Outdoor WLANs

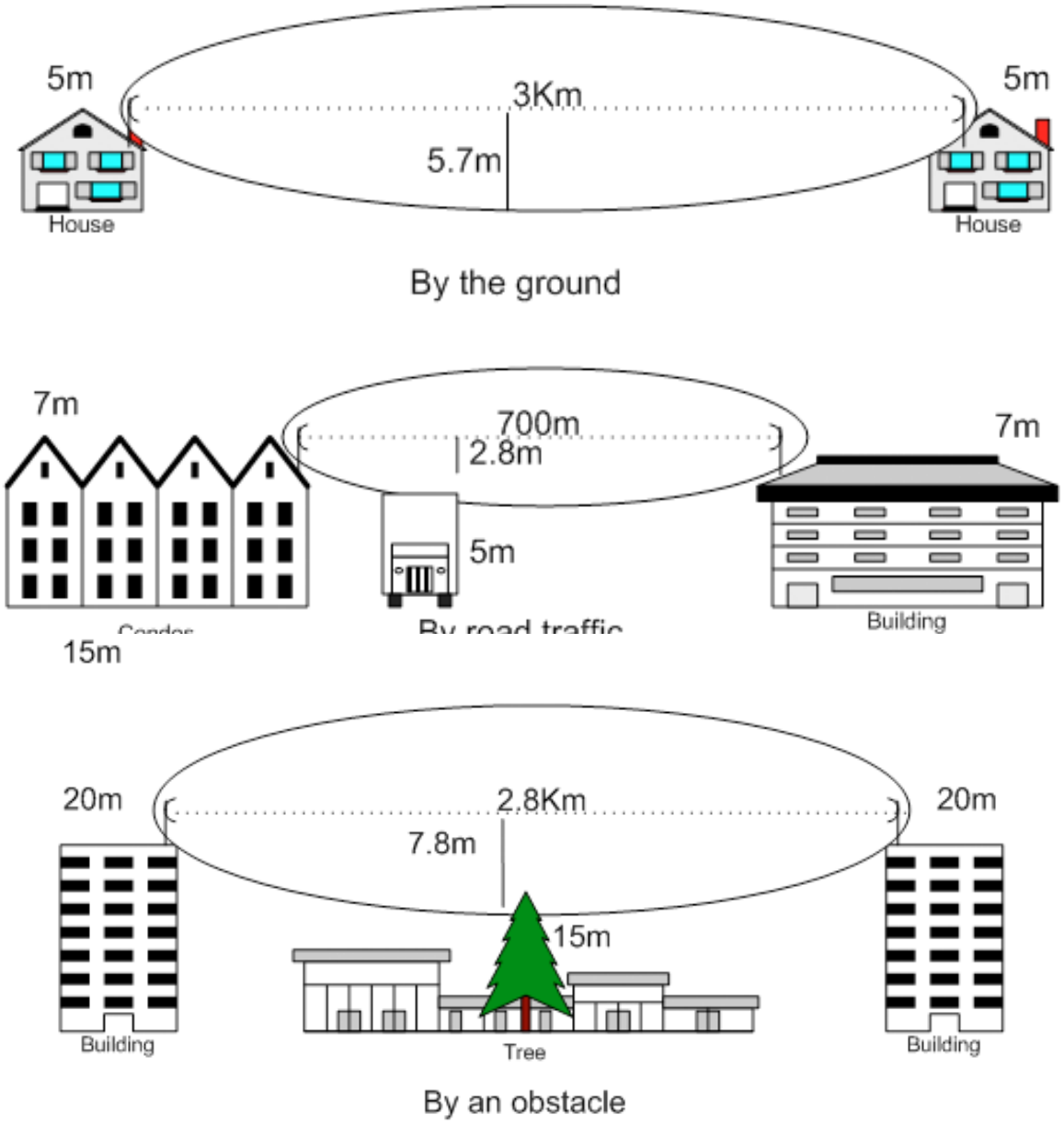
Jennifer Huber, CWNE #51
World Wide Technology

Agenda

- RF Fundamentals
- Antenna Choices
- Connector Types
- EIRP / LMR cabling attenuation
- Lightning arrestors
- Powering the site survey rig
- Google Earth Pro
- Licensed vs Unlicensed Spectrum
- Mesh
- High Density Deployments

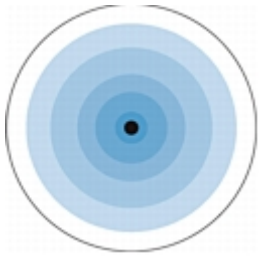
RF Fundamentals

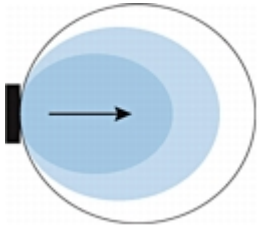
- Fresnel Zone: Path of a radio beam not to be obstructed to avoid interfering with the radio reception.
- Max obstruction = 40%
  Recommended = 20%

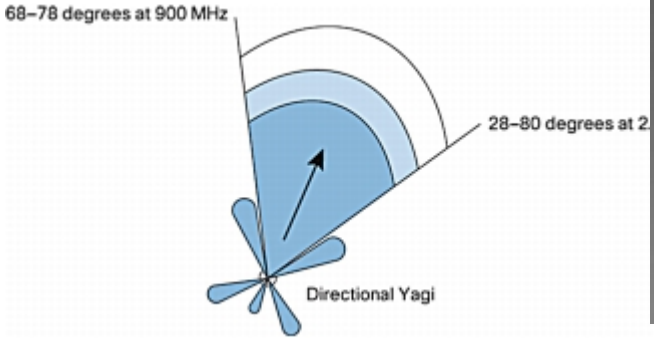


Antenna Types

- Omni
- Patch
- Sector
- Parabolic

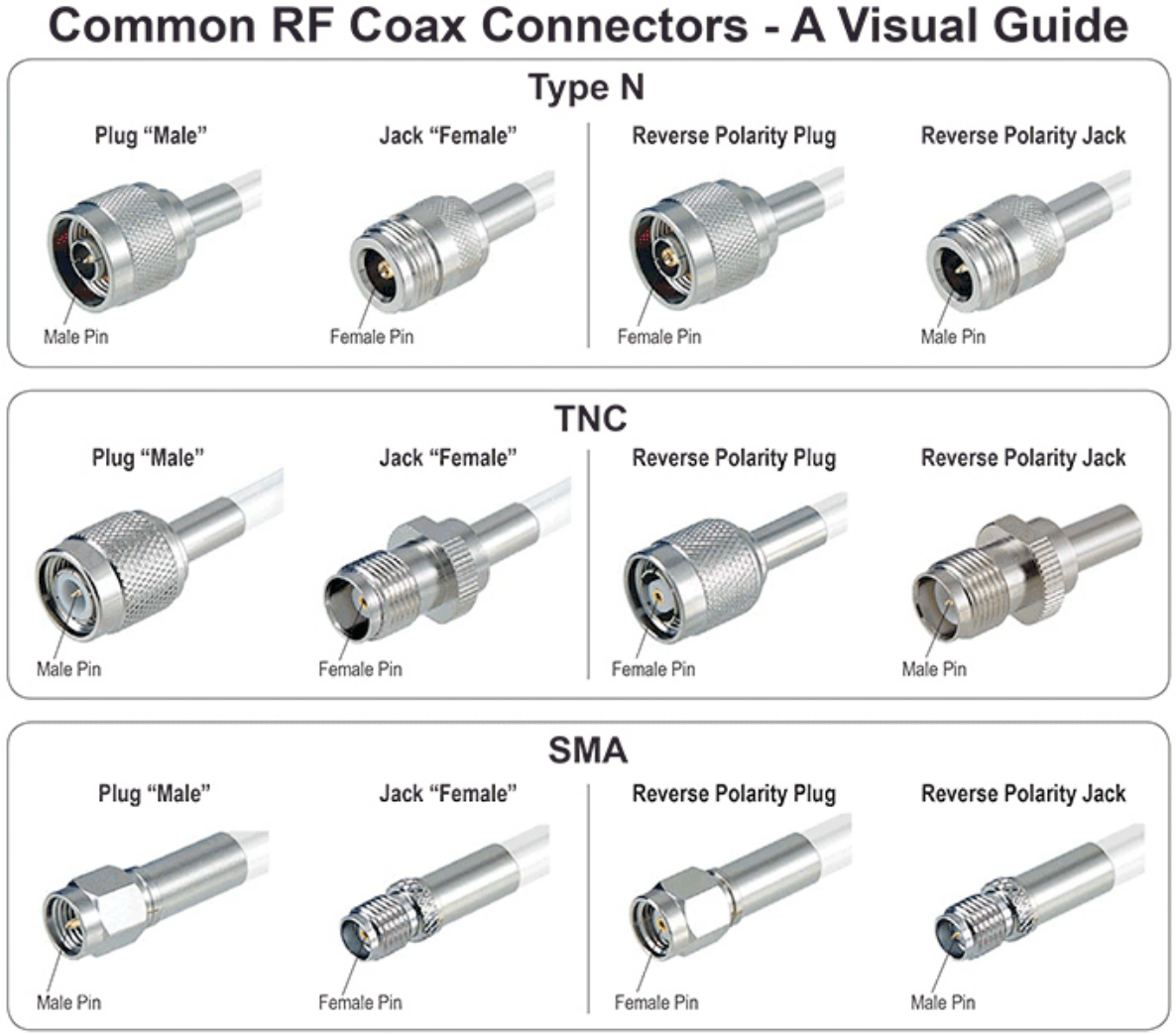






Connector Types

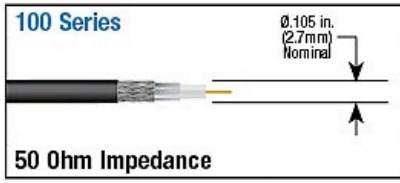
- N-Male
- N-Female
- RP-TNC
- SMA



FCC part 15 rules, EIRP, Cable Loss

- Max transmitter output power = 30 dBm (**1 watt**).
- Max Effective Isotropic Radiated Power (**EIRP**) = 36 dBm (**4 watt**).

100 Series

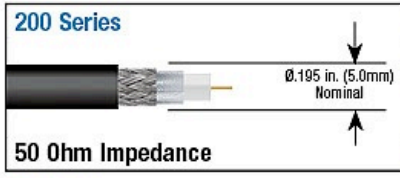


NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	22.8	74.8
1800	33.2	108.8
2500	39.8	130.6

195 Series

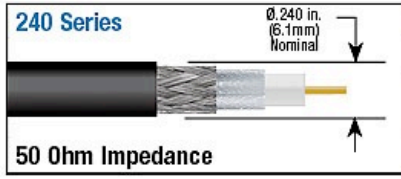
NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	11.1	36.5
1800	16.0	52.5
2500	19.0	62.4
5800	29.9	98.1

200 Series



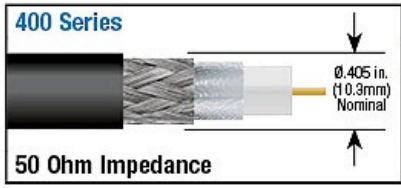
NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	9.9	32.6
1800	14.2	46.6
2500	16.9	55.4
5800	26.4	86.5

240 Series



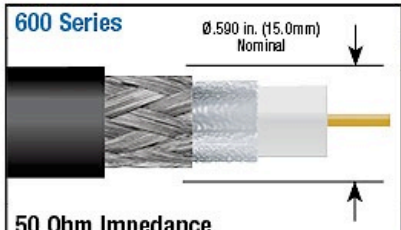
NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	7.6	24.8
1800	10.9	35.6
2500	12.9	45.4
5800	20.4	66.8

400 Series



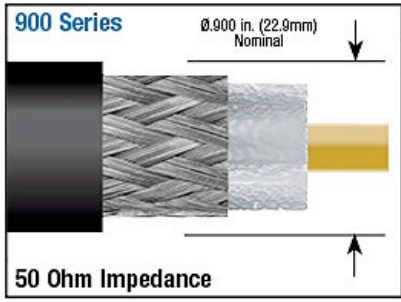
NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	3.9	12.8
1800	5.7	18.6
2500	6.8	22.2
5800	10.8	35.5

600 Series



NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	2.5	8.2
1800	3.7	12.1
2500	4.4	14.5
5800	7.3	23.8

900 Series



NOMINAL ATTENUATION		
MHz	db/100ft	db/100m
900	1.7	5.6
1800	2.5	8.2
2500	2.9	9.8
5800	4.9	16.0

Lightning Arrestors

- RP-TNC
- N-Male
- SMA

Powering the Site Survey Rig

- Automotive Power Invertor

1,000 watt

2,000 watt

3,000 watt

- Inverter Generator

2,000 watt

3,000 watt

3,500 watt

Google Earth Pro

- Elevation Profile
- Path Distance
- Tower Height
- Geo obstructions

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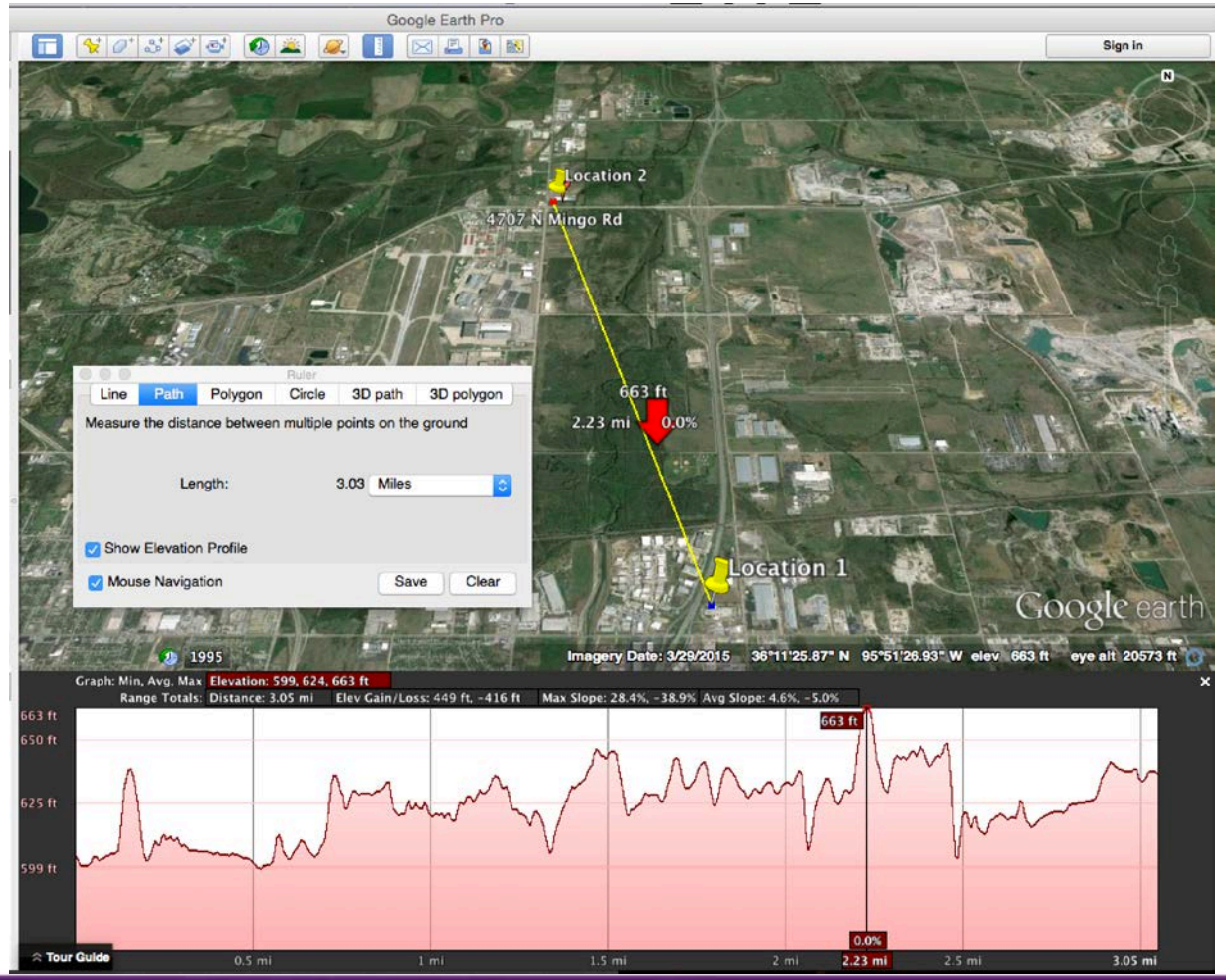
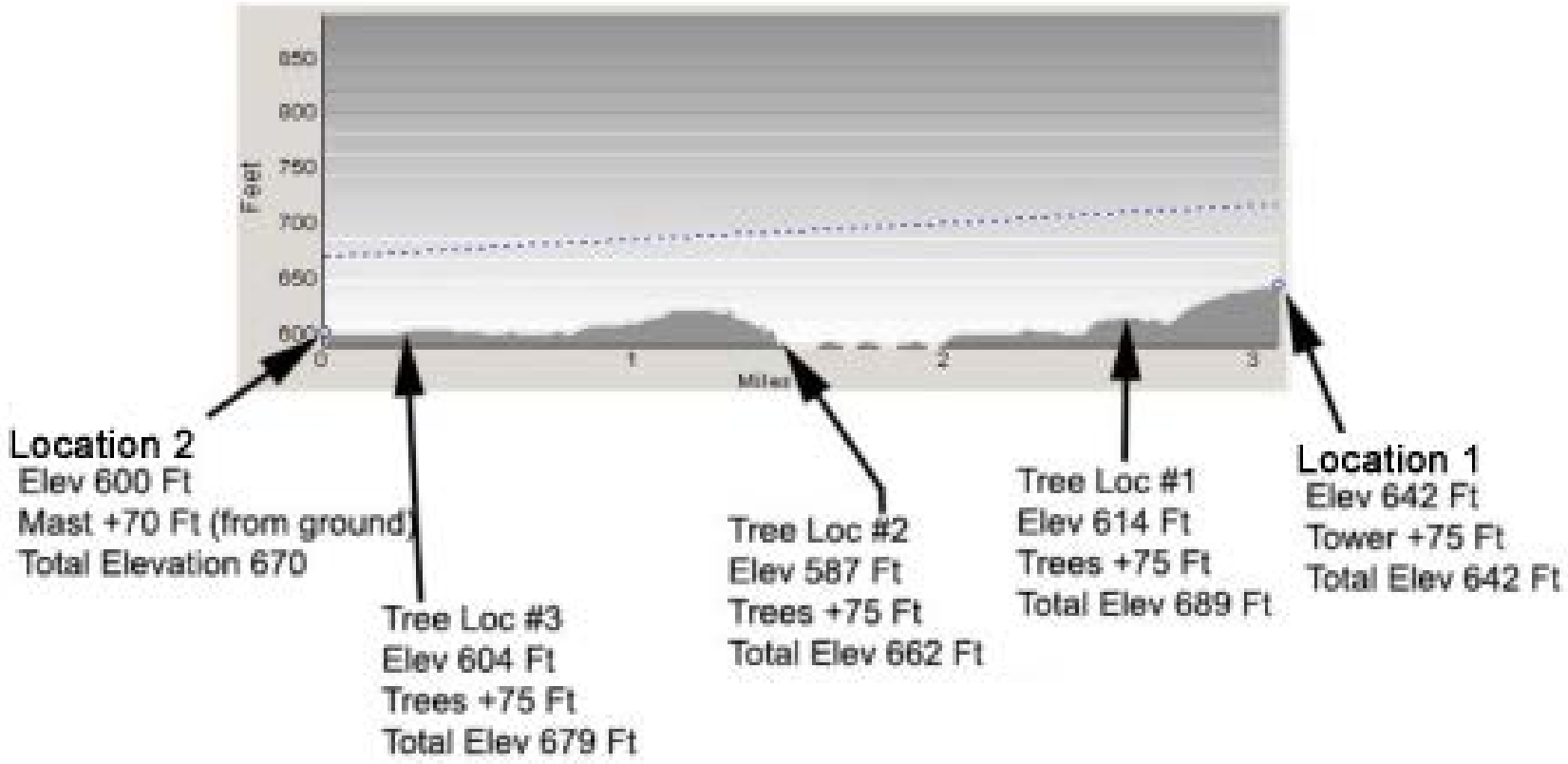
www.cnet.com › Software ▾ CNET ▾
Feb 3, 2015 - The **Pro** version of everyone's favorite virtual globe used to cost $399 -- per year! Now it's **free**. Freeeeee!



Maptech Elevation Data

- Do the math:
  - Elevation
  - Obstructions
  - Tower Height
  - Fresnel Zone



Point to Point Links

- Licensed Spectrum
  - No Interference
  - Allow time to obtain rights to spectrum
  - Cost
- Unlicensed Spectrum
  - Must tolerate interference from other networks
  - No cost
  - Avoid DFS channels

DFS (Dynamic Frequency Selection)

- Wireless networks must use DFS so as not to interfere with radar systems.
- Radar systems are commonly found at airports, harbors or weather radar stations.
- If an AP detects radar on the channel it is configured for, the radio must cease transmitting for 60 seconds while the AP scans for an optimal channel to utilize.

Towers

- Obstruction Evaluation
  - Airport Airspace Analysis (OE/AAA)
  - https://oeaaa.faa.gov/oeaaa/external/portal.jsp

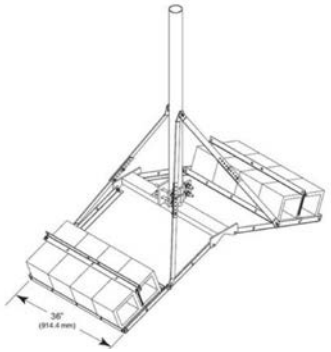
The requirements for filing with the Federal Aviation Administration for proposed structures vary based on a number of factors: height, proximity to an airport, location, frequencies emitted from the structure, etc. For more details, please reference CFR Title 14 Part 77.13.

For example:

- If your structure will exceed 200 ft. above ground level, you must file with the FAA.
- If your structure antennas will emit frequencies, except for those pre-approved frequencies contained in the agreement between the FAA and the Collocation Void Clause Coalition, you must file with the FAA.

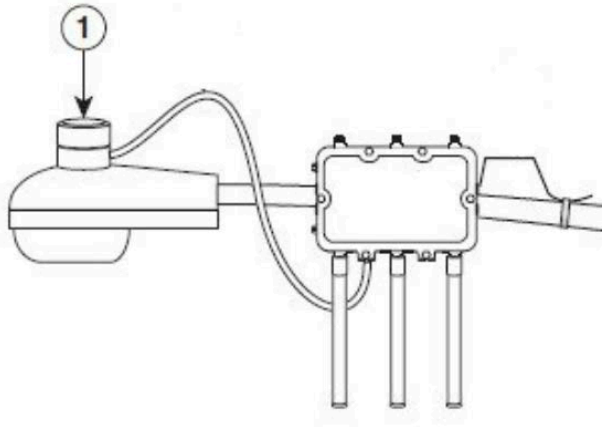
Tower Types

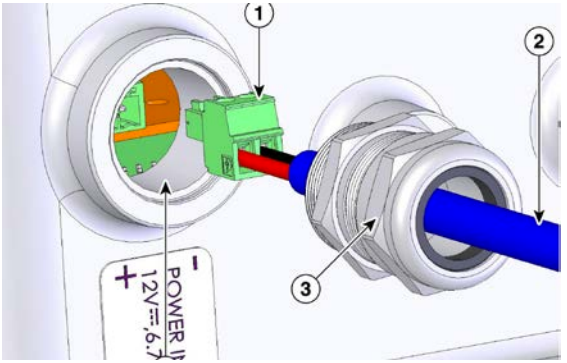
- Non Penetrating Roof Mount
- Antenna Tower
- Custom mount



Powering the Outdoor AP

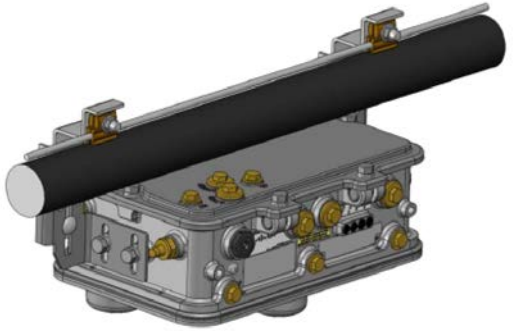
- Power over Ethernet
- Solar / Battery Backup
- Local AC Power
- Street Light Tap

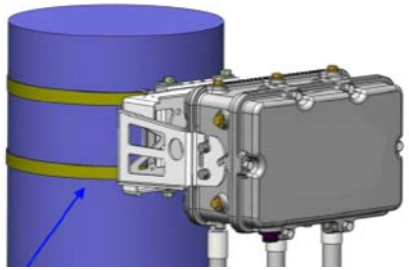


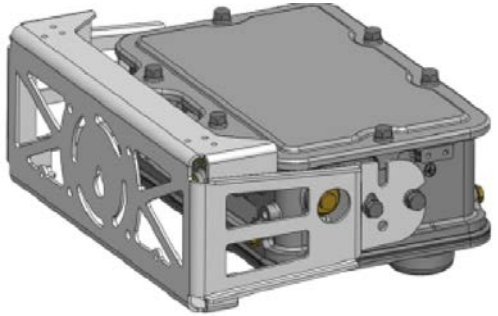


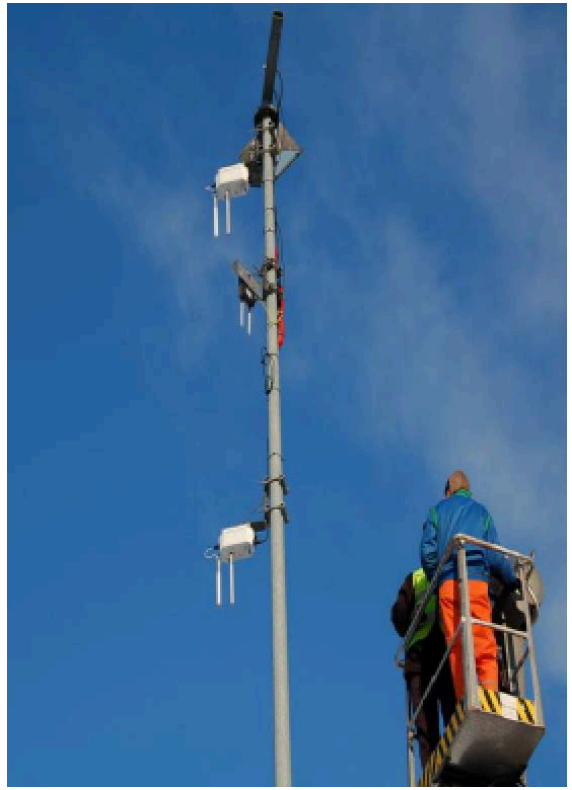
Mounting the Outdoor AP

- Pole Mount
- Bracket Mount
- Strand Mount
- Collocating APs
  - Minimum Vertical Separation of 3 meters
    - 10m if on adjacent channels
  - Use vertical alignment on antennas









Mesh Terminology

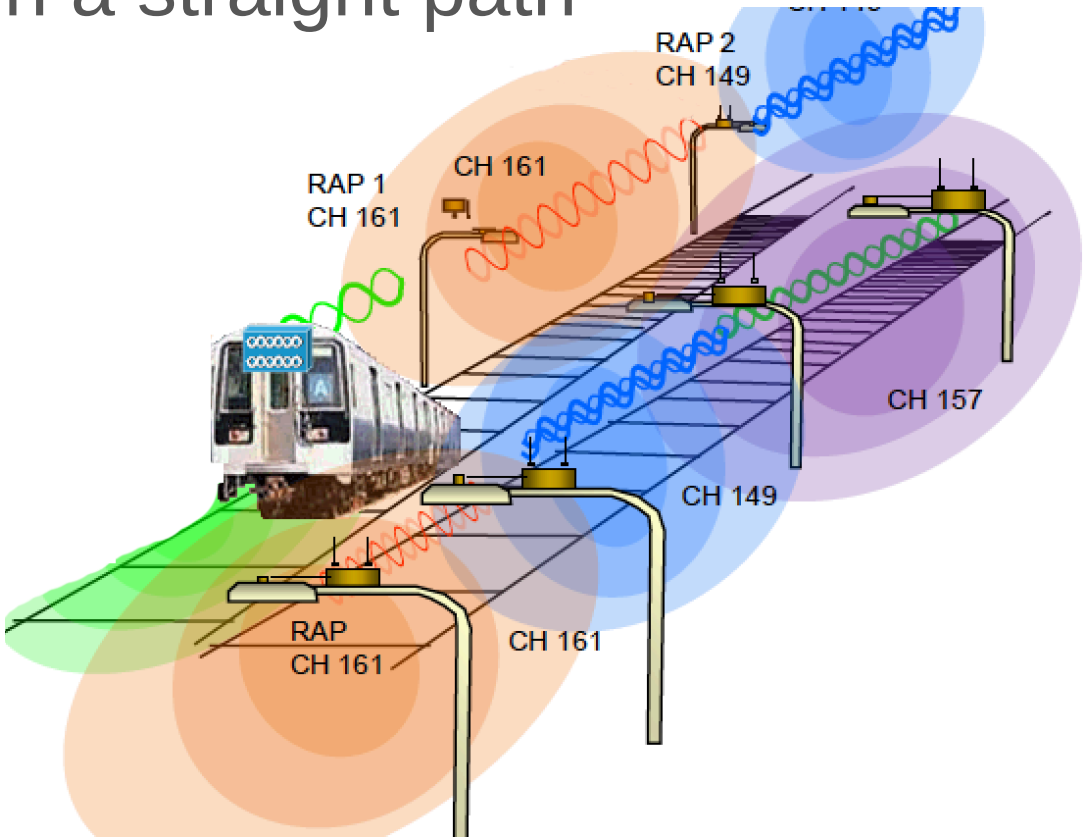
- MAP/Mesh Point – uses WiFi backhaul for network connectivity
- RAP/Mesh Portal – has wired connection to nework
- LoS – Line of Sight
- Hop Count – Number of devices in between MAP and RAP

Mesh Considerations

- Cisco
  - 20 MAPS per RAP
  - 4 hops from RAP
- Aruba/HP
  - 6 hops (multi-channel backhaul)
  - 3 hops (single channel backhaul)

Splitters

- Extend a backhaul signal down a straight path
  - Highways, Train Tracks



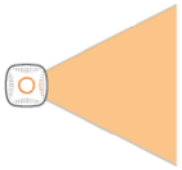
Very High Density WiFi

- Stadiums
- Auditoriums
- Hotel Ballrooms
- Casinos
- Airport Concourses
- Lecture Halls
- Use 20MHz wide channels
- Refer to Reference Design Guides from the vendor of choice

Very High Density Terminology

- Take Rate – Percentage of seating capacity expected to associate to WLAN (usually 50%) / Also known as Associated Device Count (ADC)

Overhead Coverage: APs are placed on a ceiling, catwalk, roof, or other mounting surface directly above the users to be served. Depending on the height difference, one can use APs with integrated antennas or connectorized APs with specially chosen external antennas. In either case, the direction of maximum gain is oriented downward.



Side Coverage: APs are mounted to walls, beams, columns, or other structural supports that exist in the space to be covered. Generally, APs are placed no more than 4 m (13 ft) above the heads of the crowd to be served. Either directional or omnidirectional antennas can be used, with the direction of maximum gain aimed sideways with a shallow down-angle.

Floor Coverage: This design creates picocells using APs mounted in, under, or just above the floor of the coverage area. This strategy is the only one that can allow for spatial reuse of channels inside a room of 1,000 m^2 (10,700 ft^2) or less. In general, picocells use APs with integrated antennas to minimize the required space under the seat.

Best Practices

- Integrated Antennas should be used for ceilings of 33 ft or less.
- Minimum ceiling height to consider external antennas is 15 meters (50 ft).
- For venues with less than 10,000 seats, your VHD designs should always use overhead or side coverage.

Other Considerations

- Aesthetics?
- Mounting Structures?
- Electricity?
- Appropriate stakeholders?

Aesthetics

- Does the cabling team know what is needed?
- Don’t end up on BadFi.com!

Mounting structures

- Do they exist?
- Will that light pole hold the weight of the AP?
- Did you get approval (from the correct person) to use that as a final installation location?

Electricity

- Is power available from the light pole 24/7?
- Does the building owner also **own** that electrical bill?
- Do you have the proper clearances to survey city street intersections?