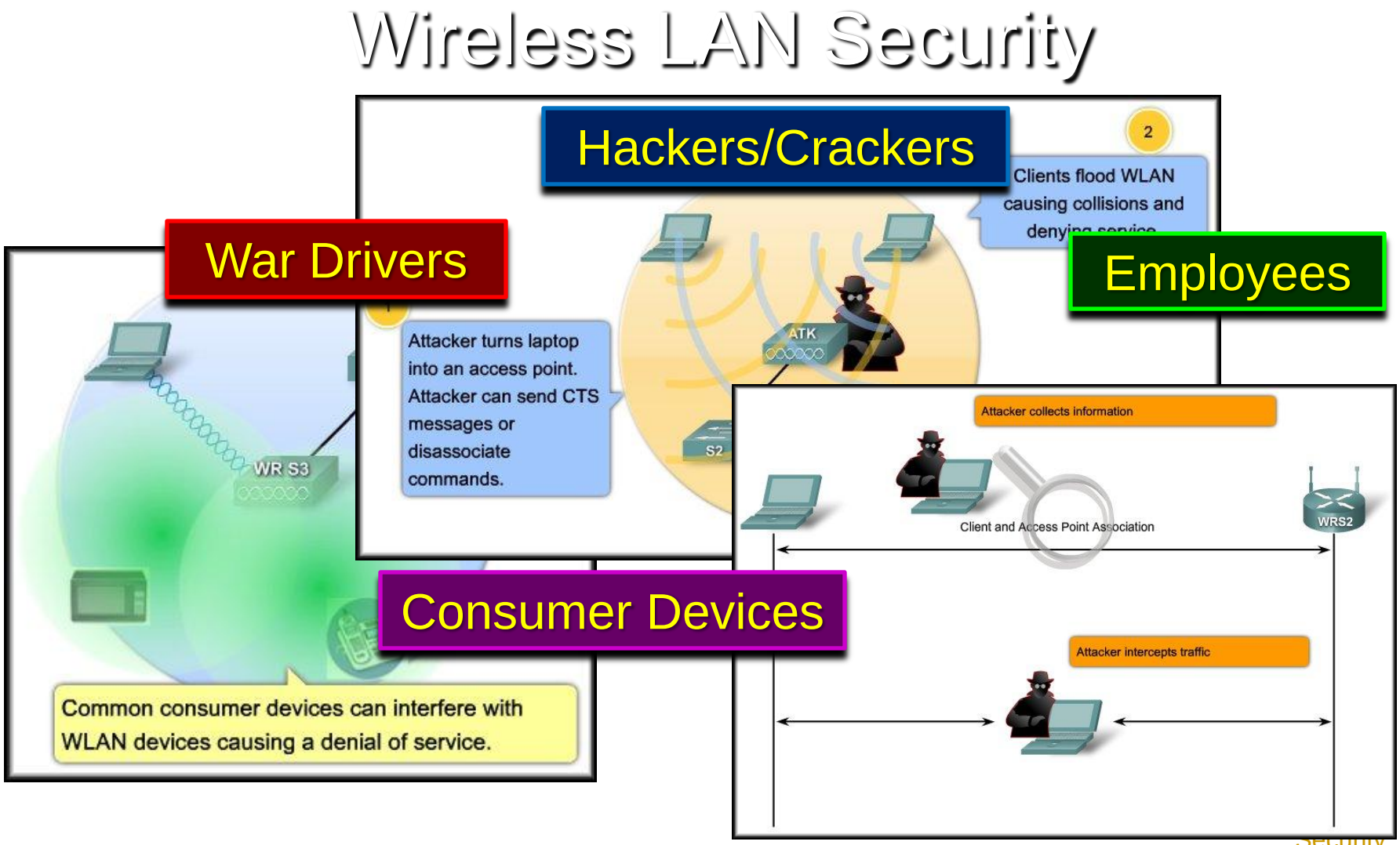
Instructor: Dr.Hanal ABUZANT

Security in Wireless Networks

Note for Instructors

- These presentations are the result of a collaboration among the instructors at St. Clair College in Windsor, Ontario.
- Thanks must go out to Rick Graziani of Cabrillo College. His material and additional information was used as a reference in their creation.
- If anyone finds any errors or omissions, please let me know at:
  - tdame@stclaircollege.ca.

Basic Wireless Concepts and Configuration

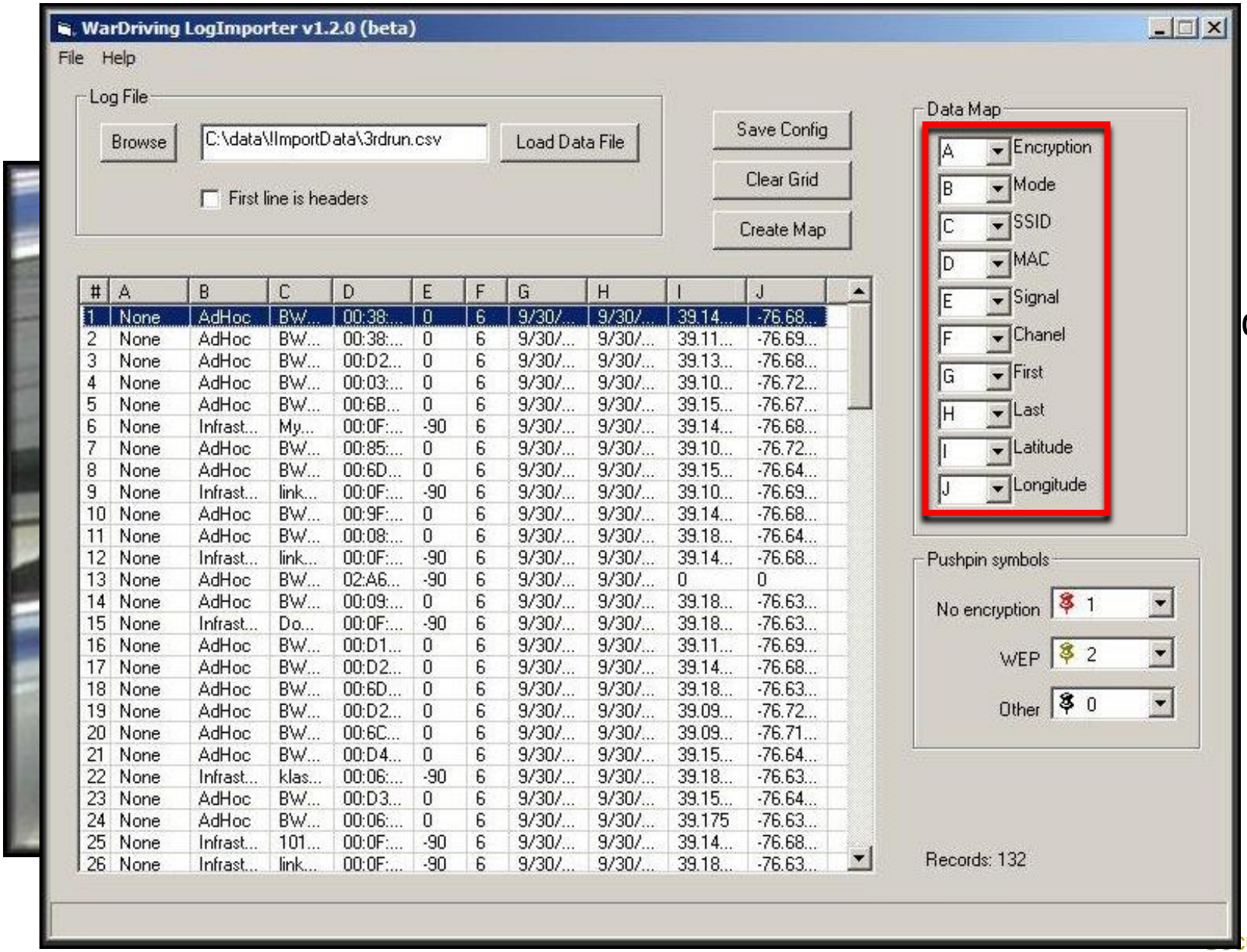


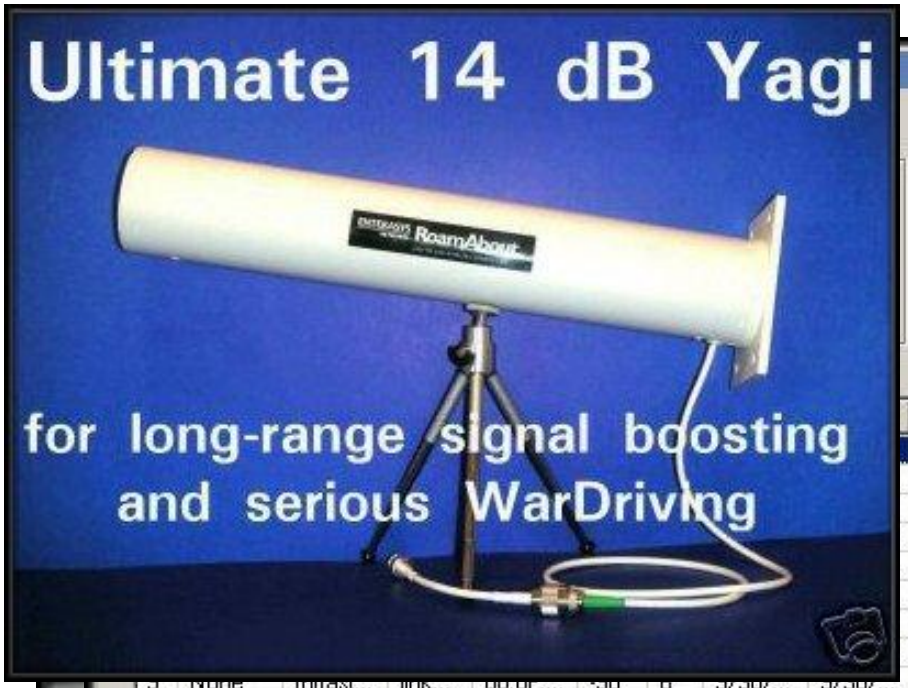
Wireless LAN Security

- Three Major Categories of Security Threats:
  - War Drivers:
    - War driving means driving around a neighborhood with a wireless laptop and looking for an unsecured 802.11b/g system.
  - Hackers/Crackers:
    - Malicious intruders who enter systems as criminals and steal data or deliberately harm systems.
  - Employees:
    - Set up and use Rogue Access Points without authorization. Either interfere with or compromise servers and files.

Threats to Wireless Security

- War Drivers:
  - "War driving" originally referred to using a scanning device to find cellular phone numbers to exploit.
  - War driving now also means driving around a neighborhood with a laptop and an 802.11b/g client card looking for an unsecured 802.11b/g system to exploit.
  - Software is readily available.


WarDriving LogImporter v1.2.0 (beta)
File Help
Log File
Browse
C:\data\ImportData\3rdrun.csv
Load Data File
First line is headers
Save Config
Clear Grid
Create Map
Data Map
A Encryption
B Mode
C SSID
D MAC
E Signal
F Chanel
G First
H Last
I Latitude
J Longitude
Pushpin symbols
No encryption 1
WEP 2
Other 0
Records: 132



Save Config
Clear Grid
Create Map

Data Map
A Encryption
B Mode
C SSID
D MAC
E Signal
F Chanel
G First
H Last
I Latitude
J Longitude

Pushpin symbols
No encryption 1
WEP 2
Other 0

									I	J
10	None	AdHoc	BW...	00:9F:...	0	6	9/30/...	9/30/...	39.14...	-76.68...
11	None	AdHoc	BW...	00:08:...	0	6	9/30/...	9/30/...	39.18...	-76.64...
12	None	Infrast...	link...	00:0F:...	-90	6	9/30/...	9/30/...	39.14...	-76.68...
13	None	AdHoc	BW...	02:A6...	-90	6	9/30/...	9/30/...	0	0
14	None	AdHoc	BW...	00:09:...	0	6	9/30/...	9/30/...	39.18...	-76.63...
15	None	Infrast...	Do...	00:0F:...	-90	6	9/30/...	9/30/...	39.18...	-76.63...
16	None	AdHoc	BW...	00:D1...	0	6	9/30/...	9/30/...	39.11...	-76.69...
17	None	AdHoc	BW...	00:D2...	0	6	9/30/...	9/30/...	39.14...	-76.68...
18	None	AdHoc	BW...	00:6D...	0	6	9/30/...	9/30/...	39.18...	-76.63...
19	None	AdHoc	BW...	00:D2...	0	6	9/30/...	9/30/...	39.09...	-76.72...
20	None	AdHoc	BW...	00:6C...	0	6	9/30/...	9/30/...	39.09...	-76.71...
21	None	AdHoc	BW...	00:D4...	0	6	9/30/...	9/30/...	39.15...	-76.64...
22	None	Infrast...	klas...	00:06:...	-90	6	9/30/...	9/30/...	39.18...	-76.63...
23	None	AdHoc	BW...	00:D3...	0	6	9/30/...	9/30/...	39.15...	-76.64...
24	None	AdHoc	BW...	00:06:...	0	6	9/30/...	9/30/...	39.175	-76.63...
25	None	Infrast...	101...	00:0F:...	-90	6	9/30/...	9/30/...	39.14...	-76.68...
26	None	Infrast...	link...	00:0F:...	-90	6	9/30/...	9/30/...	39.18...	-76.63...

Records: 132

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Ultimate 14 dB Yagi
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SPICY CAJUN
Potato Crisps
RINGLES
Totally and completely ILLEGAL!!!!!!!!

Threats to Wireless Security

- Man-in-the-Middle Attacks:
  - Attackers select a host as a target and position themselves logically between the target and the router of the target.
  - In a wired LAN, the attacker needs to be able to physically access the LAN to insert a device logically into the topology.
  - With a WLAN, the radio waves emitted by access points can provide the connection.
  - Because access points act like Ethernet hubs, each NIC in a BSS hears all the traffic.
  - Attackers can modify the NIC of their laptop with special software so that it accepts all traffic.

Threats to Wireless Security

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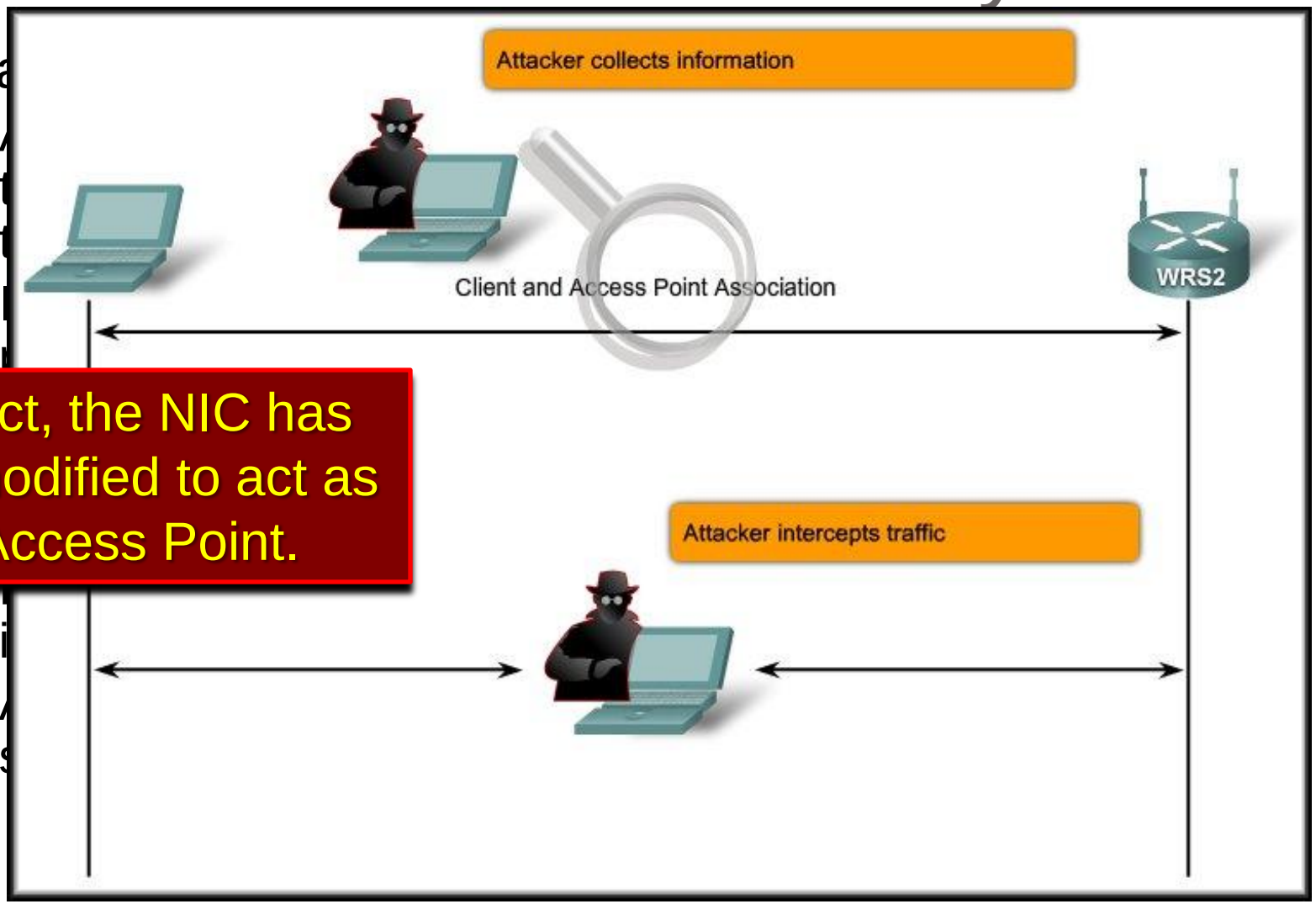
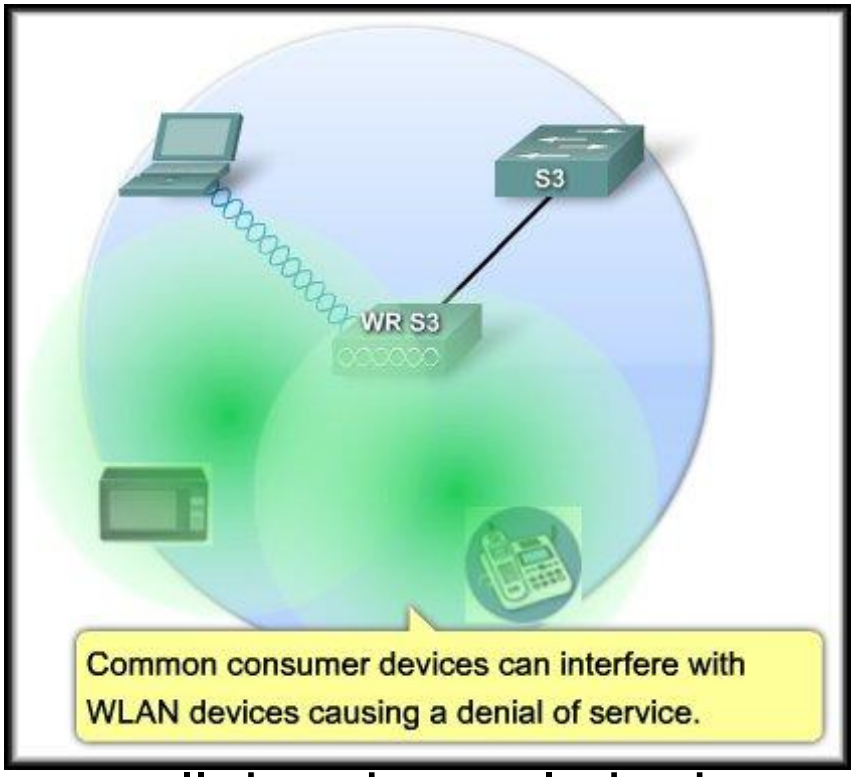


In effect, the NIC has been modified to act as an Access Point.

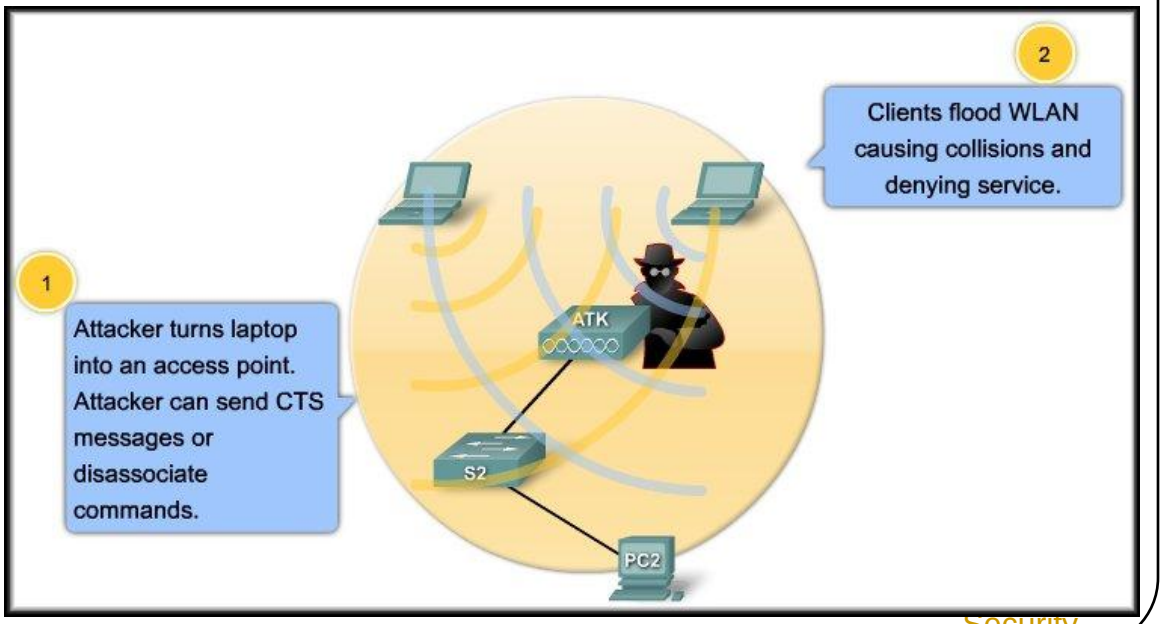
Threats to Wireless Security

- Denial of Service (DoS):
  - 802.11b/g WLANs use the unlicensed 2.4 GHz band.
  - This is the same band used by most baby monitors, cordless phones, and microwave ovens.
  - With these devices crowding the RF band, attackers can create noise on all the channels in the band with commonly available devices.



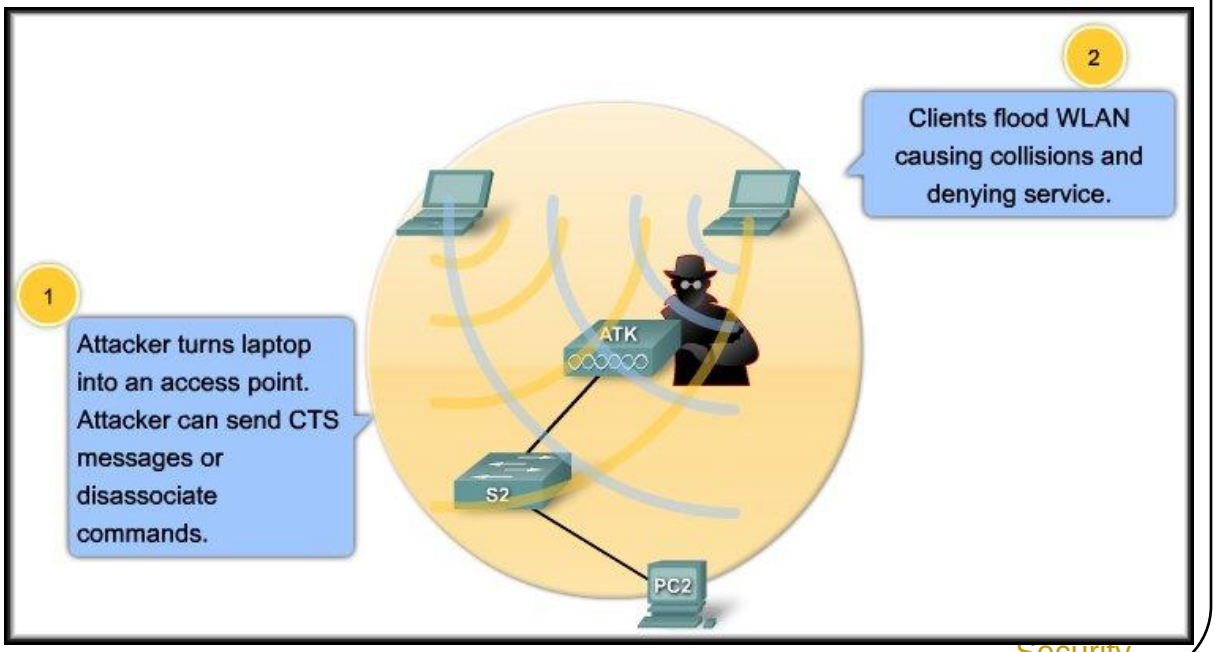
Threats to Wireless Security

- Denial of Service (DoS):
  - An attacker can turn a NIC into an access point.
  - The attacker, using a PC as an AP, can flood the BSS with clear-to-send (CTS) messages, which defeat the CSMA/CA function used by the stations.
  - The actual AP, floods the BSS with simultaneous traffic, causing a constant stream of collisions.



Threats to Wireless Security

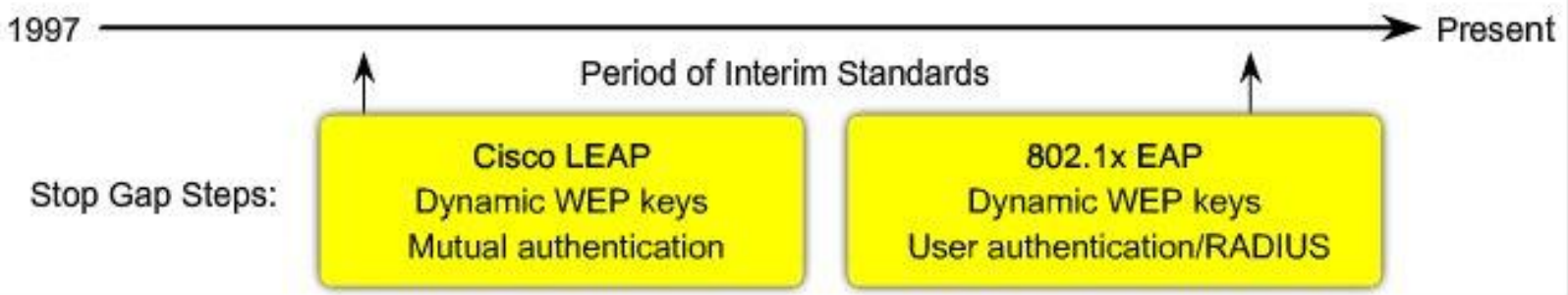
- Denial of Service (DoS):
  - Another DoS attack that can be launched in a BSS is when an attacker sends a series of disassociate commands that cause all stations to disconnect.
  - When the stations are disconnected, they immediately try to reassociate, which creates a burst of traffic.
  - The attacker sends another disassociate and the cycle repeats itself.



Wireless Security Protocols

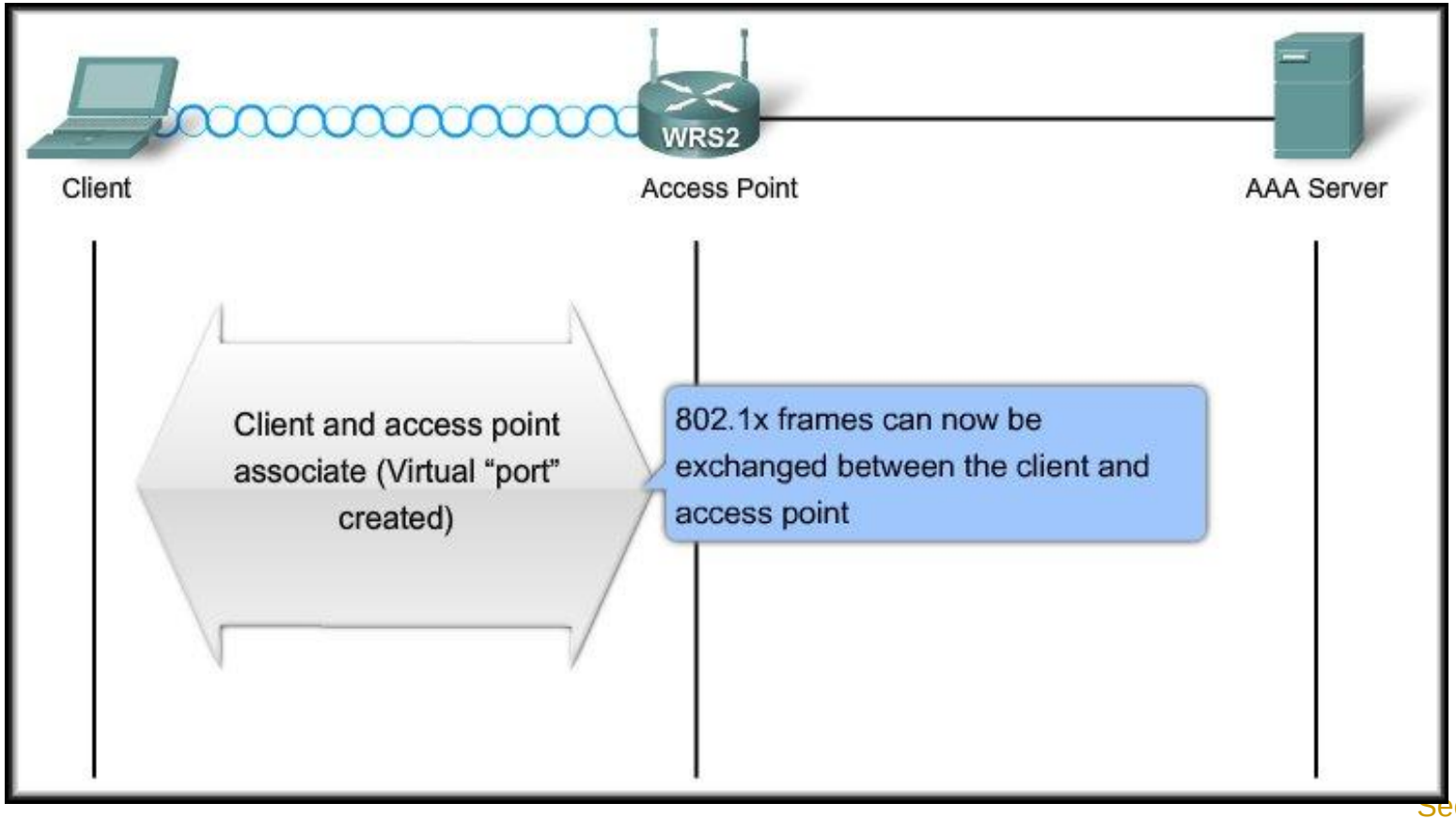
Major Stepping Stones to Secure WLAN

Open Access	First Generation Encryption	Interim	Present
SSID	WEP	WPA	802.11i/WPA2
• No encryption • Basic authentication • Not a security handle	• No strong authentication • Static, breakable keys • Not scalable	• Standardized • Improved encryption • Strong, user-based authentication (e.g., LEAP, PEAP, EAP-FAST)	• AES Encryption • Authentication: 802.1X • Dynamic key management • WPA2 is the Wi-Fi Alliance implementation of 802.11i



Authenticating to the Wireless LAN

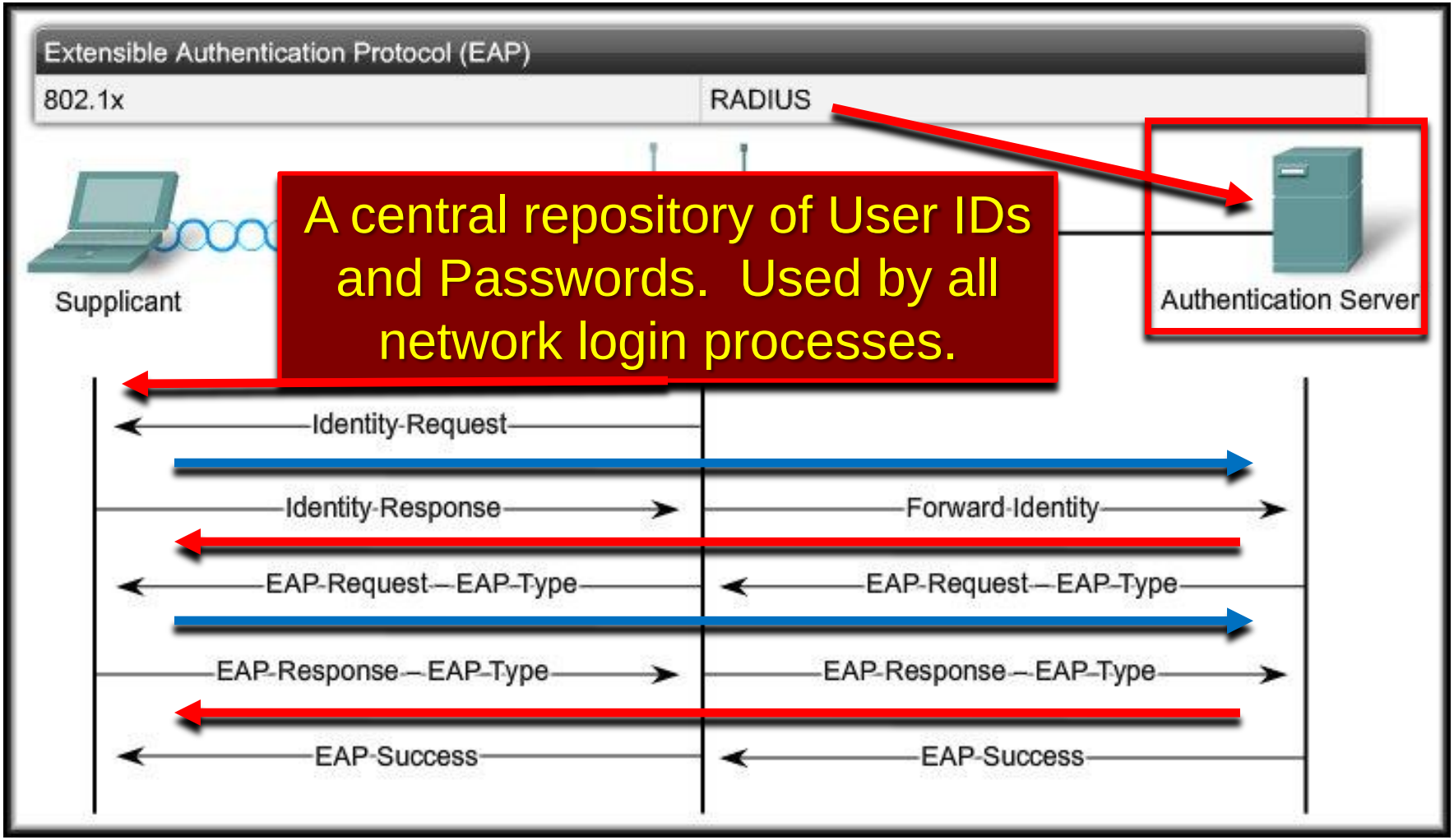
- In an open network, such as a home network, association may be all that is required to grant a client access to devices and services on the WLAN.



Authenticating to the Wireless LAN

- In networks that have stricter security requirements, an additional authentication or login is required to grant clients such access.
- This login process is managed by the Extensible Authentication Protocol (EAP).

Authenticating to the Wireless LAN



Wireless Encryption

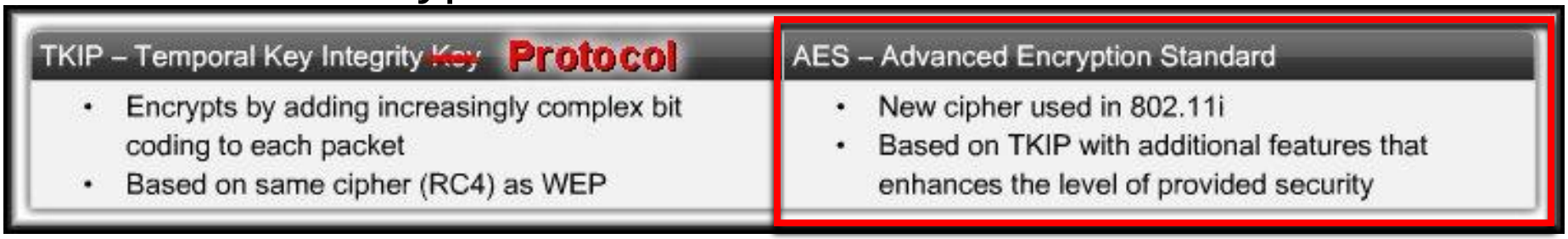
- Two Encryption Mechanisms:

TKIP – Temporal Key Integrity ~~Key~~ Protocol	AES – Advanced Encryption Standard
• Encrypts by adding increasingly complex bit coding to each packet • Based on same cipher (RC4) as WEP	• New cipher used in 802.11i • Based on TKIP with additional features that enhances the level of provided security

- TKIP is the encryption method certified as Wi-Fi Protected Access (WPA).
  - Provides support for legacy WLAN equipment by addressing the original flaws associated with the 802.11 WEP encryption method.
  - Encrypts the Layer 2 payload.
  - Message integrity check (MIC) in the encrypted packet that helps ensure against a message tampering.

Wireless Encryption

- Two Encryption Mechanisms:



- The AES encryption of WPA2 is the preferred method.
  - WLAN encryption standards used in IEEE 802.11i.
  - Same functions as TKIP.
  - Uses additional data from the MAC header that allows destination hosts to recognize if the non-encrypted bits have been tampered with.
  - Also adds a sequence number to the encrypted data header.

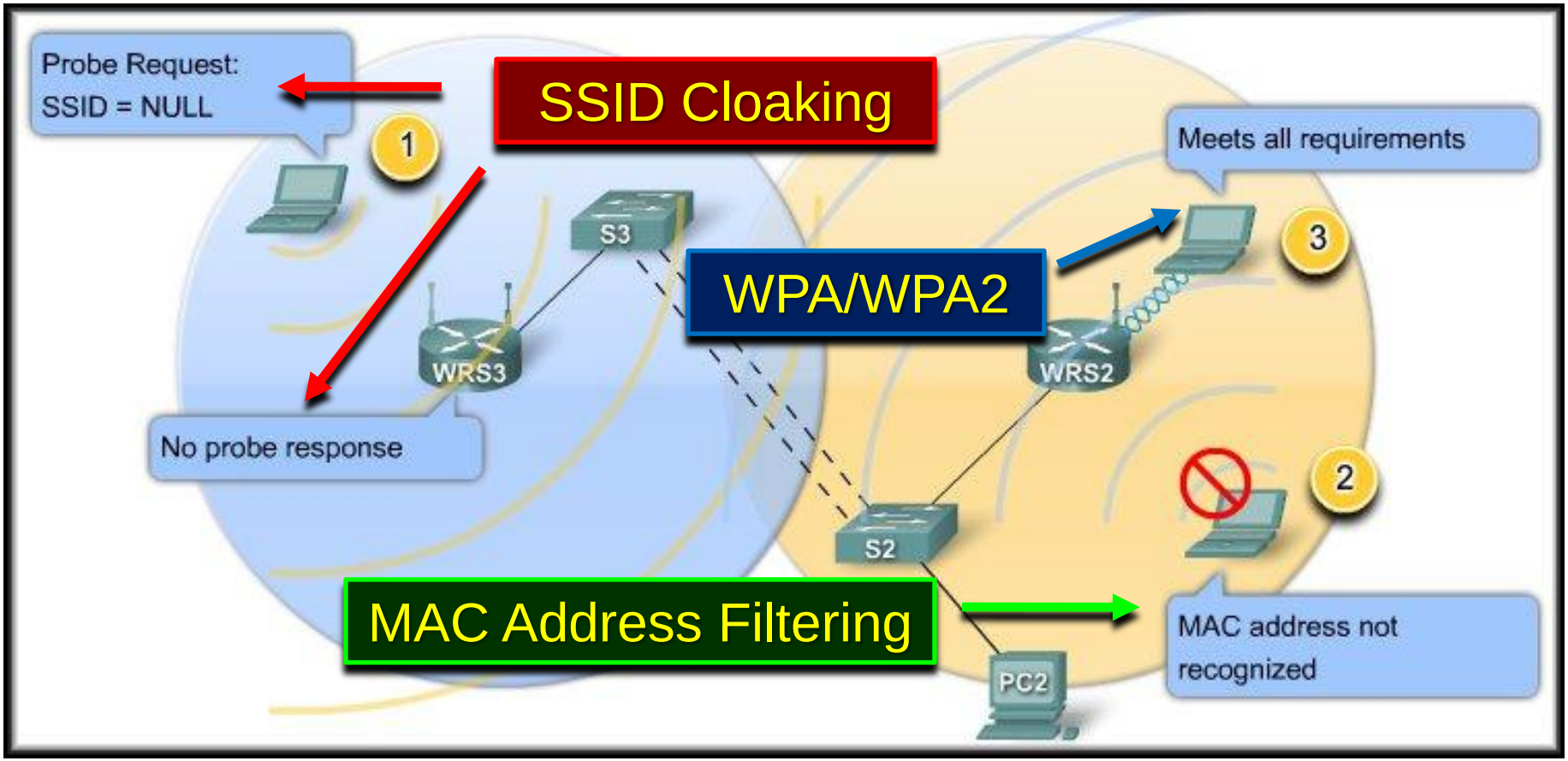
Wireless Encryption

- *When you configure Linksys access points or wireless routers you may not see WPA or WPA2.*
  - Instead you may see references to something called
    pre-shared key (PSK).
  - Types of PSKs:
    - PSK or PSK2 with TKIP is the same as WPA.
    - PSK or PSK2 with AES is the same as WPA2.
    - PSK2, without an encryption method specified, is the same as WPA2.

Controlling Access to the Wireless LAN

- When controlling access, the concept of depth means having multiple solutions available.
  - Three step approach:
    - SSID cloaking:
      - Disable SSID broadcasts from access points.
    - MAC address filtering:
      - Tables are manually constructed on the access point to allow or disallow clients based on their physical hardware address.
    - WLAN Security:
      - Implement WPA or WPA2.

Controlling Access to the Wireless LAN

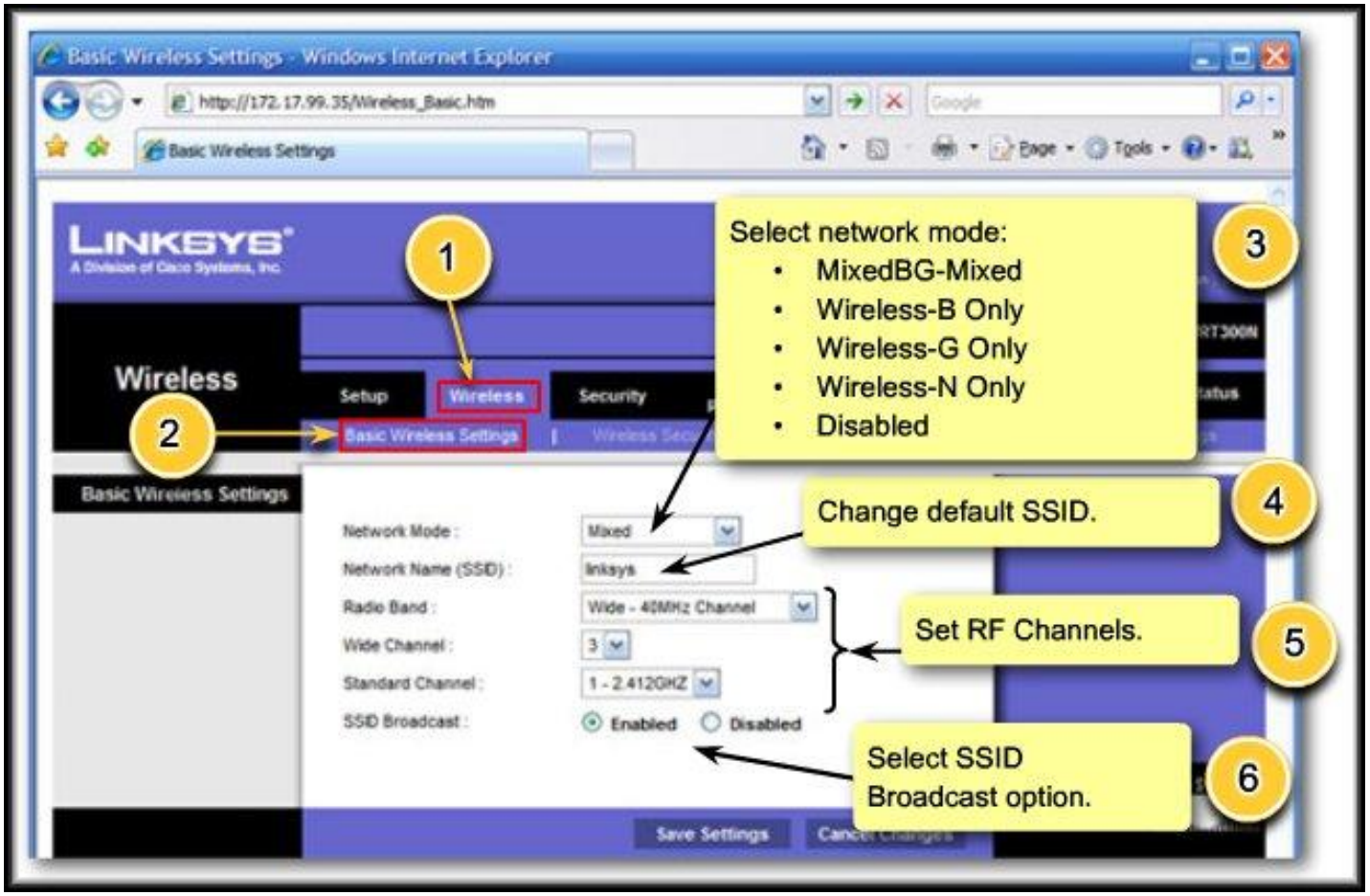


Controlling Access to the Wireless LAN

- An additional consideration is to configure access points that are near outside walls of buildings to transmit on a lower power setting than other access points closer to the middle of the building.
- This is to merely reduce the RF signature on the outside of the building.
  - Anyone running an application such as Netstumbler, Wireshark, or even Windows XP can map WLANs.

Basic Wireless Concepts and Configuration

Configuring Wireless LAN Access



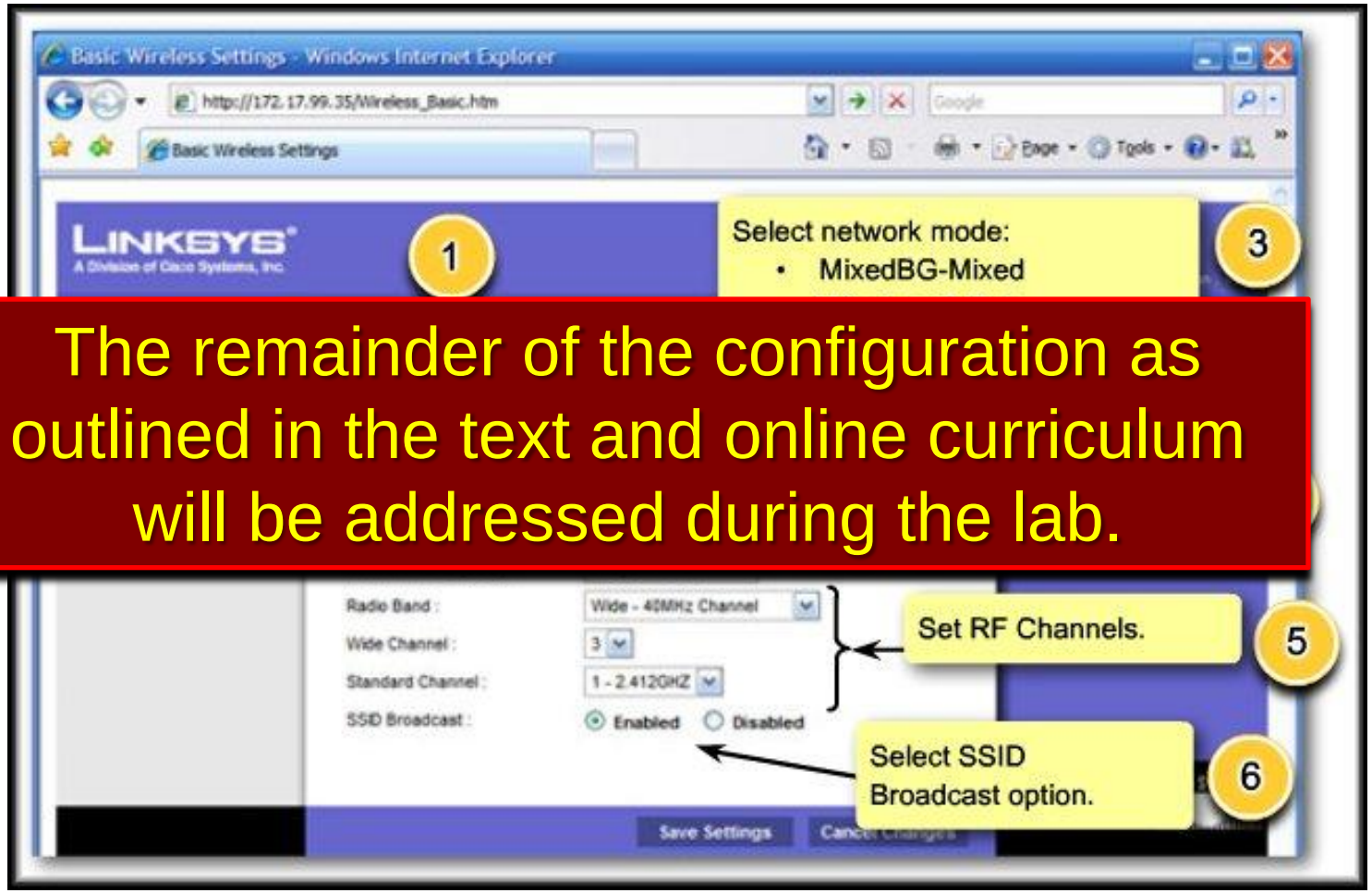
Configuring the Wireless Access Point

- In this topic, you will learn:
  - How to configure a wireless access point.
    - How to set the SSID.
    - How to enable security.
    - How to configure the channel.
    - How to adjust the power settings.
    - How to back up and restore the configuration.

Configuring the Wireless Access Point

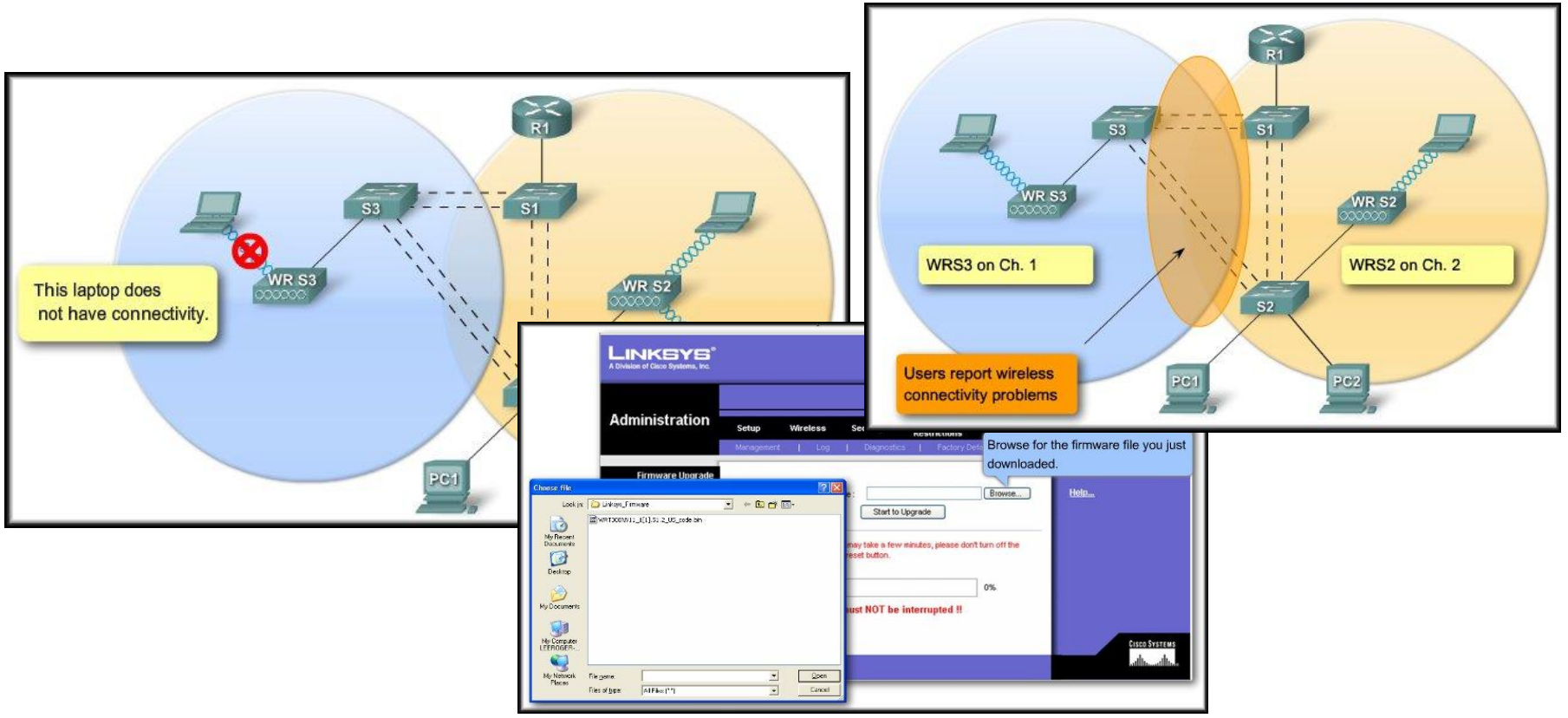
- The basic approach to wireless implementation, as with any basic networking, is to configure and test incrementally.
  - Verify the existing network and Internet access for the wired hosts.
  - Start the WLAN implementation process with a single access point and a single client, without enabling wireless security.
  - Verify that the wireless client has received a DHCP IP address and can ping the local wired default router and then browse to the external Internet.
  - Finally, configure wireless security with WPA2.
    - Use WEP only if the hardware does not support WPA.

Configuring the Wireless Access Point

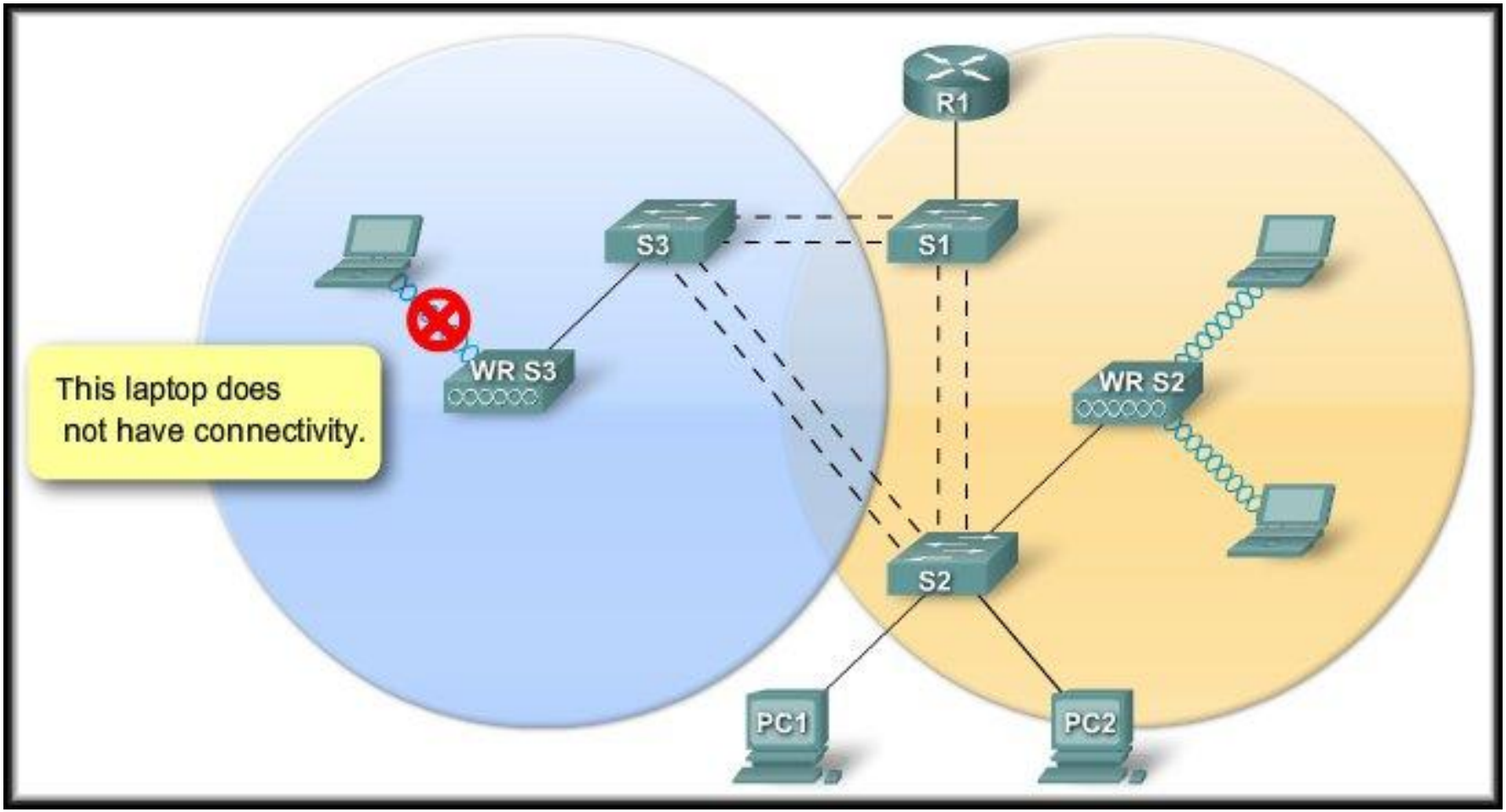


Basic Wireless Concepts and Configuration

Troubleshooting Simple WLAN Problems



A Systematic Approach



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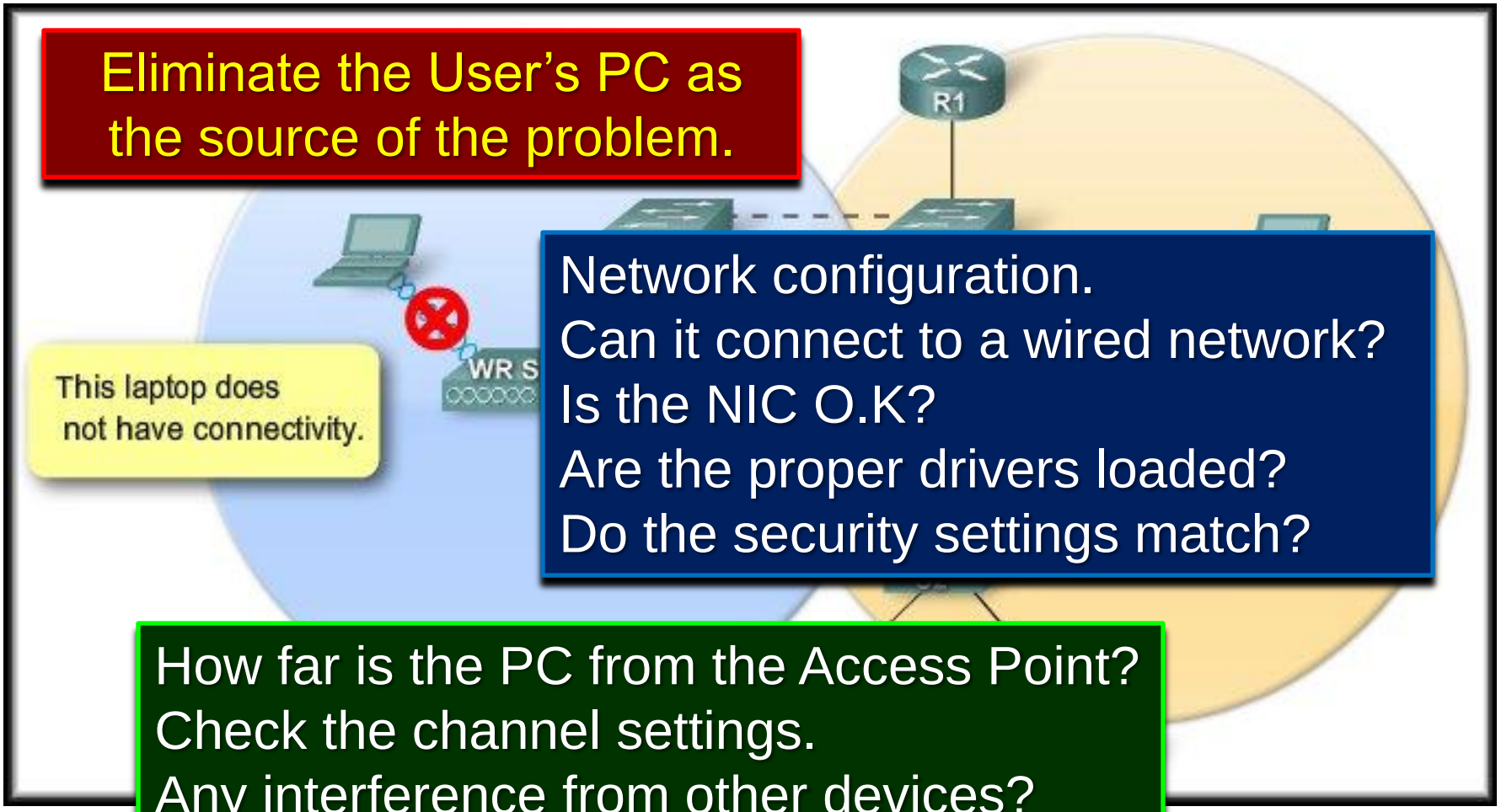

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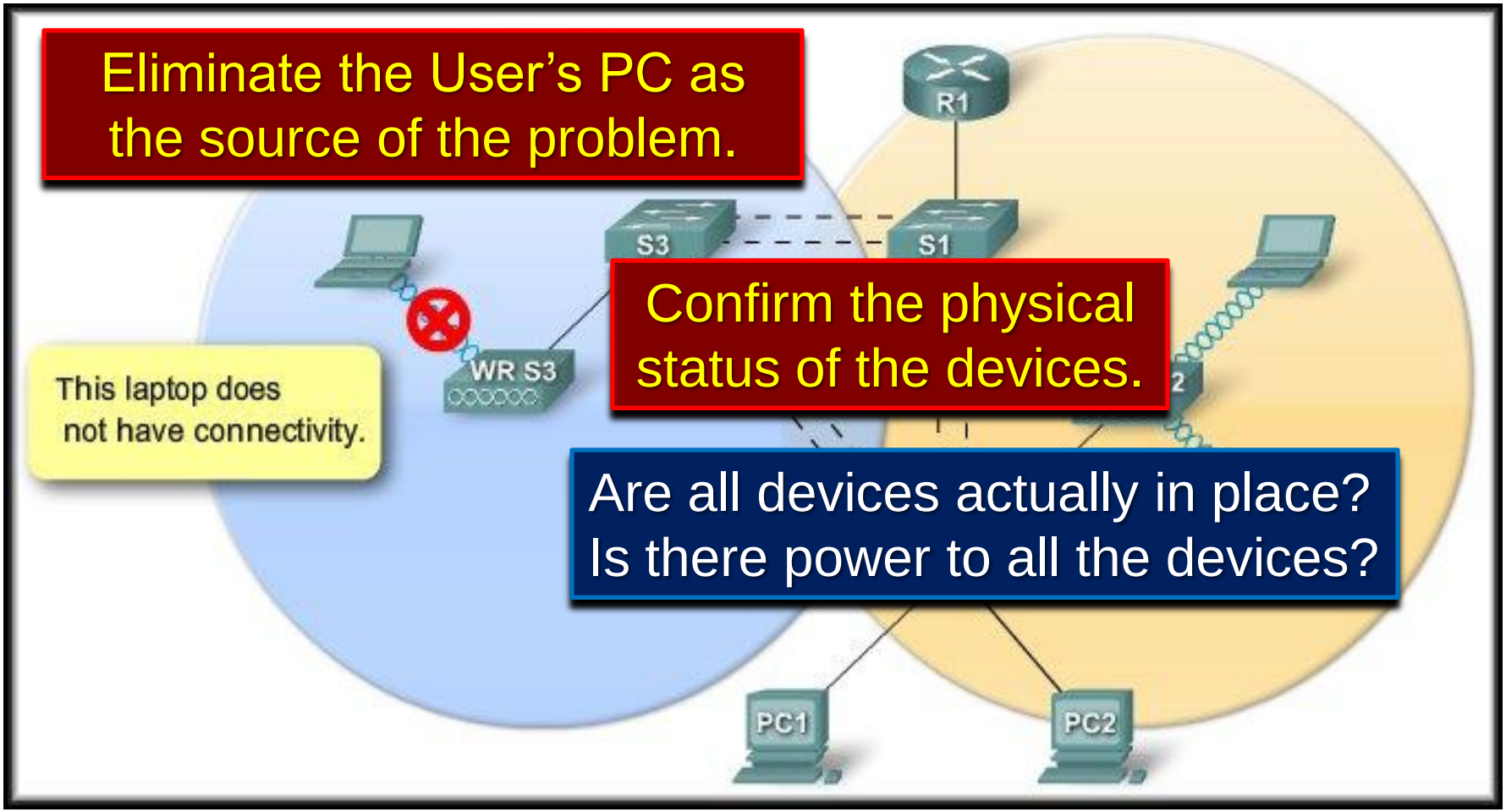

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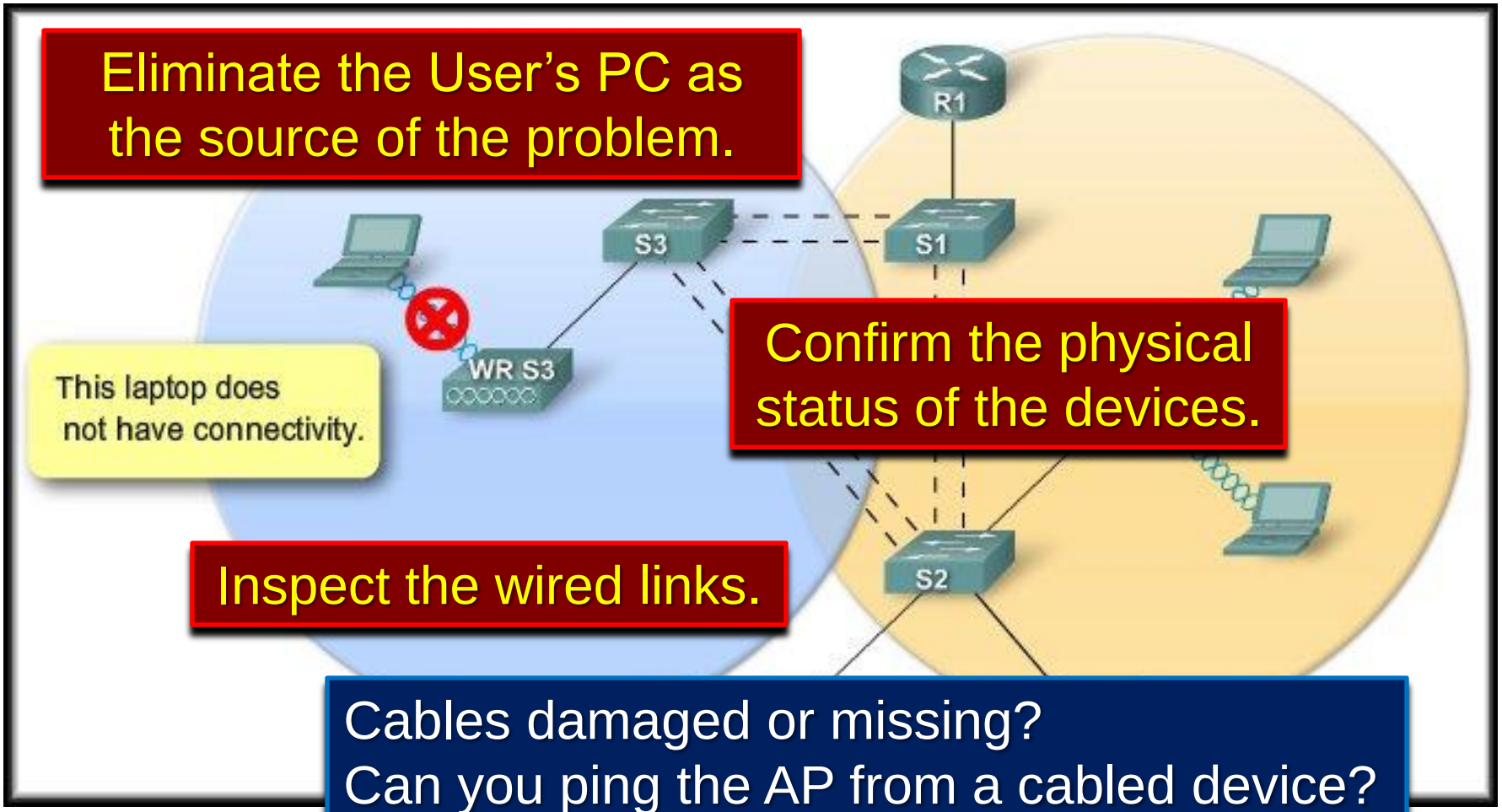

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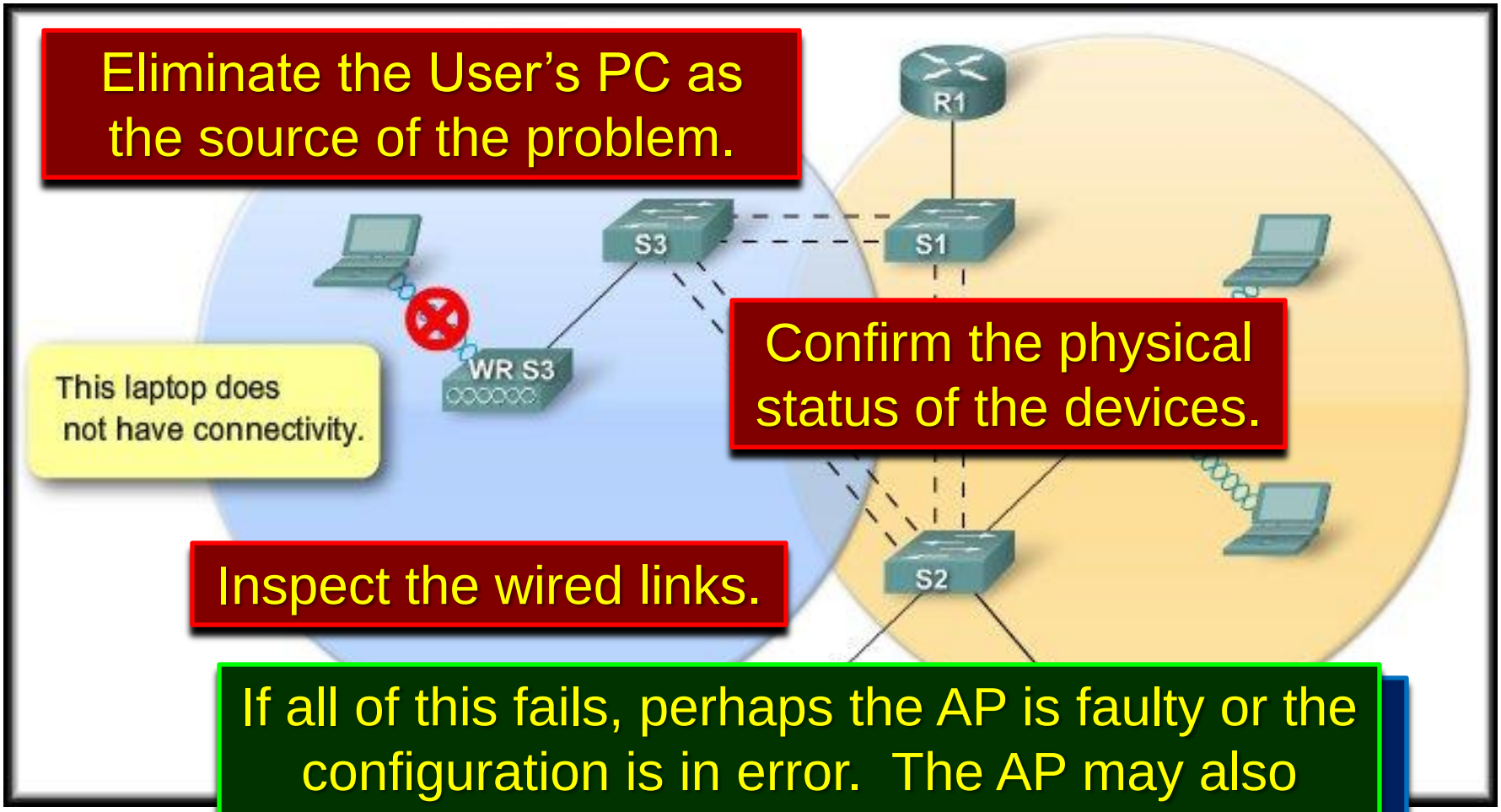
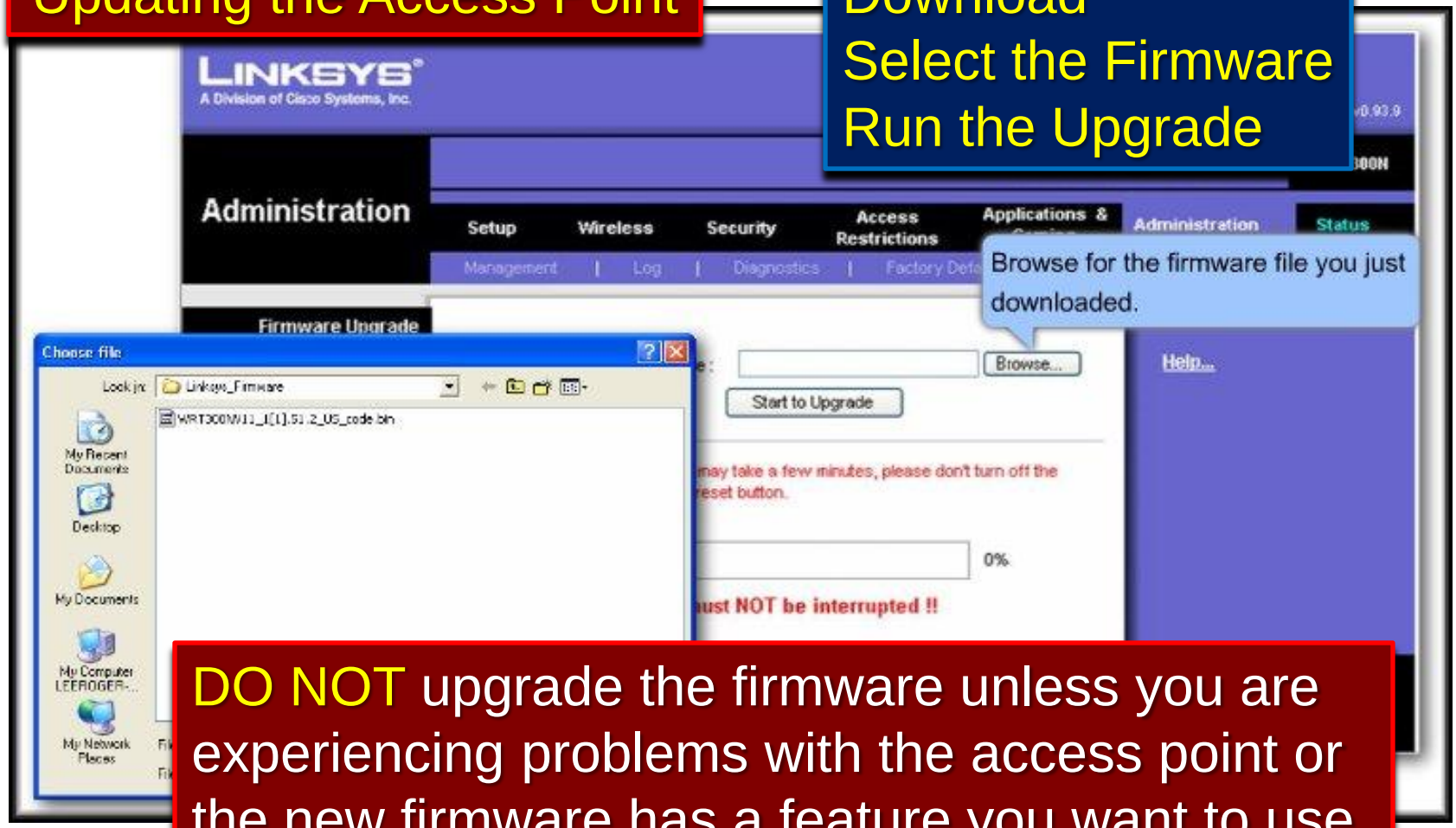


A Systematic Approach

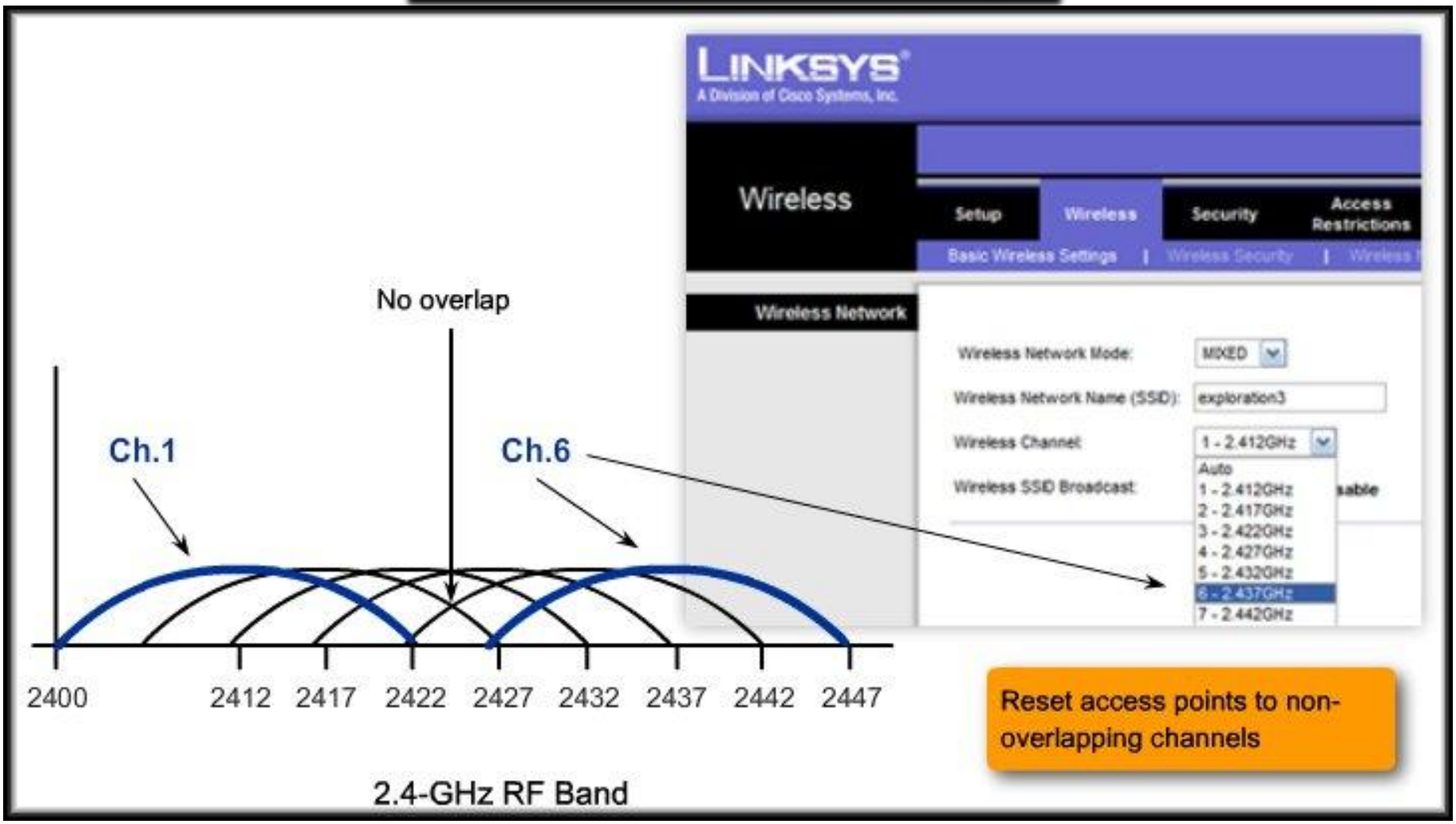
Updating the Access Point



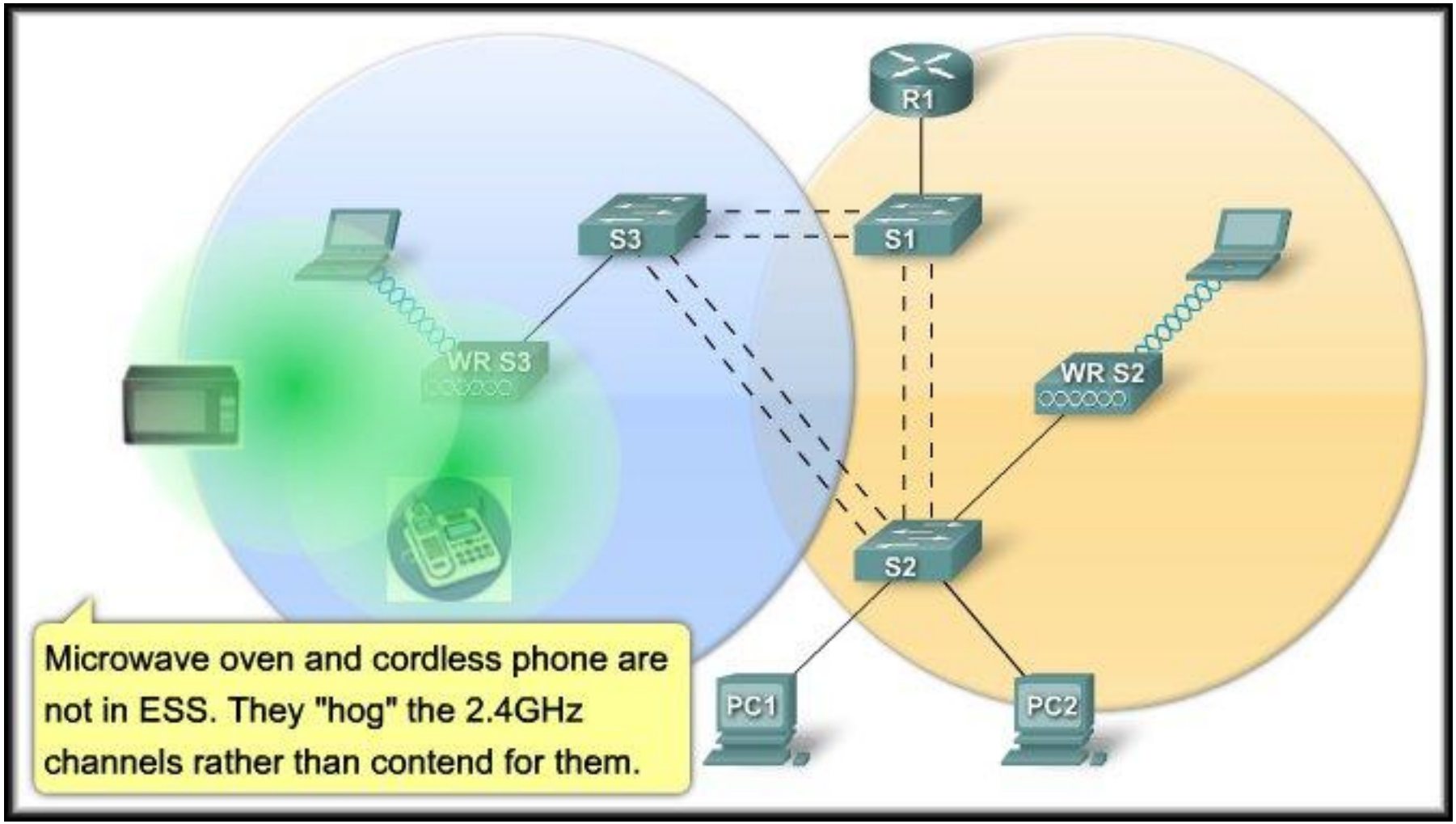
DO NOT upgrade the firmware unless you are experiencing problems with the access point or the new firmware has a feature you want to use.

A Systematic Approach

Incorrect Channel Settings



RF Interference Issues



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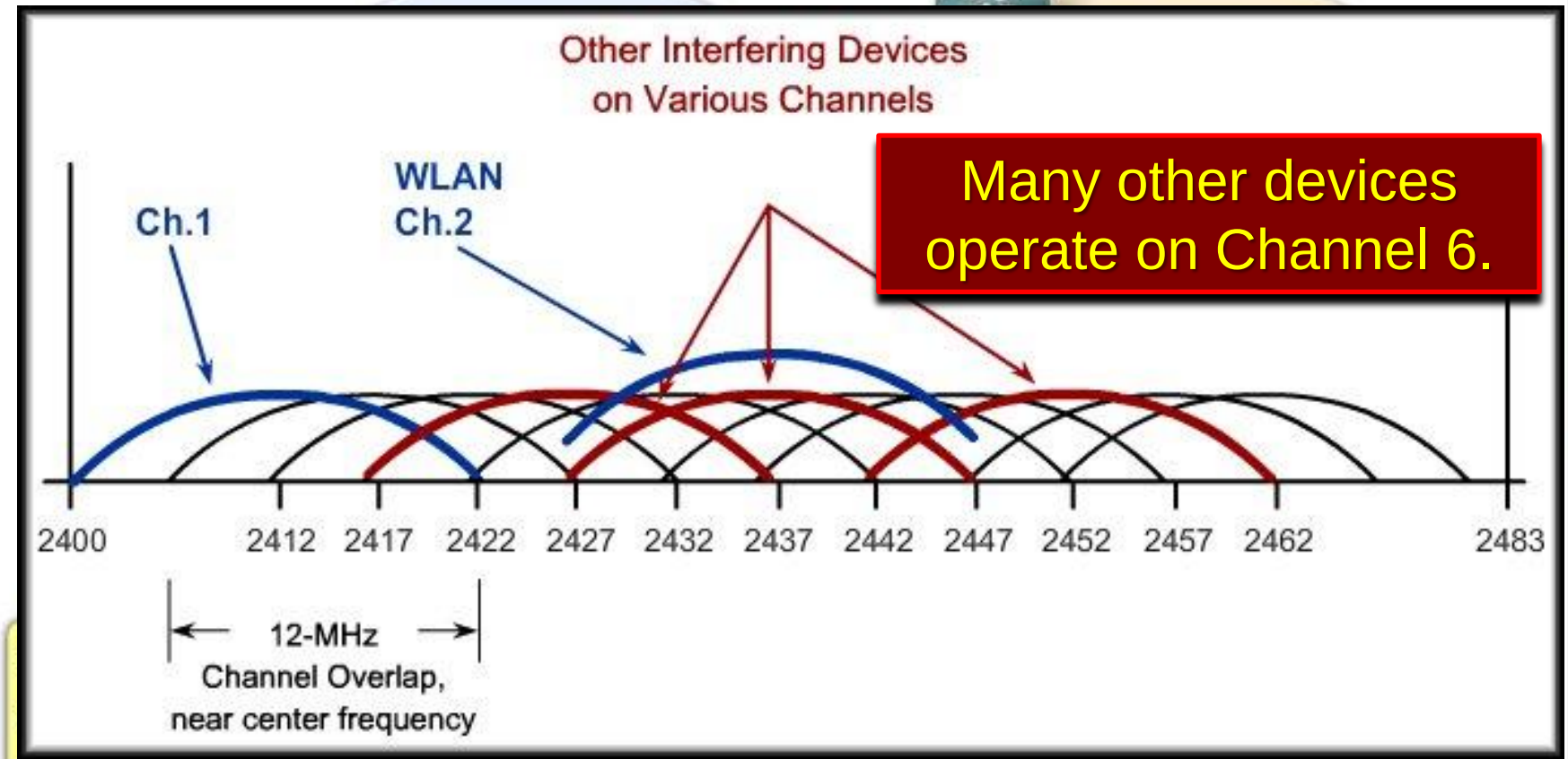

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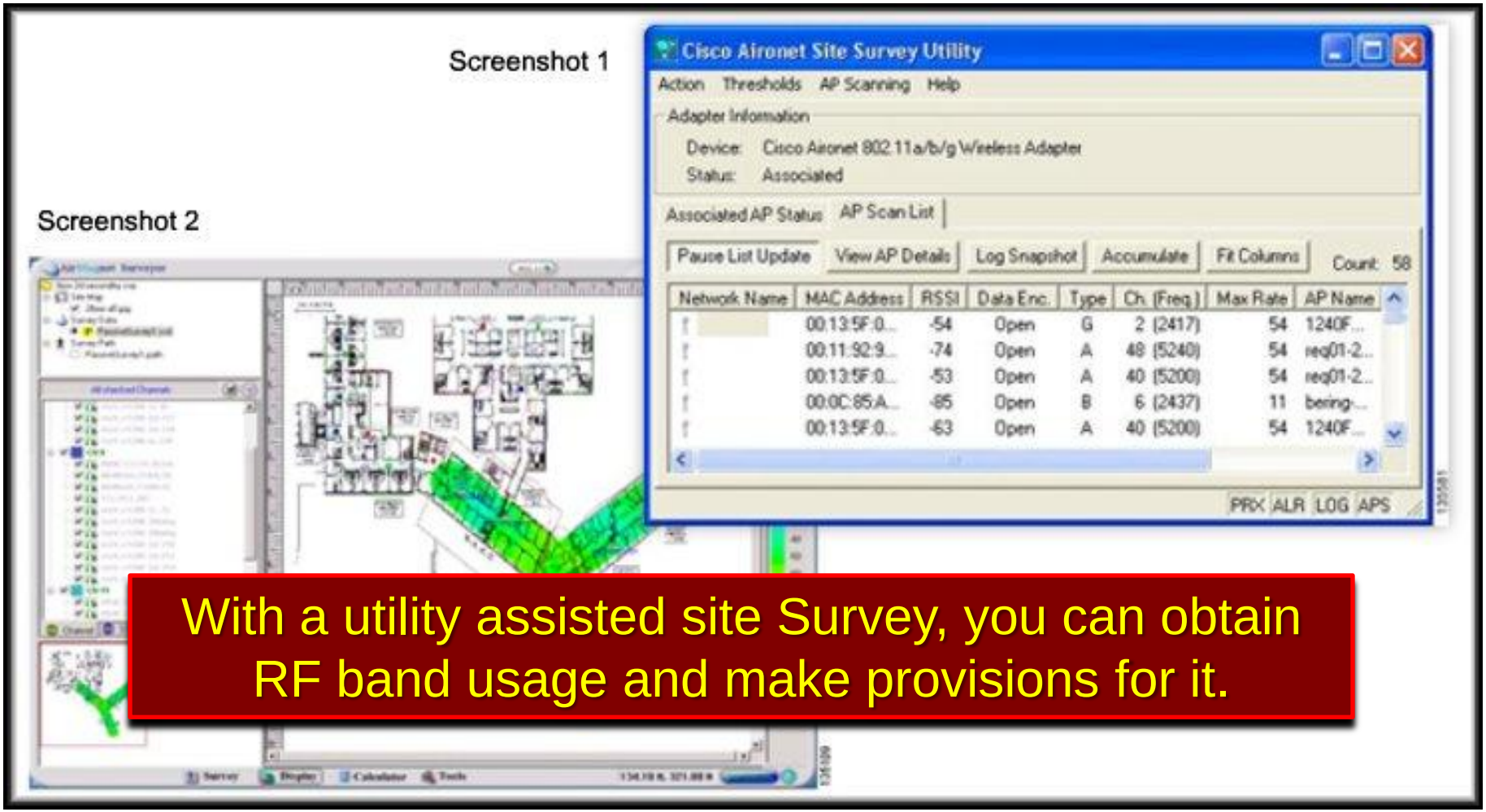
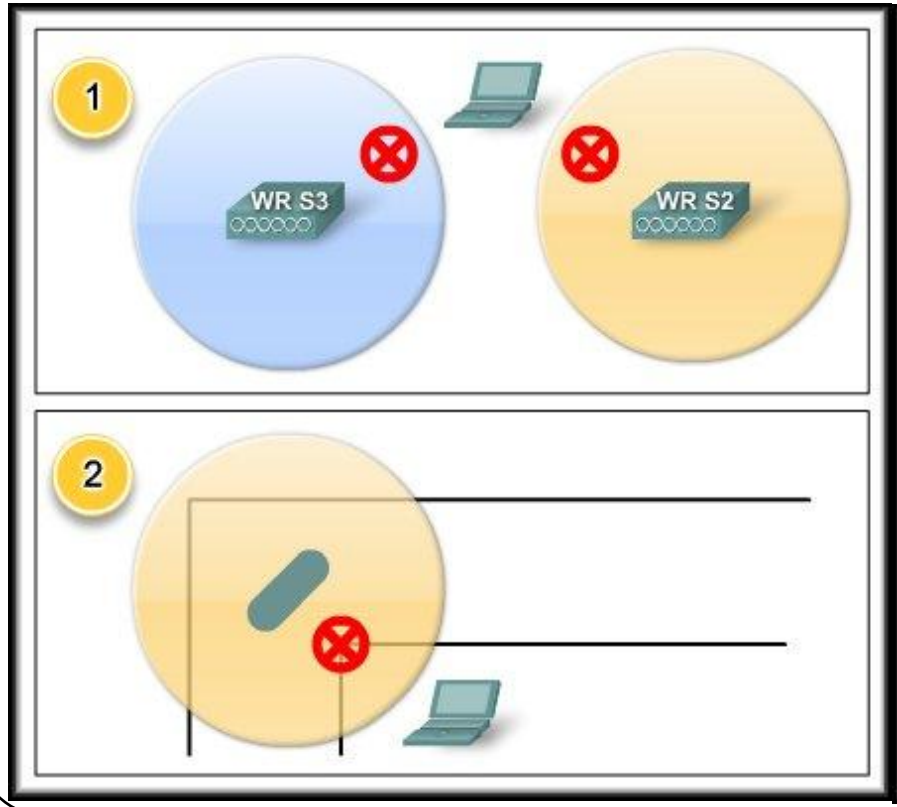
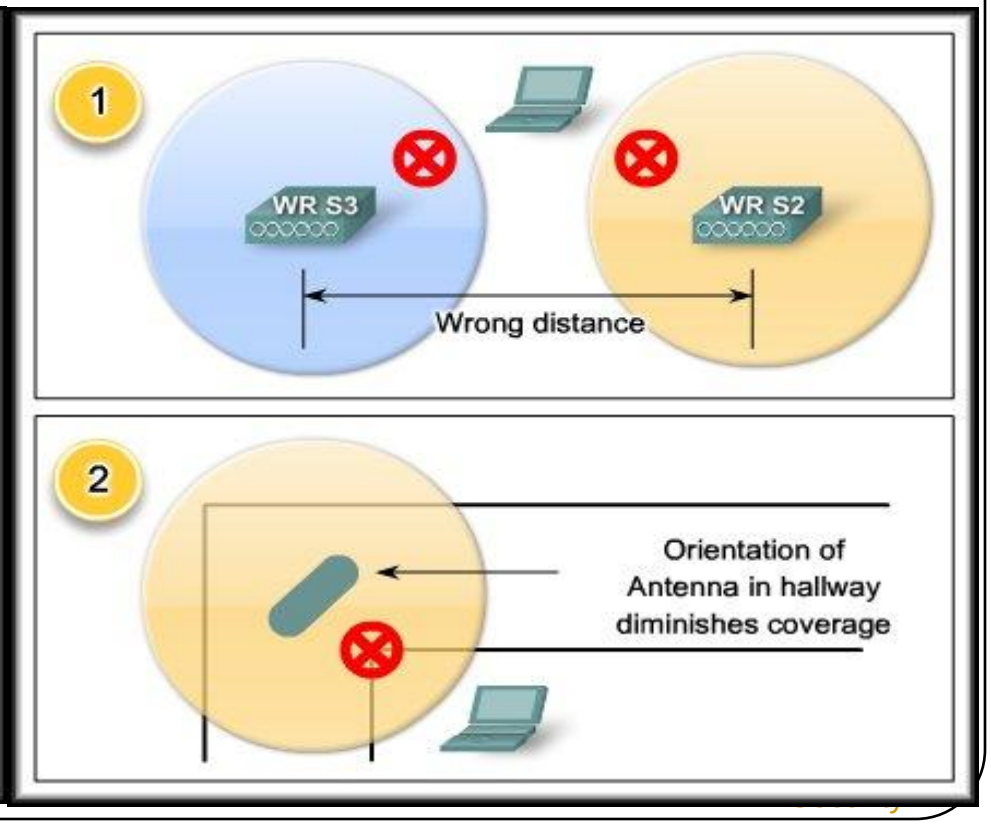


Access Point Placement

- A WLAN that just did not seem to perform like it should.
  - You keep losing association with an access point
  - Your data rates are much slower than they should be.





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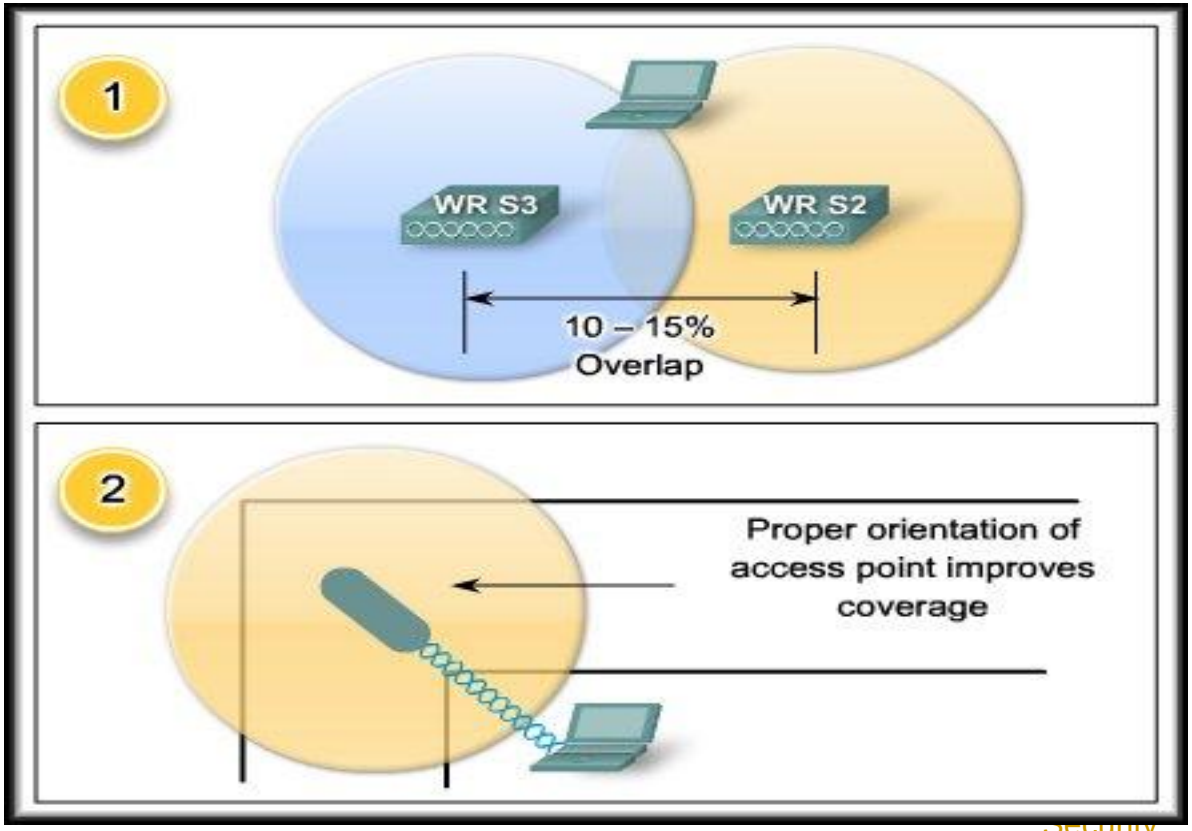

Access Point Placement

- Some additional specific details:
  - Not mounted closer than 7.9 inches (20 cm) from the body of all persons.
  - Do not mount the access point within 3 feet (91.4 cm) of metal obstructions.
  - Install the access point away from microwave ovens.
  - Always mount the access point vertically..
  - Do not mount the access point outside of buildings.
  - Do not mount the access point on building perimeter walls, unless outside coverage is desired.
  - When mounting an access point in the corner of a right-angle hallway intersection, mount it at a 45-degree angle.

Authentication and Encryption