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CCNP Wireless: Performing a Wireless Site Survey: tips and tricks

BRKCRT-8303

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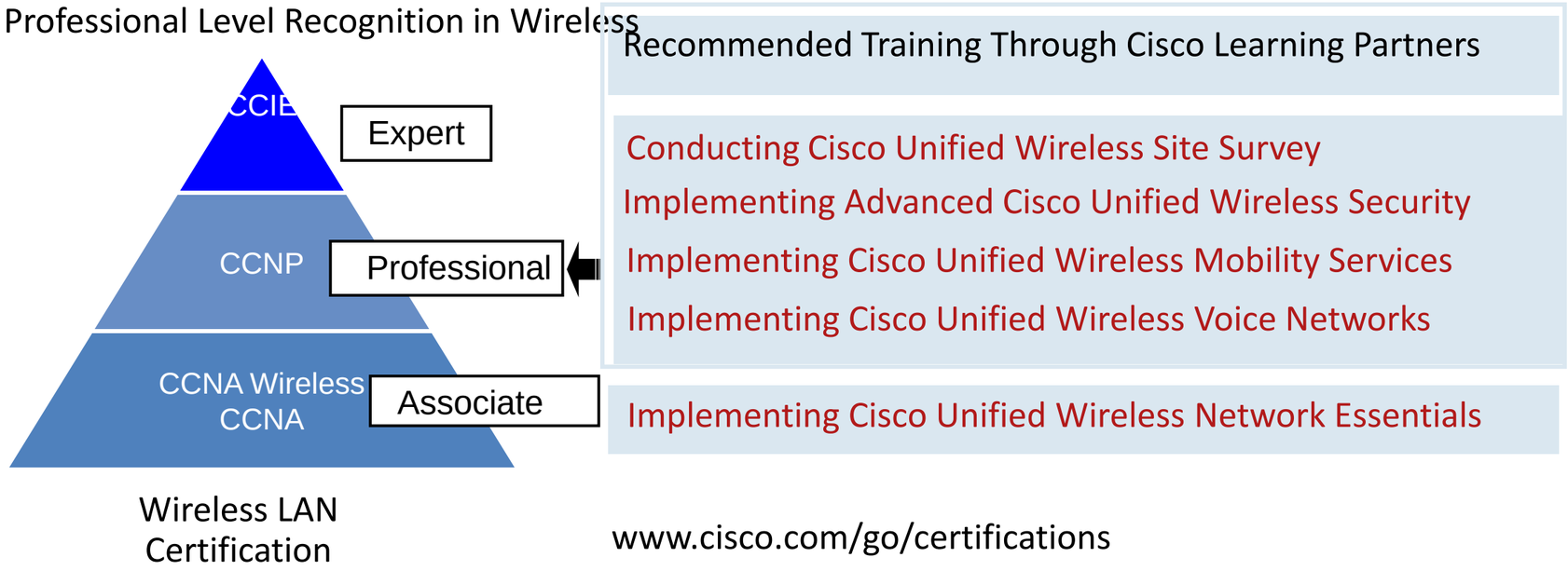
Cisco Wireless Certification Track

CCNP Wireless -> CUWSS

- Conducting Cisco Unified Wireless Site Survey is part of the CCNP Wireless curriculum



“To provide learners with information and practice activities to prepare them to technically plan and conduct a wireless site survey”

Conducting Cisco Unified Wireless Site Survey

Conducting a Site Survey: Before the Survey

Survey Project and Customer

Know Your Customer, Know Their Intent

- Project initiator may not have the final word:
  - Project Sponsor
  - Technical Resource
  - Influencers
- How will the network look like in 2 years?
  - Make sure to determine the scope of the project

    Data? Voice? Location? Where?
  - Build a precise statement of work to avoid surprises and misunderstandings
- Make sure to determine the business needs:
  - What issue is wireless expected to solve

Site Survey Types

- Predictive surveys
  - Use a simple map of the facility
  - Limited in time investment and cost
  - Do not take into account the real investment
  - Used as basic estimate for deployment budget
- Passive surveys
  - Capture the existing 802.11 state
- Active surveys
  - Capture the coverage area from one BSSID
- Thorough vs. sample area surveys
  - Survey the entire facility, or just a sample area

Physical Survey Scope

Survey Effort Depends On Customer Needs

- New deployment or upgrade: what are the reasons for the deployment (why now), or the upgrade?
- Scale: one room or several campuses?
- Timeline: over the upcoming months or next week?
- Budget: constraints or open?
- Users: paying customers or staff?
- Applications: what throughput, jitter and roaming requirements?
- Evolution: Are changes expected to the network after deployment?

802.11n Special Case

Many Surveys Migrate Legacy Networks to 802.11n

- 802.11n allows for longer range or higher data rates, but the performances depend on if the environment is multipath rich or not
  - Office environment often MIMO compatible
  - Hallway environment often not MIMO compatible
- Migration strategies
  - New survey, new deployment: existing network is ignored

    Best strategy, costly
  - One-to-one replacement: legacy APs are replaced with 802.11n APs

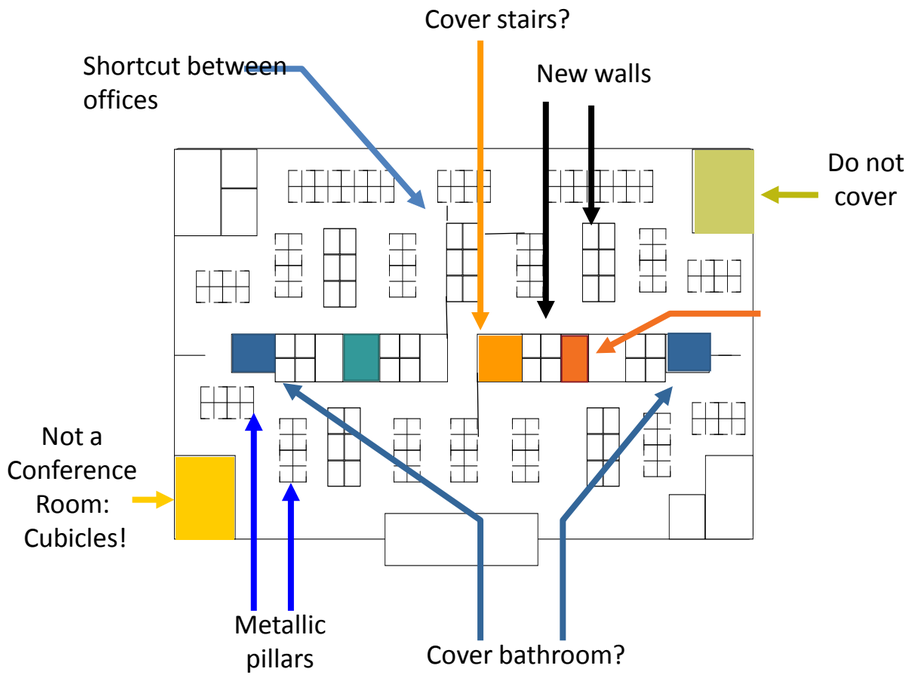
    Limited by previous design (coverage)
  - Phased migration: 802.11n complement legacy APs

    Good compromise, new survey needed after few years

Initial Walkthrough

Assess Areas to be Surveyed with a Wireless Professional Eye

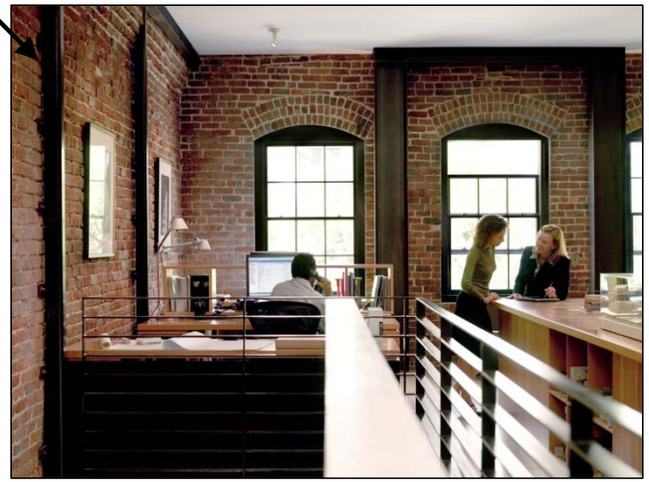
- Before the actual survey
  - Assess building type
  - Anticipate difficult zones
  - Confirm surveyed areas
    - Areas where full coverage and full performances are needed
    - Areas where coverage is optional
    - Areas were coverage is not needed
    - Areas where coverage should not be present
  - Check details of areas not mentioned on the main coverage map
  - Check unexpected roaming paths



Initial Walkthrough Surprises

Affect the Survey and Project Scope and Cost

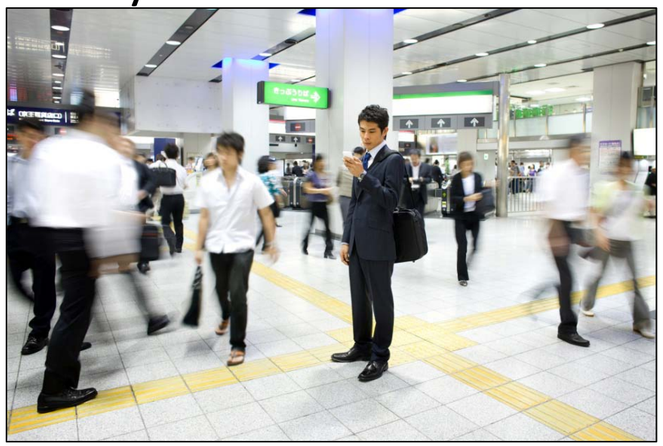
"Wall"



Dangerous environment

Hard-to-reach areas

Safety concern



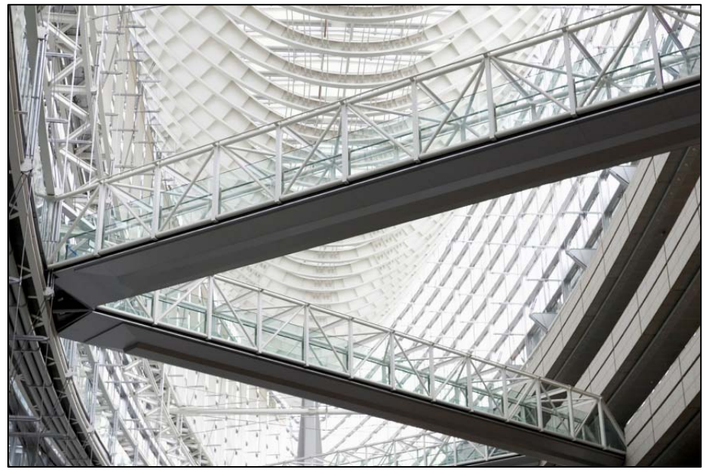
Difficult areas

Initial Walkthrough Surprises

Affect the Survey and Project Scope and Cost

"Install APs, but do not touch the building"

"It's a building to building bridge"



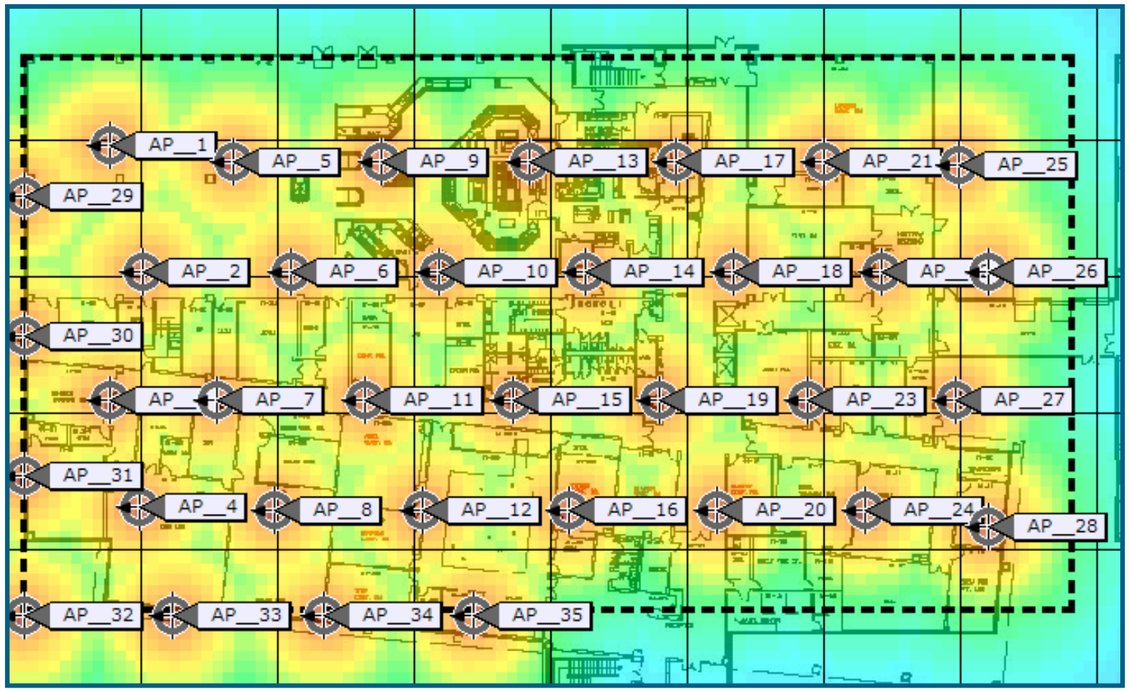
"Could you hide the APs in the ceilings?"

Conducting a Site Survey: Choosing the Tools

Planning Tool

Estimate AP Number, Survey Duration

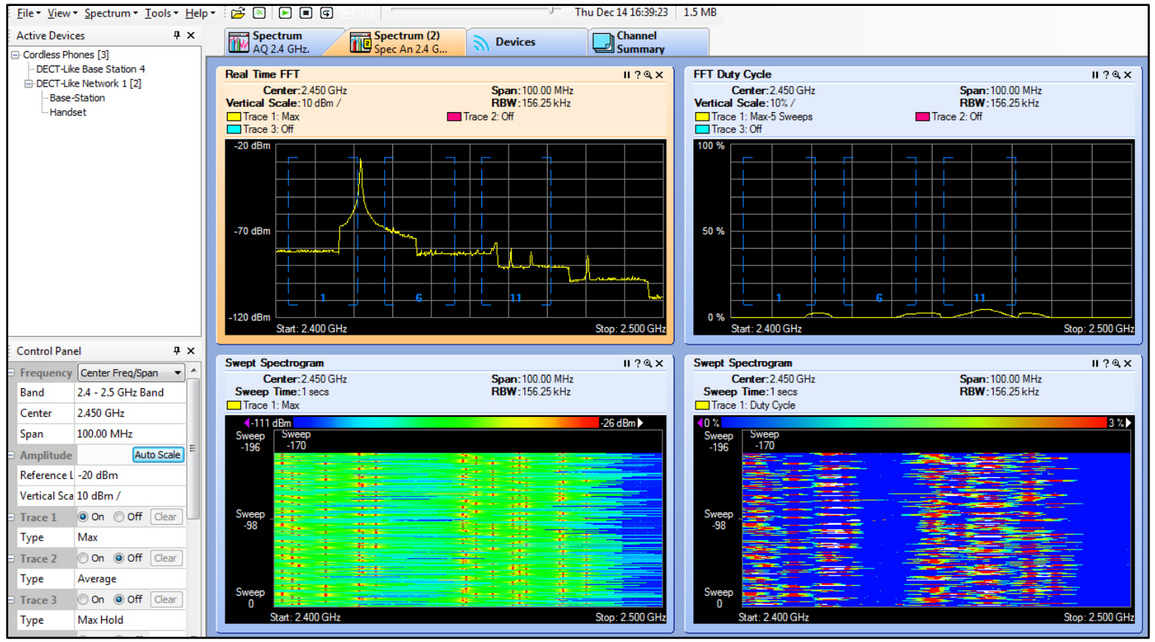
- Predict access point count and placement based on criteria:
- Traffic type active on the network:
  - Data
  - Voice
  - Location-based services
  - Combination of application services
- Standard survey speed is 8/10 APs /day



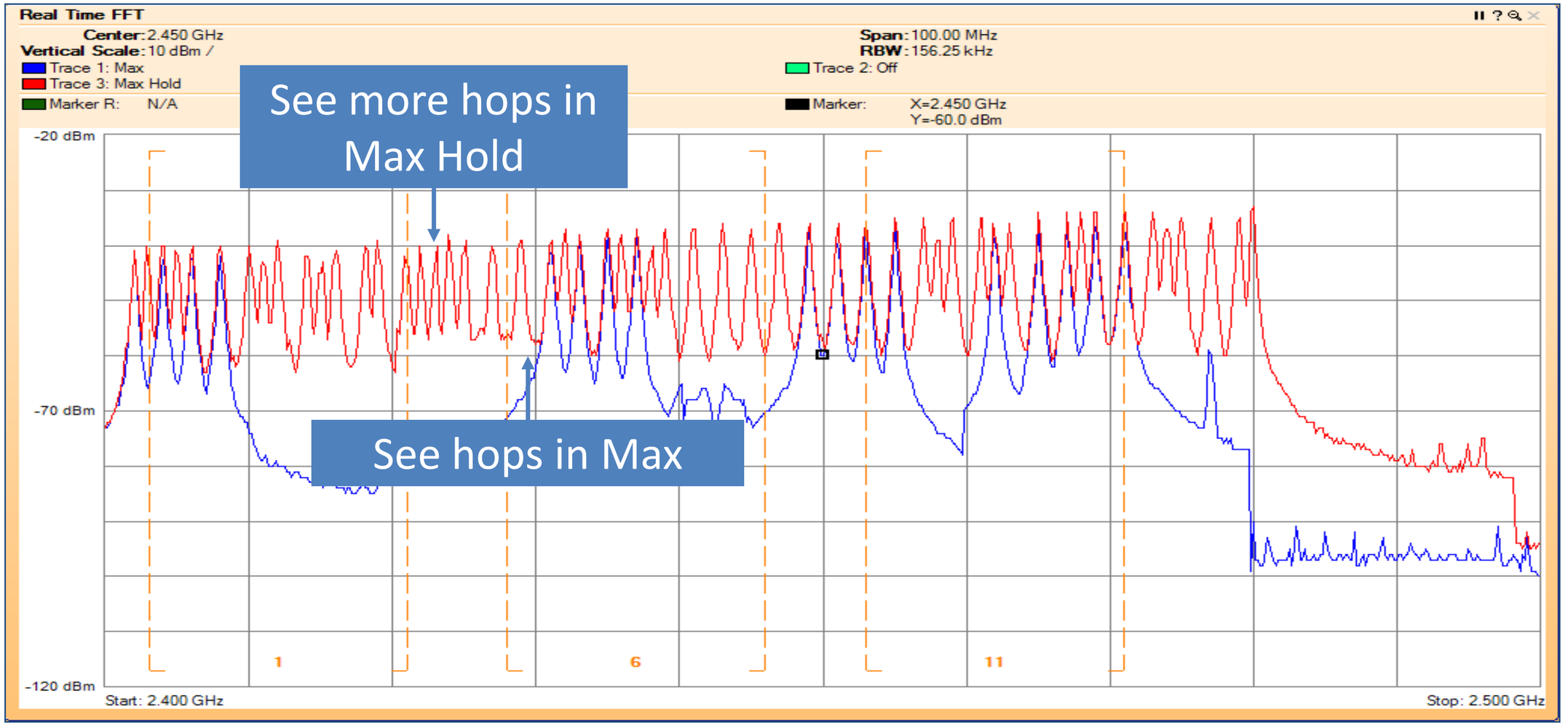
RF Spectrum Analysis Tools

Assess the Layer 1 Environment

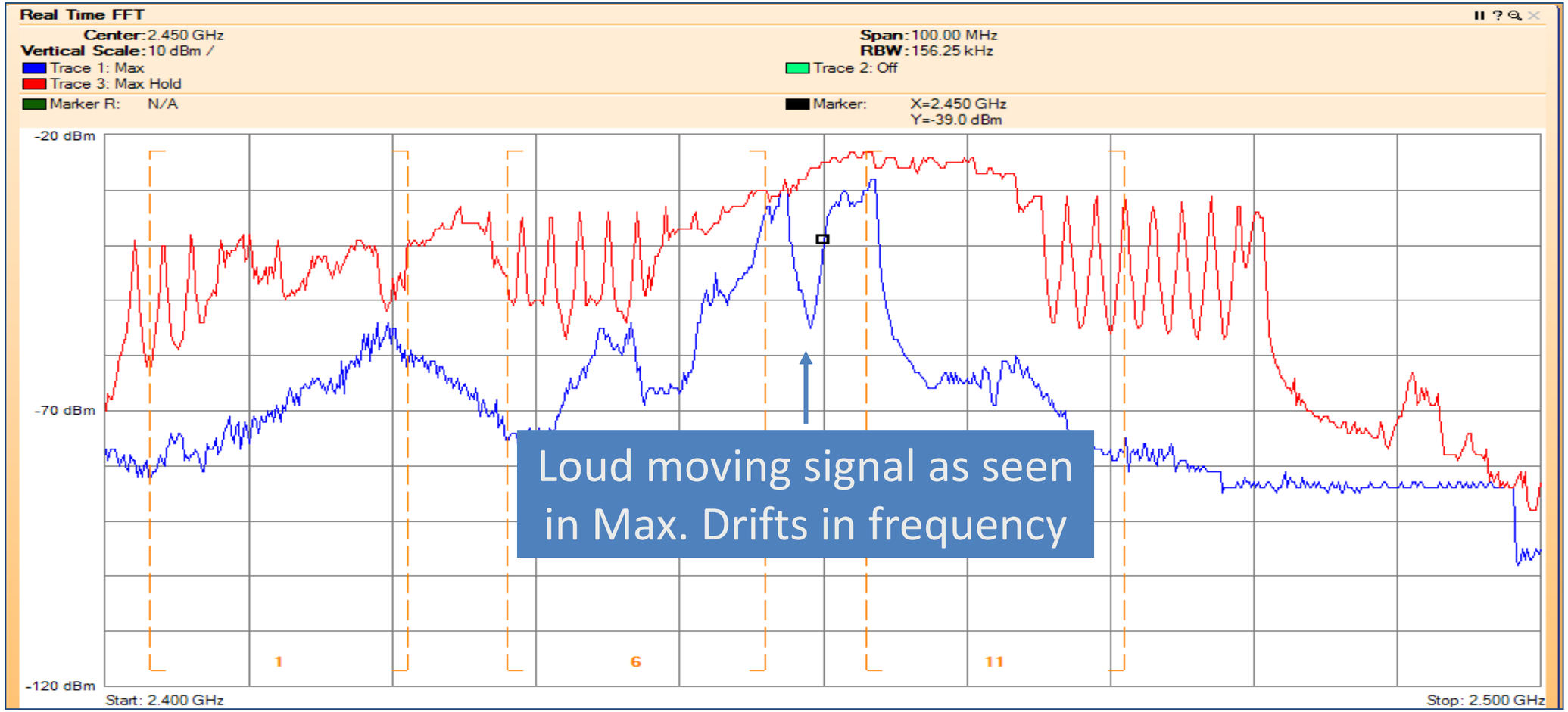
- Cisco Spectrum Expert
  - Detects non-802.11 sources of interference
  - Interferences need to be taken into account in the coverage design, or removed
- Entry level alternatives:
  - Metageek Airview
  - Nutsaboutnets Airsleuth



Example of Bluetooth

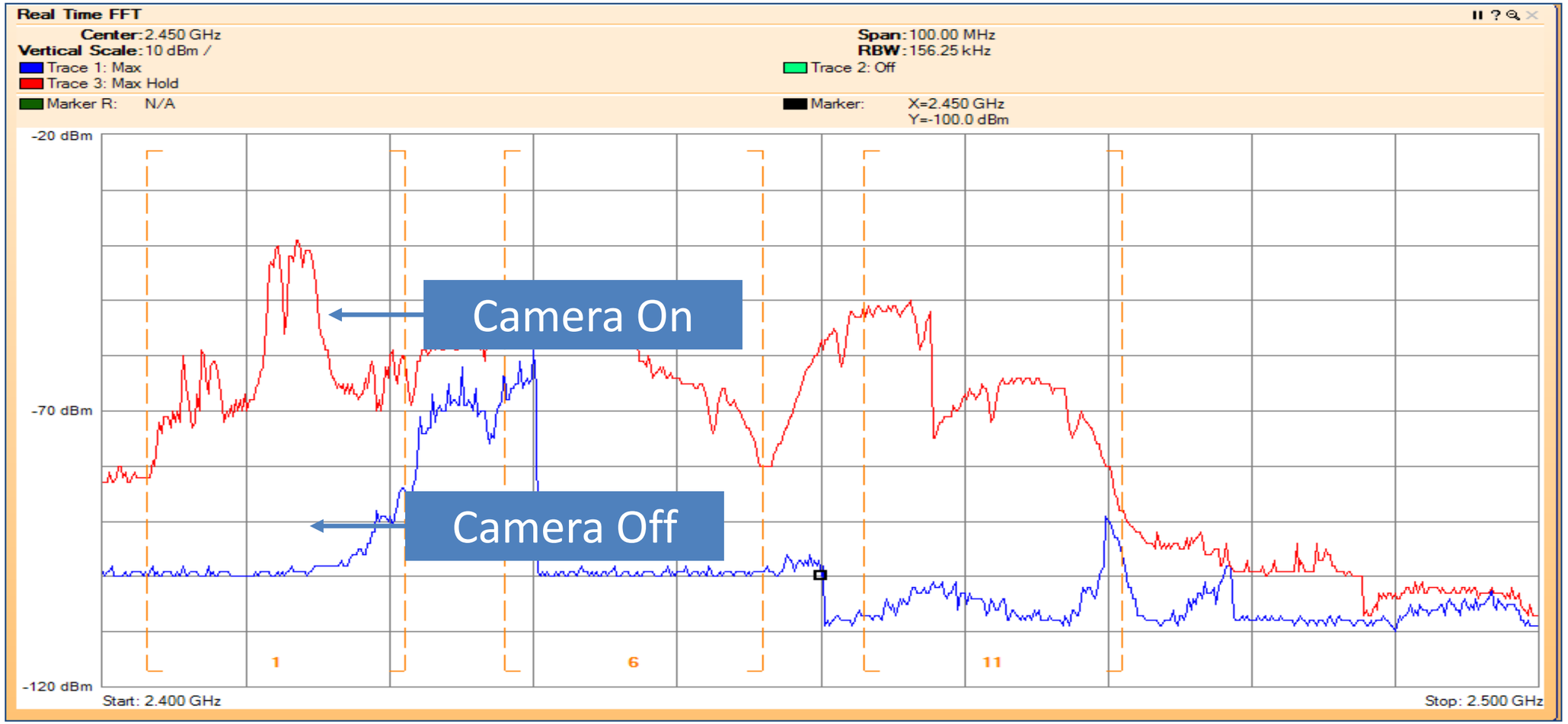


Example of Microwave Oven



Example of Cordless 2.4-GHz Phone

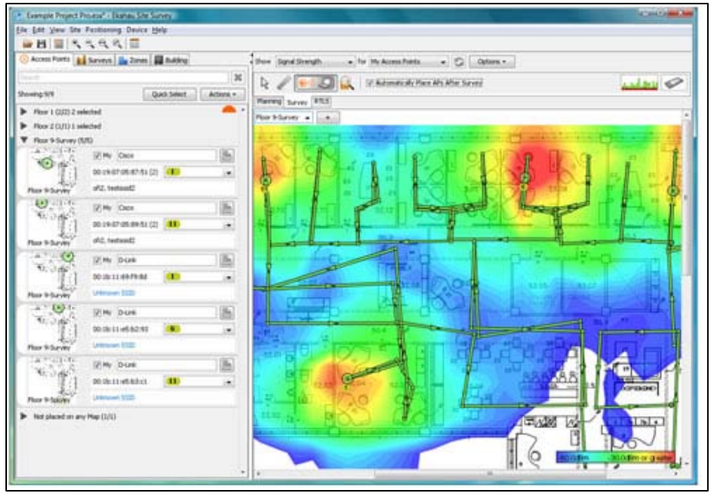
Example of Wireless Video Camera

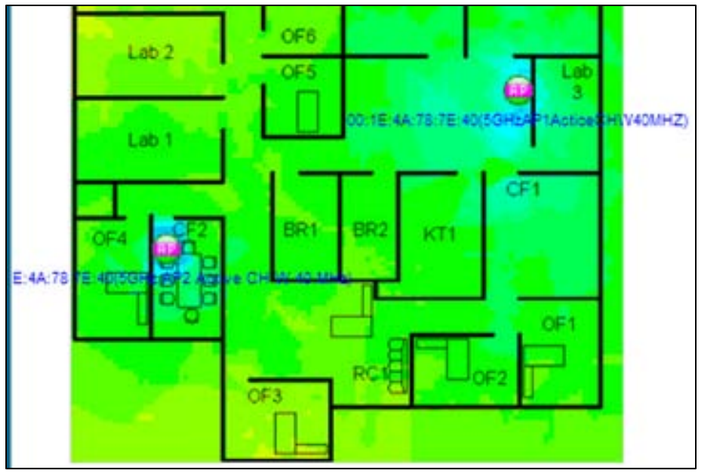


Mapping Site Survey Tool

The Core Survey Tool

- Major brands: Ekahau Site Survey, AirMagnet Survey
- Lower grade alternatives
  - Visiwave, Tamograph
- Choose carefully:
  - 802.11a/b/g and 802.11n support?
  - Network planning (2D, 3D)?
  - Hybrid Site Surveys support?
  - Integrated spectrum Analyzer?
  - GPS assisted automated outdoor site surveys?

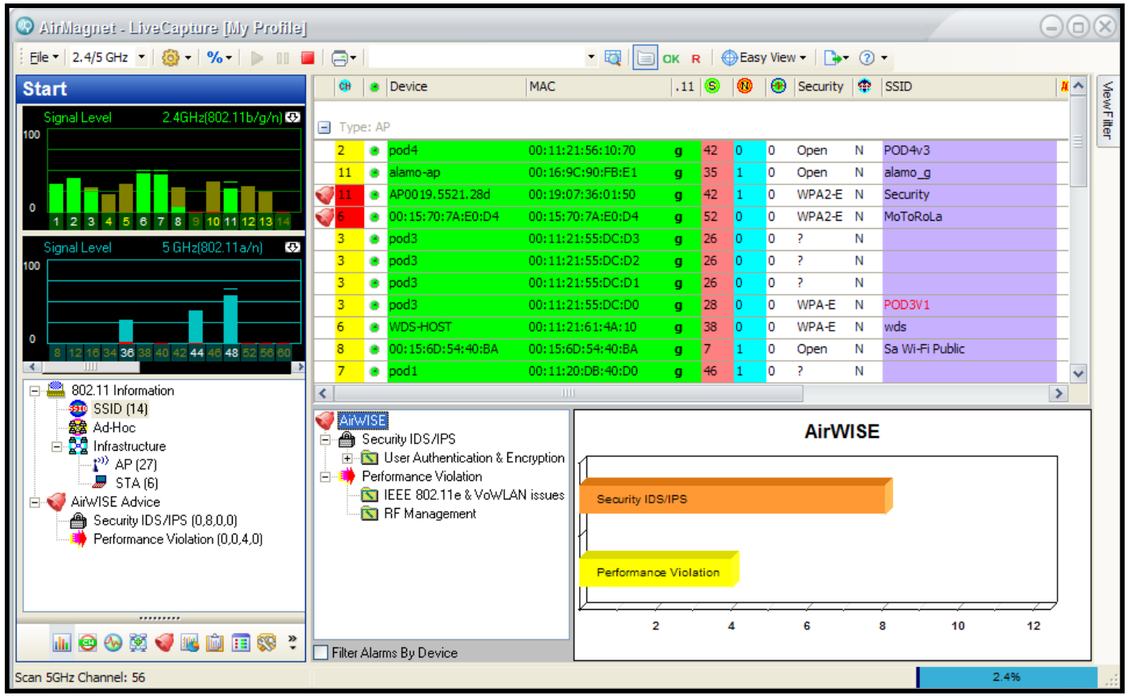




WiFi Analyzer

Understand the 802.11 Environment

- Used to capture and analyze the 802.11 state
- Secondary to the site survey itself, except when a 802.11 network is already present… and does not perform as expected
  - AirMagnet Wi-Fi Analyzer
  - Omnipeek
  - Capsa for WiFi



Wireless Hardware

AP, Antennas and Clients

- Site Survey mapping tool can usually emulate clients
- Choose the weakest clients planned for the deployment
- Use the AP models planned for the deployment
  - Two of every antenna you might have to use.
  - Use diversity antennas.
- Clamps, temporary mounting hardware, velcro, zip ties, poles

Other Hardware

- Battery pack
- Charger
- Spare laptop battery and charger
- RJ-45 to DB-9 rollover cable
- Measuring wheel or laser (for horizontal distances)
- Height measurement
- digital camera
- Access Point Marking Locators

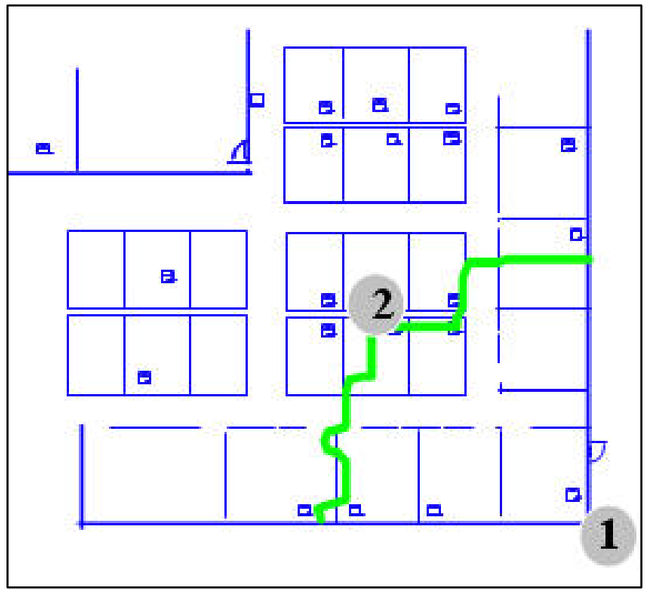
Plan the Survey Trip

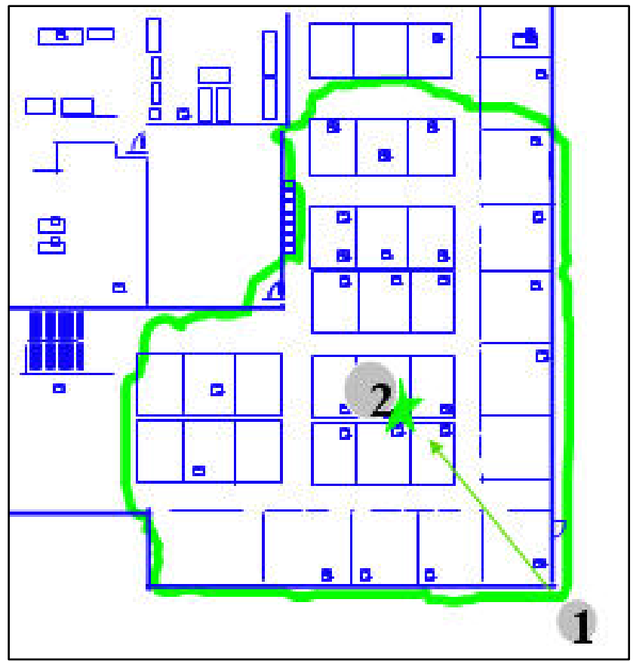
- How many days, how many surveyors?
- Security clearance needed?
  - Specific pass
  - Security training
  - Security staff availability
- Special equipment needed onsite?

Performing the Site Survey

Start From Corners, or Stairs

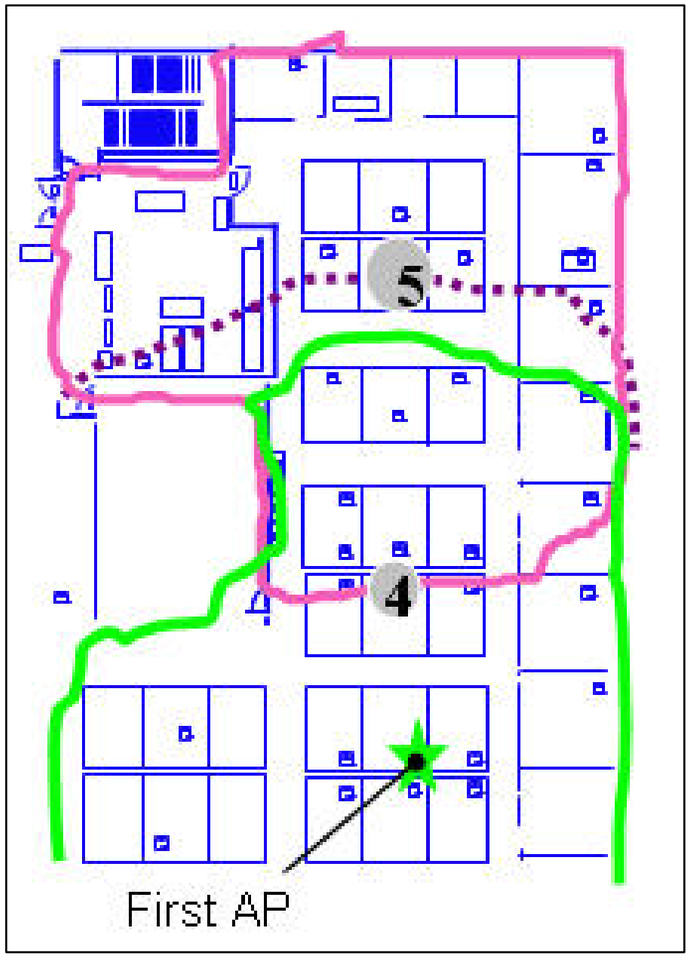
- Determine coverage boundary for data rate desired
- Pull the access point out to the center of the boundary drawn
- Re-verify coverage

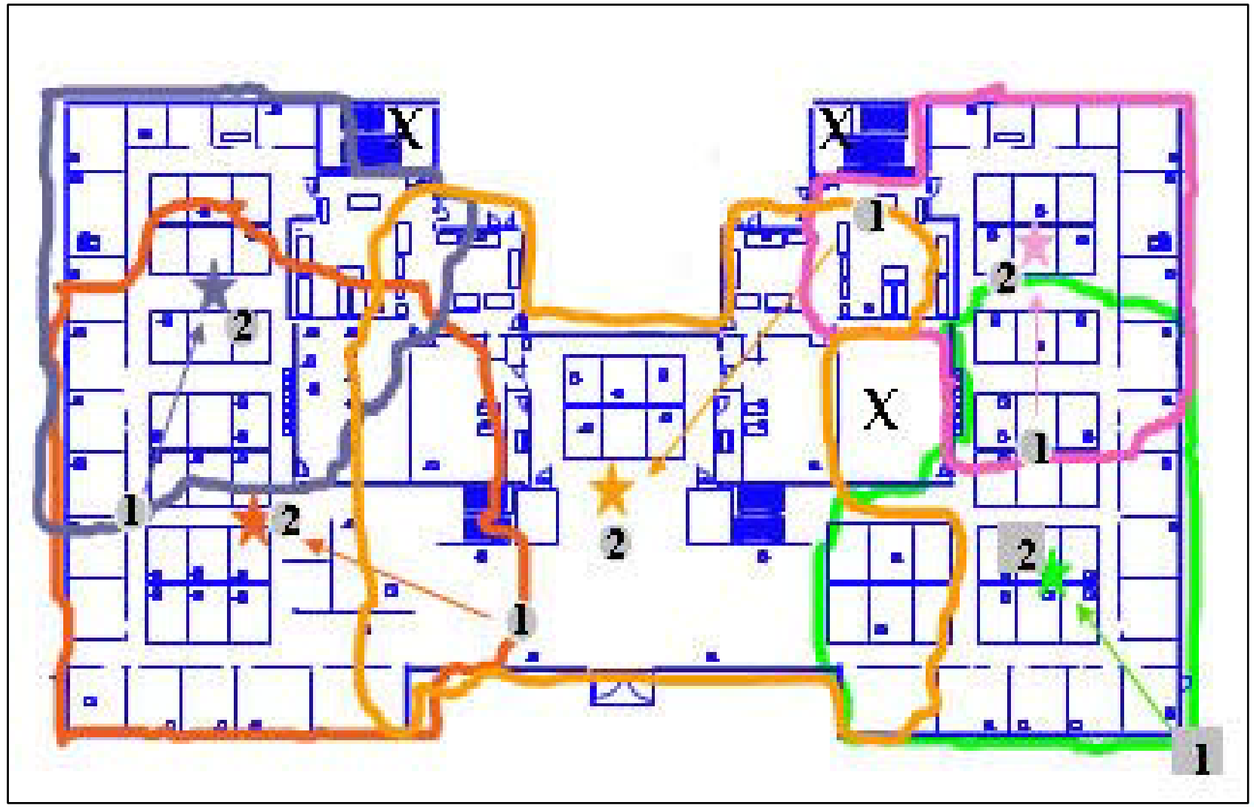




Other APs Placement

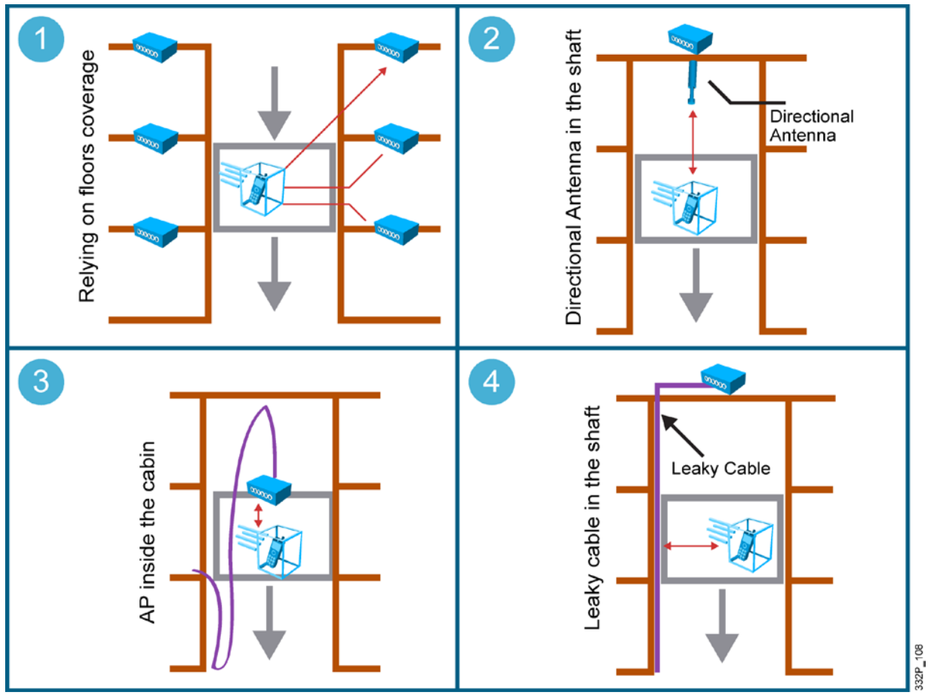
- Repeat to create coverage areas for the entire floor.





Difficult Areas

- Elevator shafts block and reflect RF signals.
  - AP with directional antenna on top of shaft
  - AP inside the cabin
  - Leaky cable
  - APs on each floor
- Supply rooms and storage with inventory absorb RF signals.
  - Warehouse with 50 % of inventory has different RF footprint than at 100 % of inventory.
  - Paper/cardboard, pet food, paint, petroleum products, etc. absorb the RF signals.
  - Survey when inventory is high

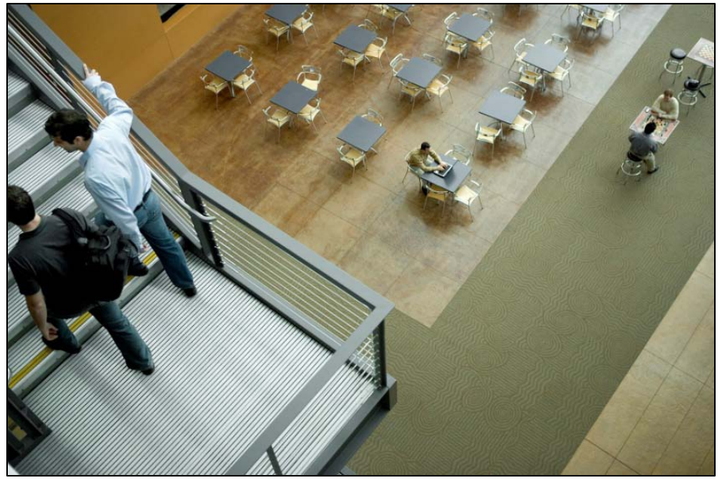


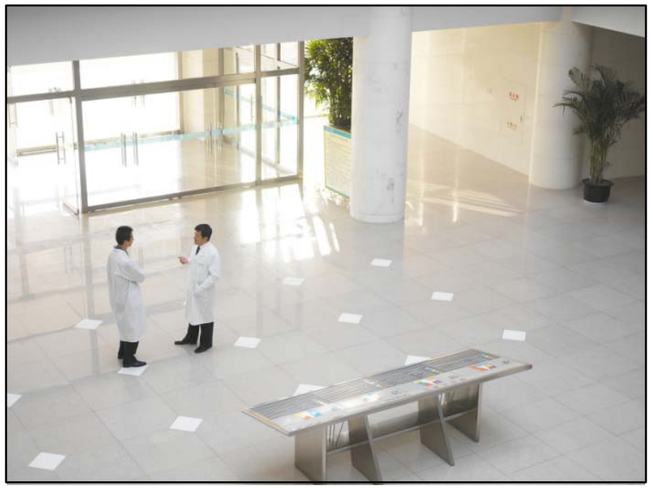
Difficult Areas

- Break rooms (kitchens) may produce 2.4-GHz interference through the use of microwave ovens.
  - Depends on oven brand, position, age
  - Try to avoid worst direction of leakage
- Test labs may produce 2.4- or 5-GHz interference, creating multipath distortion and RF shadows.
  - No magic solution!
- Cubicles tend to absorb and block signals.
  - Coverage from ceiling usually offers best performances

Difficult Areas

- Conference rooms, auditoriums, have high-utilization requirements and require a greater number of access points.
  - APs in the ceiling, directional antennas
  - APs under the floor, low power
  - Cannot solve the client collision issues
- Atriums
  - Signal from many APs around the atrium, on different floors, are detected from the atrium area, creating interference issues.
  - Position the APs far from the atrium area, keeping only one or two APs specifically to cover the open space





Site Survey: Performance Objectives

Clients and Applications

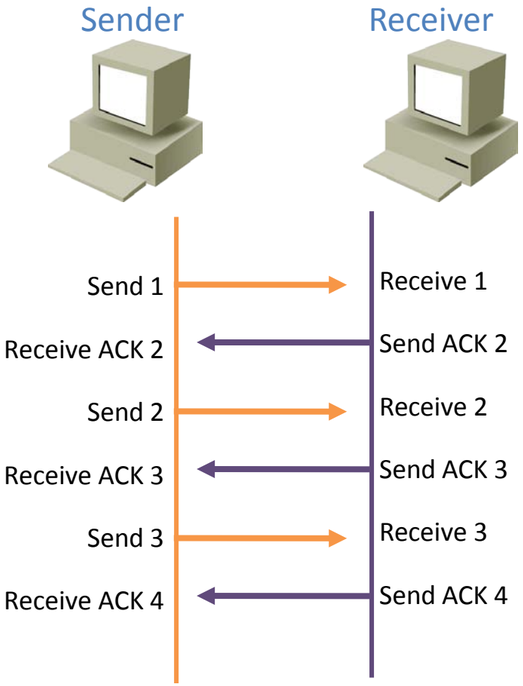
Test Each Client Type, Determine the Intended Applications

- Each application type has a specific network behavior, and network specific requirements (bandwidth, bursts, delay, etc.)
- Each client hardware type has specific performance characteristics and limitations
  - Protocol support (802.11b/g/a/n)
  - Roaming behavior
  - Feature support (WMM, U-APSD, TSPEC, etc.)
- A wireless network is designed for client types and application types

Application Types

Applications will Determine Throughput and Roaming Performance Requirements

- TCP-based applications are usually resistant to throughput changes and short disconnections:
  - TCP is connection oriented
  - Ensures connectivity, packet delivery
  - Resends lost packets (TCP resends are different from 802.11 resends)
- UDP-based applications are not session oriented
  - Packets are sent without session establishment, windowing or packet numbering
  - Adapted for applications using another system for session control, e.g. VoIP



Application Types

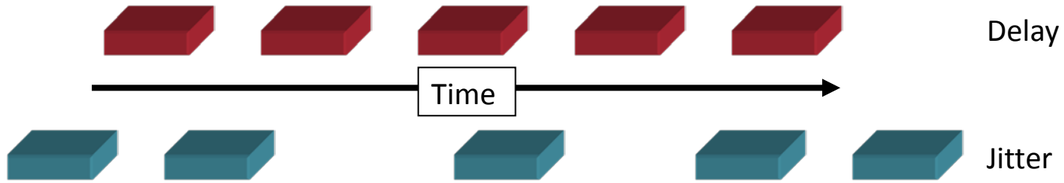
Common TCP-based Applications

- HTTP/HTTPS
  - Not always persistent session-oriented (each page is a new session)
  - Quality of client experiences relies on reachability of the pages (DNS), page download speed, 802.11 connection persistence (coverage holes while downloading)
  - Web, most email clients
- Telnet/ssh:
  - Connection oriented
  - Session persistence is required
  - Long 802.11 coverage holes may disconnect the TCP session
  - Barcode scanners are usually Telnet/ssh devices

Application Types

Common UDP-based Applications

- VoIP
  - Carries voice sound with UDP and Real Time Protocol (RTP), voice control traffic uses Real Time Control Protocol (RTCP)
  - Voice audio quality perception depends on codec selected, percentage of lost packets and delay/jitter issues
- VoIP packet rate (e.g. 50 packets/second) is not wireless transmission rate (0.03 milliseconds per packet at 54 Mbps)



1: Phone sends a fixed amount of VoIP packets per second to the network stack

2: Phone wireless stack empties its buffer as fast as possible, then returns to idle state

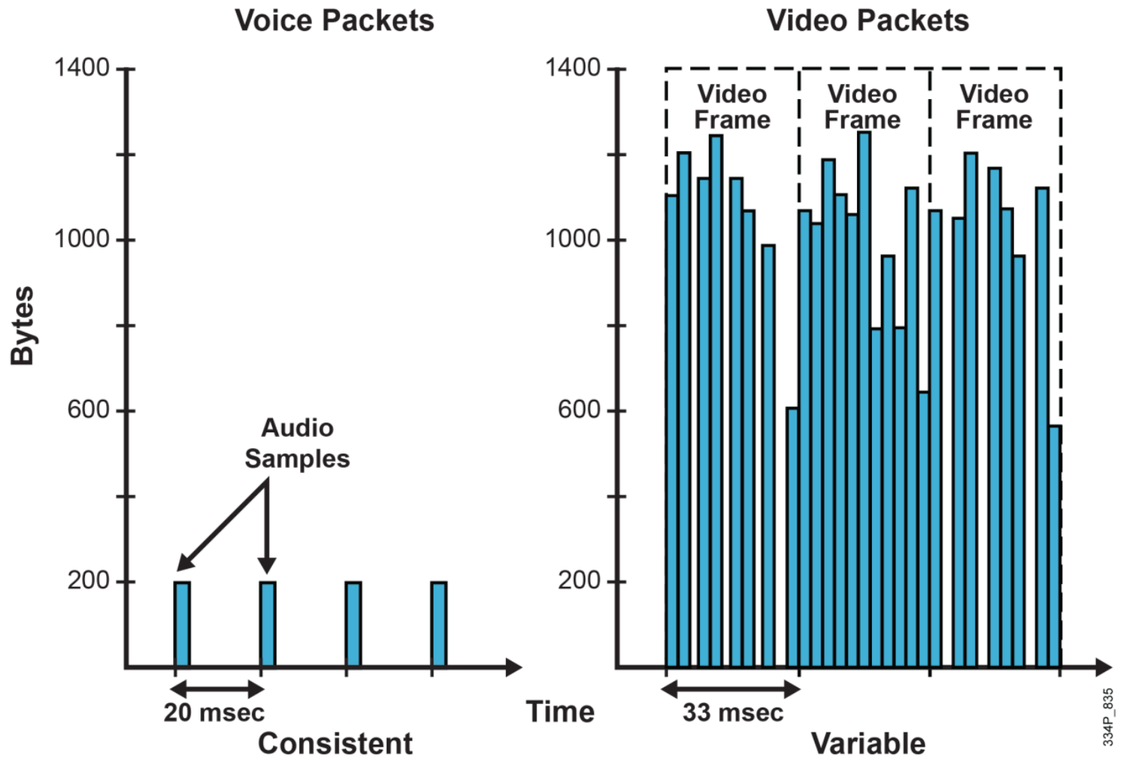
3: AP wireless stack empties its buffer as fast as possible

4: Phone stores received packets in its buffer, then plays them at regular pace

Application Types

Common UDP-based Applications

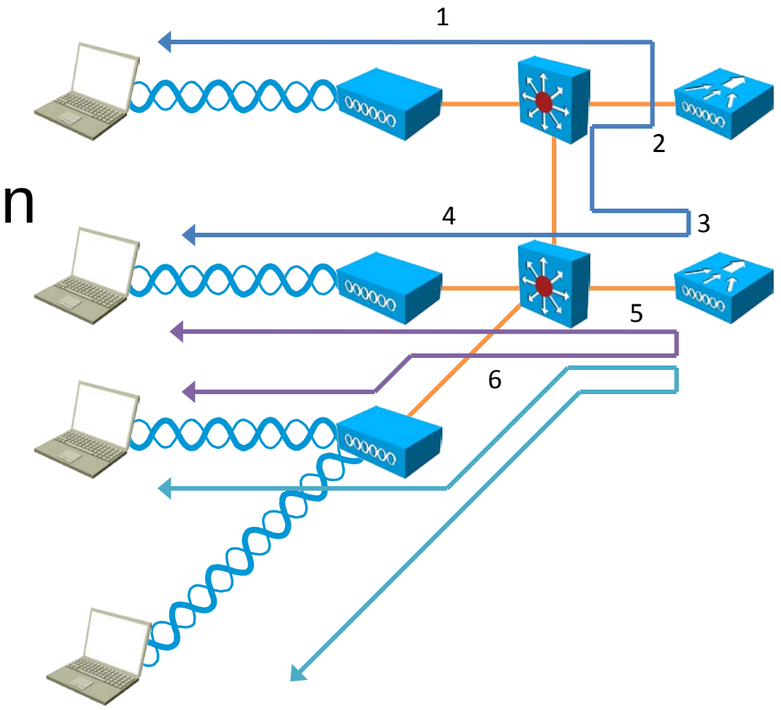
- Video uses video and audio codecs
  - Some codecs are built for real time exchange, some for streaming
  - Video algorithms refresh entire images when large changes occur
  - The changes generate traffic bursts

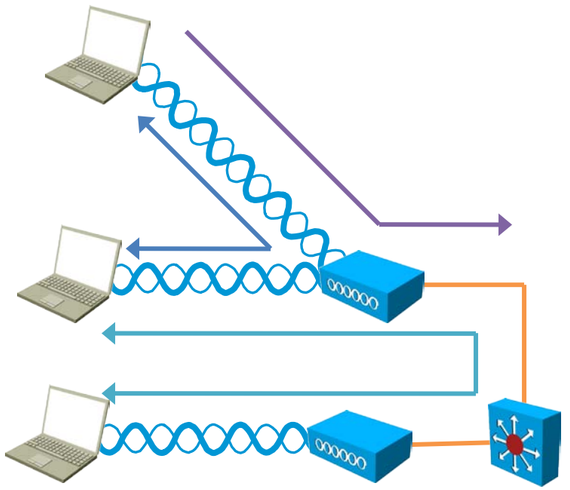


Traffic Patterns

How Much Bandwidth Consumed?

- Network behavior is key to bandwidth consumption
  - Client/Server type of applications client cache behavior impact network bandwidth consumption
  - Cloud oriented policy dramatically changes network bandwidth consumption
- Controller-based traffic depends on model chosen (FlexConnect, local AP, inter-controller roaming, and is different from IOS AP traffic pattern

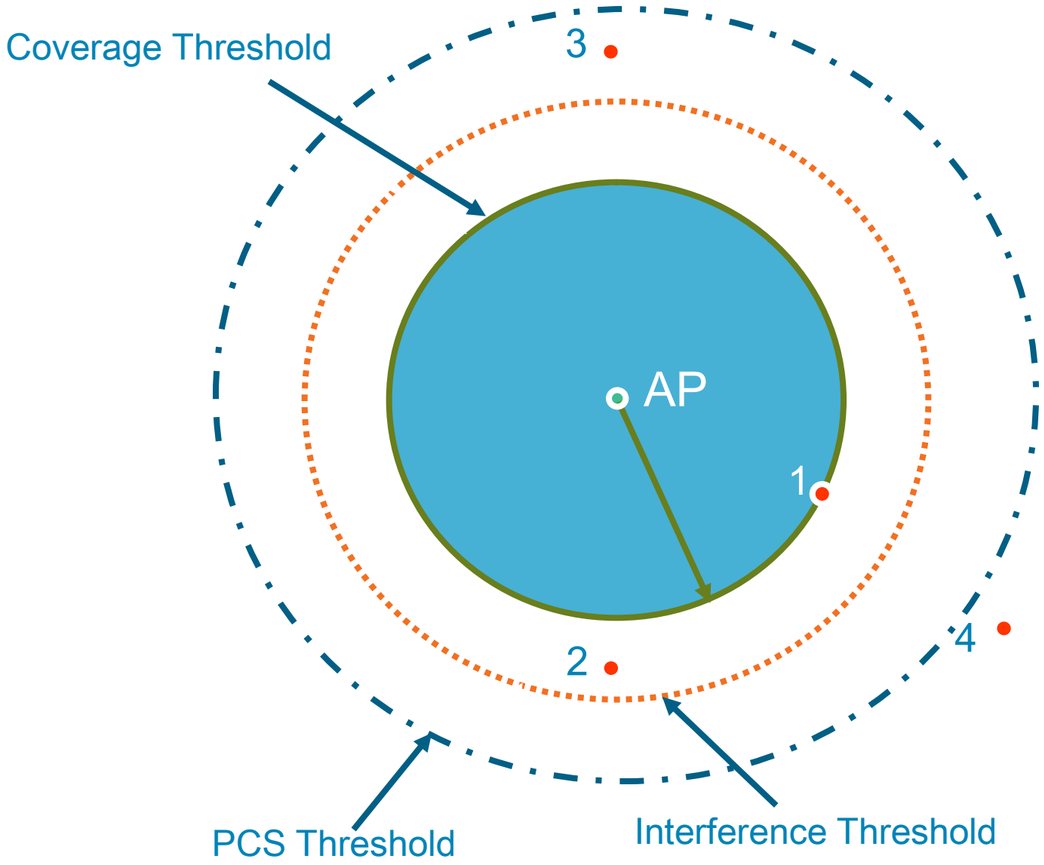




Anticipating Cell Edge Issues

Beyond Cell Performances, Roaming Quality is Key to Perceived Quality

- **STA 1**
  - Above coverage threshold
  - AP can read frames
  - Duration field reduces collisions
- **STA 2**
  - Outside coverage area
  - Above Interference Threshold
  - Can see frames, but can't read them
  - Increased possibility of data corruption and collisions
- **STA 3**
  - Below Interference Threshold
  - Above PCS Threshold
  - Can detect energy, but no frames
  - Potential for collisions
- **STA 4**
  - Below PCS Threshold
  - Does not detect AP signal

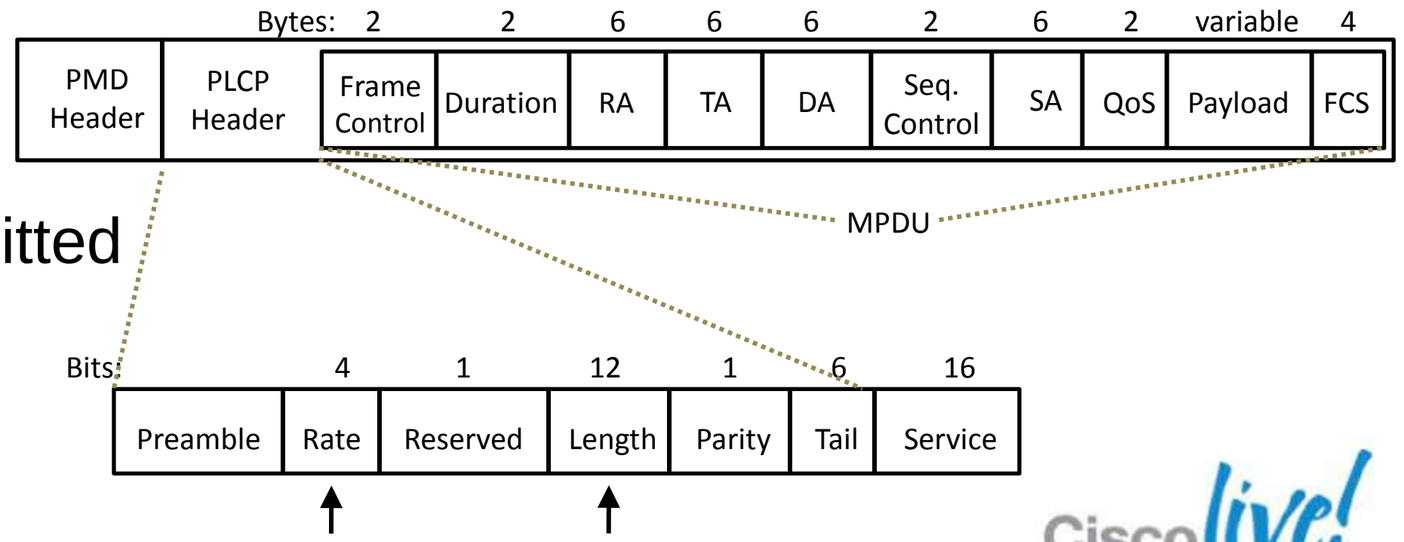


PCS = Physical Carrier Sensing

Anticipating Cell Edge Issues

Beyond Cell Performances, Roaming Quality is Key to Perceived Quality

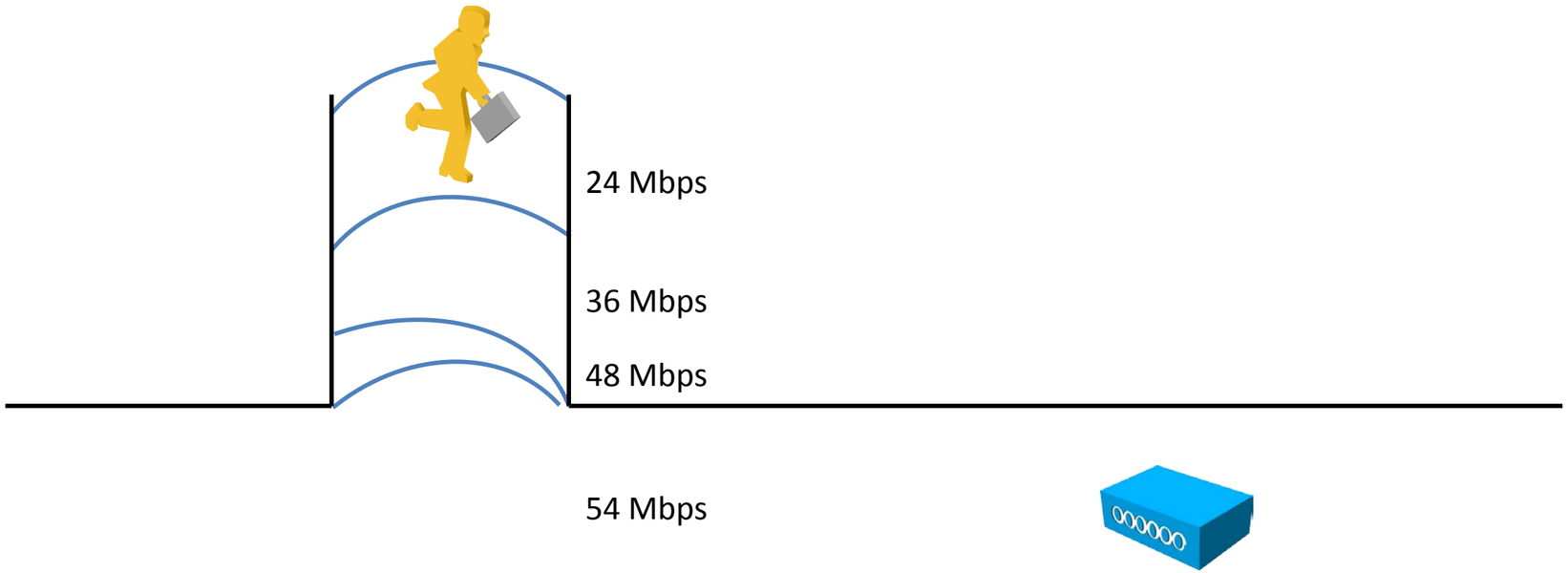
- Virtual CCA allows stations to read MPDU Duration value
  - Sent at same data rate as frame body
- PLCP header sent at slow data rate
  - Contains Rate and Length that can be used to calculate duration
  - Does not account for SIFS/ACK
- Stations can also use Energy Detect to deduce from increased energy level that a frame is being transmitted
- Allowed only if energy is 20 dBm above receiver max sensitivity level



Anticipating Rate Shifting Issues

How Much Time Wasted?

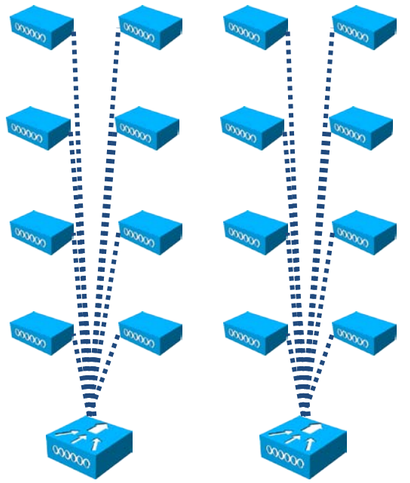
- 200 byte frame @ 54 Mbps is sent in 3.7 µs
- 200 byte frame @ 24 Mbps is sent in 8.3 µs
- Rate shifting from 54 Mbps to 24 Mbps wastes 1100 µs (65 times longer to send the next frame), in ideal (no congestion) conditions



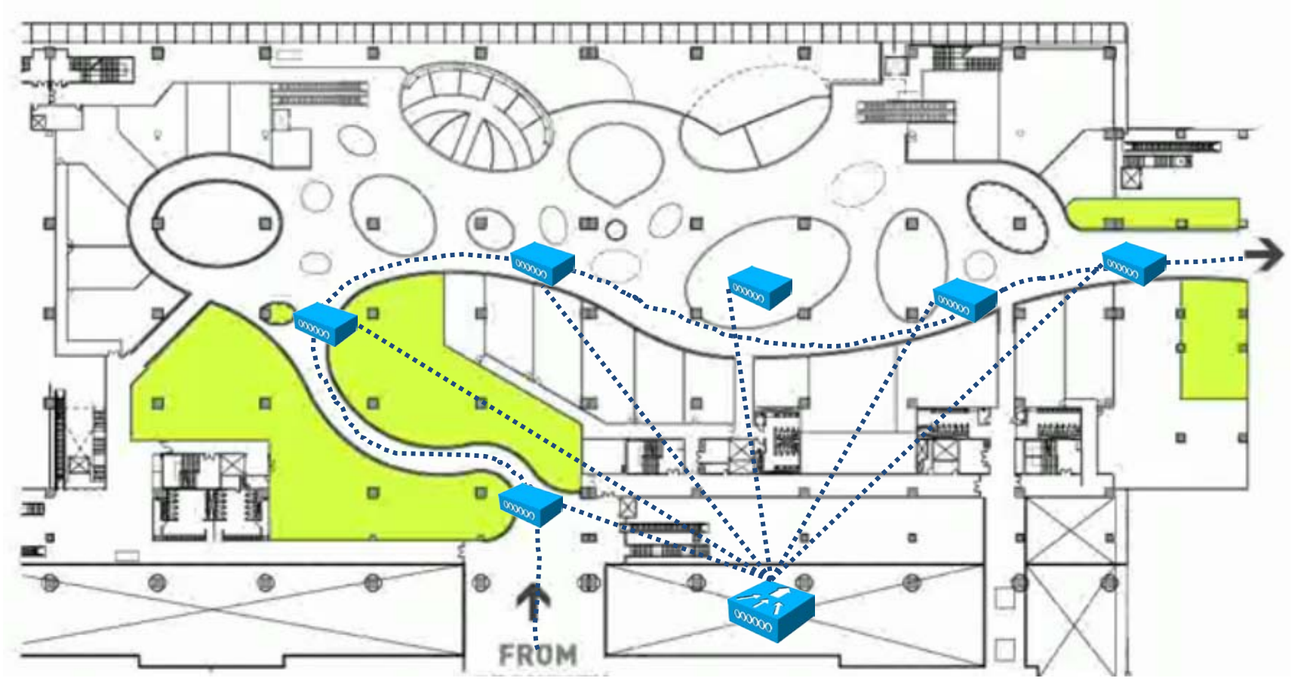
Anticipating Roaming Issues

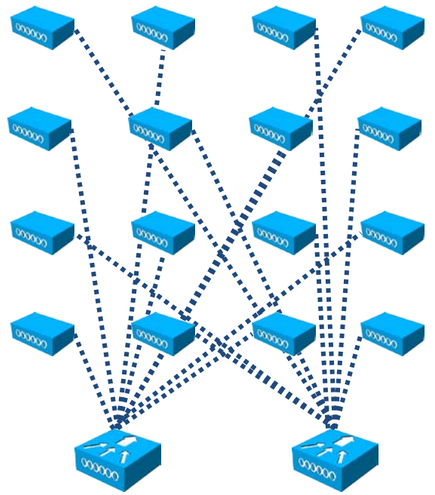
Roaming Models vs. Redundancy Models

- Salt and Pepper redundancy is adapted to stationary network usage
- When roaming is expected, make sure all APs on a path connect to the same controller



Standard redundancy Design





Salt and Pepper redundancy Design

How to Test Performances

Testing Rate Shifting

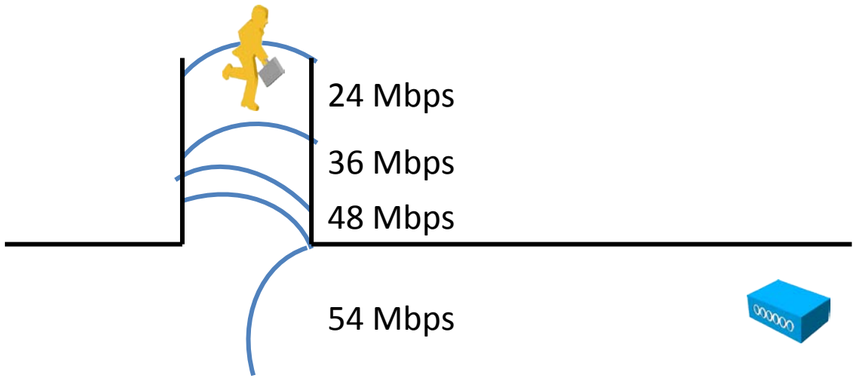
Anticipating Issues

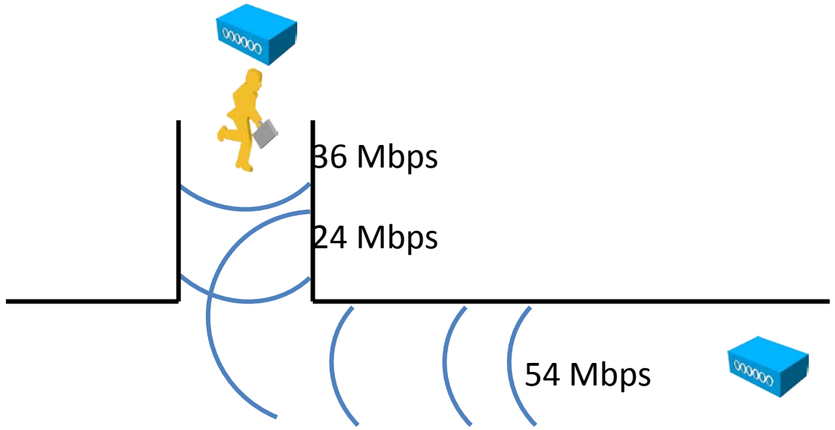
- Identify rate-shifting risky areas:
  - Self closing doors
  - Corridor angles
  - Environmental issues
- Test data-rate shifting areas for time-sensitive clients:
  - Client maintains its connection or roam
  - Data rate shifting parameters (RSSI/SNR/throughput and after)
  - Delay added because of the shift
  - Test in both directions
- Evaluate if client performances are still acceptable

Testing Rate Shifting

Anticipating Issues

- Data-rate shifts can be manipulated by changing AP parameters
  - AP power levels
  - Antenna type and position
- Try to make the client shift rate before getting to an area where conditions change brutally
- Client should then roam instead of sticking to old AP

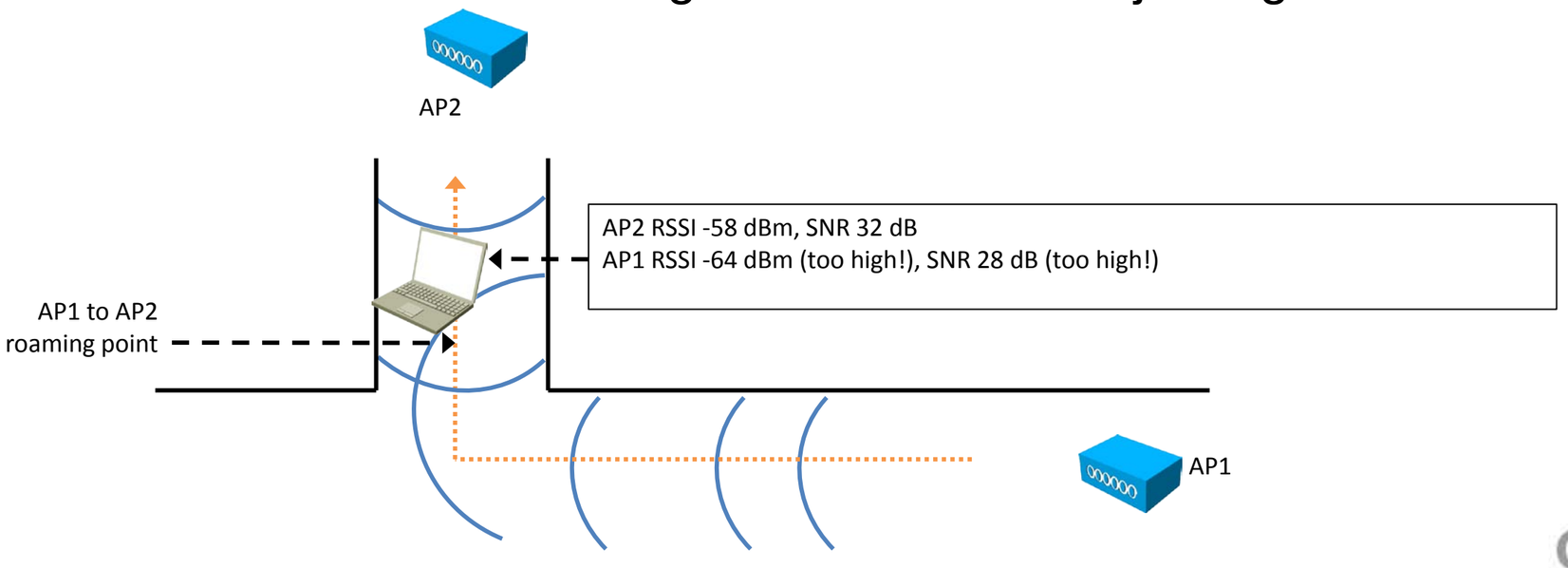




Testing Roaming Performances

Anticipating Issues

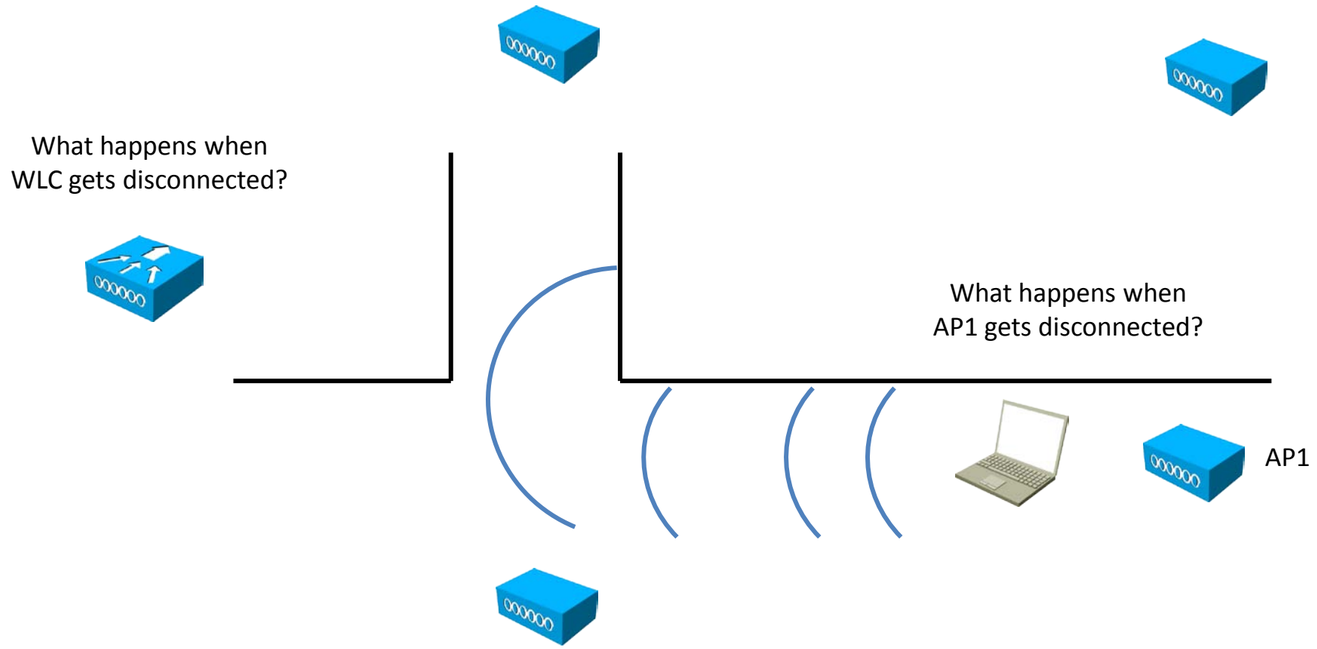
- Verify RSSI, SNR, retries levels triggering client roam
- Check errors, round - trip delay and jitter at the time of the roam
- Check roaming both ways (from AP1 to AP2, from AP2 to AP1)
- Check first AP RSSI/SNR after the roam
  - Client should not consider roaming back to AP1 after joining AP2



Testing Failover Performances

Anticipating Issues

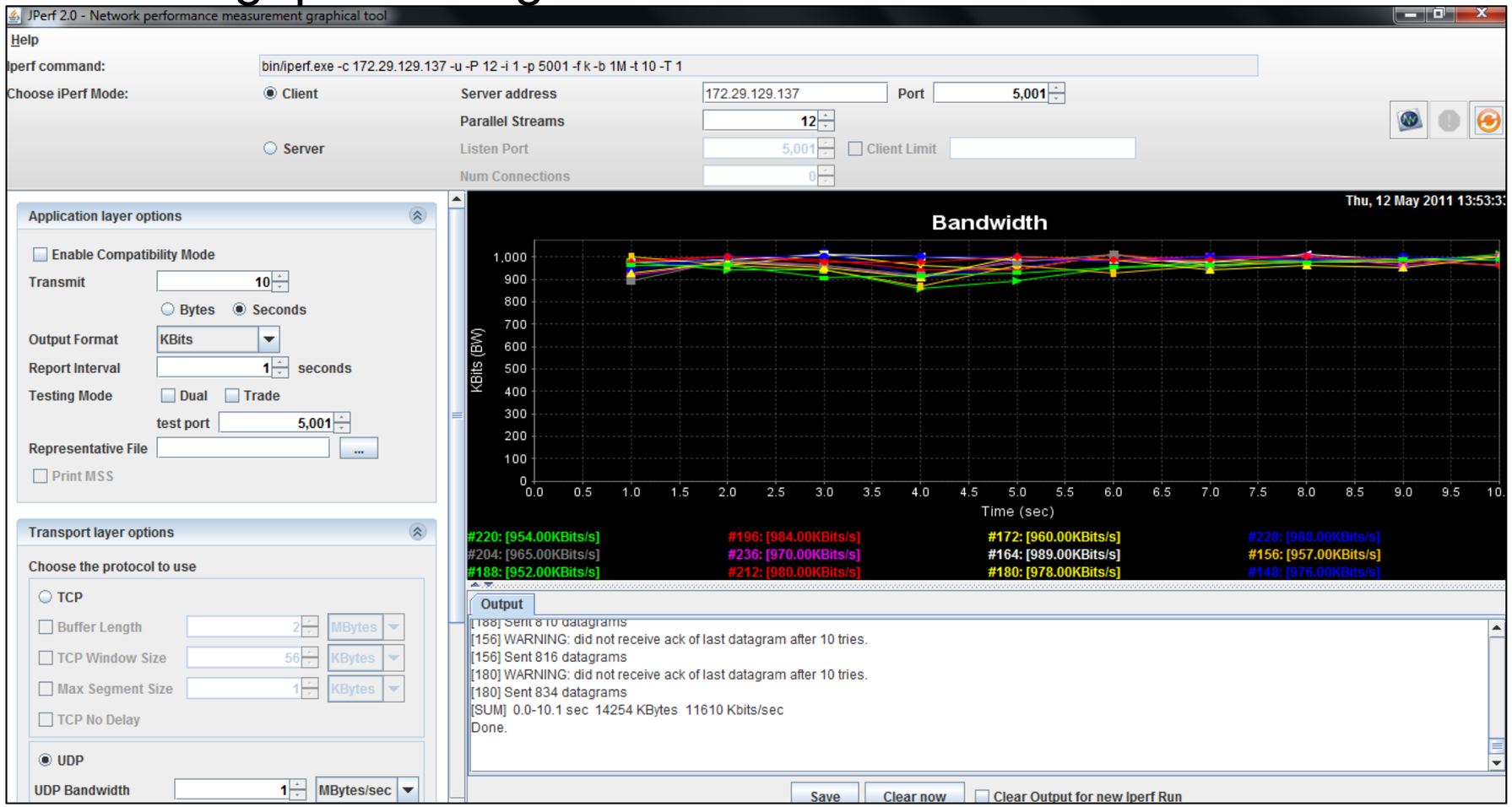
- Position a client in the center of a cell, then disconnect the AP
  - Does the client still get connectivity to other AP?
  - If controller-based solution, how long before other APs increase their power?
- What happens when you disconnect a controller?



Throughput Test

Iperf - Jperf

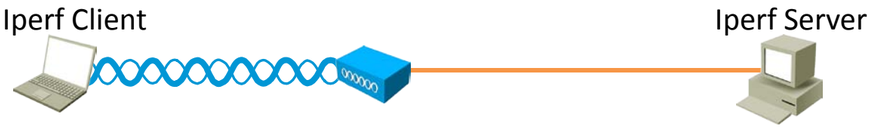
- Free throughput testing tool for TCP/UDP



Throughput Test

Iperf - Jperf

- On the server:
  - Start Iperf/Jperf in server mode
- On the client:
  - Define flow type (number of parallel streams, segment size, protocol [TCP/UDP], duration of the test
  - Enter the server IP address and start Iperf/Jperf in client mode
- Test runs and bandwidth consumption is displayed in near-to-real time



Throughput Test

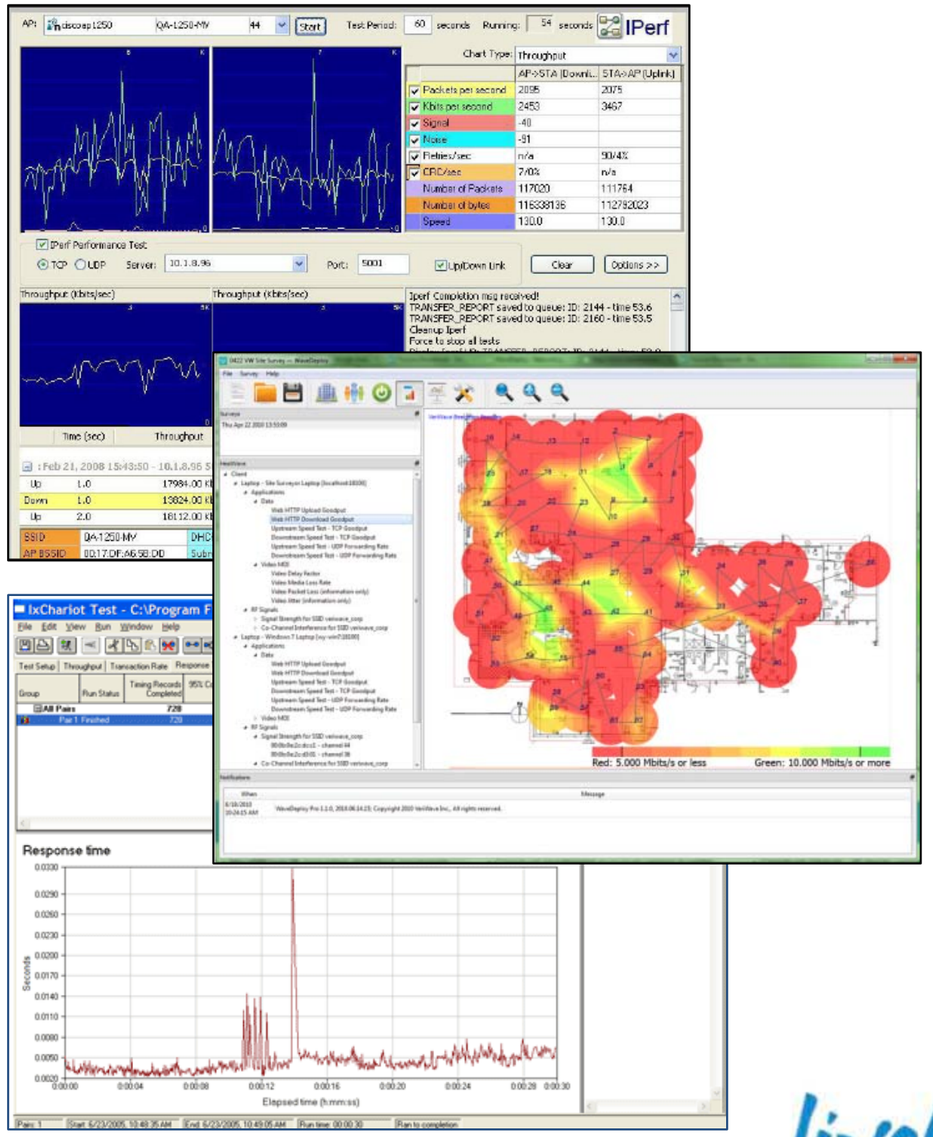
Free Tools

- Netperf:
  - Network performance test tools
  - Windows/Linux
  - Many plugins to test anything from CPU load to specific applications
  - CLI-based, possible export to web pages
- Nuttcp:
  - TCP testing tool
  - Built to interact with OS native tools (ping/traceroute, etc.)
  - Can test TCP and UDP
  - CLI-based, possible export to Web pages

Throughput Test

Vendor Tools

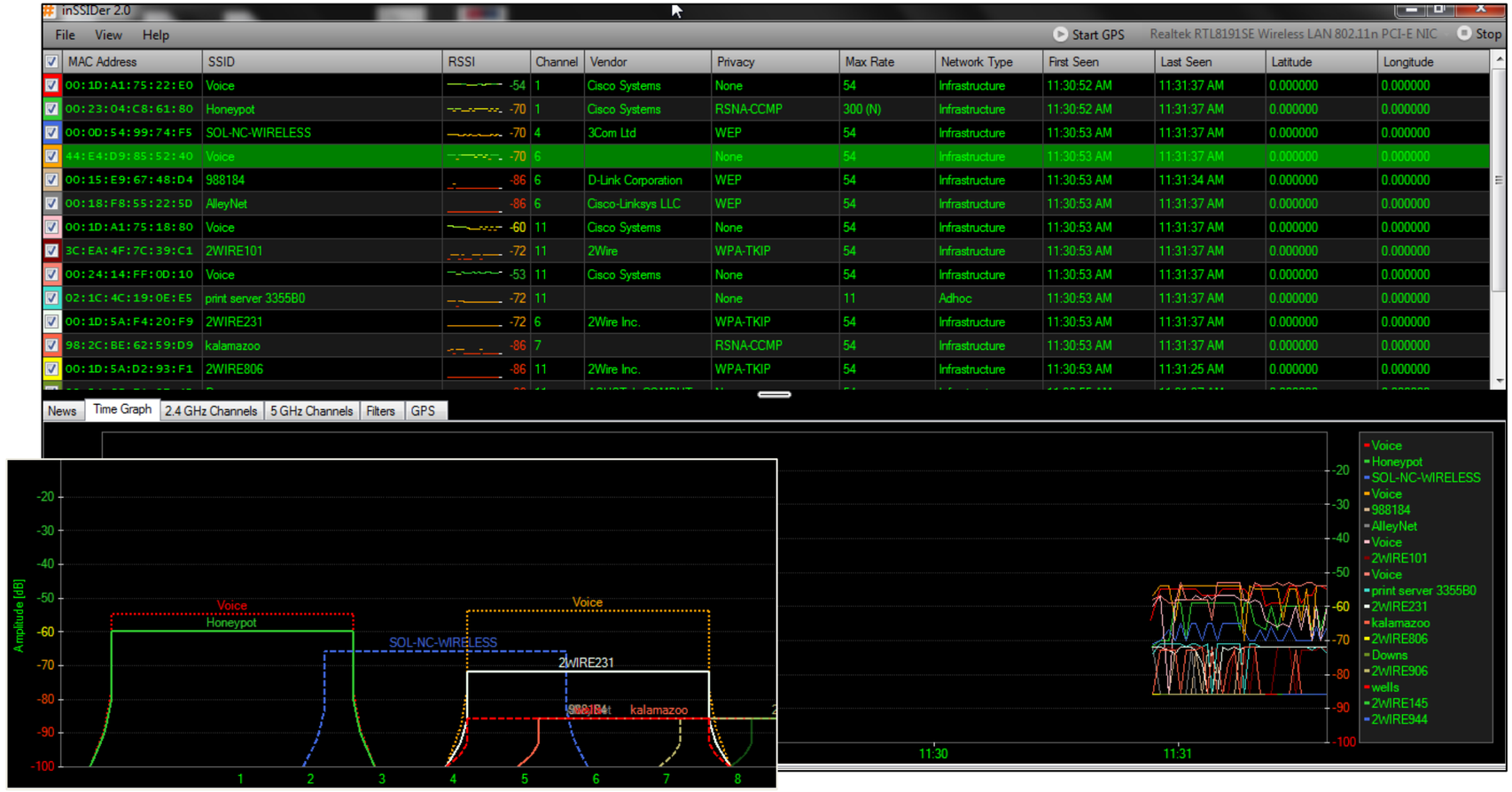
- Airmagnet WiFi Analyzer:
  - Uses Iperf engine for throughput tests
- WaveDeploy:
  - Network performance testing tool
  - Display similar to site survey mapping tools
- IxChariot:
  - Network performance testing tool
  - Can emulate 150 different applications



Wireless Network Assessment Tools

Free Tools

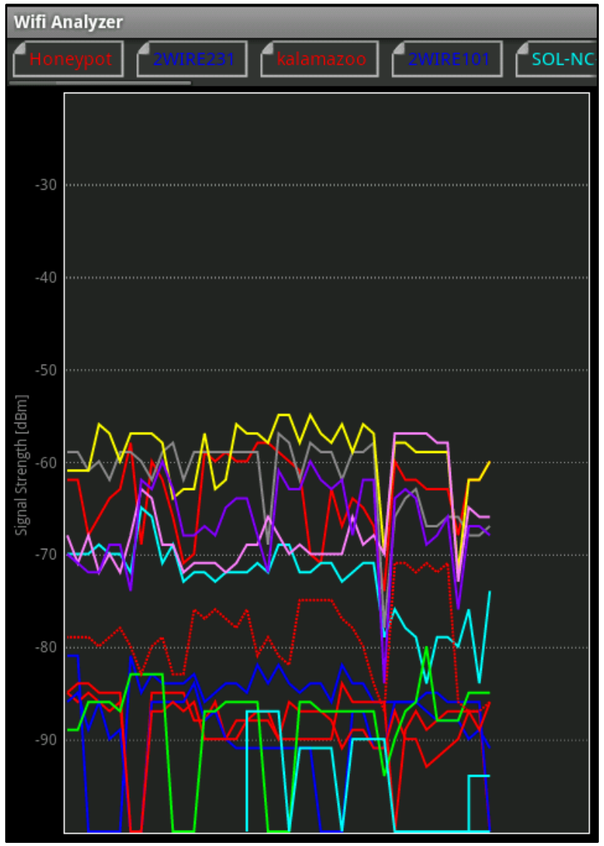
- InSSIDer, Windows-based, provides live graphs for detected SSIDs RSSI and SNR values, with filtering capabilities

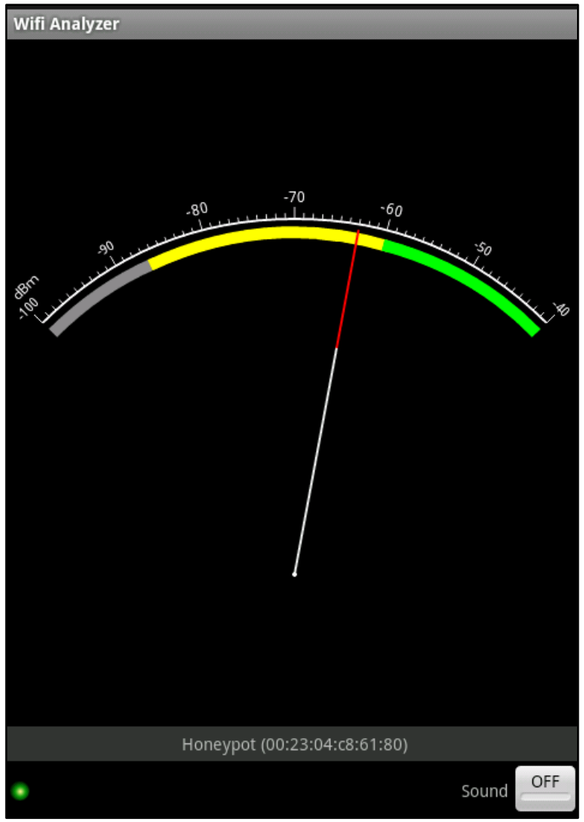


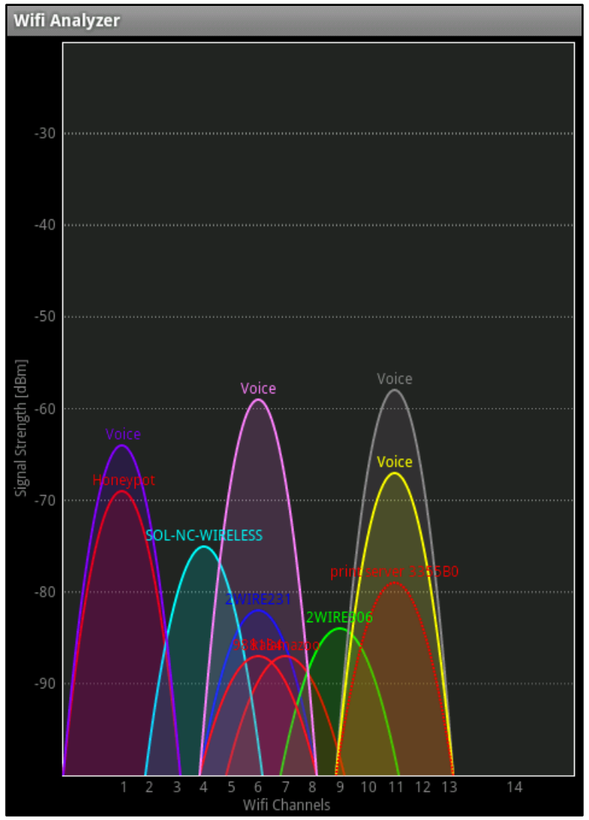
Wireless Network Assessment Tools

Free Tools

- Free wireless analysis utilities are available for most standard OS platform, e.g. Wireless Analyzer for Android





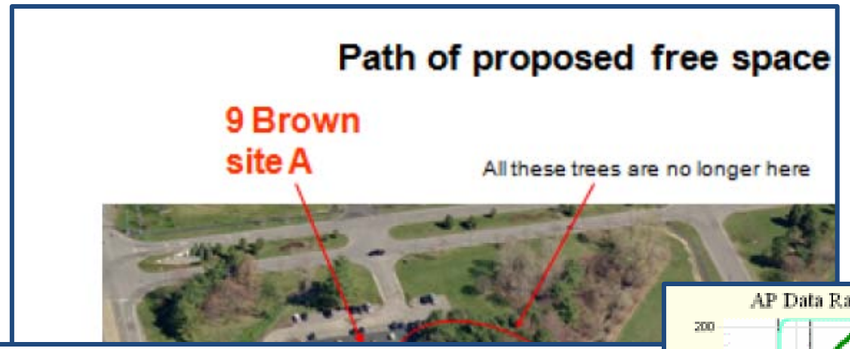


Survey Report

Site Survey Report

Deliverable to Your Customer

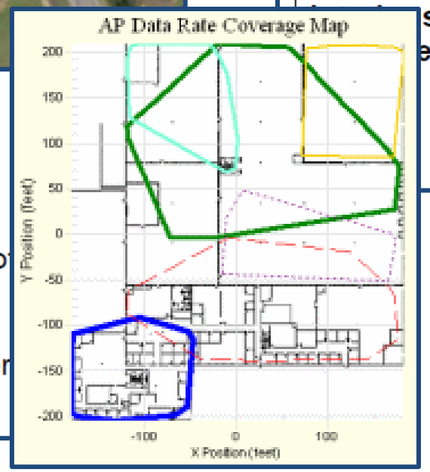
- Many types, depending on survey type and extent
- Several levels of details are possible
  - Depends of your involvement level into the deployment and maintenance cycles



General Information:

- Building construction type: Steel
- Height: 1 story (4 meters)
- Link head location: Sidewall parapet at roo
- Orientation: North West to South East

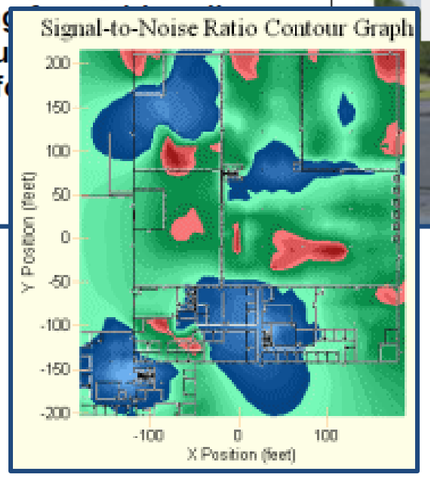
Line of sight: Clear but potential for tree top inter

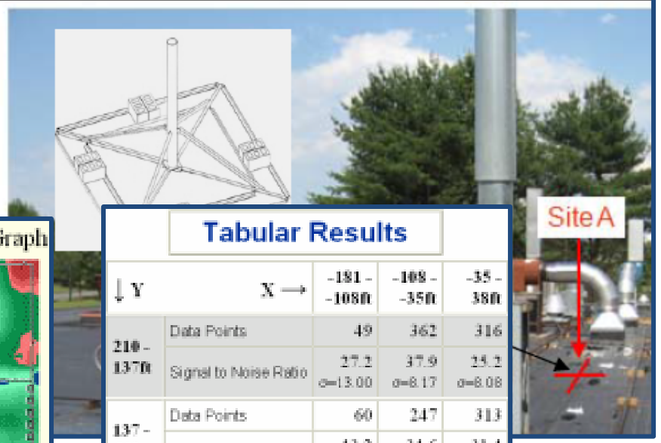


Site A

Rooftop view of mount location

Note: position non-penetrating mount as tight against supporting





Tabular Results

↓ Y	X →	-181 - -108ft	-108 - -35ft	-35 - 38ft
210 - 137ft	Data Points	49	362	316
	Signal to Noise Ratio	27.2 σ=13.00	37.9 σ=8.17	25.2 σ=8.08
137 - 64ft	Data Points	60	247	313
	Signal to Noise Ratio	43.2 σ=2.06	34.6 σ=13.61	31.4 σ=8.42
64 - -9ft	Data Points	0	130	361
	Signal to Noise Ratio	0.0 σ=0.00	21.0 σ=2.42	32.2 σ=7.97
-9 - -82ft	Data Points	57	293	365
	Signal to Noise Ratio	31.6 σ=2.10	36.9 σ=3.59	36.4 σ=10.49

Exam Taking Tips!
Preparing for the CUWSS exam

Exam Taking Tips

- ✓ Eliminate options—look for subtleties
- ✓ Look for the best answer
- ✓ Budget time—total and individual
- ✓ Sw/Hw context—v5.0, not later
- ✓ Make an intelligent guess
- ✓ Provide feedback during exam

Exam Taking Tips

- ✓ Site Survey tools are covered, know Ekahau, Cisco Spectrum Expert, Cisco WCS (7.0MR1) well
- ✓ Understand the underlying protocols: spectral masks, receiver sensitivity, modulations
- ✓ Know your Cisco hardware (controllers, APs, antennas, connector types, WCS, MSE and licenses)
- ✓ Know site survey best practices: understand the steps, read or practice to make informed best decisions based on scenarios
- ✓ CUWSS covers pre-site survey, site survey, network design and deployment reports… indoor and outdoor

Exam Format
Preparing for the CUWSS Exam

Exam Format

Test Practical Implementation Skills

- Question formats
  - Declarative
  - Procedural
  - Complex procedural (simulation)
  - Drag and drop
- Avoided question formats:
  - Memorization of command syntax or interface/menus
  - Trick questions

Exam Format—Declarative

A Declarative Exam Item Tests Simple Recall of Pertinent Facts:

Which of the following is an 802.11b speed?

A. 6 Mbps

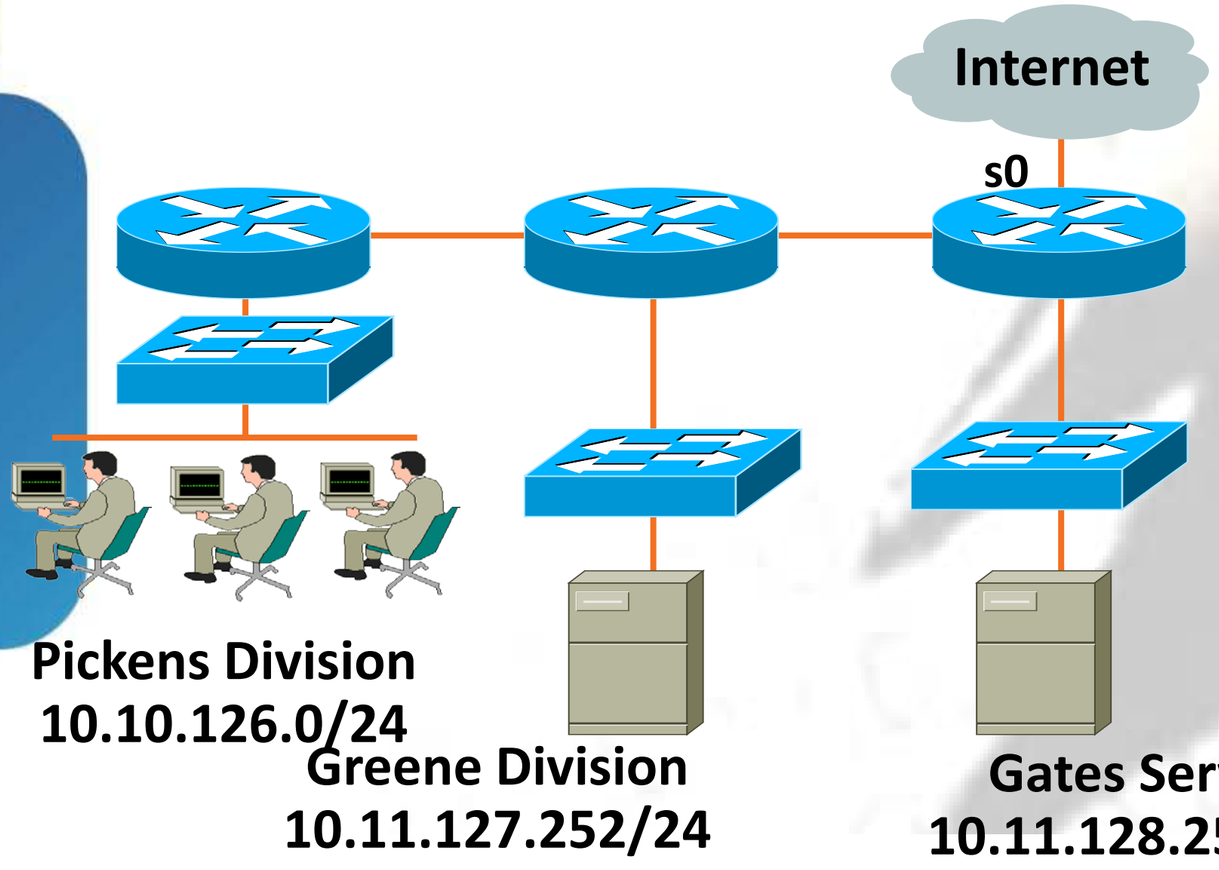
B. 11 Mbps

C. 18 Mbps

D. 48 Mbps

Exam Format—Procedural

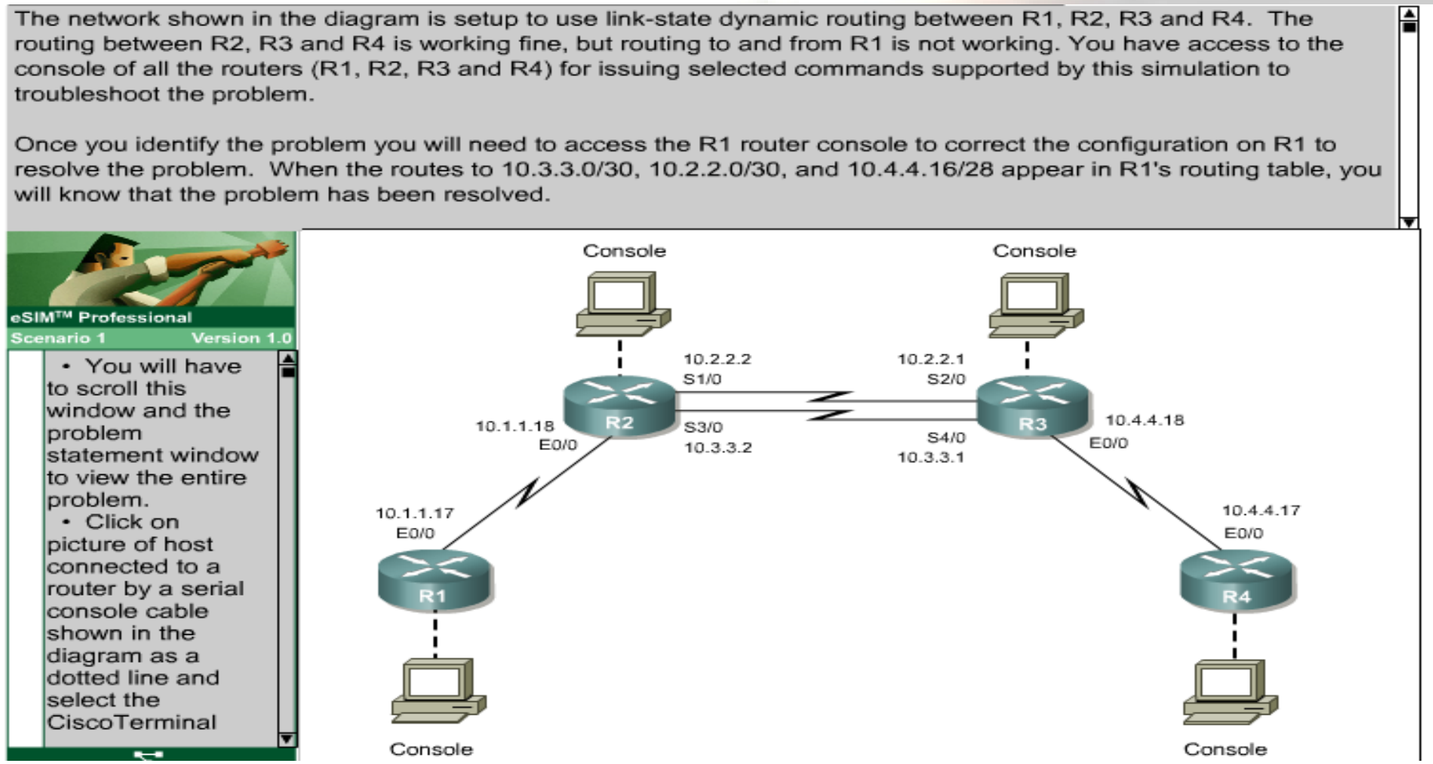
A Procedural Exam Item Tests the Ability to Apply Knowledge to Solve a Given Issue:



Which two access list statements are necessary on s0 of the Guilford router to allow FTP access to the Greene Division server from the Internet while blocking all other traffic? (Select two)

Exam Format—Simulation

A Complex Procedural Exam Item Tests the Ability to Apply Multiple Knowledge Points to Solve a Given Issue:



Exam Format—Drag and Drop

A Drag and Drop Tests the Ability to Relate Concepts:

Click and drag the correct Layer to the Network Model to which it applies

Internetwork	OSI Model
Session	TCP/IP Model
Link	
Presentation	

CUWSS Exam Practice

Practice Item #1

What tool would be the best choice to estimate the number of APs needed without conducting the survey itself?

A. WCS
B. Ekahau Site Survey
C. Iperf - Jperf
D. Cisco Spectrum Expert

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Practice Item #2

Suppose your AP max power is 100 mW, and the expected client max power is 25 mW. At what power level should you set your AP during the survey?

A. 12.5 mW
B. 25 mW
C. 50 mW
D. 100 mW

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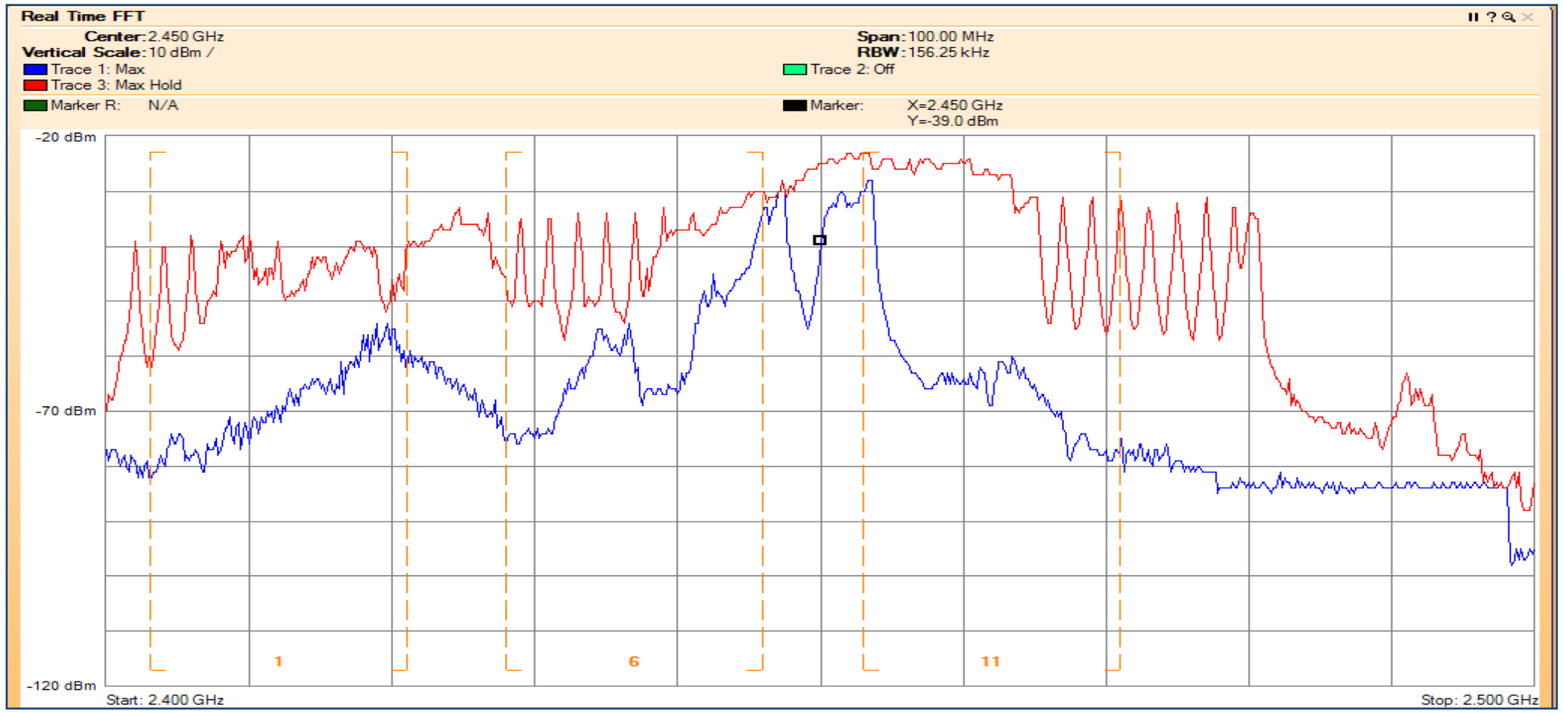
Practice Item #3

What device is likely to generate the interferences captured by Cisco Spectrum Expert?

A. Microwave Oven
B. Bluetooth Device
C. RF Jammer
D. Wireless camera



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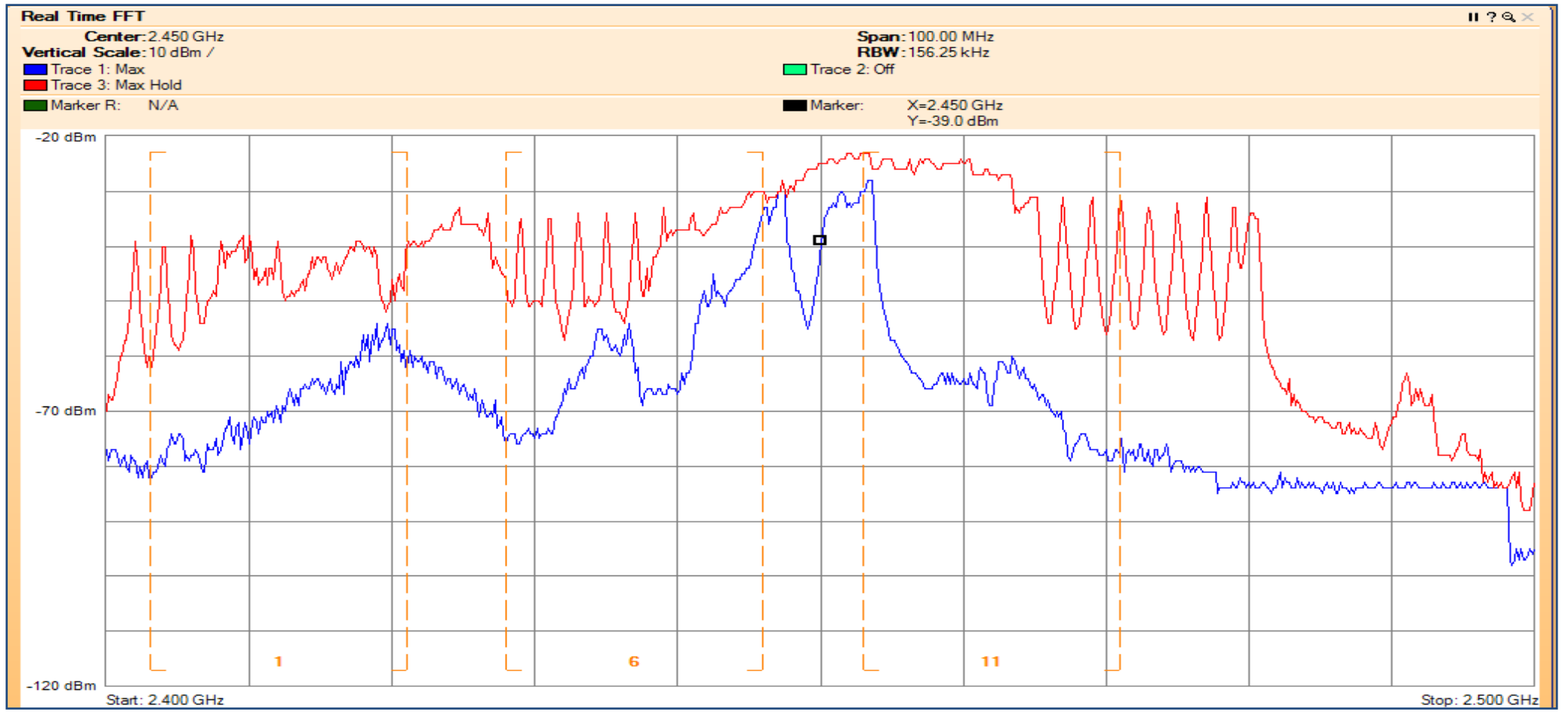

Practice Item #4

What wired network element should you verify while performing a site survey?

A. Presence of dynamic routing
B. Presence of switch ports with PoE availability
C. Router and switch brands to guaranty a pure Cisco network
D. QoS configuration to ensure optimal VoWLAN deployment

Practice Item #4

What wired network element should you verify while performing a site survey?

A. Presence of dynamic routing
B. Presence of switch ports with PoE availability
C. Router and switch brands to guaranty a pure Cisco network
D. QoS configuration to ensure optimal VoWLAN deployment

Practice Item #5

Which tool would probably be useful during a site survey?

A. Wrenches and pliers (standard sizes and forms)
B. Temporary attaching tools (tape, velcro, etc.)
C. Multi-country power adapters
D. Scuba-diving mask

Practice Item #5

Which tool would probably be useful during a site survey?

A. Wrenches and pliers (standard sizes and forms)
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C. Multi-country power adapters
D. Scuba-diving mask

Q&A

Thank you!

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Final Thoughts

- Get hands-on experience with the Walk-in Labs located in World of Solutions, booth 1042
- Come see demos of many key solutions and products in the main Cisco booth 2924
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