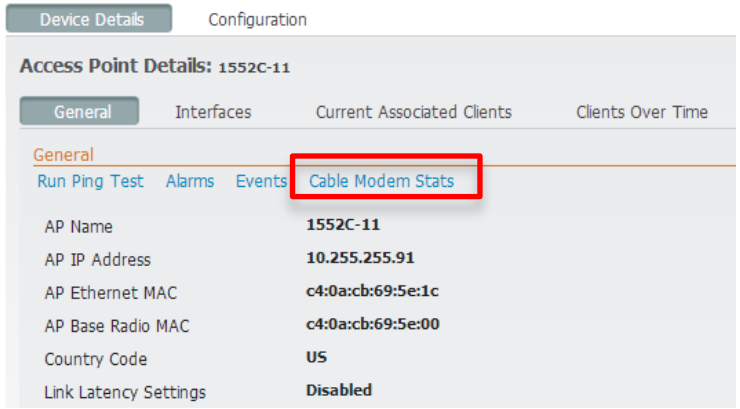
- Simplified Deployment
- Export KML file from Google Earth
- Audit of MAC address and access point name performed by Cisco PI
- Launch Google Earth from within Cisco PI
- Alternate: Import a CSV file into Cisco PI

Prime Infrastructure: Cable Modem Monitoring 1.4

Add CMTS to CPI 1.4 using:
Administrator->System Settings->CMTS Configuration



Operate->Device Work Centre->Device Type->Unified AP
Then select a 1552C



Prime Infrastructure: Cable Modem Monitoring 1.4

Cable Modem Details

Statistics | Event Logs

Properties	Values
Cable Modem MAC Address	60:2a:d0:02:88:b0
Cable Modem Serial Number	N/A
Mesh AP MAC Address	c4:0a:cb:69:8d:20
Cable Modem status	RegistrationComplete
Downstream Receive Frequency	0
Upstream Transmit Frequency	17000000
Downstream Receive Power Signal level	0
Upstream Transmit Power Signal level	0
Upstream Carrier-to-Noise Ratio	300

Cable Modem Details

Statistics | Event Logs

ID	First Time	Last Time	Level	Description
80090005	2013-2-28 12:28:29.7	2013-2-28 12:28:29.7		LinkDown:Interface Cable5/0/4 changed state to down
80090004	2013-2-28 12:28:36.0	2013-2-28 12:28:36.0		LinkUp:Interface Bundle1 changed state to up
80090005	2013-2-28 12:28:36.4	2013-2-28 12:28:36.4		LinkDown:Interface Integrated-Cable5/0/1:3 changed state to down
80090004	2013-2-28 12:28:36.5	2013-2-28 12:31:31.1		LinkUp:Interface Cable5/0/4 changed state to up

Note: The SNMP community string must be r/w

Access Point Modes Overview

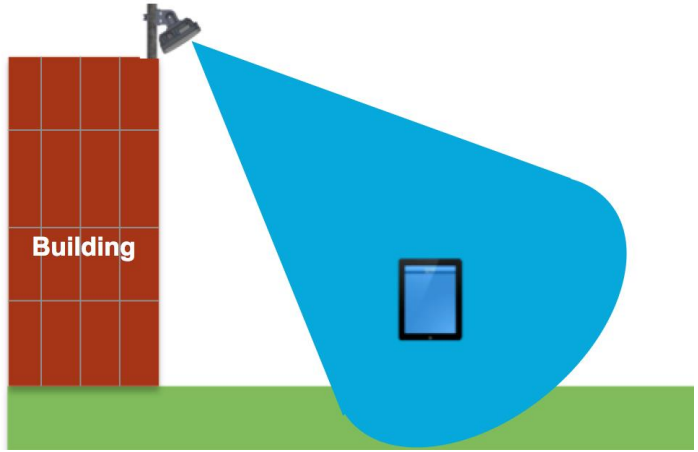
AP Modes Supported

- Mesh Access Points Now Support:
  - Local mode
  - Monitor mode
  - Flexconnect Mode
  - Sniffer Mode
  - Rogue Detector Mode
- New Modes provide flexibility
  - No longer just an outdoor meshing product!
- Why use a AP15X2, not an indoor AP?
  - Ruggedised AP (IP67 rated)
  - Transmits at higher power levels (depending on Regulatory Domain)
  - Meets outdoor regulatory constrains
  - No expensive NEMA enclosure

AP Modes Overview

Local Mode vs. Bridge Mode

- Local mode is supported
- Features:
  - Local mode feature parity
    - Client link 1.0 (if supported by AP)
    - CleanAir on both bands (if supported by AP)
    - ED-RRM on both bands
    - Band select
    - VideoStreaming
    - Improved VoWLAN performance
    - Avoids sending mesh beacons when no MAPs are present

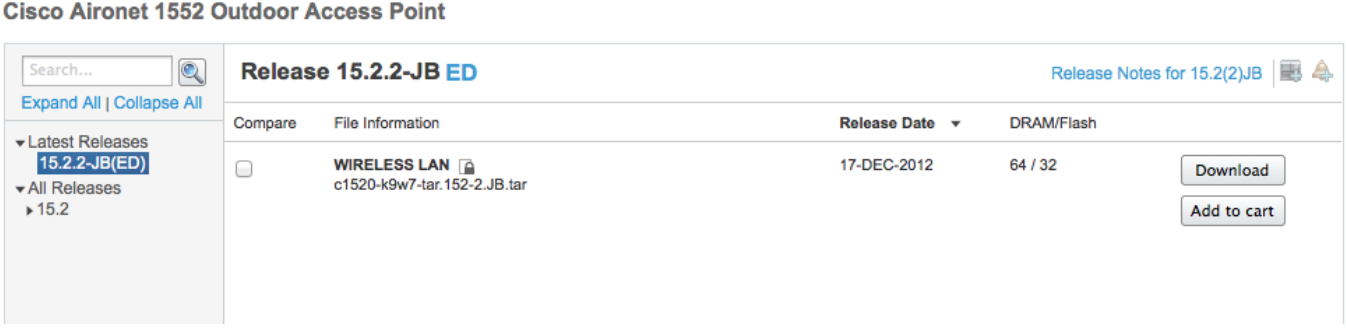


- Use case: Citywide WIFI using the AP1552C
  - Each AP has a dedicated backhaul, so there is no need to mesh. Local Mode provides a feature rich end-user experience

AP Modes Overview

Autonomous Mode

- Fully functional aIOS image for the AP1552 and AP1532
  - Feature parity with all other aIOS APs!!
- aIOS Features
  - IPv6 Support
  - Spectrum Expert Mode
  - 802.11r
- Orderable as a separate AP1552 product, but as a single skew for AP1532



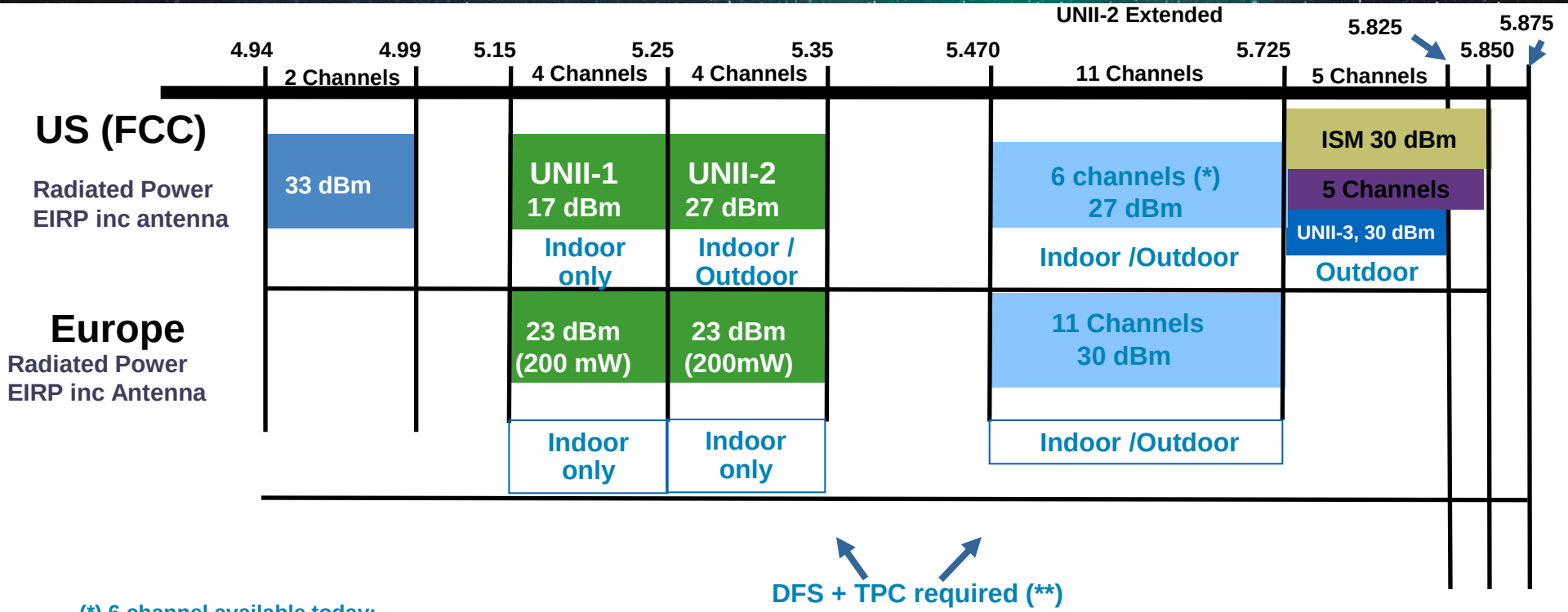
How to Deploy Cisco Outdoors Mesh Network

How to Deploy an Outdoor Wireless Network

Wi-Fi network planning and deployment involves….

- Regulatory considerations:
  - 802.11 Standard, Radio Emissions, Radar and Dynamic Frequency Selection (DFS). Certifications. All this varies per country.
- Design and Planning
  - Coverage considerations
  - Client type (Smart Phones, Tablets, Laptops, …). Weakest Link typically would be the Uplink on a Smart Phone
  - User Experience: Minimum Throughput to User, Type of Applications (Internet, Video, Gaming, ….)
  - CAPEX & OPEX available for project; match to type of Service, robustness of Coverage, etc.
- Site Survey
  - Location & Height, Line-of-Sight (LoS)/Partial LoS, Interference, Access to wired backhaul (i.e. Max # Hops)

Current Standards and Directives:
The 5 GHz Spectrum



(*) 6 channel available today:
120, 124, 128 disabled to be compliant with DFS rules in Canada
116 &132 disabled to be compliant with new FCC Enforcement to protect TDWR

(**) Dynamic Frequency Selection (DFS) – Transmit Power Control (TPC)

Current Standards and Directives:

Dynamic Frequency Selection (DFS) requirements

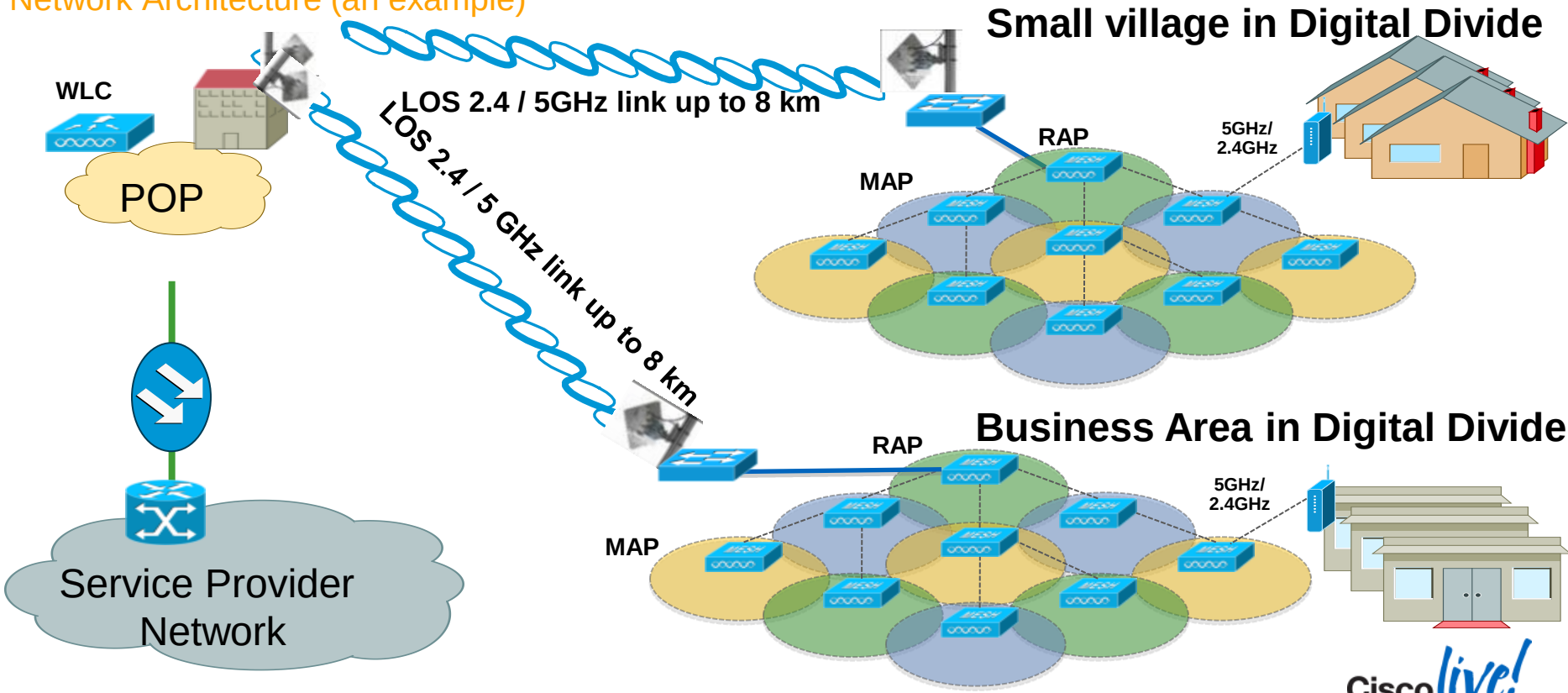
	Frequency (MHz)	CH
1	5150 – 5250 (UNII-I) (Indoors) DFS Not Required	36 40 44 48
2	5250 – 5350 (UNII-II) (Indoors/Outdoors)	52 56 60 64
	5470 – 5725 (UNII-II extended) (Indoors/Outdoors)	100 104 108 112 116 120 124 128 132 136 140
3	5725 – 5850 (ISM) (Outdoors) DFS Not Required	149 153 157 161 165

- DFS required by Regulations to allow WLAN to share the 5GHz band with Radar
- All Cisco products are compliant
- Best Practices for Radars:
  - ✓Do a Survey and contact the local authorities to know if there are radars nearby
  - ✓Use “Full Sector Mode” that prevents MAPs to be isolated after detecting a radar
  - ✓Correctly mount the APs (spacing and antennas alignment)
  - ✓Remove the radar affected channels from the Controller channel list

Design & Planning

Design and Planning

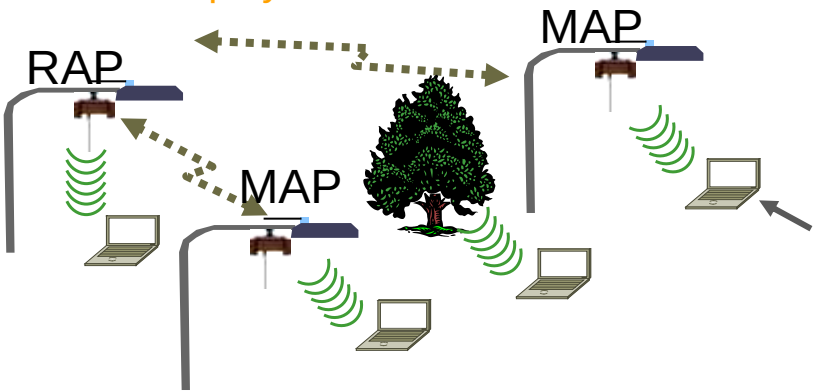
Network Architecture (an example)



Design and Planning

1 meter = 3.28 ft	1 sq-meter = 10.7 sq-ft
1 mile = 1.61 km	1 sq-mile = 2.6 sq-km

Greenfield deployment in a flat environment



- Recommendations
  - Consider your weak link (client)
  - AP to AP distance = double AP to client

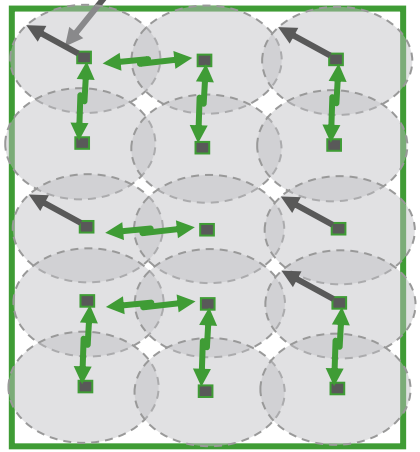
    AP1552C/I: 1600 ft/**500 m**

    AP1552E/H: 2000 ft/**600 m**

    AP1532I: 1050 ft/**320 m**

    AP1532E: 1180 ft/**360 m**
  - Decreasing AP to AP improves coverage

800 ft/ **250 meters** (cell radius) at 2.4 Ghz

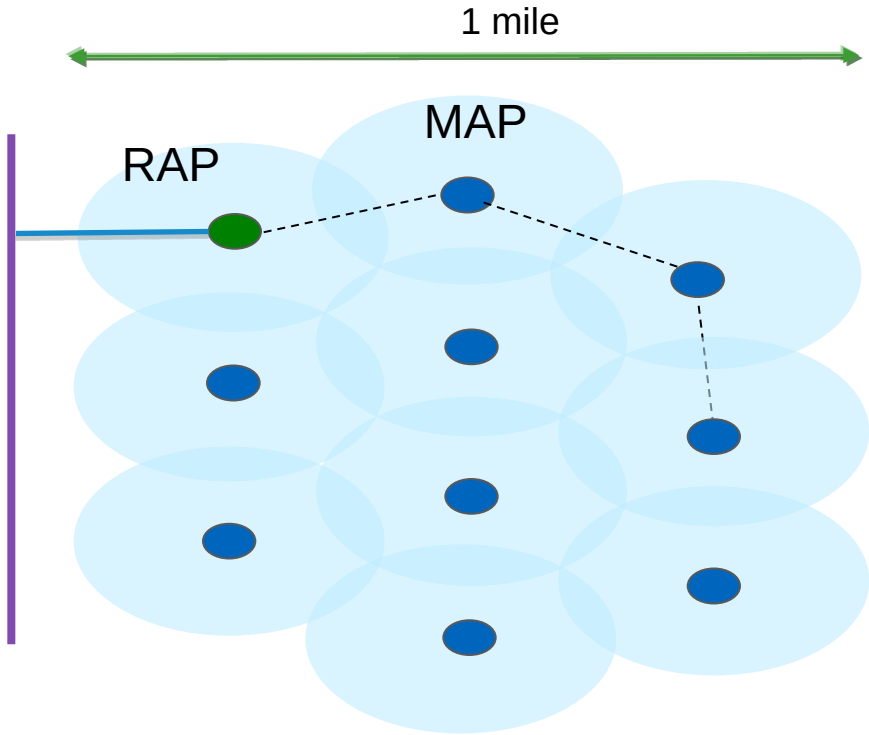


1 square mile ~ 14 Cells

- Assumptions:
  - 100% coverage needed
  - APs are at 10 m; client at 1 m height
  - Data rate of 9 Mbps to estimate range
  - Throughput @ client >= 1 Mbps
  - LoS or Near LoS
  - Flat Terrain Environment

Design and Planning

General consideration



- In real world scenario you need to take in consideration obstacles; add more APs to have Line of Sight (LOS)
- At 2.4GHz MAPs' distance is given by the coverage you want for clients
- Client type (smart phones, tablets, etc): weakest link typically would be the Uplink on a smart phone
- For backhaul set the data rate to "auto"
- The number of MAPs per RAP should be less than 32 but really depends on the application and bandwidth you want!
- Max hop count is 8. Four hops recommended..again throughput!
- Use the range and capacity calculator

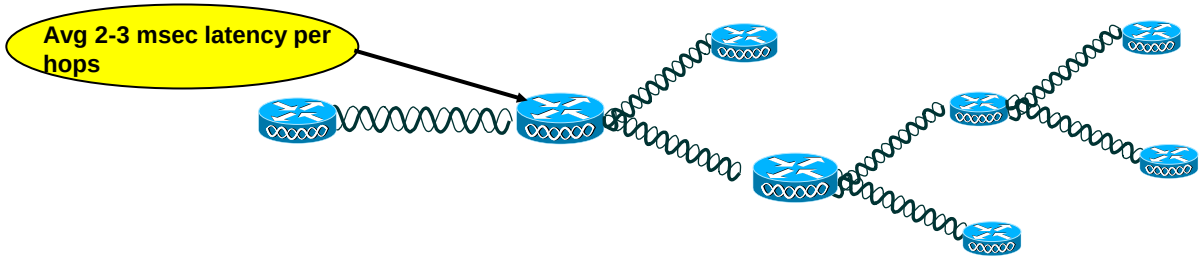
Cisco Range and Capacity Calculator

Best way to estimate access point distances prior to a site survey

http://www.cisco.com/en/US/docs/wireless/access_point/1550/range/calculator/WNG_Coverage_Capacity_QOS_Calculator_V1.37_external.xlsm

Design and Planning

Typical Backhaul Throughput and Latency



HOPS	RAP	One	Two	Three	Four
MAX Throughput (20MHz BH)	112 Mbps	83 Mbps	41 Mbps	25 Mbps	15 Mbps
MAX Throughput (40MHz BH)	206 Mbps	111 Mbps	94 Mbps	49 Mbps	35 Mbps

- Latency: 10 ms per Hop, 0.3-1 milliseconds typical
- Hops: Outdoor: code supports 8 Hops; 3–4 Hops are recommended
- Nodes: 20 MAPs per RAP are recommended

- Packet size to be 1370 bytes (Veriwave Client)
- 5-GHz 802.11n
- MCS 15
- Less than 1 percent packet loss
- Greater than 40 dB SNR for client access and backhaul
- UDP traffic, security enabled, and universal access enabled

Design and Planning

At what distance shall I place the MAPs?

- It all depends on the bandwidth you need. Need to consider Data rate vs SNR
- Need to find a compromise between coverage and throughput

MCS index	Spatial Stream	Media capacity (Mbps) **	Minimum LinkSNR * (dB)
MCS 0	1	15	9.3
MCS 1	1	30	11.3
MCS 2	1	45	13.3
MCS 3	1	60	17.3
MCS 4	1	90	21.3
MCS 5	1	120	24.3
MCS 6	1	135	26.3
MCS 7	1	157.5	27.3
MCS 8	2	30	12.3
MCS 9	2	60	14.3
MCS 10	2	90	16.3
MCS 11	2	120	20.3
MCS 12	2	180	24.3
MCS 13	2	240	27.3
MCS 14	2	270	29.3
MCS 15	2	300	30.3

(*) LinkSNR = *Minimum SNR – MRC gain + fade margin*

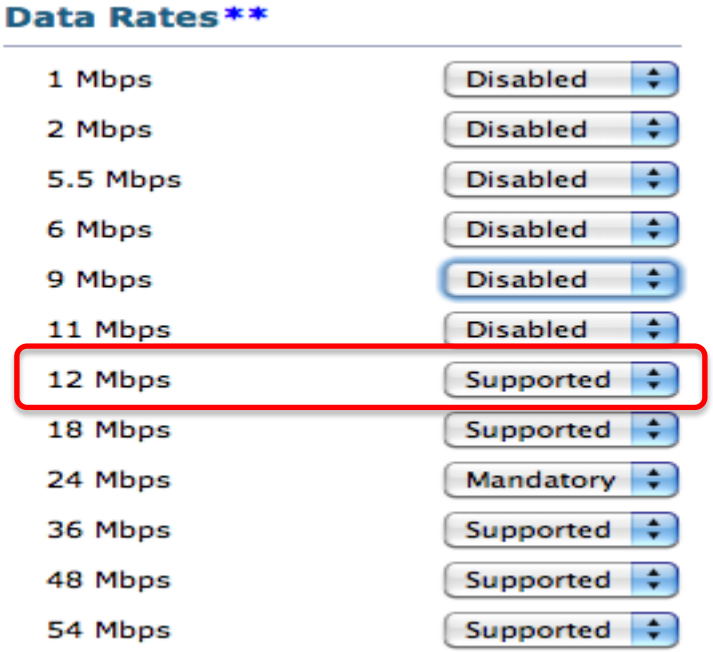
(**) Max data rate considering 5Ghz, 40 Mhz channel, 40ns GI

802.11n Client Matrix

Product Name	Standard	2.4 GHz Spatial Stream		5 GHz Spatial Stream		Authentication Supported
		Tx	Rx	Tx	Rx	
iPhone 5S	a/b/g/n	1	1	1	1	EAP-TLS, TTLS, PEAP
iPhone 5	a/b/g/n	1	1	1	1	EAP-TLS, TTLS, PEAP
iPhone 4S	b/g/n	1	1			EAP-TLS, TTLS, PEAP
HTC One	a/b/g/n/ac	1	1	1	1	EAP-TLS/TTLS/PEAP/FAST
Samsung Note	a/b/g/n	1	1	1	1	EAP-TLS, TTLS, PEAP
Samsung Galaxy S4	a/b/g/n/ac	1	1	1	1	EAP-TLS/TTLS/PEAP/FAST/SIM/AKA
Blackberry bold 9790	a/b/g/n	1	1	1	1	EAP-TLS/TTLS/PEAP/FAST/SIM/AKA
Nokia Lumina 800	b / g / n	1	1			EAP-PEAP
Nokia Lumina 710	b / g / n	1	1			EAP-PEAP
iPad 2	a/b/g/n/h	1	1	1	1	EAP-TLS, TTLS, PEAP
Dell Steak	b / g / n	1	1			EAP-TLS, TTLS, PEAP
Sony Ericsson Tablet	b / g / n	1	1			EAP-TLS/TTLS/PEAP/FAST
Motorola Xoom Tablet	b / g / n	1	1			EAP-TLS/TTLS/PEAP/FAST
Samsung Tablet 7 Inch	a/b/g/n	1	1	1	1	EAP-TLS, TTLS, PEAP
Samsung Tablet 10 Inch	a/b/g/n	1	1	1	1	EAP-TLS, TTLS, PEAP
Blackberry Playbook Tablet	a/b/g/n	1	1	1	1	EAP-TLS/TTLS/PEAP
Macbook Pro	a/b/g/n/ac	3	3	3	3	EAP-TLS/TTLS/PEAP/FAST
Macbook Air	a/b/g/n/ac	2	2	2	2	EAP-TLS/TTLS/PEAP/FAST
HP Pavilion G6	b / g / n	1	1			EAP-TLS/TTLS/PEAP/FAST/SIM/AKA
Broadcom WiFi Adapter 2012	b / g / n	1	1			EAP-TLS/TTLS/PEAP/FAST
Broadcom WiFi Adapter 2011	a/b/g/n	2	2	2	2	EAP-TLS/TTLS/PEAP/FAST

Coverage Limits for Capacity

- Each SSID requires a separate Beacon
- Each SSID will advertise at the minimum mandatory data rate
- Disabled – not available to a client
- Supported – available to an associated client
- Mandatory – Client must support in order to associate



Design and Planning

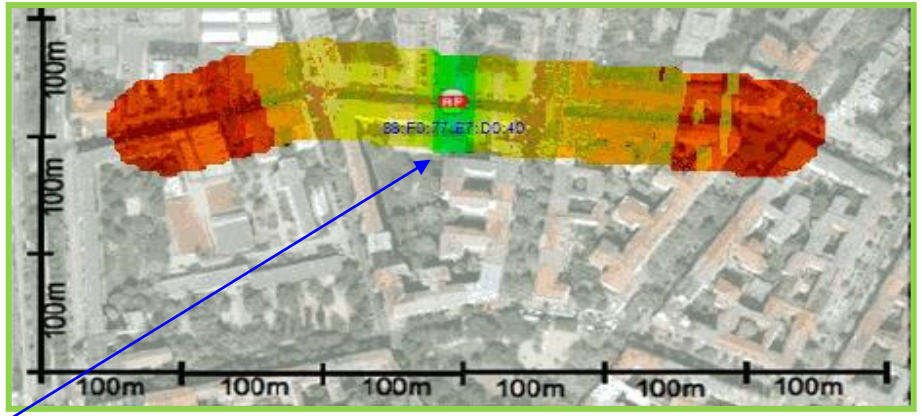
How to check backhaul connected data rate?

- How do you see the actual backhaul rate? Is it 802.11n rate?

  - (Cisco Controller) >show mesh neigh summary MAP_8c40
  - AP Name/Radio Channel Rate Link-Snr Flags State
  - ----------------- ------- ---- -------- ------- -----
  - RAP_e380 136 m15 33 0x0 UPDATED NEIGH PARENT BEACON
  - Or:
  - Cisco Controller) >show mesh neigh detail MAP_8c40
  - AP MAC : 1C:AA:07:5F:E3:80 AP Name: RAP_e380
  - backhaul rate m15
  - FLAGS : 86F UPDATED NEIGH PARENT BEACON
  - Neighbor reported by slot: 1
  - worstDv 0, Ant 0, channel 136, biters 0, ppiters 10
  - Numroutes 1, snr 0, snrUp 40, snrDown 43, linkSnr 39
  - adjustedEase 8648576, unadjustedEase 8648576
  - […snip]

Design and Planning

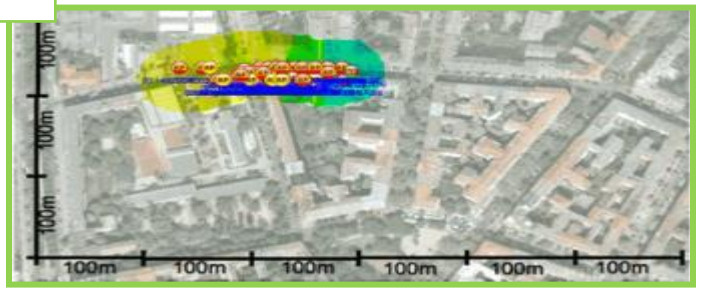
Real case example of urban coverage



Access Points

AP Name	Media Type	Mac Address	Channel	SSID
Non ACL, Neighborings, Rogues				
88:F0:77:B7:D0:4D	802.11n-5.0 GHz	88:F0:77:B7:D0:4D	108	
88:F0:77:B7:D0:40	802.11n-2.4 GHz	88:F0:77:B7:D0:40	11	

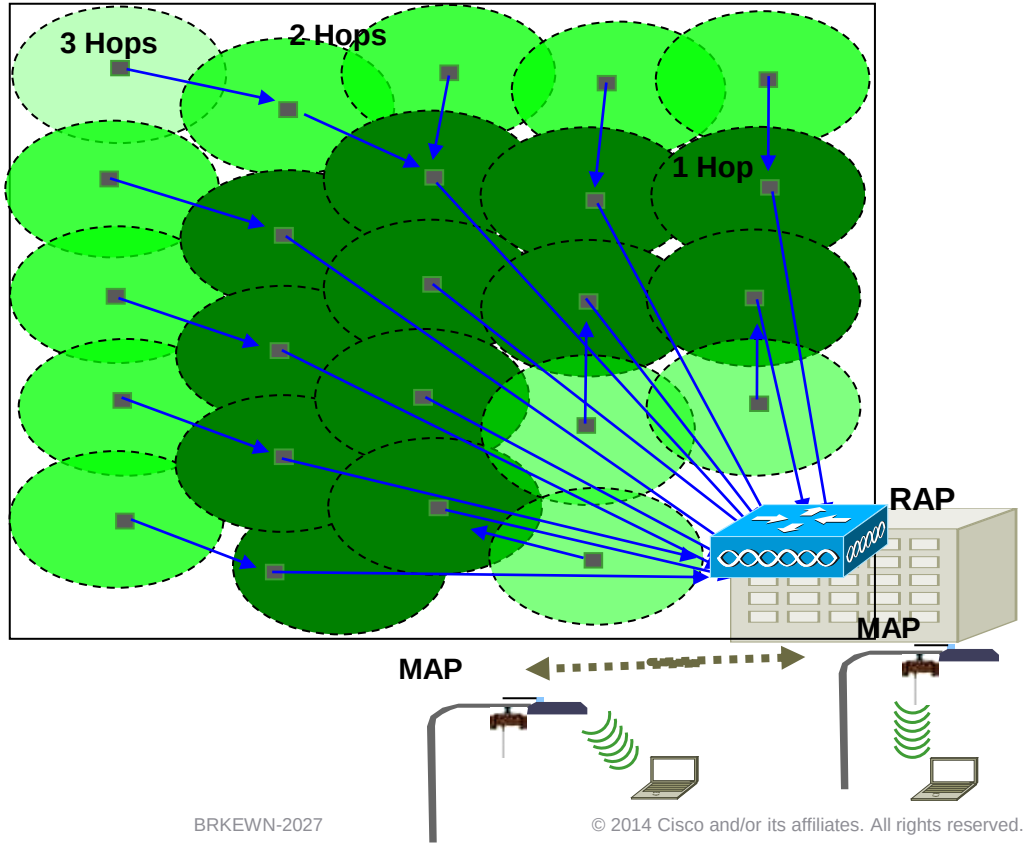
# of AP 2



2.4 GHz Interferers

Design and Planning

Sectorisation (Bridge Group)



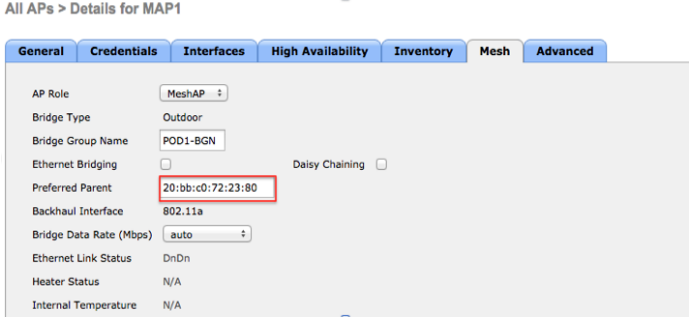
- Logically groups APs and controls the association of the radios
- For adding capacity we recommend that you have more than one RAP in the same sector, with the same BGN, but on different channels
- Having multiple RAPs with same BGN in an area is good for redundancy: when a RAP goes down its MAPs will join a different sector with same name
- A factory default BGN is empty (NULL VALUE). It allows the MAP to do the first association

Design and Planning

Preferred Parent

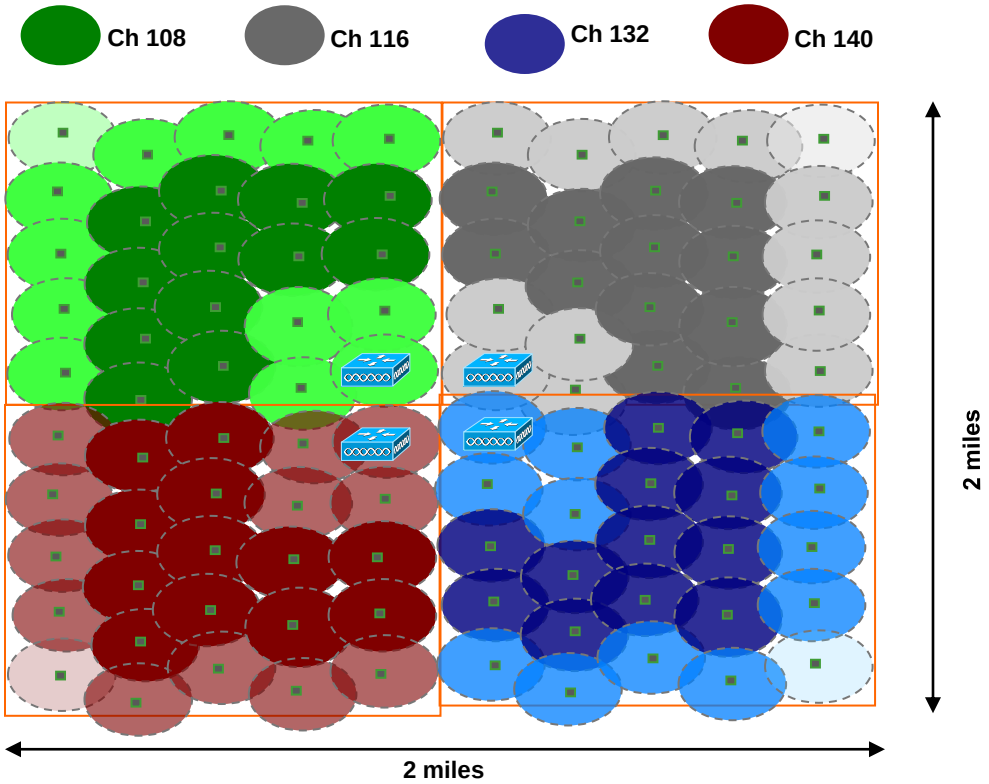
Preferred Parent will be selected for the following conditions:

- P.P parent is the best parent
- P.P link SNR is at least 20dB (In this case, other parents, however good, are ignored)
- P.P has link SNR between 12 and 20 dB, but no other parent is significantly better (SNR more than 20% better). For lower than 12dB SNR, P.P configuration is ignored
- P.P is not blacklisted
- P.P is not in silent mode due to DFS.
- P.P is in the same Bridge Group Name (BGN). If no other parent available in the same BGN, the child will join the P.P using the default BGN



Design and Planning

Mesh coverage model



- A Wired POP building might have 4 RAPs.
- Each RAP has 20-25 Mesh APs (MAPs)
- Each RAP on a different non adjacent channel, but same Bridge Group Name
- Most of MAPs within 3 hops of RAP
- If a RAP fails the MAPs belonging to the sector will go in SCAN mode and register to another MAP/RAP on a different channel/sector

Design and Planning

High Availability anti-stranded features

- Stranded: a MAP that is not able to associate and find a path to WLC
- DEFAULT BGN (Bridge Group Name): Mesh APs with incorrect BGN, can still join a running network using BGN named “DEFAULT”. With “DEFAULT” BGN:
  - MAP associates clients, and forms mesh relationships
  - After 15 minutes APs will go to SCAN state rather than rebooting
  - Do not confuse an unassigned BGN (null value) with DEFAULT, which is a mode that the access point uses to connect when it cannot find its own BGN
- DHCP fall back: this features allow a MAP configured with a wrong static IP address to fall back to DHCP and find a WLC. If even this fails, AP then attempts to discover a controller in Layer 2 mode
- FULL SECTOR DFS: DFS functionality allows a MAP that detects a radar signal to transmit that up to the RAP, which then acts as if it has experienced radar and moves the sector

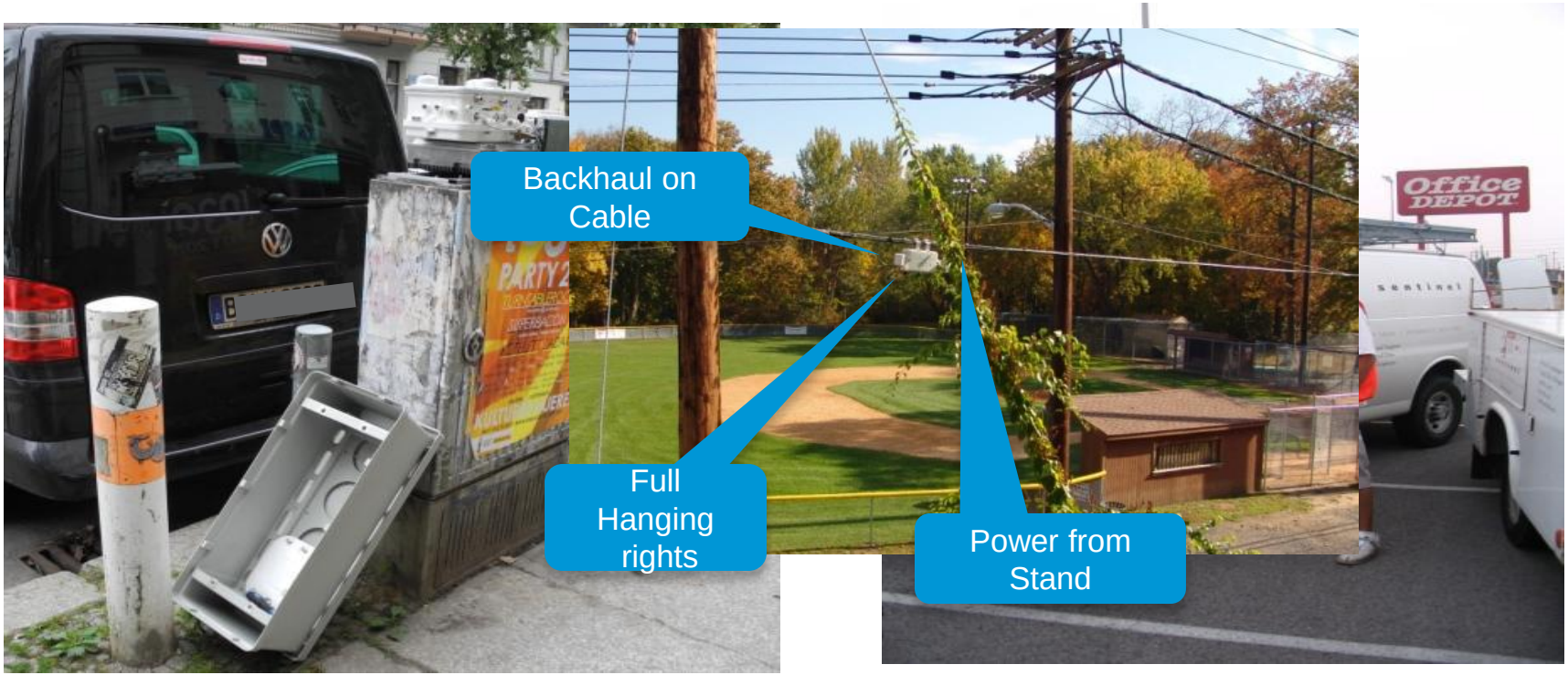
Site Survey and Deployment

The importance of site surveys

- Given the nature of the outdoor environment and the lightly licensed spectrum being used for WiFi based outdoor MESH
  - Site Survey's are important
  - Spectrum scans are equally important
  - You may not be able to remove the interference source
  - But you can design around it
- Remember to also survey at street level where clients will be operating
- If possible survey with either the client or "worst" client you expect to support
- Time based surveys may also be required n months after deployment
- Check for power availability
- Do you have the permits?
- Use the AP1550 in autonomous mode for a site survey

Site Survey and Deployment

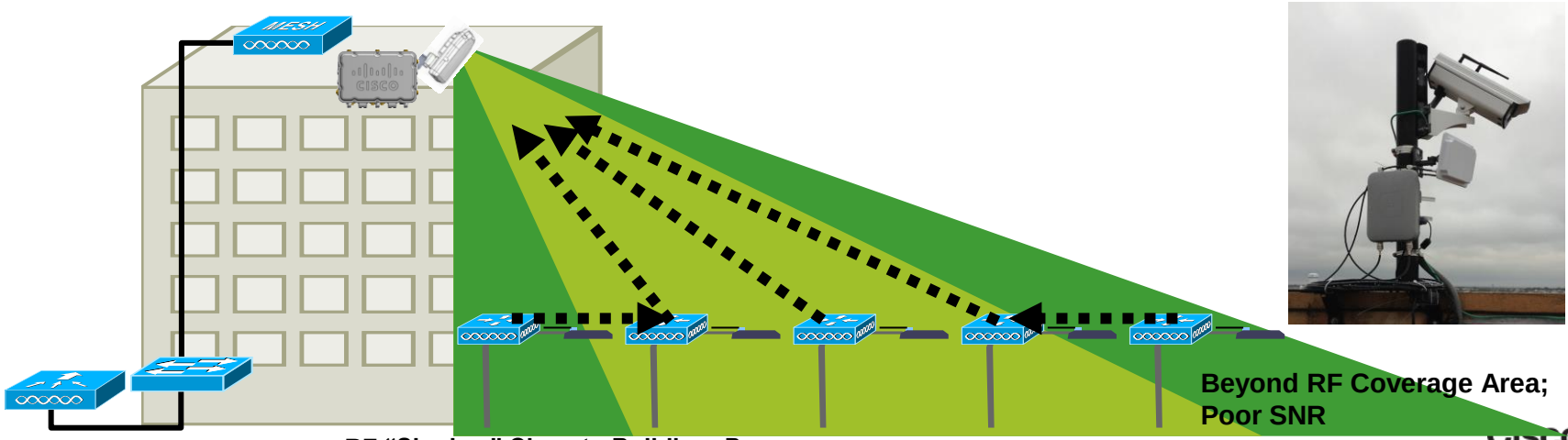
Get creative use different tools



Site Survey and Deployment

Mounting the APs

- Mount the Root AP to have a good view of the area to be covered
- Understand RAP coverage. Use Directional Antennas for the RAPs on the Roof Tops.
- Max recommended height for MAPs is 30 feet/10 meters
- Recommend placing the APs at the same height
- Minimum recommendation is 20~25 dB of SNR, RSSI of -67 dBm for all data rates, 15% cell overlap
- Do not install the MAPs in an area where structures, trees, or hills obstruct radio signals to and from the access point



Site Survey and Deployment

Access Point Pre-Provisioning

- By default the following parameters are set
  - AP Role: MAP
  - Default 2.4GHz and 5GHz channels are selected
  - Default Transmit Power is set: Power Level 1
  - Default Mesh Distances estimation is set to 12000ft
  - Default BGN
  - Backhaul Client Access is enabled
  - Default Mesh Encryption type is EAP
- Primary, Secondary, Tertiary Wireless LAN Controller should be set
- DCHP Sever
  - Option 43 – IP addresses of Wireless LAN Controllers
  - Option 60 – AP Type
  - Option 82 – DHCP Relay Information
- MAC-Authentication must be performed
  - At each Wireless LAN Controller
  - Use an External AAA

Site Survey and Deployment

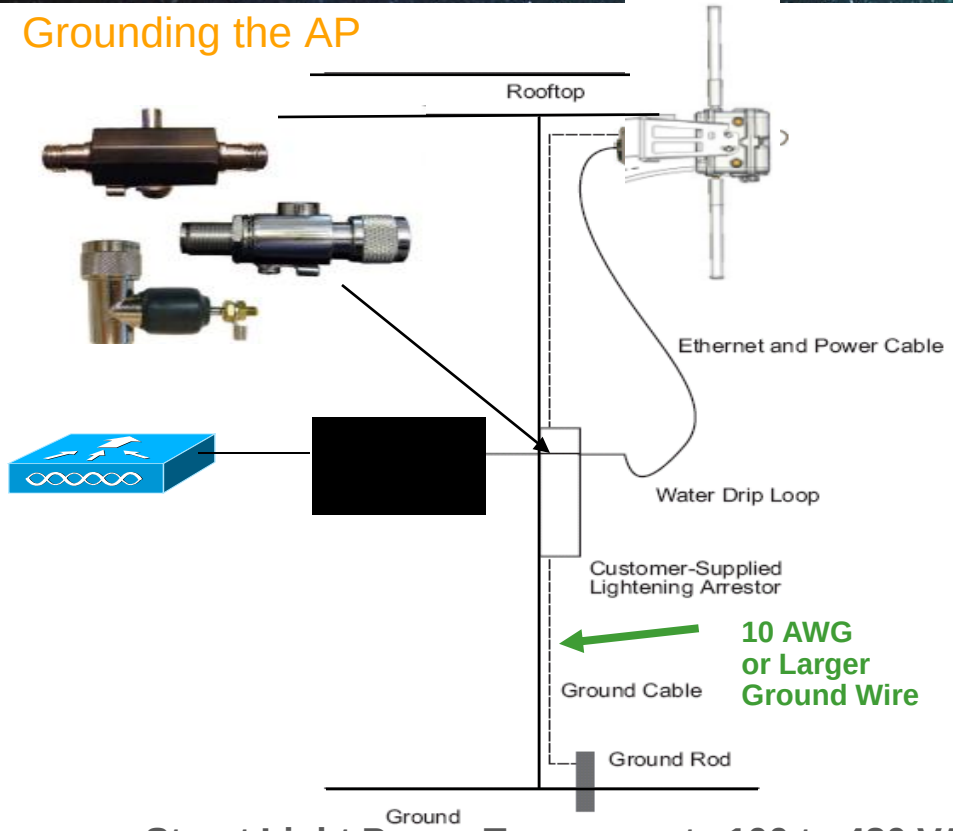
Collocating APs

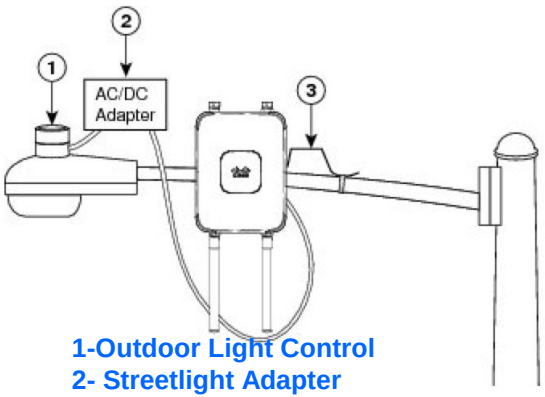
- Proper spacing = better performance and coverage
- Minimum Vertical Separation of 3 meters (10m if on adjacent channels)
- Recommended horizontal separation: 30 meters
- Antennas vertical alignment is another important factor
- Consider RF interferences: use Spectrum Expert

Now That's Better

Site Survey and Deployment

Grounding the AP





1-Outdoor Light Control
2- Streetlight Adapter
3-Copper Grounding wire

Street Light Power Tap supports 100 to 480 VAC

Site Survey and Deployment

Environmental Impact




Cisco Outdoor Product Line

Cisco Aironet Outdoor 802.11n Access Points

Ultra-low Profile
1532I
1532E

- Sleek design
- Int./Ext. antennas
- Value

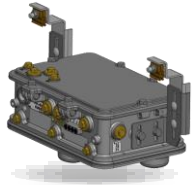
Internal Antenna
1552I

- Seamless Connectivity
- GPS
- CleanAir, ClientLink

Versatile
1552E
1552EU

- Deployment Flexibility
- Fibre SPF / Battery
- PoE Out
- GPS
- CleanAir, ClientLink

MSO / Cable
1552C
1552CU



- Integrated DOCSIS 3.0 Cable Modem
- Cable Plant Powered
- GPS
- CleanAir, ClientLink

Industrial
1552H
1552S

- Haz Loc Certified Class 1/Div 2/Zone 2
- Integrated Honeywell Sensor Gateway (S)
- CleanAir, ClientLink

SP / Cost Competitive | Enterprise | MSO | Internet of Things

AP1532 Series

- **Ultra Low-Profile, Outdoor-AP**
- **802.11n Dual-band (2.4 & 5 GHz)**
- **Models: Internal (1530I) or External (1530E) Antenna**
  - Cisco Flexible Antenna Port – SW configure ports for single-band or dual-band antennas
- **Unified or Autonomous modes**
  - New boot logic allows AP to boot Unified or Autonomous from same HW PID
- **Supports Bridging on 2.4 or 5 GHz**
  - Point-to-point or point-to-multipoint topology
- **Supports Daisy Chaining**
  - Serial backhaul or enhanced universal access

1532I (Internal Antenna)

- Antenna Gain: 3/5 dBi (2/5GHz)
- 2G: **3x3:3** (Tx/Rx/3SS)
  5G: **2x3:2**
- Tx Power
  - 2G: 24 dBm/Tx = 28 dBm; EIRP= 31 dBm
  - 5G: 24 dBm/Tx = 27 dBm; EIRP= 32 dBm
- Power Interface: PoE or DC (48V)
- Power Consumption: 28.5 W
- Weight: 2.3kg
- LAN port (10/100/1000 Mbps Ethernet)
- LTE & WiMAX Signal Rejection (2.1/2.3 GHz; 30 dB; 2.5 GHz; 35 dB)
- Spectrum Intelligence (potential future SW release)
- India Extended Band: 5.825-5.875 GHz
- IP67
- -30 to +65 ºC Ambient, +55 ºC with Solar Loading (1200W/m^2)

23 x 17 x 10 cm (9 x 7 x 4”); < 3.0 Liters; **2.3 kg**

1532E (External Antenna)

26 x 17 x 10 cm (10 x 7 x 4”); 3.0 Liters; 2.5 kg

- Antenna Gain: Supports same antennas as 1552
- 2G: **2x2:2**
  5G: **2x2:2**
- Tx Power
  - 2G: 24 dBm/Tx = 27 dBm
  - 5G: 24 dBm/Tx = 27 dBm
- Power Interface: PoE or DC (48V)
- Power Consumption: 24 W
- Weight: 2.5kg
- LAN port (10/100/1000 Mbps Ethernet)
- LTE & WiMAX Signal Rejection (2.1/2.3 GHz; 30 dB; 2.5 GHz; 35 dB)
- Spectrum Intelligence (potential future SW release)
- India Extended Band: 5.825-5.875 GHz
- IP67
- -30 to +65 ºC Ambient, +55 ºC with Solar Loading (1200W/m^2)
- Bridge Functionality WGB as Bridge-Like replacement (1310 or 1410)

Ultra-Low Profile Access Point

1530-I

1550-I

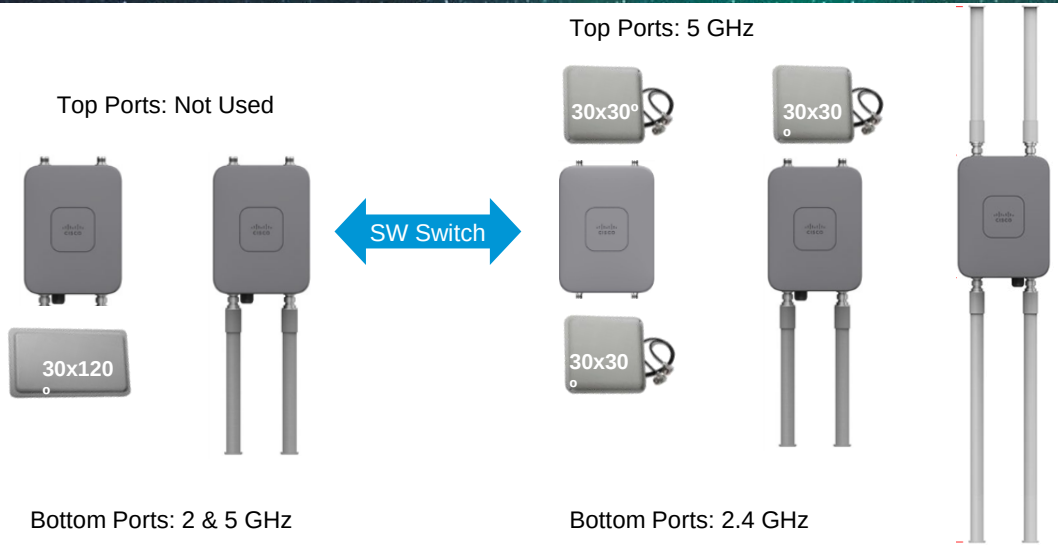
• **Volume:**	3.0 Liters (70% smaller)	vs.	10.0 Liters
• **Weight:**	2.3 kg (64% lighter)	vs.	6.4 kg
• **Size:**	23 x 17 x 11 cm	vs.	31 x 23 x 14 cm
• **Profile:**	Vertical along pole	vs.	Horizontal
• **Shape:**	Tapered Trapezoid	vs.	Rectangle Box
• **Colour:**	Gray	vs.	White
• **Plugs:**	Gray & flat screw	vs.	Metallic Silver bolt
• **Cover:**	Yes (paintable)	vs.	No

1550 Remains Flagship Outdoor AP

1550 supports many options not available on the 1530

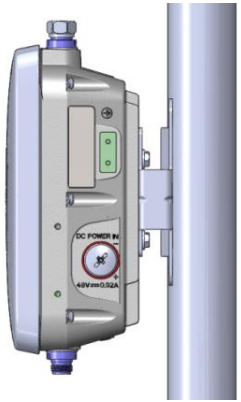
1550	Parameter	1530
✓	SFP backhaul	X
✓	Cable backhaul	X
✓	CleanAir	X
✓	ClientLink	X
✓	Direct AC power input	X
✓	PoE Out	X
✓	GPS	X
✓	Battery Backup	X
✓	Haz Loc version	X

Flexible Antenna Ports:
Support for Uniband or Dualband Antennas



- FlexPort can support either dual-band or single band antennas on the same platform
- Configurable via a software command
- Dual-band ports, use the bottom 2 antenna ports to connect to dual-band omni or directional antennas
- Single-band ports, use two separate 2.4 GHz and two 5 GHz antenna ports

1530 Wall/Pole Mount Bracket (AIR-ACC1530-PMK1) (1 of 2)



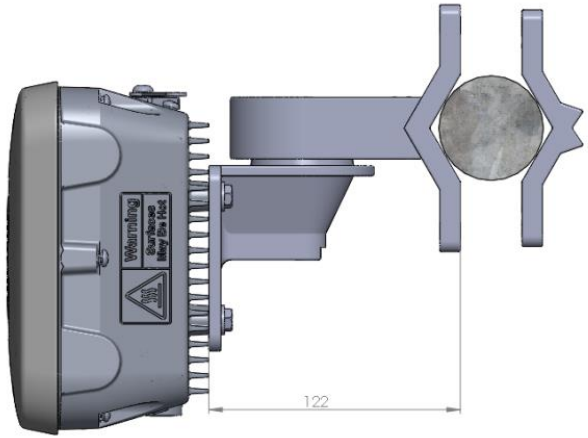
Keyhole slotted mounting holes.

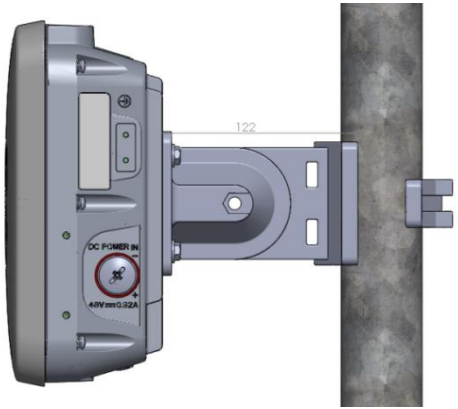
Allows bracket to be mounted prior to AP installation.

- Pole mount banding included
- No special tool needed
- 2 sets supplied with kit
  - 2x for 2-5” diameter pole
  - 2x for 5-8” diameter pole

1530 Wall/Pole Mount Bracket (AIR-ACC1530-PMK1) (2 of 2)

1530 Wall/Pole Mount Bracket with Tilt (AIR-ACC1530-PMK2=)
(2 of 2)

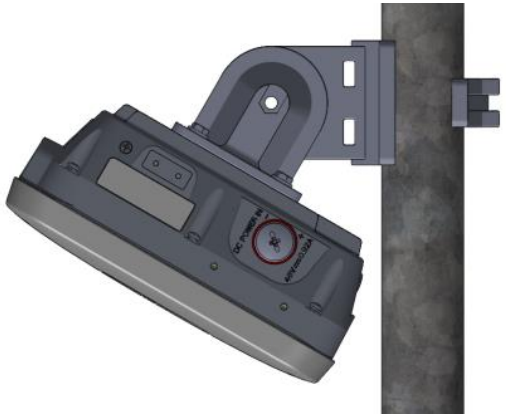


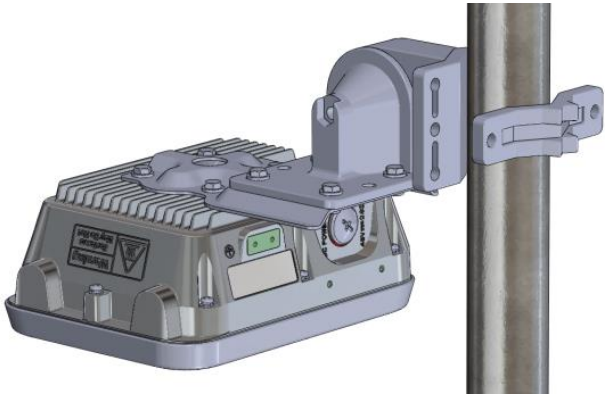


- Pole mount banding Included for 2-8” poles
- No special tool needed
- Clamp can do 1-2” poles

1530 Wall/Pole Mount Bracket with Tilt (AIR-ACC1530-PMK2=)

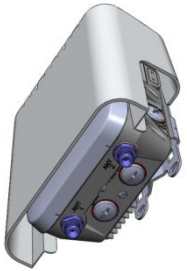
(2 of 2)





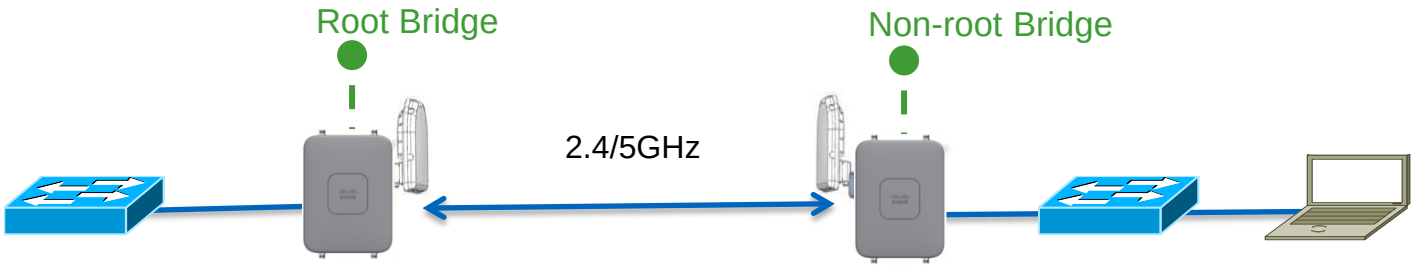
- 90°downtilt possible w/ adapter plate included
- Better Omni Coverage

1530 Cover / Solar Shield (AIR-ACC1530-CVR=)



- Cover can be painted to blend with background
- No Cisco logo

1532 as a Point to Point Bridge



- 1532 are point to point bridging replacements for 1310/1410
- Root Bridges/Non-root Bridges can bridge on either the 2.4GHz radio or the 5GHz radio
- Directional antennas should be used to maximise bridging distance
- New Install mode that flashes the LEDs to denote link quality

Switching to Autonomous

- Default mode is Unified
- Before the1532 access point joins a WLC, it can be changed to aIOS mode by issuing:

```
AP#capwap ap autonomous

Convert to Autonomous image. Proceed? (yes/[no]):
```

- After initial priming, the autonomous image is deleted from flash and the standard upgrade procedure is required
- http://www.cisco.com/en/US/docs/wireless/controller/technotes/7.6/b_1532_dg.html

AP 1532 in Action

Links

- 7.6 Mesh Deployment Guide: http://www.cisco.com/en/US/docs/wireless/technology/mesh/7.6/design/guide/mesh76.html
- AP1532 Deployment Guide: http://www.cisco.com/en/US/docs/wireless/controller/technotes/7.6/b_1532_dg.html
- Range and Capacity Calculator: http://www.cisco.com/en/US/docs/wireless/access_point/1550/range/calculator/WNG_Coverage_Capacity_QOS_Calculator_V1.37_external.xlsm

Summary

- As outdoor wireless continues to grow, Cisco plays an integral role in enabling your outdoor wireless network, be it mesh access points, ruggedised outdoor access points, or point to point bridges
- By following these recommendations, network operators will have well performing outdoor wireless network
- Cisco is committed to providing industry leading outdoor access points, enabling the best possible wireless network

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