# Learning to Troubleshoot Wireless Networks: If They Troubleshot Themselves - We Would Be Out of Jobs

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- Author - CWTS Official Study Guide by Sybex
- Author - Mobile Computing Deployment and Management: Real World Skills for CompTIA Mobility+ Certification and Beyond by Sybex


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# Agenda

- Troubleshooting concepts
- Common troubleshooting methodology
- The Open Systems Interconnection (OSI) model and wireless networking
- IEEE 802.11 frame types
- Basic IEEE 802.11 connectivity
- Common wireless LAN problems
- Wireless LAN troubleshooting tools
- Spectrum Analyzer demonstration
- Protocol Analyzer demonstration
- Site Survey software demonstration

# Troubleshooting Concepts

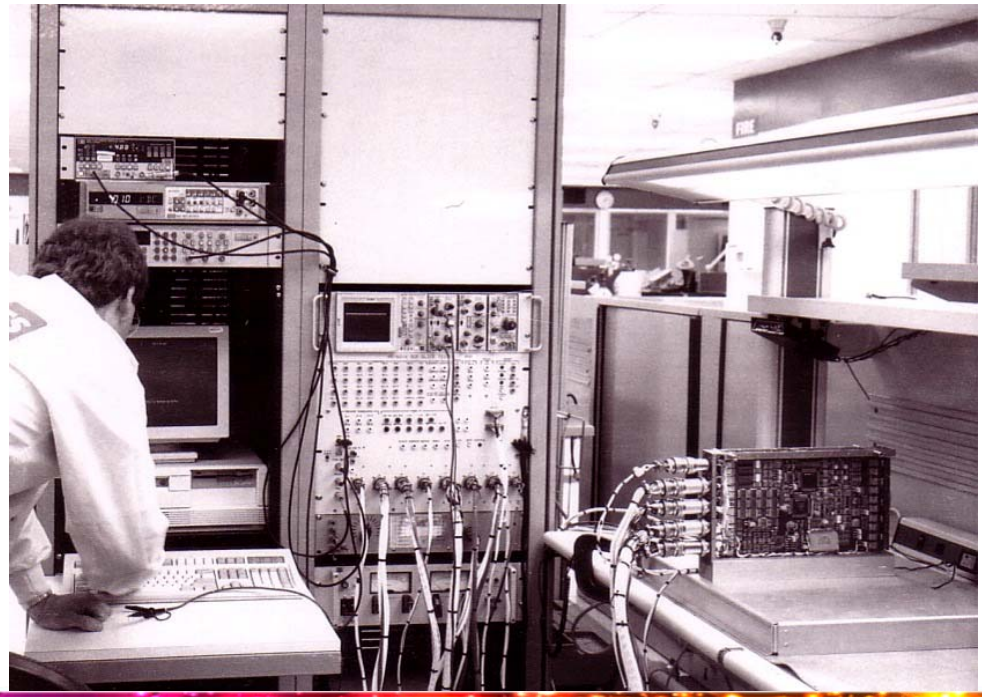
**Myth: Troubleshooting is easy**

"Relax, alright, my old man is a television repairman and he's got this ultimate set of tools, I can fix it"

Sean Penn as Jeff Spicoli, Fast Times at Ridgemont High (1982)

## Reality: Troubleshooting is not easy, it is an acquired skill

- Comes naturally to some
- Education / training
- Experience
- School of hard knocks



# Troubleshooting is Troubleshooting

- Electronics / Electrical

- Mechanical

- Automotive

# Automotive / Engine Troubleshooting

Bobcat Skid Steer Loader

# Bobcat 610 Skid Steer Loader

**Based on a true story**


- No start or crank – “clunk” sound when key is turned
  - Weak battery?
    - Jump start
- Still no start or crank – “clunk” sound
  - Loose battery cables?
    - Yes, tighten cables
- Cranks but no start

# Bobcat 610 Skid Steer Loader

**Based on a true story**


- Cranks but no start
  - Check for spark?
    - Spark OK
- Cranks but no start
  - Check Fuel level?
    - Fuel level OK
- Cranks but no start
  - Check fuel pressure?
    - No fuel pressure
- Replace fuel pump

# Bobcat 610 Skid Steer Loader

**Based on a true story**

## Starts OK

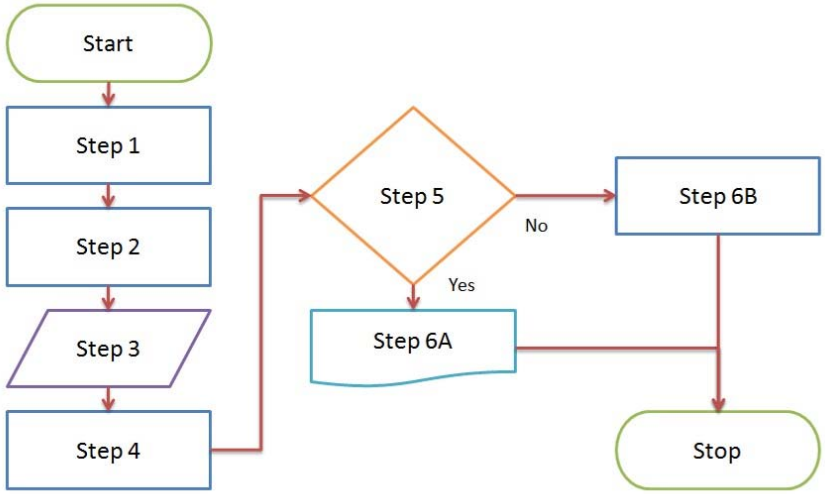
Successful troubleshooting session

# Common Troubleshooting Methodology

# Common Troubleshooting Methodology

**Steps in a common troubleshooting methodology**

1. Identify the problem
2. Determine the scale of the problem
3. Possible causes
4. Isolate the problem
5. Resolution or escalation
6. Corrective action / verify solution
7. Document, document and document



# Common Troubleshooting Methodology

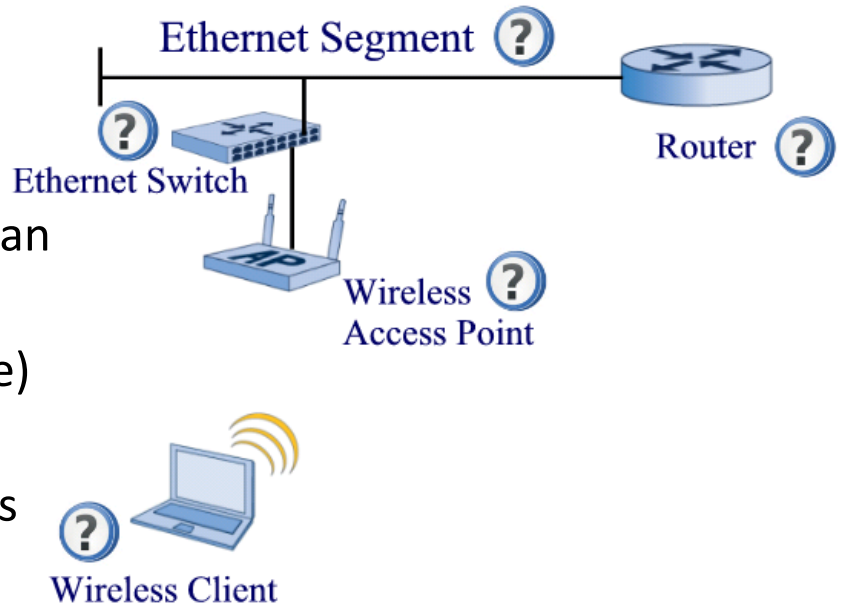
## 1. Identify the problem

- Gather Information by asking questions
- Ask more questions
- Never assume anything

# Common Troubleshooting Methodology

## 2. Determine the scale of the problem

- First identify whether the problem is global or an individual
- Global (many devices) or individual (one device)
  - "The Internet is down"
- A global problem usually involves many devices or groups of devices

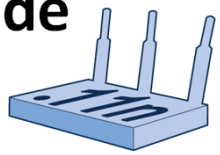


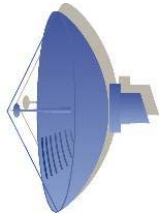
# Common Troubleshooting Methodology

**Global Problem**

**Items that can be related to a global Wireless LAN (WLAN) problem include**

- Wireless access points
- Wireless bridges
- Wireless LAN controllers
- Wired infrastructure devices



# Common Troubleshooting Methodology

**Individual Problem (one device)**

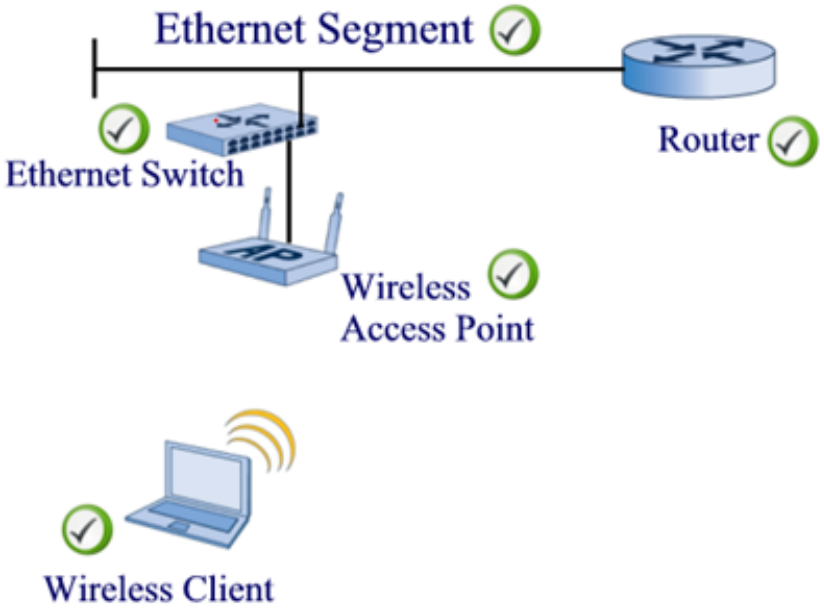
**Items that can be related to a individual WLAN problem include**

- Connection issues
- Application issues
- Device issues
- User error

# Common Troubleshooting Methodology

## 3. Possible causes

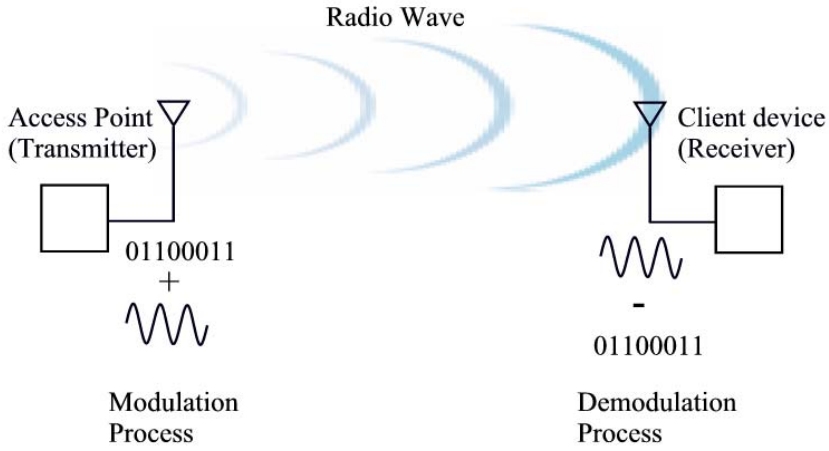
- Wireless LANs have a lot of moving parts
- Unbounded medium
- Don’t forget about the wired side



# Common Troubleshooting Methodology

## 4. Isolate the problem

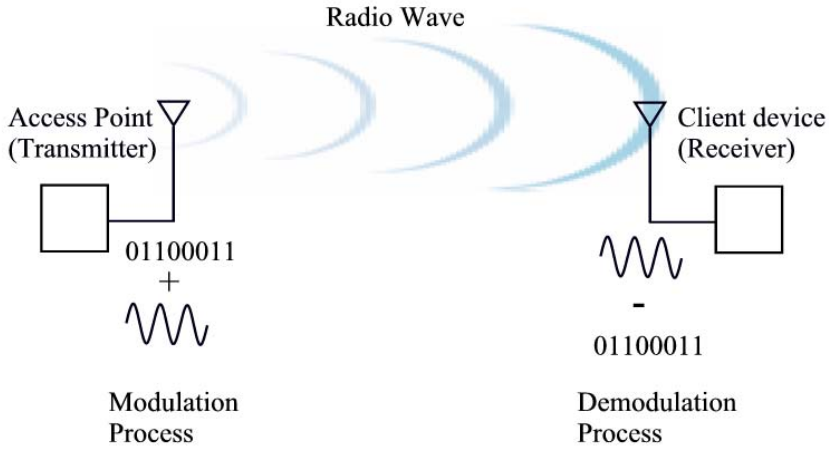
- Wireless LANs require two way communications
- Radio transmitter
  - Prepares data to be propagated across the air
- Radio receiver
  - Collects the propagated signal from the air



# Common Troubleshooting Methodology

## 4. Isolate the problem (continued)

- The transmitter must hear the receiver
- The receiver must hear the transmitter
- Unbounded medium causes various problems



# Common Troubleshooting Methodology

## 5. Resolution or escalation

- In many cases based on previous experience
- Refer to support database / documentation
- Must know your limitations
- Escalate the problem as appropriate

# Common Troubleshooting Methodology

## 6. Corrective action/verify

- Test the solution
- Implement the solution
- Verify the solution

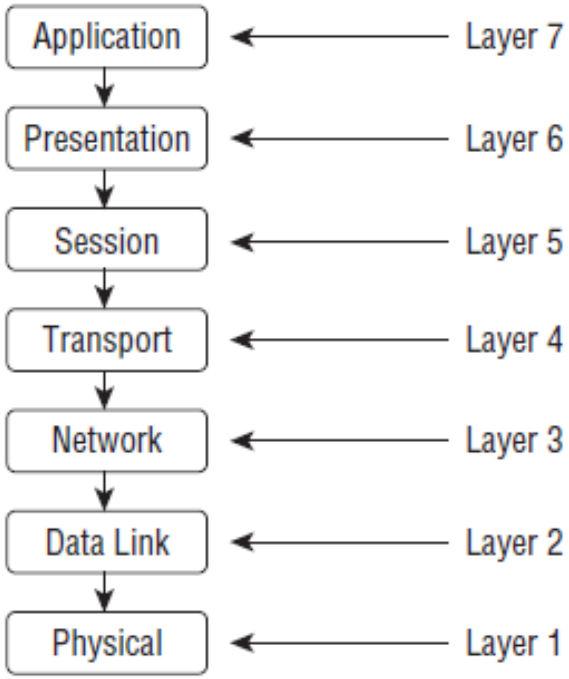
## Common Troubleshooting Methodology

# 7. Document, document and document

- Documentation is an important component
- Manual or electronic methods
- Helps you and others

# The OSI model and Wireless Networking

# Remember the OSI Model?




- Open Systems Interconnection (OSI)
- The basic concept of communications in the computer network environment
- Consists of seven layers
- Each layer is made up of many protocols and serves a specific function
- Data is encapsulated at some layers
- WLAN technology operates at the two lowest layers

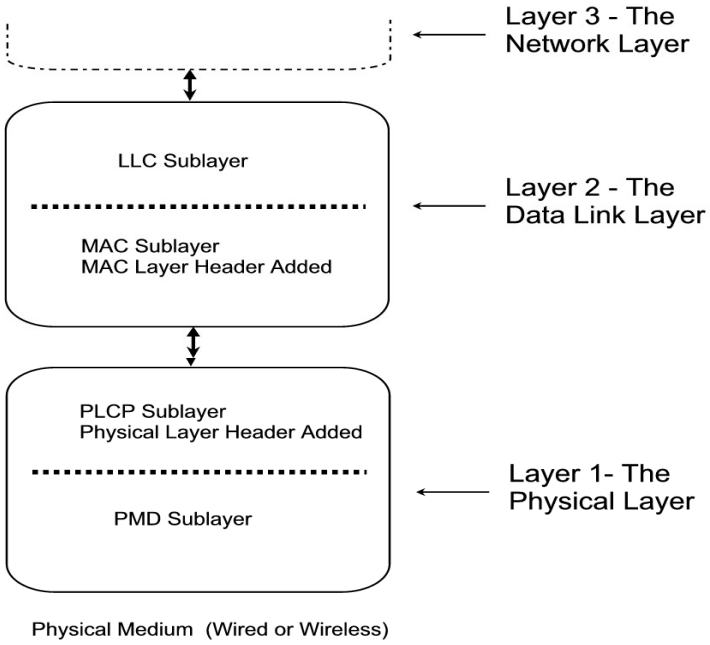
# The OSI Model and Wireless Networking

**Layer 2 – Data Link Layer (MAC)**

- Two sublayers
- Responsible for organizing the bit-level data for communications (frames)
- Detecting and correcting Physical layer errors

**Layer 1 – Physical Layer (PHY)**

- Two Sublayers
- Bit-level data streams and computer network hardware connecting the devices together



# IEEE 802.11 Frame Types

# IEEE 802.11 Frame Types

## General Frame Format

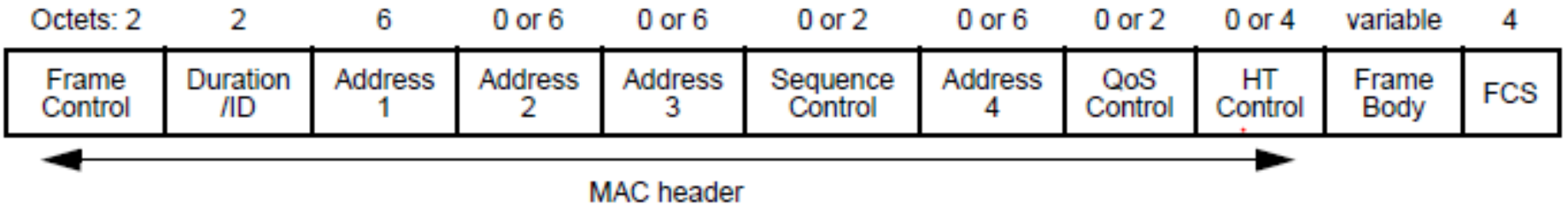
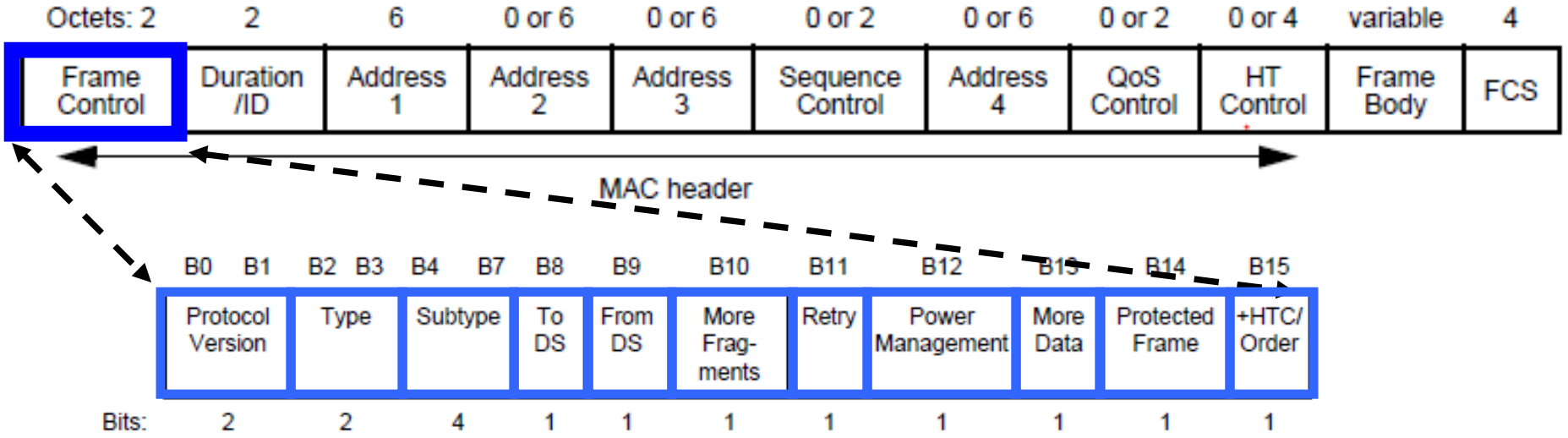



Image provided by IEEE Std 802.11™-2016

# IEEE 802.11 Frame Types

## Frame Control Field

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# IEEE 802.11 Frame Types

Three Frame Types in IEEE 802.11 Networking

1) Management Frames
2) Control Frames
3) Data Frames

# IEEE 802.11 Frame Types

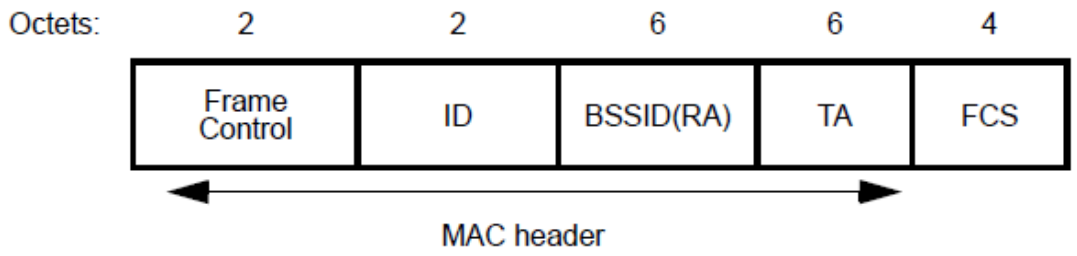
## Frame Types in IEEE 802.11 Networking

- Common Management Frames
  - Beacon
  - Probe Request / Response
  - Authentication
  - Association Request / Response

# IEEE 802.11 Frame Types

## Frame Types in IEEE 802.11 Networking

- Common Control Frames
  - RTS / CTS
  - ACK
  - PS Poll

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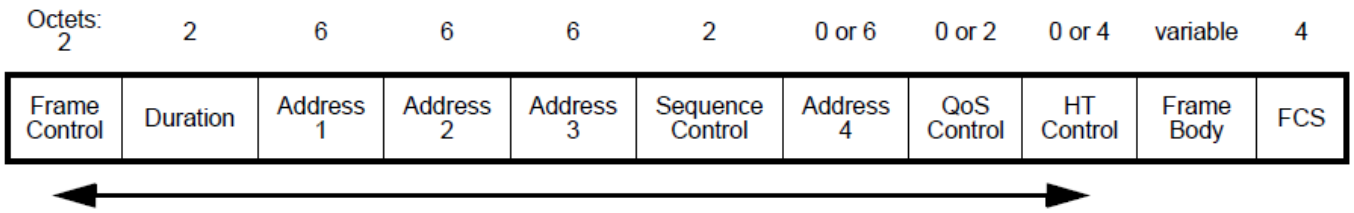
# IEEE 802.11 Frame Types

## Frame Types in IEEE 802.11 Networking

- Data Frames (two types)
  - Data
  - Null Data

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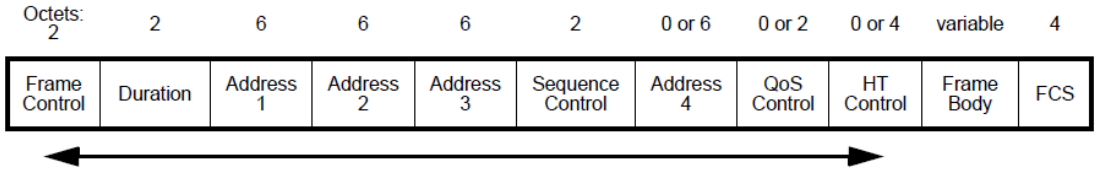
# IEEE 802.11 Frame Types

## Frames Types in IEEE 802.11 Networking

- Data
  - Carry data payload

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# IEEE 802.11 Frame Types

Frames Types in IEEE 802.11 Networking

- Null Data
  - Does not carry data payload
  - Power management
  - Channel scanning
  - Maintaining an association

# Basic IEEE 802.11 Connectivity

IEEE 802.11 Open System
Authentication and Association

# Basic IEEE 802.11 Connectivity

**The IEEE 802.11 Authentication and Association Process**

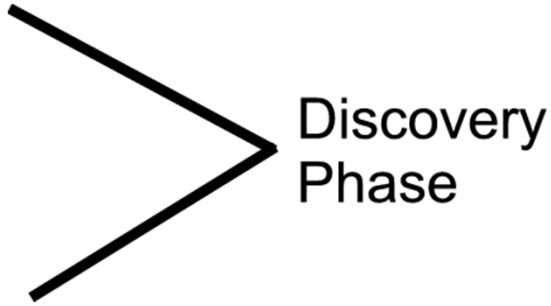
## Passive Scanning

Beacon – (Broadcast) – client device listens for beacons

## Active Scanning

Probe Request (from client device to access point)

Probe Response (from Access point to client device)



# Basic IEEE 802.11 Connectivity

**The IEEE 802.11 Authentication and Association Process**

## IEEE 802.11 Authentication

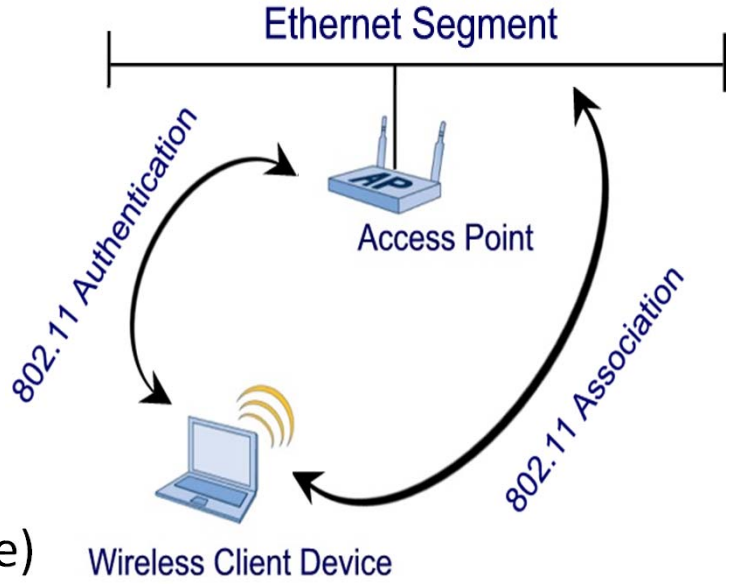
Authentication (from client device to access point)

Authentication (from access point to client device)

## IEEE 802.11 Association

Association Request (from client device to access point)

Association Response (from access point to client device)



# Basic IEEE 802.11 Connectivity

## The IEEE 802.11 Authentication and Association Complete Process

Beacon – (broadcast) – client device listens for Beacons

Probe Request (from client device to access point)

Probe Response (from access point to client device)

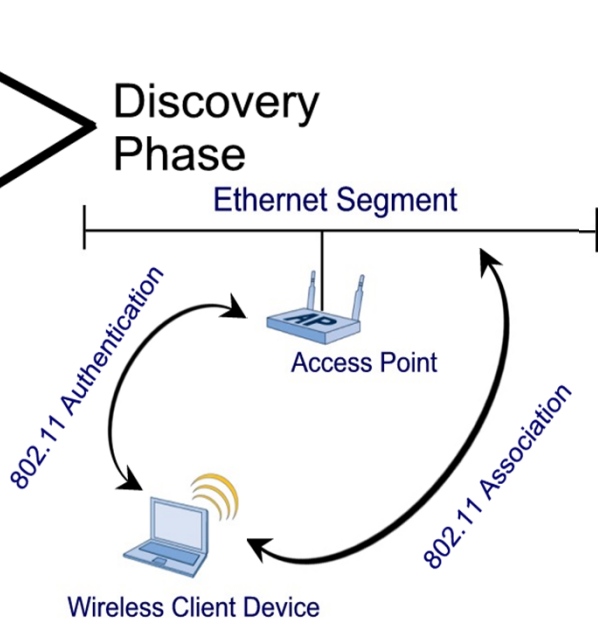
802.11 Authentication (from client device to access point)

802.11 Authentication (from access point to client device)

802.11 Association Request (from client device to access point)

802.11 Association Response (from access point to client device)

**802.11 Open System Authenticated and Associated**

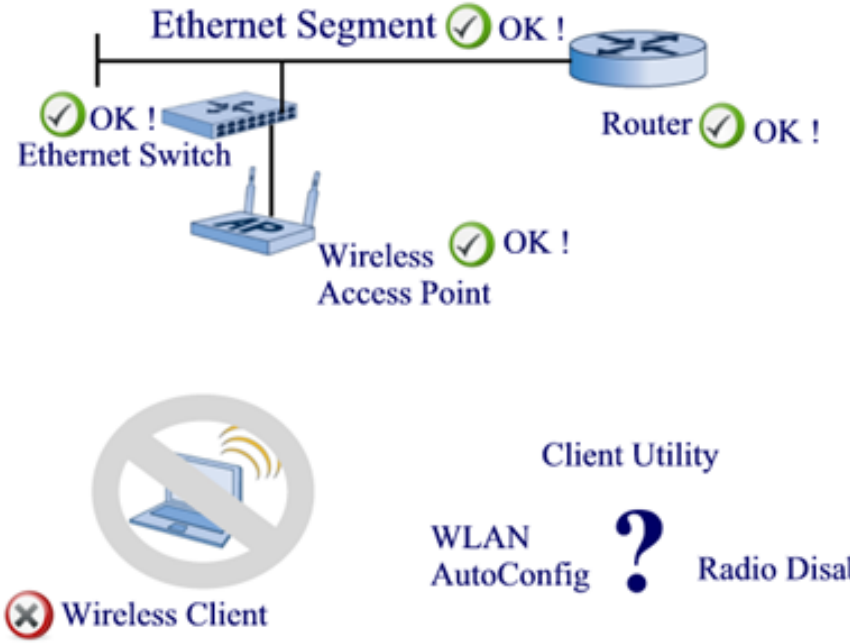


# Common Wireless LAN Problems

# Common Wireless LAN Problems

## Coverage and Capacity Problems – No Wireless Connectivity

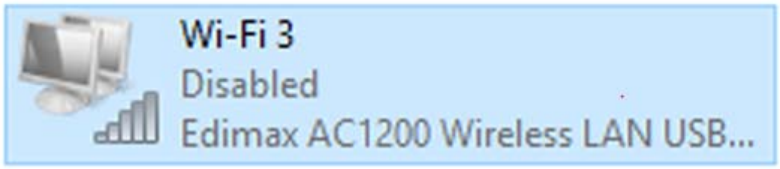
- No connectivity on the client side
- Other connectivity issues
- IP Address connectivity issues
- Security settings



# Common Wireless LAN Problems

## Coverage and Capacity Problems – No Wireless Connectivity

**No connectivity on the client side**




- Disabled radio or wireless network adapter
- Misconfigured wireless client utility
- Microsoft Windows AutoConfig service not running or not configured
- Protective supplicants (wireless client device side) that can disable the radio in response to specific policy violations

# Common Wireless LAN Problems

## Coverage and Capacity Problems – No Wireless Connectivity

### Other connectivity issues

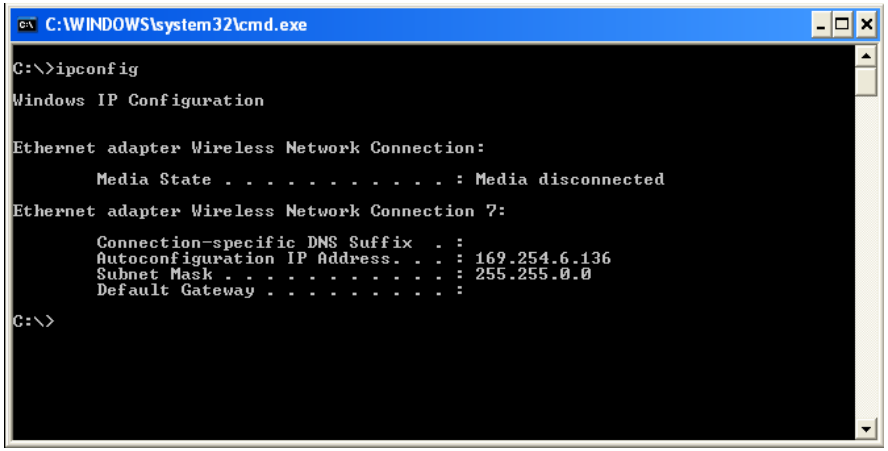
- Misconfigured wireless client utility
- Incorrect wireless LAN security settings
- IP address issues

# Common Wireless LAN Problems

## Coverage and Capacity Problems – No Wireless Connectivity

### IP Address Connectivity Issues

- Misconfigured IP address information
- Static IP addresses
- Dynamic Host Configuration Protocol (DHCP) addresses

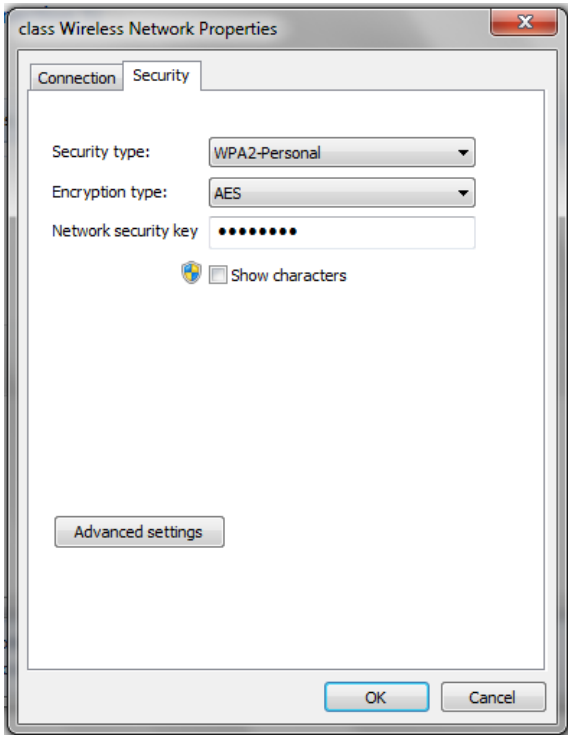


# Common Wireless LAN Problems

## Coverage and Capacity Problems – No Wireless Connectivity

### Wireless Security Settings

- Incorrect security settings can also cause connectivity issues
- Security settings must match on the client device and the infrastructure

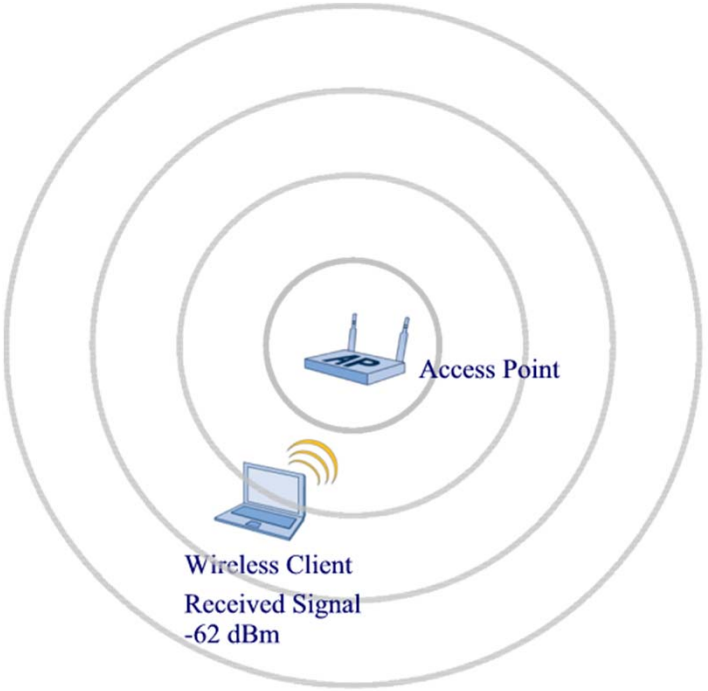


# Common Wireless LAN Problems

## Coverage and Capacity Problems

### Intermittent connectivity

- Received signal strength
- Testing received signal strength
- Weak signal or no signal

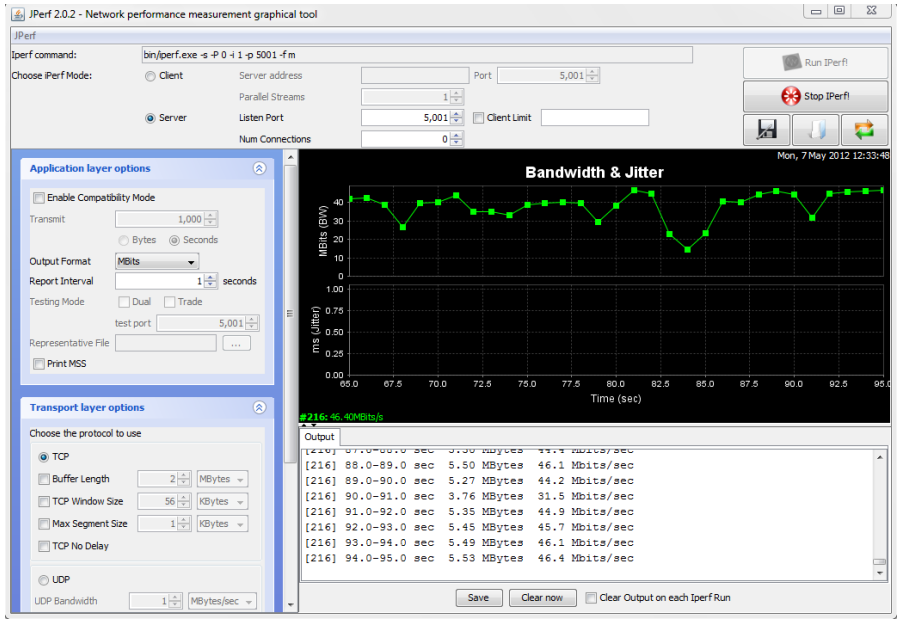


# Common Wireless LAN Problems

## Coverage and Capacity Problems

### Wireless LAN Throughput

- Distance from access point (cell edge associated devices)
- RF output power settings
- Number of devices associated to the access point
- Applications in use

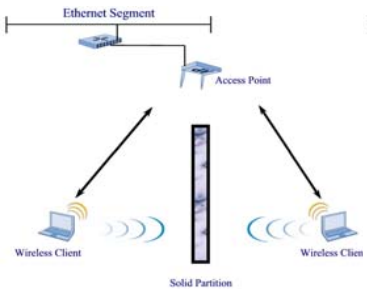


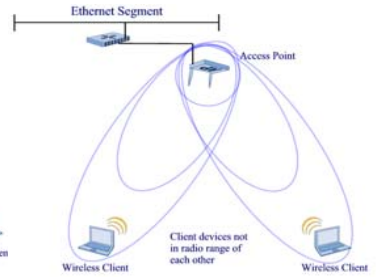
# Common Wireless LAN Problems

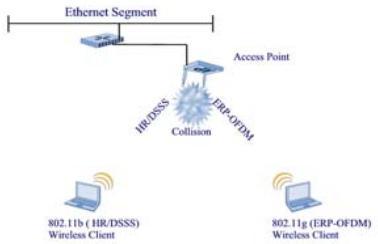
## Coverage and Capacity Problems

### Hidden Node

- Carrier sense multiple access with collision detection (CSMA/CD)
- Carrier sense multiple access with collision avoidance (CSMA/CA)
- Hidden node obstruction
- Hidden node signal strength
- Hidden node technology (signaling methods)



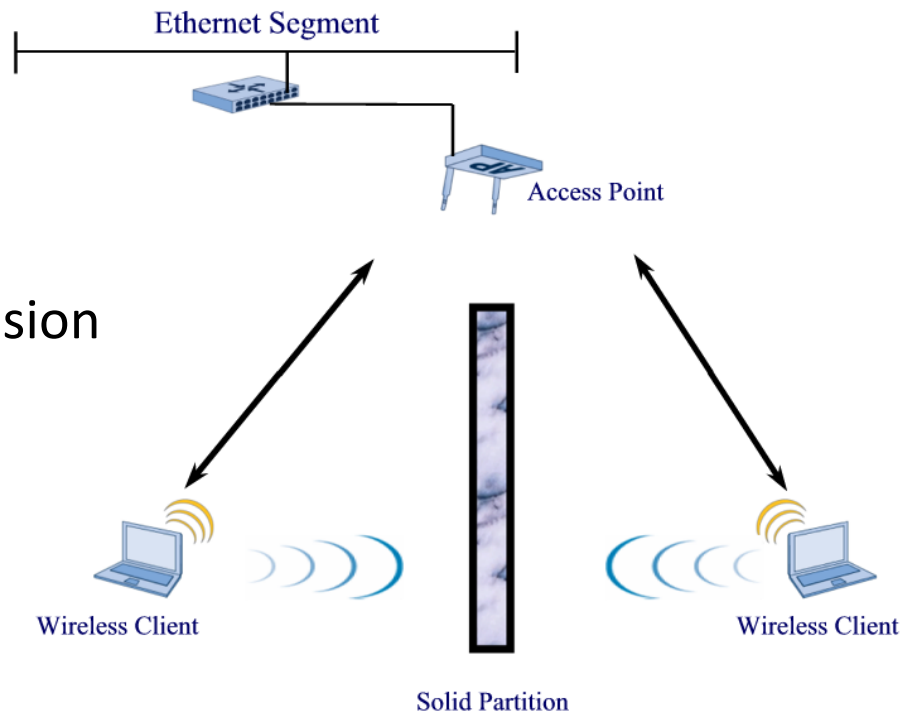



# Common Wireless LAN Problems

## Coverage and Capacity Problems

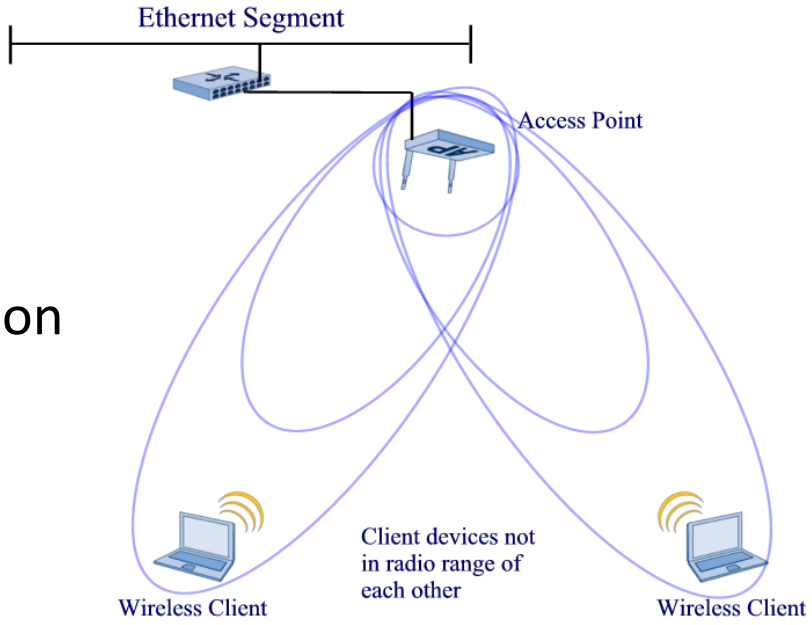
### Hidden Node Obstruction

- Client devices **can not** hear each other
- Carrier sense multiple access with collision avoidance (CSMA/CA)
- Obstruction blocks ability to hear



# Common Wireless LAN Problems

## Coverage and Capacity Problems

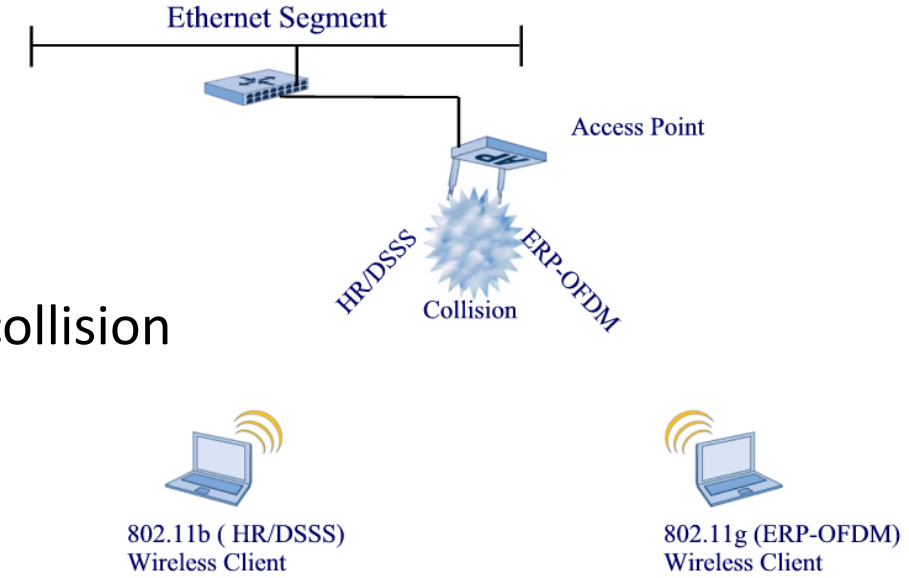



## Hidden Node Signal Strength

- Client devices **can not** hear each other
- Carrier sense multiple access with collision avoidance (CSMA/CA)
- Distance limits ability to hear

# Common Wireless LAN Problems

**Coverage and Capacity Problems**




**Hidden Node Signaling Methods**

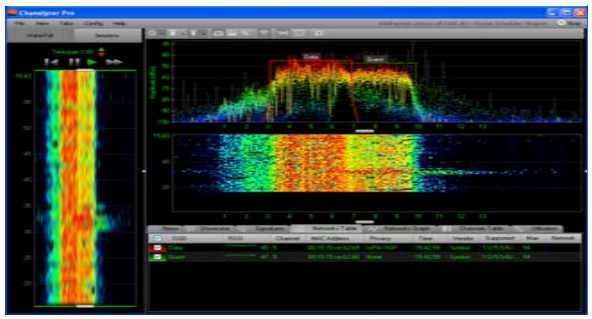
- Client devices **can** hear each other
- Carrier sense multiple access with collision avoidance (CSMA/CA)
- Wireless technology types used
- ERP protection mechanisms

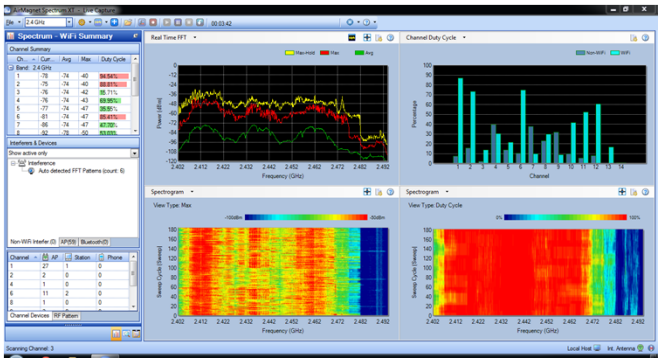
# Wireless LAN Troubleshooting Tools

# Layer 1 Physical Layer (PHY) Troubleshooting Tools

## Wi-Fi Centric Spectrum Analyzers

- MetaGeek Chanalyzer
- Netscout Spectrum XT



# Layer 1 Physical Layer (PHY) Troubleshooting Tools

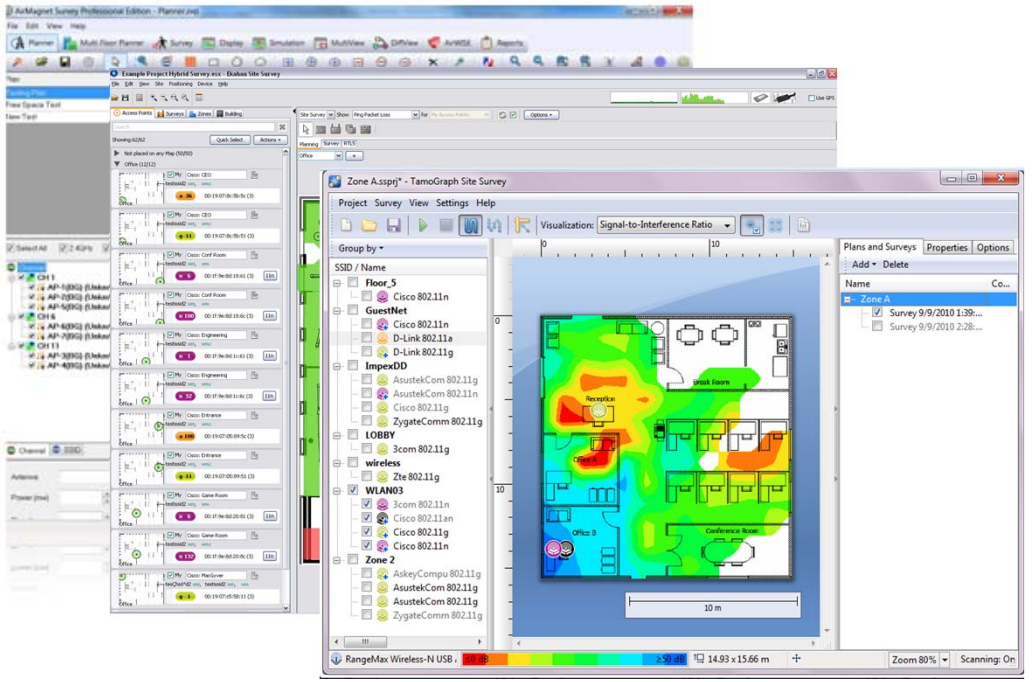
**Instrumentation Spectrum Analyzers**

- Agilent
- Fluke
- Tektronics
- Rohde & Schwarz

# Layer 1 Physical Layer (PHY) Troubleshooting Tools

## Site Survey / Design Software

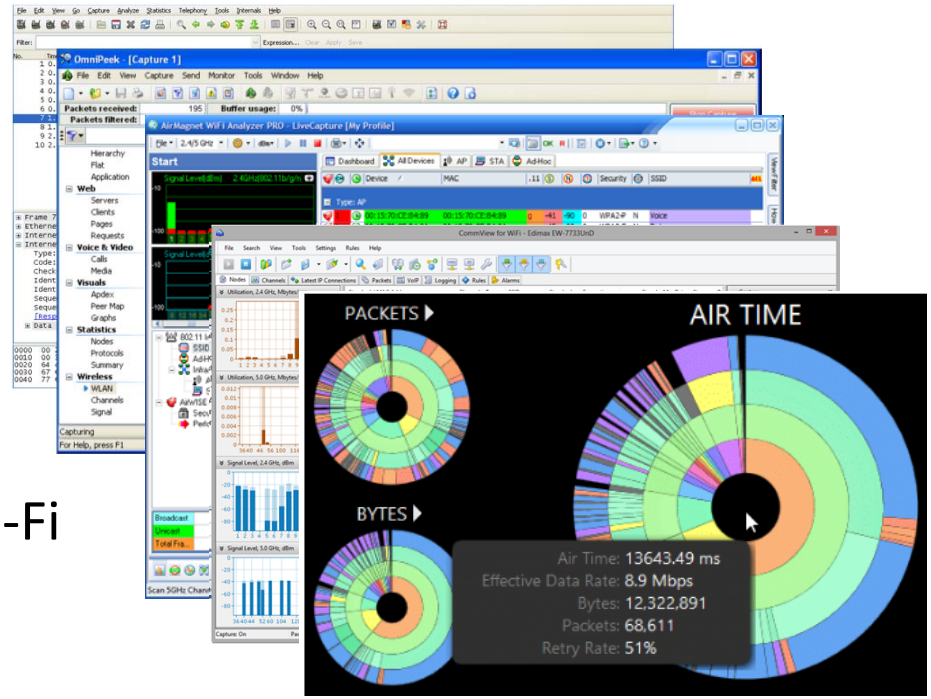
- Netscout Survey Pro
- Ekahau Site Survey
- Tamosoft TamoGraph



# Layer 2 Data link Layer (MAC) Troubleshooting Tools

## Protocol (Packet) Analyzers

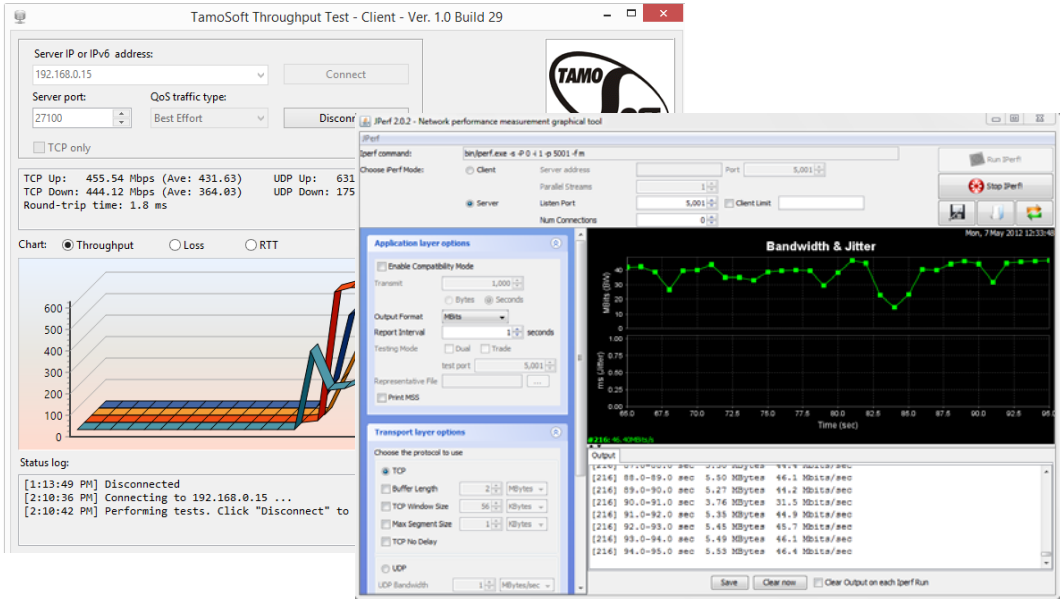
- Wireshark
- Savvius Omnipeek
- Netscout Wi-Fi Analyzer
- Tamosoft CommView for Wi-Fi
- MetaGeek Eye P.A.



# Layer 2 Data link Layer (MAC) Troubleshooting Tools

## Throughput Test Tools

- Tamosoft
- jPerf
- iPerf



# Additional Software Troubleshooting Tools

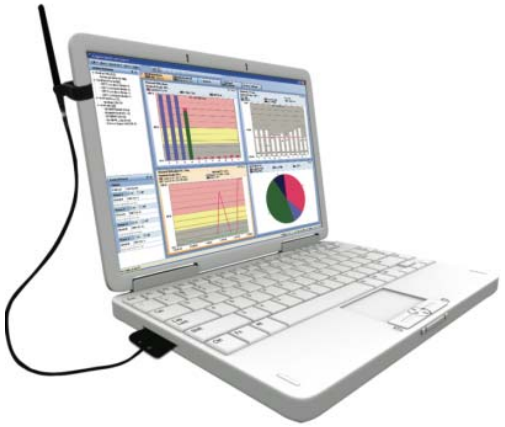
**Wi-Fi Test Tools**

- Acrylic WiFi Home (Windows) - Free
- AirGrab WiFi Radar (Mac OSX) - Free
- LizardSystems Wi-Fi Scanner (Windows) Free and purchase version

# Additional Software Troubleshooting Tools

**Wi-Fi Test Tools**

- MetaGeek InSSIDer - (Windows or Mac)
- NetSpot (Windows or Mac)
- WiFi Explorer (Mac) – Free and purchase version
- Xirrus W-Fi Inspector (Windows) Free



# Hardware Troubleshooting Tools

## Wi-Fi Test Tools

- Netscout LinkSprinter
- Netscout AirCheck G2
- Berkeley Varitronics Yellowjacket-BANG
- Netscout OptiView XG

# Spectrum Analyzer Demonstration

# Protocol Analyzer Demonstration

# Site Survey Software Demonstration

# Questions ?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# Thank You!

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