TOMORROW starts here.
Design & Deployment of Outdoor Mesh Wireless Networks

BRKEWN-2027

Brian Levin – Technical Marketing
ENG
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

Mobility

What is outdoor wireless?

Applications

- YouTube
- Facebook
- P

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Cisco Public
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

Reduce Churn
Local Low Cost WiFi Vendors
WebAuth Side Business
3G-like Experience (EAP-SIM)
Average Return Per User

Wi-Fi Value to the SP

3G Offload
Future networks supporting the mobile Internet will need to seamlessly integrate a lot more smaller cells.
Enterprise/SP Outdoor Wireless Evolution

Performance Protection for 802.11n Networks

Media Rich Apps & Mission Critical

Pervasive Outdoors

Casual

AP 1550

AP 1520

AP 1510

802.11n

802.11a/b/g

Unified WLAN Architecture Flexibility

Cisco RF Leadership

• Outdoor 802.11n
• RRM
• ClientLink
• CleanAir

• Fast Seamless Roaming
• Universal Access

• Cable Modem
• Dual Radio Backhaul Mesh

• Outdoor 802.11abg
• Unified Architecture
Cisco Outdoor Mesh Architecture Overview
Cisco Outdoor Mesh Architecture Overview

Bridging

Bridging: basic LAN to LAN wireless connectivity
Cisco Outdoor Mesh Architecture Overview

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

- **L3/L2 switch**
- **CPI**
- **WLC**
- **MSE**

2.4 GHz Access

5 GHz Access

Local / Flexconnect
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

Mesh carries two types of traffic:
- Wired client traffic
- Wireless client traffic

CAPWAP in mesh header

Ethernet in mesh header

MAPs dynamically build a tree with the best path to the RAP

Intranet

WLAN Controller

RAP
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

**Intranet**
Cisco Outdoor Mesh Architecture Overview

Seamless user mobility

<table>
<thead>
<tr>
<th>MAC</th>
<th>SSID</th>
<th>AP</th>
<th>WLAN</th>
<th>WLC</th>
<th>VLAN</th>
<th>IP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA-AA</td>
<td>OpenWiFi</td>
<td>47</td>
<td>2</td>
<td>B-A</td>
<td>2</td>
<td>10.10.10.2</td>
</tr>
</tbody>
</table>

Intra-controller Roaming
Dynamic VLAN Assignment

- 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 Outdoor Mesh Architecture Overview

Robust embedded security

- 802.1x WPA/WPA2
- X.509 Certificate Authentication
- Mutual AP Auth
- EAP for Encrypted Links
- IPSec VPN
- Controller
- Integrated Wireless IDS

Cisco’s AnyConnectVPN Client uninterrupted L3 roaming between Wi-Fi, cellular, etc. networks
Prime Infrastructure: Tracking Mesh APs / Clients
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
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

<table>
<thead>
<tr>
<th>Frequency</th>
<th>US (FCC)</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.94-4.99</td>
<td>33 dBm</td>
<td>23 dBm (200 mW)</td>
</tr>
<tr>
<td>5.15-5.25</td>
<td>17 dBm</td>
<td>23 dBm (200 mW)</td>
</tr>
<tr>
<td>5.25-5.35</td>
<td>27 dBm</td>
<td>Indoor only</td>
</tr>
<tr>
<td>5.35-5.47</td>
<td>Indoor / Outdoor</td>
<td>Indoor only</td>
</tr>
<tr>
<td>5.470-5.725</td>
<td>6 channels (*)</td>
<td>11 Channels 30 dBm</td>
</tr>
<tr>
<td>5.77-5.725</td>
<td>Indoor / Outdoor</td>
<td>Indoor only</td>
</tr>
<tr>
<td>5.825-5.875</td>
<td>ISM 30 dBm</td>
<td>Indoor / Outdoor</td>
</tr>
</tbody>
</table>

**US (FCC)**
- Radiated Power EIRP inc antenna: 33 dBm
- UNII-1: 17 dBm (Indoor only)
- UNII-2: 27 dBm (Indoor / Outdoor)
- UNII-2 Extended: 6 channels (*)
- ISM: 30 dBm (Outdoor)

**Europe**
- Radiated Power EIRP inc Antenna: 23 dBm (200 mW)
- Indoor only
- Indoor / Outdoor
- 11 Channels: 30 dBm

*(*) 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)

DFS + TPC required (**)

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### Current Standards and Directives:

#### Dynamic Frequency Selection (DFS) requirements

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>CHs</th>
</tr>
</thead>
<tbody>
<tr>
<td>5150 – 5250 (UNII-I) (Indoors) DFS Not Required</td>
<td>36, 40, 44, 48</td>
</tr>
<tr>
<td>5250 – 5350 (UNII-II) (Indoors/Outdoors)</td>
<td>52, 56, 60, 64</td>
</tr>
<tr>
<td>5725 – 5850 (ISM) (Outdoors) DFS Not Required</td>
<td>149, 153, 157, 161, 165</td>
</tr>
</tbody>
</table>

- 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 and Planning

Network Architecture (an example)

Service Provider Network

Small village in Digital Divide

Los 2.4 / 5GHz link up to 8 km

Business Area in Digital Divide

Los 2.4 / 5GHz link up to 8 km

WLC

POP

RAP

MAP

5GHz/2.4GHz

5GHz/2.4GHz
Design and Planning

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

- **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

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

1 square mile ~ 14 Cells

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

Design and Planning

Typical Backhaul Throughput and Latency

- 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

<table>
<thead>
<tr>
<th>HOPS</th>
<th>RAP</th>
<th>One</th>
<th>Two</th>
<th>Three</th>
<th>Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX Throughput (20MHz BH)</td>
<td>112 Mbps</td>
<td>83 Mbps</td>
<td>41 Mbps</td>
<td>25 Mbps</td>
<td>15 Mbps</td>
</tr>
<tr>
<td>MAX Throughput (40MHz BH)</td>
<td>206 Mbps</td>
<td>111 Mbps</td>
<td>94 Mbps</td>
<td>49 Mbps</td>
<td>35 Mbps</td>
</tr>
</tbody>
</table>

- 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

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

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

**Max data rate considering 5Ghz, 40 Mhz channel, 40ns GI**
# 802.11n Client Matrix

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Standard</th>
<th>2.4 GHz Spatial Stream</th>
<th>5 GHz Spatial Stream</th>
<th>Authentication Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tx</td>
<td>Rx</td>
<td>Tx</td>
</tr>
<tr>
<td>iPhone 5S</td>
<td>a/b/g/n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>iPhone 5</td>
<td>a/b/g/n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>iPhone 4S</td>
<td>b/g/n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>HTC One</td>
<td>a/b/g/n/ac</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Samsung Note</td>
<td>a/b/g/n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Samsung Galaxy S4</td>
<td>a/b/g/n/ac</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Blackberry bold 9790</td>
<td>a/b/g/n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nokia Lumina 800</td>
<td>b / g / n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nokia Lumina 710</td>
<td>b / g / n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>iPad 2</td>
<td>a/b/g/n/h</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dell Steak</td>
<td>b / g / n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sony Ericsson Tablet</td>
<td>b / g / n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Motorola Xoom Tablet</td>
<td>b / g / n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Samsung Tablet 7 Inch</td>
<td>a/b/g/n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Samsung Tablet 10 Inch</td>
<td>a/b/g/n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Blackberry Playbook Tablet</td>
<td>a/b/g/n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Macbook Pro</td>
<td>a/b/g/n/ac</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Macbook Air</td>
<td>a/b/g/n/ac</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>HP Pavilion G6</td>
<td>b / g / n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Broadcom WiFi Adapter 2012</td>
<td>b / g / n</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Broadcom WiFi Adapter 2011</td>
<td>a/b/g/n</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
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
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

<table>
<thead>
<tr>
<th>AP Name</th>
<th>Media Type</th>
<th>MAC Address</th>
<th>Channel</th>
<th>SSID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non ACL, Neighborings, Rogues</td>
<td>802.11n</td>
<td>88:F0:77:B7:D0:4D</td>
<td>88:F0:77:B7:D0:4D</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>802.11n</td>
<td>88:F0:77:B7:D0:40</td>
<td>88:F0:77:B7:D0:40</td>
<td>11</td>
</tr>
</tbody>
</table>

# of AP: 2

2.4 GHz Interferers

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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.

Diagram showing 3, 2, and 1 hop connections between MAPs and RAPs.
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
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
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

- Backhaul on Cable
- Full Hanging rights
- Power from Stand
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

- DHCP 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

Street Light Power Tap supports 100 to 480 VAC

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

10 AWG or Larger Ground Wire
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
- **1552E**
- **1552EU**
  - Seamless Connectivity
  - GPS
  - CleanAir, ClientLink

## Versatile
- **1552C**
- **1552CU**
  - Deployment Flexibility
  - Fibre SPF / Battery
  - PoE Out
  - GPS
  - CleanAir, ClientLink

## MSO / Cable
- **1552H**
- **1552S**
  - 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:** 2.3 kg
- **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 °C Ambient, +55 °C with Solar Loading (1200W/m²)**
1532E (External Antenna)

- 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/m²)
- Bridge Functionality WGB as Bridge-Like replacement (1310 or 1410)
Ultra-Low Profile Access Point

- **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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1550</th>
<th>1530</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFP backhaul</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Cable backhaul</td>
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<td>X</td>
</tr>
<tr>
<td>CleanAir</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>ClientLink</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Direct AC power input</td>
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<td>X</td>
</tr>
<tr>
<td>PoE Out</td>
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<td>X</td>
</tr>
<tr>
<td>GPS</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Battery Backup</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Haz Loc version</td>
<td>✓</td>
<td>X</td>
</tr>
</tbody>
</table>
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
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)
1530 Wall/Pole Mount Bracket with Tilt (AIR-ACC1530-PMK2=)

- 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=)

- 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 the 1532 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
AP 1532 in Action
Links


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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