Hacking Wireless Networks

Module 14

Unmask the Invisible Hacker.

Are You Protected from Hackers on Public Wi-Fi?

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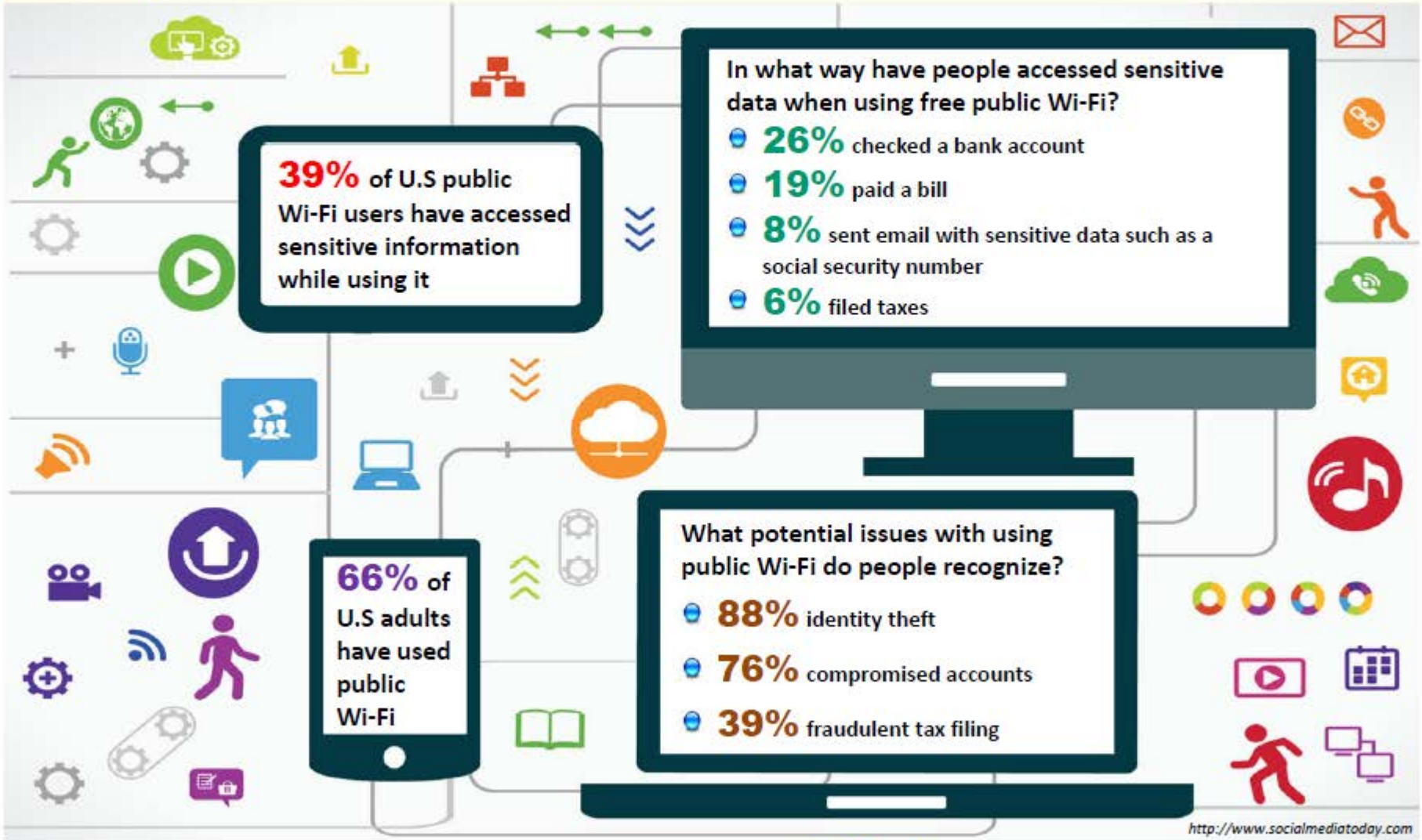

Wi-Fi Statistics

Globally, **46 percent of total mobile data traffic** was offloaded onto the fixed network through Wi-Fi

By 2018, **40 percent** of enterprises will specify Wi-Fi as the default connection for non mobile devices, such as desktops, desk phones, projectors, conference room.

http://www.cisco.com, http://www.gartner.com

Module Objectives

- Understanding Wireless Concepts
- Understanding Wireless Encryption Algorithms
- Understanding Wireless Threats
- Understanding Wireless Hacking Methodology

- Wireless Hacking Tools
- Understanding Bluetooth Hacking Techniques
- Understanding Wireless Hacking Countermeasures
- Wireless Security Tools
- Overview of Wireless Penetration Testing



Module Flow

Wireless Concepts

Wireless Encryption

Wireless Threats

Wireless Hacking Methodology

Wireless Hacking Tools

Bluetooth Hacking

Countermeasures

Wireless Security Tools

Wi-Fi Pen Testing

Wireless Terminologies

- **GSM**

  Universal system used for mobile transportation for wireless network worldwide

- **Bandwidth**

  Describes the amount of information that may be broadcasted over a connection

- **BSSID**

  The MAC address of an access point that has set up a Basic Service Set (BSS)

- **ISM band**

  A set of frequency for the international Industrial, Scientific, and Medical communities

- **Access Point**

  Used to connect wireless devices to a wireless network

- **Hotspot**

  Places where wireless network is available for public use

- **Association**

  The process of connecting a wireless device to an access point

- **Orthogonal Frequency-division Multiplexing (OFDM)**

  Method of encoding digital data on multiple carrier frequencies

- **Direct-sequence Spread Spectrum (DSSS)**

  Original data signal is multiplied with a pseudo random noise spreading code

- **Frequency-hopping Spread Spectrum (FHSS)**

  Method of transmitting radio signals by rapidly switching a carrier among many frequency channels

Wireless Networks

1. Wi-Fi refers to wireless local area networks (WLAN) based on **IEEE 802.11 standard**
2. It is a widely used technology for wireless communication across a **radio channel**
3. Devices such as a personal computer, video-game console, smartphone, etc. use Wi-Fi to connect to a **network resource** such as the Internet via a **wireless network access point**

Advantages

- Installation is fast and easy and eliminates wiring through **walls** and **ceilings**
- It is easier to **provide connectivity** in areas where it is difficult to lay cable
- Access to the network can be from anywhere within range of an **access point**
- **Public places** like airports, libraries, schools or even coffee shops offer you constant Internet connections using Wireless LAN

Disadvantages

- Security is a big issue and may **not meet expectations**
- As the number of computers on the network increases, the **bandwidth suffers**
- Wi-Fi enhancements can require new **wireless cards and/or access points**
- Some **electronic equipment** can interfere with the Wi-Fi networks

Wi-Fi Networks at Home and Public Places

- Wi-Fi networks at home allow you to be wherever you want with your laptop, iPad, or handheld device, and not have to make holes for or hide Ethernet cables

Wi-Fi at Home

- You can find free/paid Wi-Fi access available in coffee shops, shopping malls, bookstores, offices, airport terminals, schools, hotels, and other public places

Wi-Fi at Public Places

Wireless Technology Statistics

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Why Wireless Technology Matters?

More than half of all open Wi-Fi networks are susceptible to abuse

There will be more than **7 billion** new Wi-Fi enabled devices in the next 3 years

90% of all smartphones are equipped with Wi-Fi capabilities

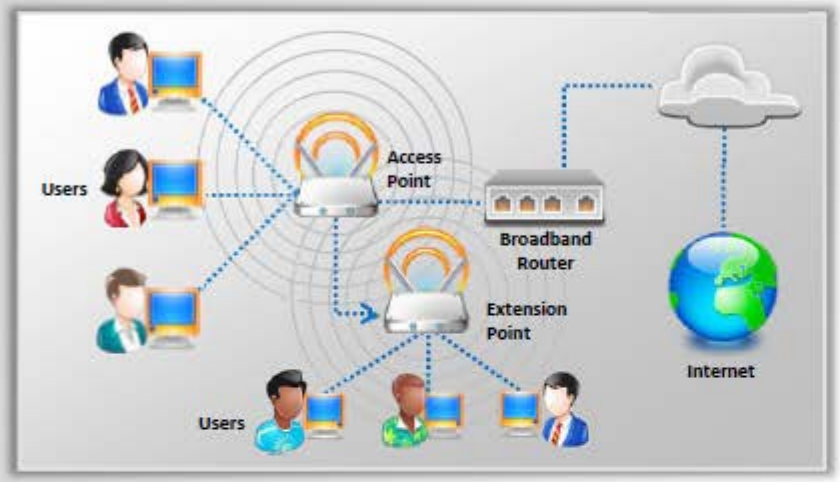
A Wi-Fi attack on an open network can take less than **2 seconds**

By 2017, **60%** of carrier network traffic will be offloaded to Wi-Fi

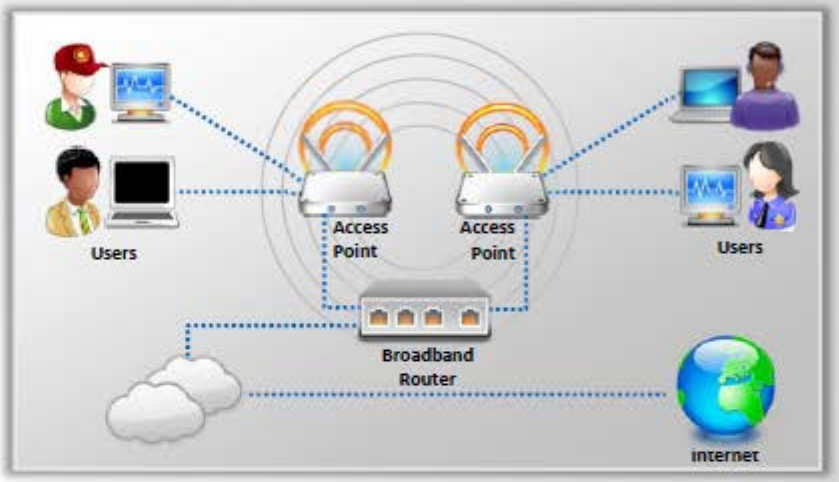
71% of all mobile communications flows over Wi-Fi

http://www.huffingtonpost.com

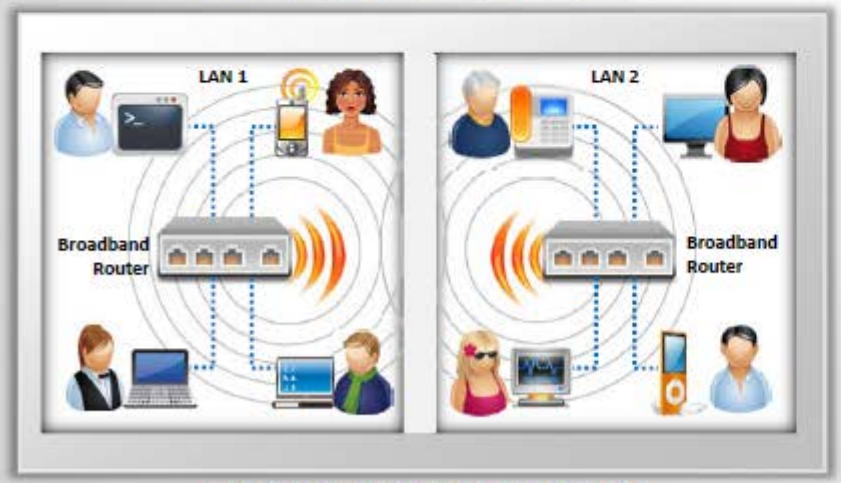
Types of Wireless Networks



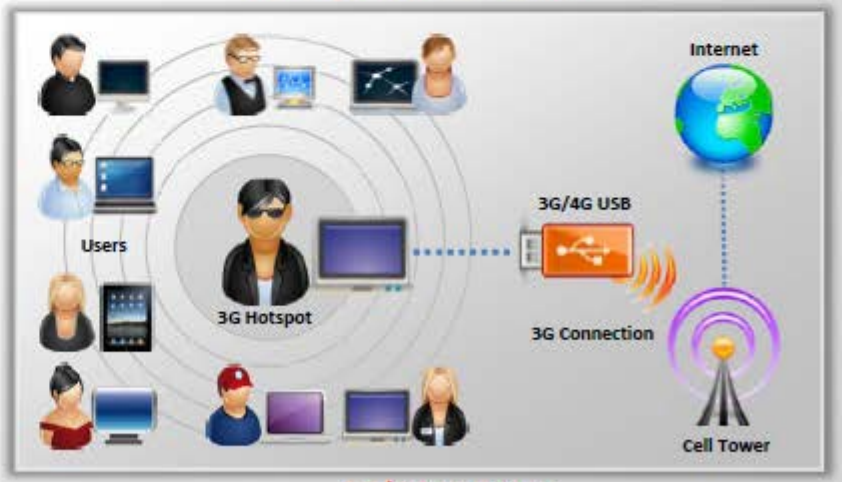
Extension to a Wired Network



Multiple Access Points



LAN-to-LAN Wireless Network



3G/4G Hotspot

Wireless Standards

Amendments	Freq. (GHz)	Modulation	Speed (Mbps)	Range (ft)
802.11a	5	OFDM	54	25 – 75
802.11b	2.4	DSSS	11	150 – 150
802.11g	2.4	OFDM, DSSS	54	150 – 150
802.11i	Defines WPA2-Enterprise/WPA2-Personal for Wi-Fi			
802.11n	2.4, 5	OFDM	54	~100
802.16 (WiMAX)	10 - 66		70 – 1000	30 miles
Bluetooth	2.4		1 - 3	25

Service Set Identifier (SSID)

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01 SSID is a token to **identify a 802.11 (Wi-Fi) network**; by default it is the part of the frame header sent over a wireless local area network (WLAN)

02 It acts as a **single shared identifier** between the access points and clients

03 **Access points continuously broadcasts SSID**, if enabled, for the client machines to identify the presence of wireless network

04 **SSID is a human-readable text** string with a maximum length of 32 bytes

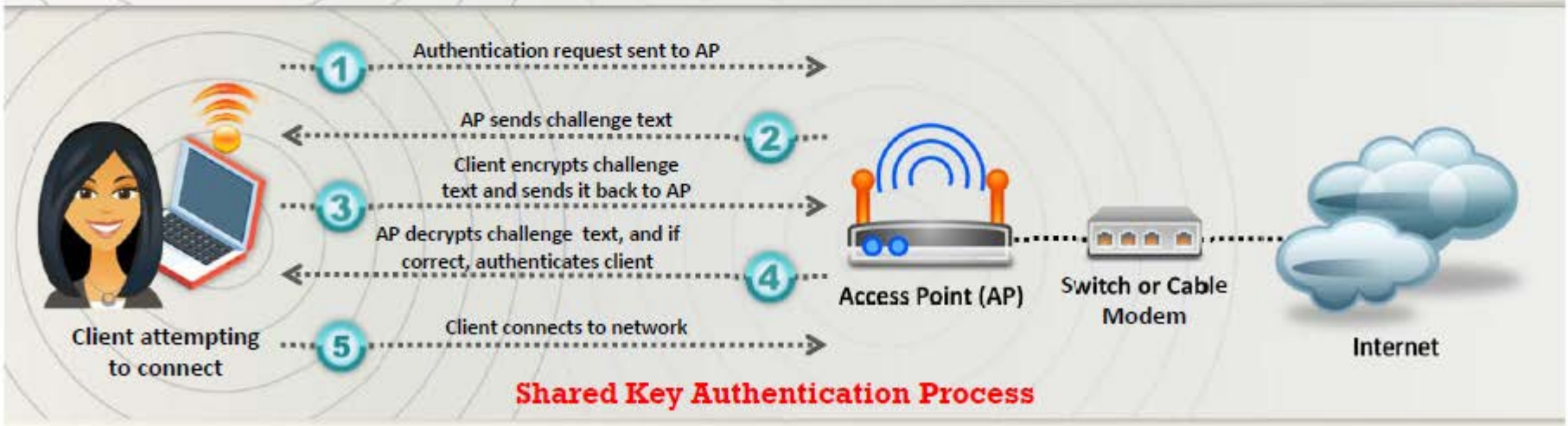
05 If SSID of the network is changed, **reconfiguration of the SSID on every host** is required, as every user of the network configures the SSID into their system

06 **A non-secure access mode** allows clients to connect to the access point using the configured SSID, a blank SSID, or an SSID configured as "any"

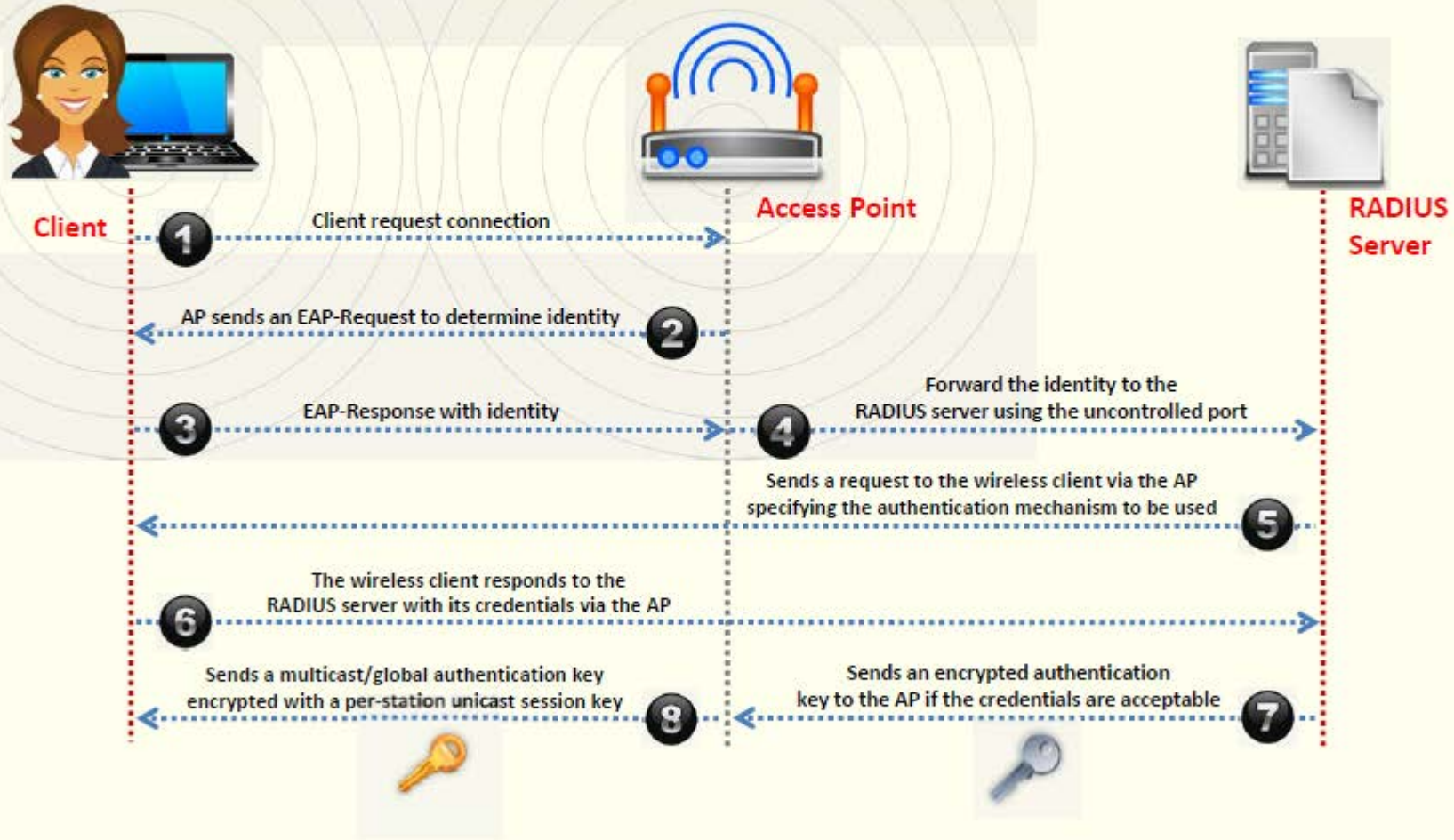
07 **Security concerns** arise when the default values are not changed, as these units can be compromised

08 The SSID **remains secret** only on the closed networks with no activity, that is inconvenient to the legitimate users

Wi-Fi Authentication Modes



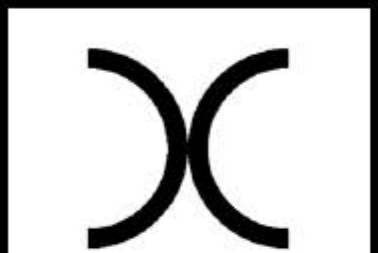
Wi-Fi Authentication Process Using a Centralized Authentication Server



Wi-Fi Chalking

WarWalking	Attackers **walk around with Wi-Fi enabled laptops** to detect open wireless networks	
WarChalking	A method used to **draw symbols in public places** to advertise open Wi-Fi networks	
WarFlying	In this technique, attackers **use drones** to detect open wireless networks	
WarDriving	Attackers **drive around with Wi-Fi enabled laptops** to detect open wireless networks	

Wi-Fi Chalking Symbols



Free Wi-Fi

Wi-Fi with MAC Filtering

Restricted Wi-Fi

Pay for Wi-Fi

Wi-Fi with WEP

Wi-Fi with Multiple Access Controls

Wi-Fi with Closed SSID

Wi-Fi Honeypot

Types of Wireless Antennas

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Directional Antenna

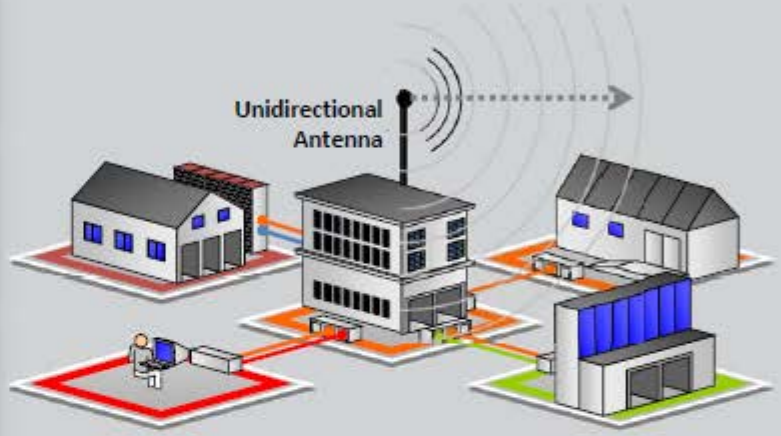
Used to broadcast and obtain radio waves from a single direction

Omnidirectional Antenna

It provides a 360 degree horizontal radiation pattern. It is used in wireless base stations.

Parabolic Grid Antenna

It is based on the principle of a satellite dish but it does not have a solid backing. They can pick up Wi-Fi signals ten miles or more.



Yagi Antenna

Yagi is a unidirectional antenna commonly used in communications for a frequency band of 10 MHz to VHF and UHF

Dipole Antenna

Bidirectional antenna, used to support client connections rather than site-to-site applications

Parabolic Grid Antenna

Parabolic grid antennas enable attackers to get **better signal quality** resulting in more data to eavesdrop on, **more bandwidth** to abuse and **higher power output** that is essential in Layer 1 DoS and man-in-the-middle attacks

Grid parabolic antennas can pick up Wi-Fi signals from a distance of ten miles

SSID	Channel	Encryption	Authentication	Signal
Apple	2	None	Unknown	24%
My Wi-Fi	5	WEP	Unknown	40%
GSM	1	WEP	Unknown	64%
Wi-Fi Planet	6	None	Unknown	38%
Awslocal	8	None	Unknown	54%

Module Flow

Wireless Concepts

Wireless Encryption

Wireless Threats

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Wireless Hacking Tools

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Types of Wireless Encryption

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WPA2 Enterprise

It integrates EAP standards with WPA2 encryption

WEP

- WEP is an encryption algorithm for IEEE 802.11 wireless networks
- It is an old and original wireless security standard which can be cracked easily

AES

It is a symmetric-key encryption, used in WPA2 as a replacement of TKIP

WPA2

WPA2 uses AES (128 bit) and CCMP for wireless data encryption

WPA

- It is an advanced wireless encryption protocol using TKIP, MIC, and AES encryption
- Uses a 48 bit IV, 32 bit CRC and TKIP encryption for wireless security

EAP

Supports multiple authentication methods, such as token cards, Kerberos, certificates etc.

802.11i

It is an IEEE amendment that specifies security mechanisms for 802.11 wireless networks

TKIP

A security protocol used in WPA as a replacement for WEP

CCMP

CCMP utilizes 128-bit keys, with a 48-bit initialization vector (IV) for replay detection

RADIUS

It is a centralized authentication and authorization management system

LEAP

It is a proprietary WLAN authentication protocol developed by Cisco

WEP Encryption

What is WEP?

- **Wired Equivalent Privacy** (WEP) is an IEEE 802.11 wireless protocol which provides security algorithms for data confidentiality during wireless transmissions
- WEP uses a **24-bit initialization vector (IV)** to form stream cipher RC4 for confidentiality, and the CRC-32 checksum for integrity of wireless transmission

64-bit WEP uses a 40-bit key

128-bit WEP uses a 104-bit key size

256-bit WEP uses 232-bit key size

WEP Flaws

It was developed without:

- Academic or public review
- Review from cryptologists

- **It has significant vulnerabilities and design flaws**

How WEP Works

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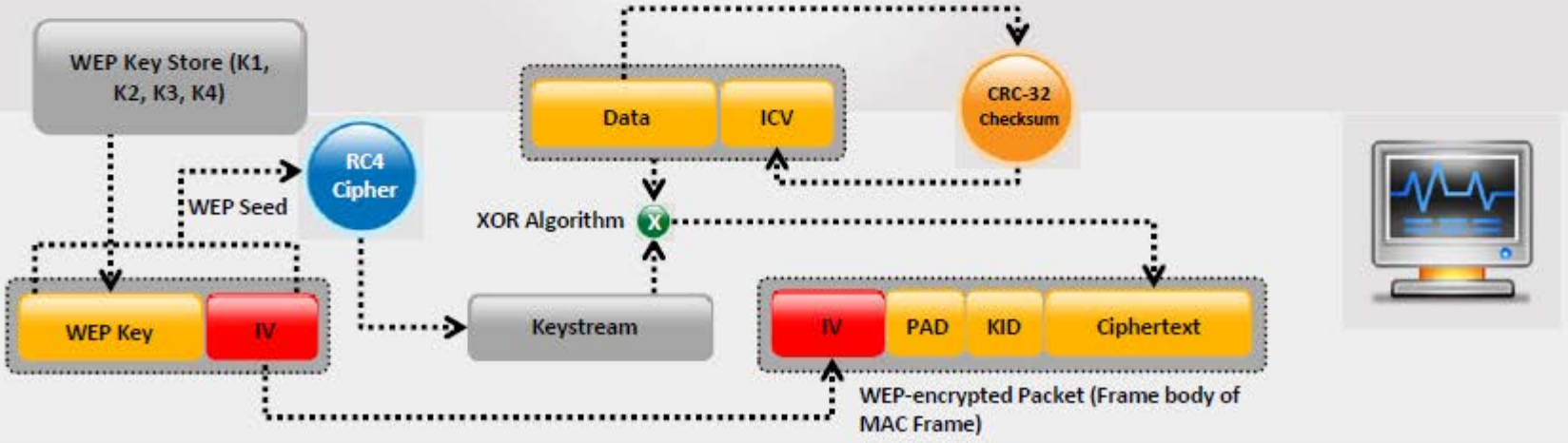
01 CRC-32 checksum is used to calculate a 32-bit **Integrity Check Value** (ICV) for the data, which, in turn, is added to the data frame

02 A 24-bit arbitrary number known as **Initialization Vector (IV)** is added to WEP key; WEP key and IV are together called as **WEP seed**

03 The WEP seed is used as the input to **RC4** algorithm to generate a key stream (key stream is bit-wise **XORed** with the combination of data and ICV to produce the encrypted data)

04 The IV field (IV+PAD+KID) is added to the ciphertext to generate a **MAC frame**



What is WPA?

- Wi-Fi Protected Access (WPA) is a **data encryption method** for WLANs based on 802.11 standards
- It is a snapshot of 802.11i (under development) providing **stronger encryption**, and enabling PSK or EAP authentication

TKIP (Temporal Key Integrity Protocol)

- TKIP utilizes the RC4 stream cipher encryption with **128-bit** keys and **64-bit** MIC integrity check
- TKIP mitigated vulnerability by **increasing the size of the IV** and using mixing functions

128-bit Temporal Key

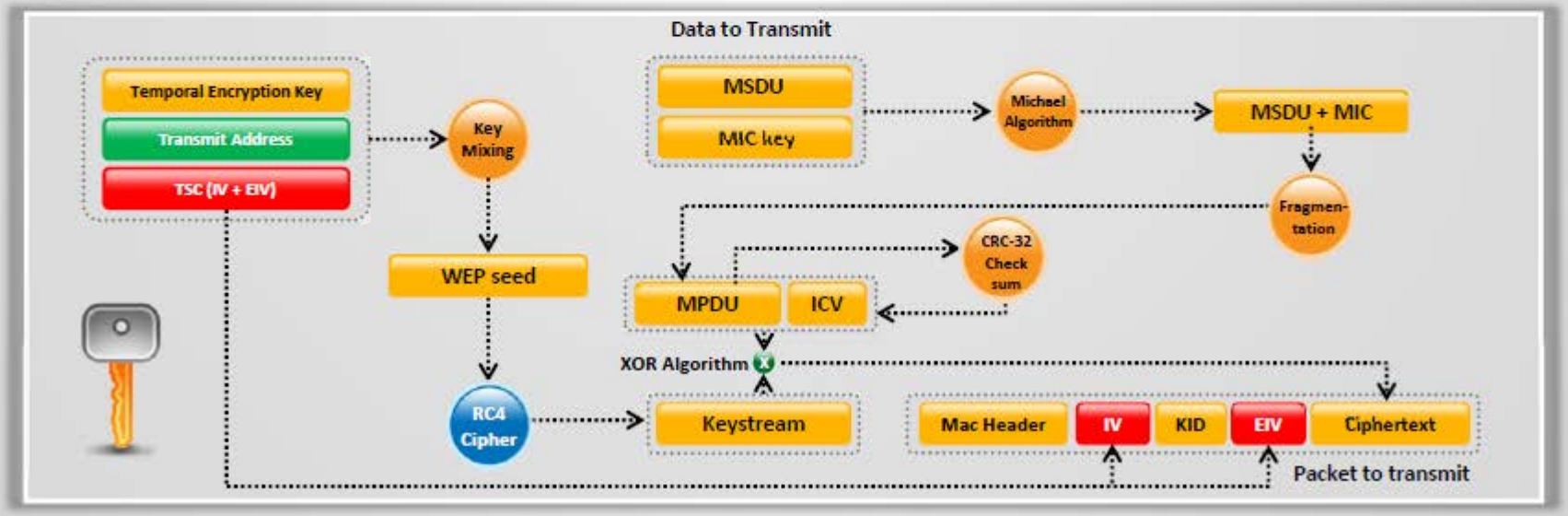
- Under TKIP, the client starts with a 128-bit "temporal key" (TK) that is then **combined with the client's MAC address** and with an IV to create a keystream that is used to encrypt data via the RC4
- It implements a sequence counter to protect against **replay attacks**

WPA Enhances WEP

- TKIP enhances WEP by adding a **rekeying mechanism** to provide fresh encryption and integrity keys
- Temporal keys are changed for every **10,000 packets**. This makes TKIP protected networks more resistant to cryptanalytic attacks involving key reuse

How WPA Works

- Temporal encryption key, transmit address, and TKIP sequence counter (TSC) is used as input to **RC4 algorithm** to generate a **Keystream**
- MAC Service Data Unit (MSDU) and message integrity check (MIC) are combined using **Michael algorithm**
- The combination of MSDU and MIC is fragmented to generate **MAC Protocol Data Unit (MPDU)**
- A **32-bit Integrity Check Value (ICV)** is calculated for the MPDU
- The combination of MPDU and ICV is bitwise **XORed with Keystream** to produce the encrypted data
- The **IV** is added to the encrypted data to generate **MAC frame**



Temporal Keys

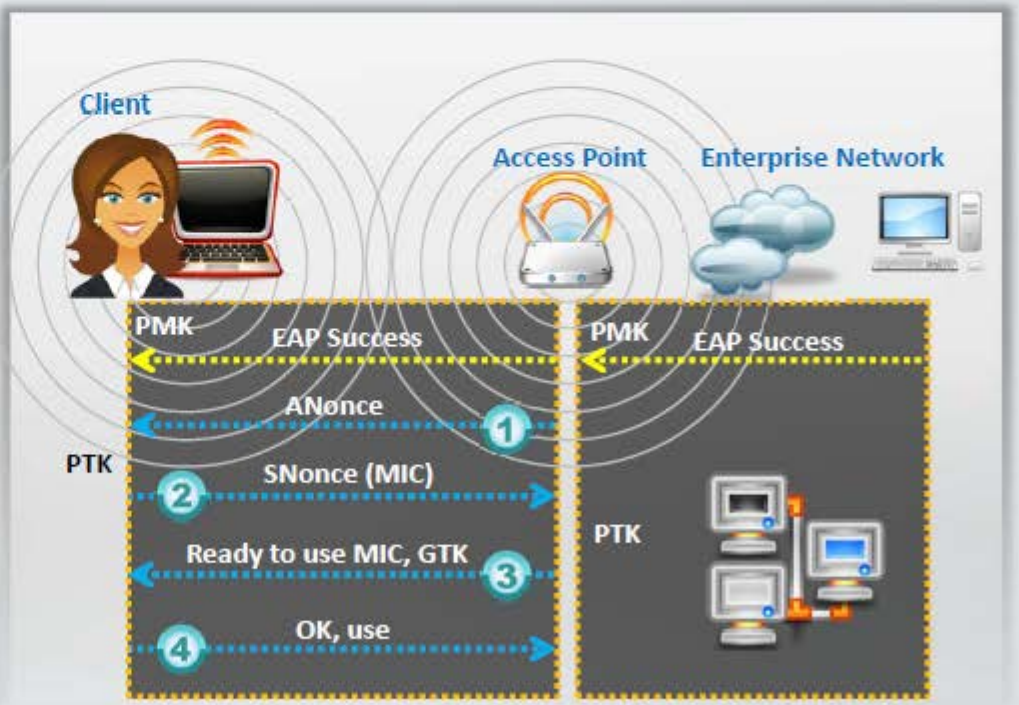
- In WPA and WPA2, the encryption keys (temporal keys) are derived during the **four-way handshake**
- Encryption keys are derived from the PMK that is derived during the **EAP authentication session**
- In the **EAP success message**, PMK is sent to the AP but is not directed to the Wi-Fi client as it has derived its own copy of the PMK

01 AP sends an ANonce to client which uses it to construct the **Pairwise Transient Key (PTK**

02 Client respond with its own nonce-value (SNonce) to the AP together with a **Message Integrity Code (MIC)**

03 AP sends the **GTK and a sequence number** together with another MIC which is used in the next broadcast frames

04 Client confirm that the temporal keys are installed



What is WPA2?

- WPA2 provides enterprise and Wi-Fi users with **stronger data protection** and **network access control**
- Provides government grade security by implementing the **National Institute of Standards and Technology** (NIST) **FIPS 140-2 compliant AES encryption** algorithm

WPA2-Personal

- WPA2-Personal uses a set-up password (**Pre-shared Key**, PSK) to protect unauthorized network access
- In PSK mode each wireless network device encrypts the network traffic using a 128-bit key that is derived from a passphrase of 8 to 63 ASCII characters

WPA2-Enterprise

- It includes **EAP** or **RADIUS** for centralized client authentication using multiple authentication methods, such as token cards, Kerberos, certificates etc.
- Users are assigned **login credentials** by a centralized server which they must present when connecting to the network

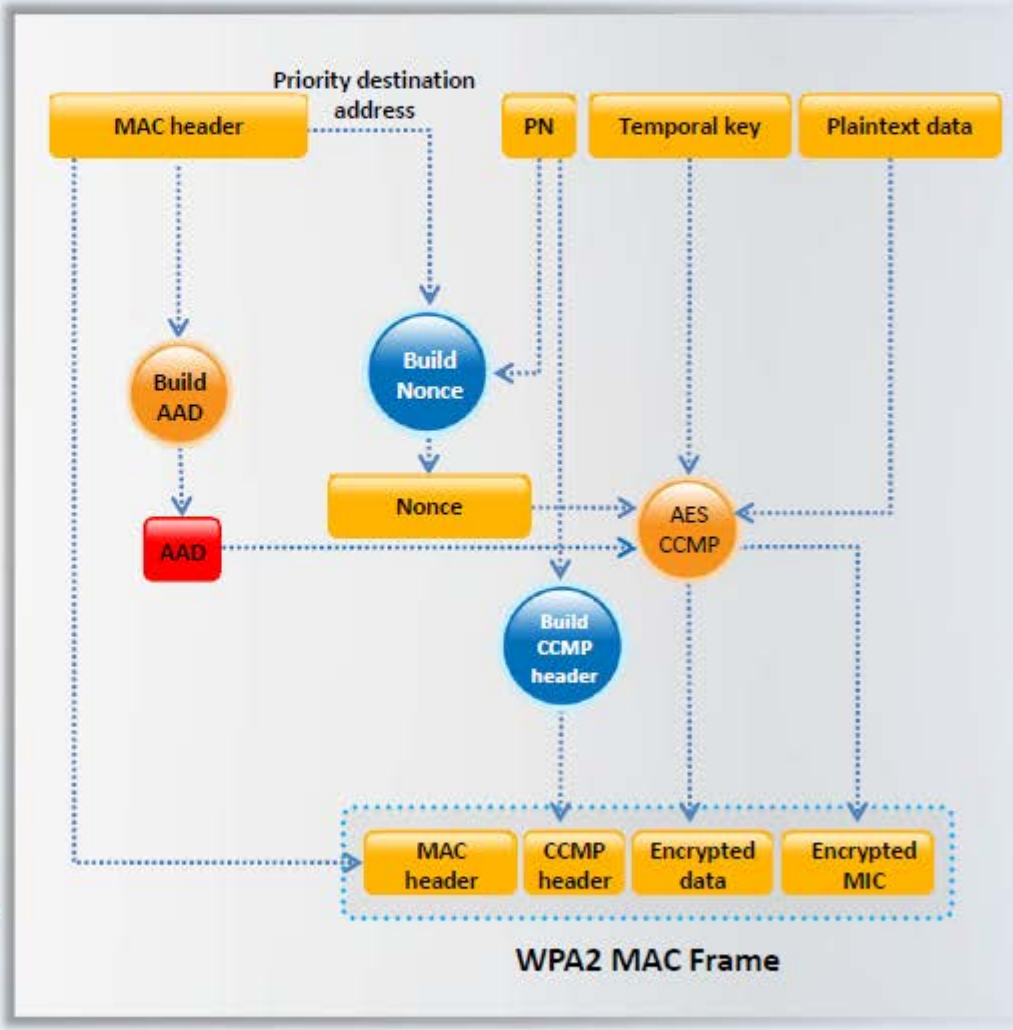
How WPA2 Works

In the CCMP implementation of WPA2, MAC header data is used to build additional authentication data (AAD)

A sequenced packet number (PN) is used to build nonce

AAD, temporal key and nonce along with CCMP are used for data encryption

A WPA2 MAC Frame is build using MAC header, CCMP header, encrypted data and encrypted MIC



WPA2 MAC Frame

WEP vs. WPA vs. WPA2

Encryption	Attributes			
	Encryption Algorithm	IV Size	Encryption Key Length	Integrity Check Mechanism
WEP	RC4	24-bits	40/104-bit	CRC-32
WPA	RC4, TKIP	48-bit	128-bit	Michael algorithm and CRC-32
WPA2	AES-CCMP	48-bit	128-bit	CBC-MAC

WEP	Should be replaced with more secure WPA and WPA2
WPA, WPA2	Incorporates protection against forgery and replay attacks

WEP Issues

1. The IV is a 24-bit field is too small and is sent in the **cleartext** portion of a message
2. **Identical key streams** are produced with the reuse of the same IV for data protection, as the IV is short key streams are repeated within short time
3. **Lack of centralized key management** makes it difficult to change the WEP keys with any regularity
4. When there is IV Collision, it becomes possible to **reconstruct the RC4 keystream** based on the IV and the decrypted payload of the packet
5. IV is a part of the RC4 encryption key, leads to a **analytical attack** that recovers the key after intercepting and analyzing a relatively small amount of traffic
6. Use of RC4 was designed to be a **one-time cipher** and not intended for multiple message use
7. No defined method for **encryption key distribution**
8. Wireless adapters from the same vendor may all **generate the same IV sequence**. This enables attackers to determine the key stream and decrypt the ciphertext
9. Associate and disassociate messages are **not authenticated**
10. WEP does not provide cryptographic integrity protection. By capturing two packets an attacker can flip a bit in the encrypted stream and **modify the checksum** so that the packet is accepted
11. WEP is based on a password, prone to **password cracking attacks**
12. An attacker can construct a decryption table of the **reconstructed key stream** and can use it to decrypt the WEP Packets in real-time

Weak Initialization Vectors (IV)

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1. In the RC4 algorithm, the **Key Scheduling Algorithm (KSA)** creates an IV based on the base key
2. The IV value is **too short and not protected** from reuse and no protection again message replay
3. A flaw in the WEP implementation of RC4 allows **"weak" IVs** to be generated
4. The way the keystream is constructed from the IV makes it susceptible to **weak key attacks** (FMS attack)
5. Those weak IVs **reveal information** about the key bytes they were derived from
6. No effective detection of **message tampering** (message integrity)
7. An attacker will collect enough weak IVs to reveal bytes of the **base key**
8. It directly uses the **master key** and has no built-in provision to update the keys

How to Break WEP Encryption

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Start the wireless interface in monitor mode on the specific access point channel

Test the injection capability of the wireless device to the access point

Use a tool such as aireplay-ng to do a fake authentication with the access point

Start Wi-Fi sniffing tool such as airodump-ng or Cain & Abel with a bssid filter to collect unique IVs

Start a Wi-Fi packet encryption tool such as aireplay-ng in ARP request replay mode to inject packets

Run a cracking tool such as Cain & Abel or aircrack-ng to extract encryption key from the IVs

How to Break WPA Encryption

01 WPA PSK

- WPA PSK uses a **user defined password** to initialize the TKIP, which is not crackable as it is a per-packet key but the keys can be brute-forced using dictionary attacks

02 Offline Attack

- You only have to be near the AP for a matter of seconds in order to capture the **WPA/WPA2 authentication handshake**, by capturing the right type of packets, you can **crack WPA keys offline**

03 De-authentication Attack

- Force the connected client to disconnect, then capture the re-connect and authentication packet using tools such as aireplay, you should be able to re-authenticate in a few seconds then **attempt to Dictionary Brute Force** the PMK

04 Brute-Force WPA Keys

- You can use tools such as **aircrack**, **aireplay**, **KisMac** to brute-force WPA Keys

How to Defend Against WPA Cracking

Passphrases

- The only way to crack WPA is to sniff the **password PMK** associated with the "handshake" authentication process, and if this password is extremely complicated, it will be **almost impossible to crack**

Passphrase Complexity

- Select a **random passphrase** that is not made up of dictionary words
- Select a complex passphrase of a **minimum of 20 characters** in length and change it at regular intervals

Client Settings

- Use WPA2 with **AES/CCMP encryption** only
- Properly set the client settings (e.g. validate the server, specify **server address**, don't prompt for new servers, etc.)

Additional Controls

- Use **virtual-private-network** (VPN) technology such as Remote Access VPN, Extranet VPN, Intranet VPN, etc.
- Implement a **Network Access Control** (NAC) or **Network Access Protection** (NAP) solution for additional control over end-user connectivity

Module Flow

Wireless Concepts

Wireless Encryption

Wireless Threats

Wireless Hacking Methodology

Wireless Hacking Tools

Bluetooth Hacking

Countermeasures

Wireless Security Tools

Wi-Fi Pen Testing

Wireless Threats: Access Control Attacks

Wireless access control attacks aims to penetrate a network by **evading WLAN access control measures**, such as AP MAC filters and Wi-Fi port access controls

1. War Driving
2. Rogue Access Points
3. MAC Spoofing
4. AP Misconfiguration
5. Ad Hoc Associations
6. Promiscuous Client
7. Client Mis-association
8. Unauthorized Association

Wireless Threats: Integrity Attacks

In integrity attacks, attackers **send forged control, management or data frames over a wireless network** to misdirect the wireless devices in order to perform another type of attack (e.g., DoS)

1. Data Frame Injection
2. WEP Injection
3. Bit-Flipping Attacks
4. Extensible AP Replay
5. Data Replay
6. Initialization Vector Replay Attacks
7. RADIUS Replay
8. Wireless Network Viruses

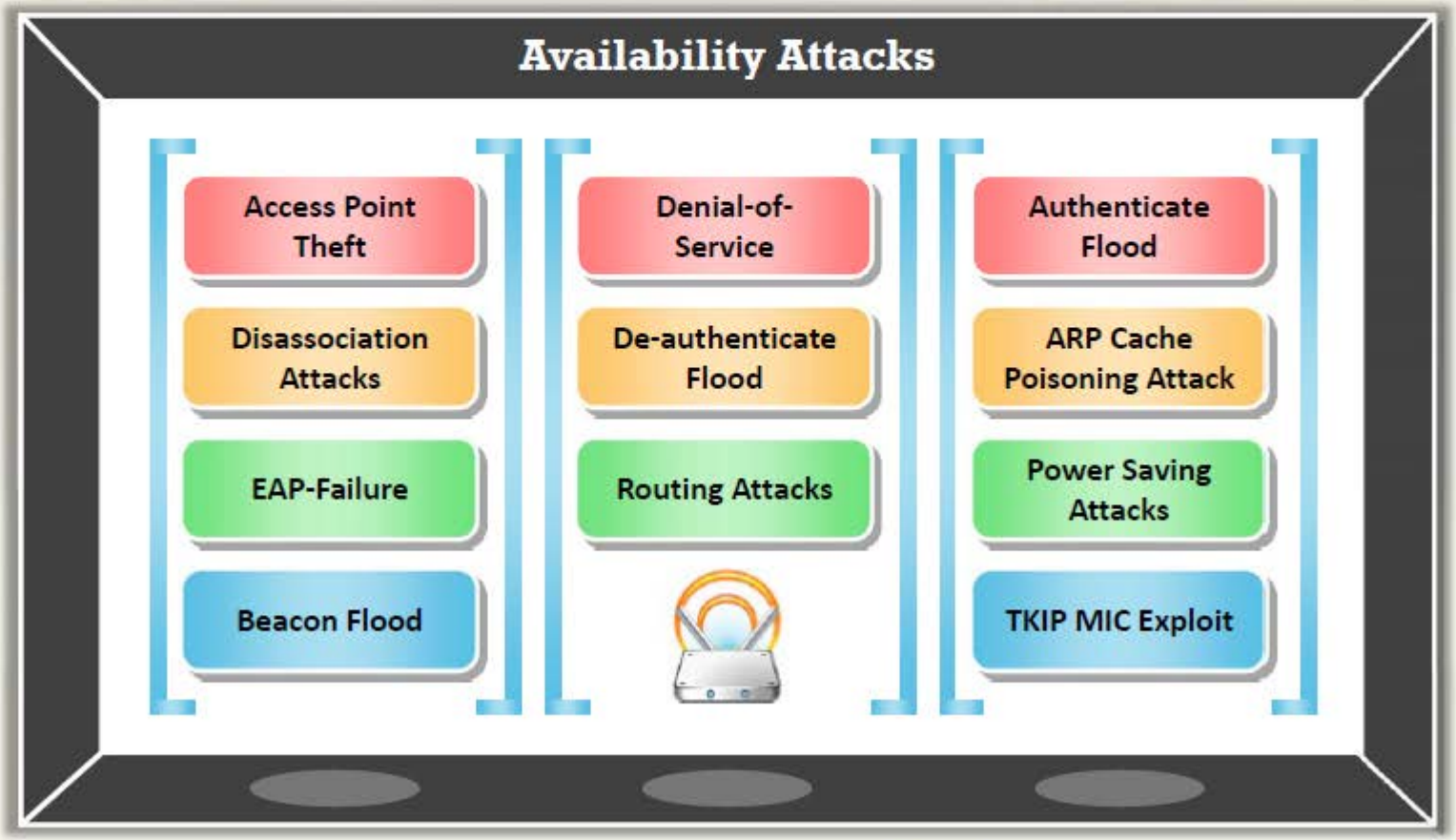
Wireless Threats: Confidentiality Attacks

These attacks attempt to **intercept confidential information sent over wireless associations**, whether sent in the clear text or encrypted by Wi-Fi protocols

- Eavesdropping
- Traffic Analysis
- Cracking WEP Key
- Evil Twin AP
- Honeypot Access Point
- Session Hijacking
- Masquerading
- Man-in-the-Middle Attack

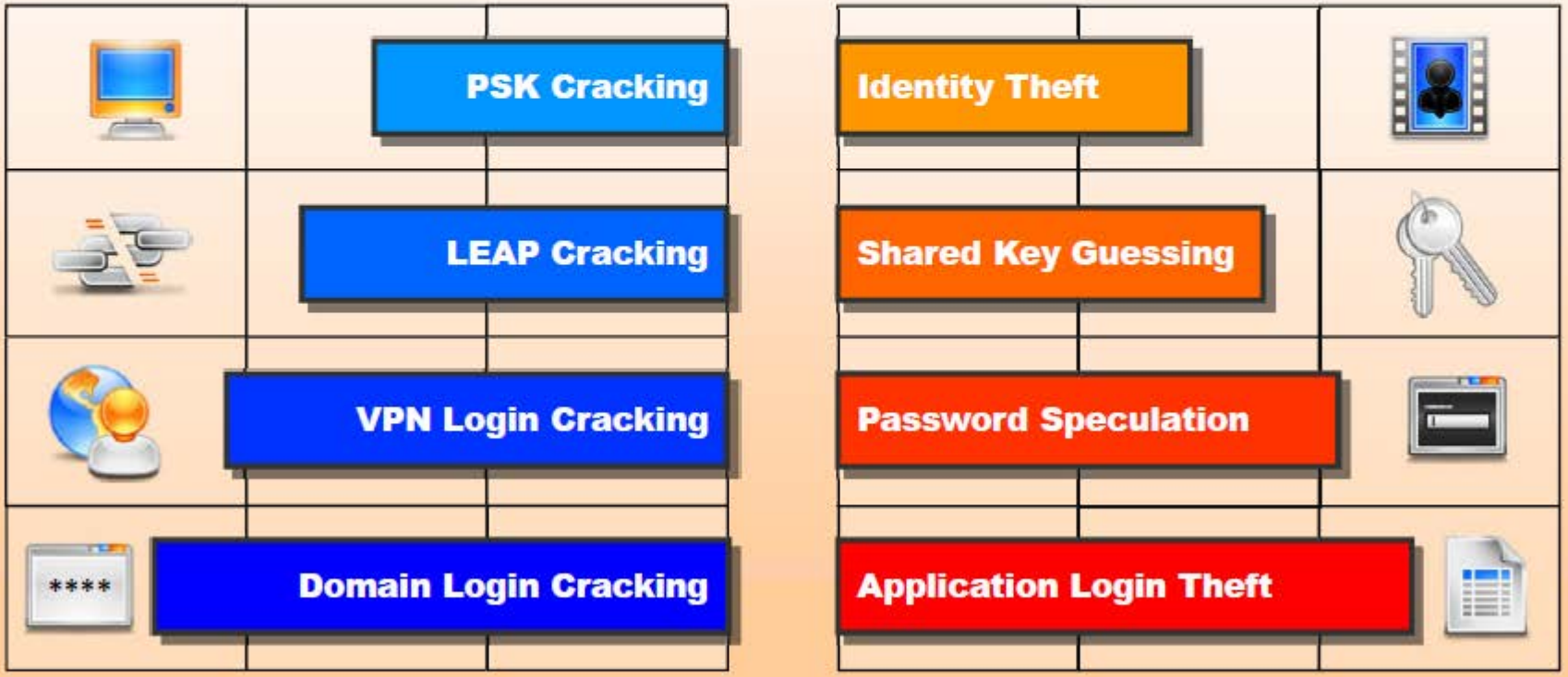
Wireless Threats: Availability Attacks

Denial-of-Service attacks aim to prevent **legitimate users from accessing resources** in a wireless network



Wireless Threats: Authentication Attacks

The objective of authentication attacks is to steal the identity of Wi-Fi clients, their personal information, login credentials, etc. to gain unauthorized access to network resources



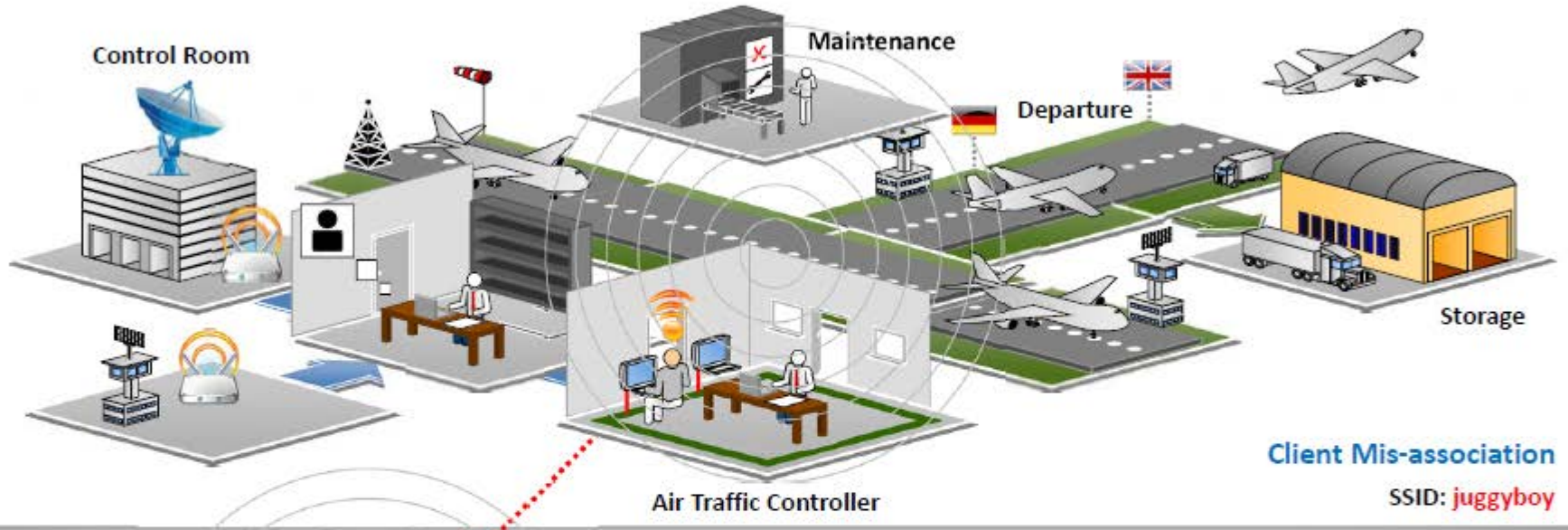
Rogue Access Point Attack

1. Rogue wireless access point placed into an 802.11 network can be used to **hijack the connections** of legitimate network users

2. When the user turns on the computer, the rogue wireless access point will offer to connect with the **network user's NIC**

3. All the traffic the user enters will pass through the rogue access point, thus enabling a form of **wireless packet sniffing**

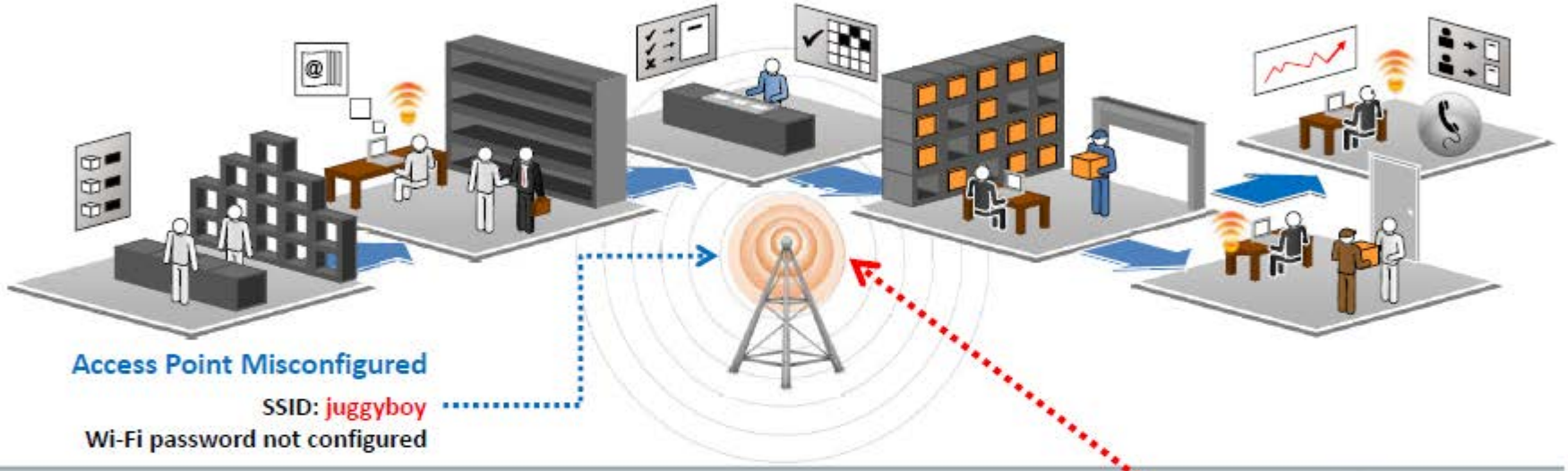
Client Mis-association



- Attacker sets up a **rogue access point outside the corporate perimeter** and lures the employees of the organization to connect with it

- Once associated, employees may **bypass** the enterprise security policies

Misconfigured Access Point Attack



SSID Broadcast

Access points are configured to **broadcast SSIDs** to authorized users

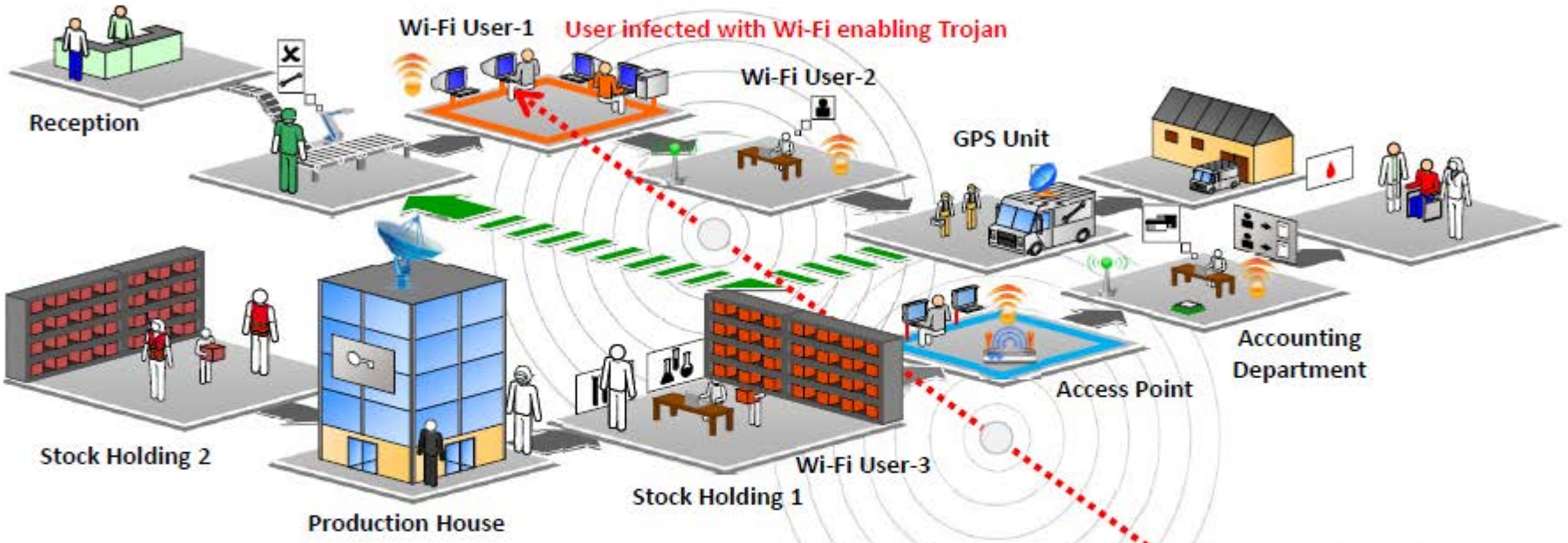
Weak Password

To verify authorized users, network administrators **incorrectly use the SSIDs as passwords**

Configuration Error

SSID broadcasting is a configuration error that assists intruders to **steal an SSID** and have the AP assume they are allowed to connect

Unauthorized Association



01

Soft access points are client cards or embedded WLAN radios in some PDAs and laptops that can be launched **inadvertently or through a virus program**

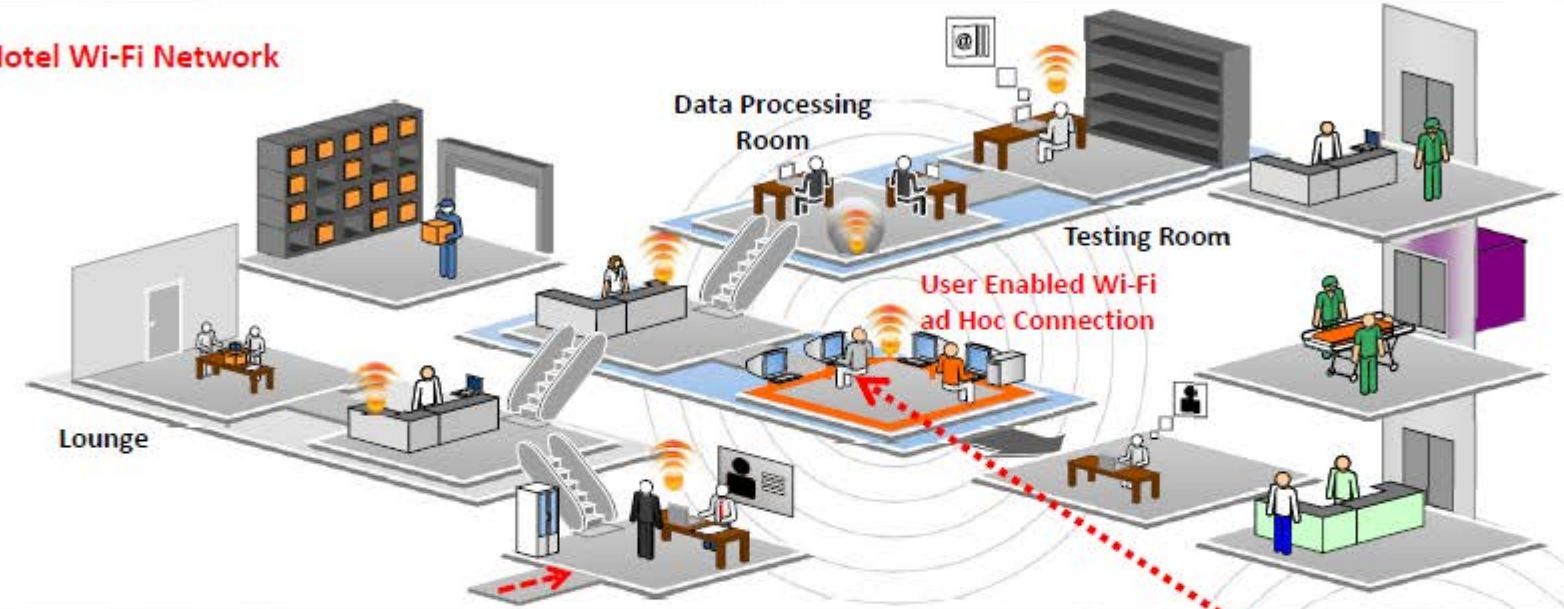
02

Attackers infect victim's machine and activate soft APs allowing them **unauthorized connection** to the enterprise network

03

Attacker connect to enterprise network through **soft APs** instead of the actual Access Points

Ad Hoc Connection Attack

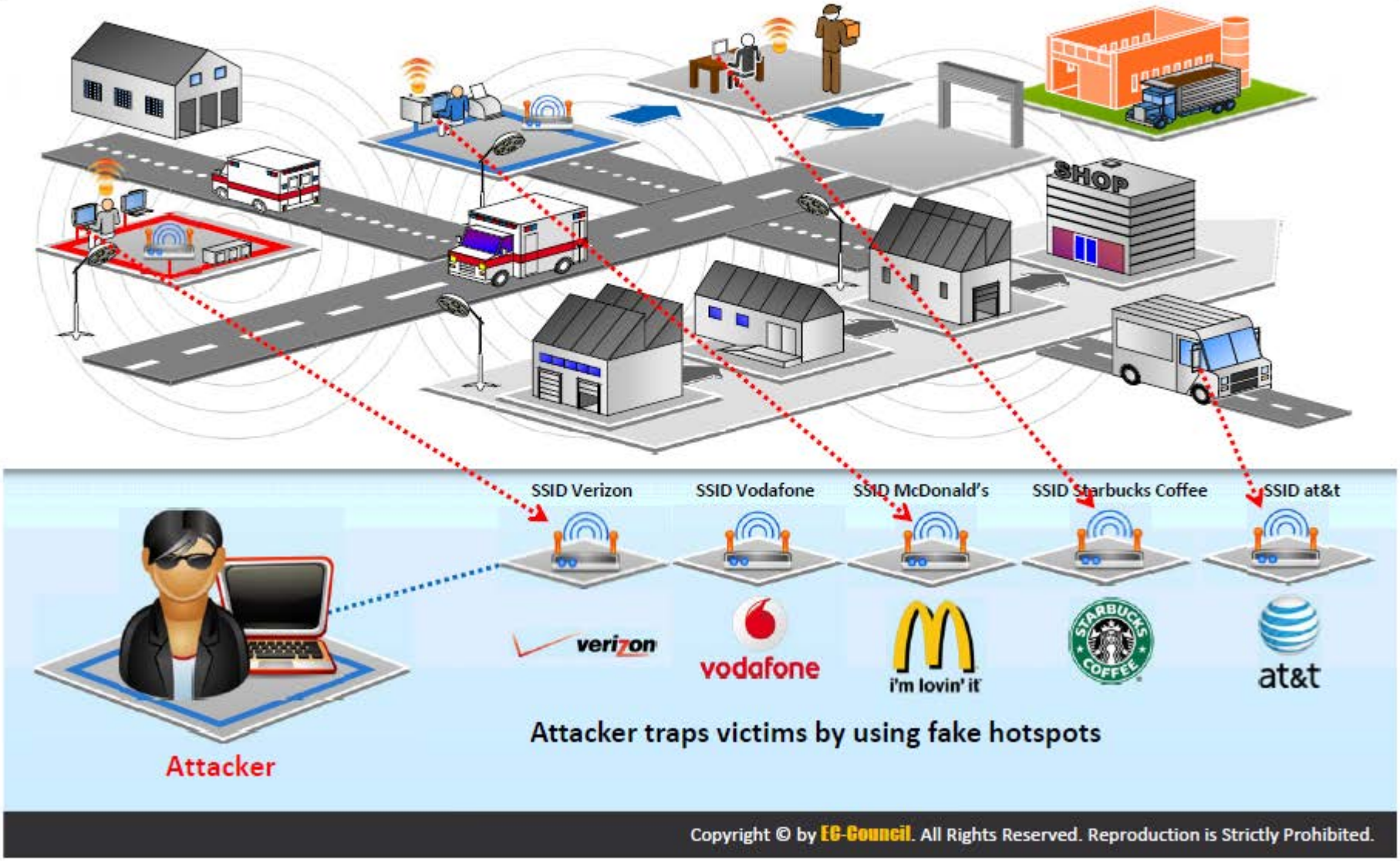


1. Wi–Fi clients communicate directly via **an ad hoc mode** that do not require an AP to relay packets

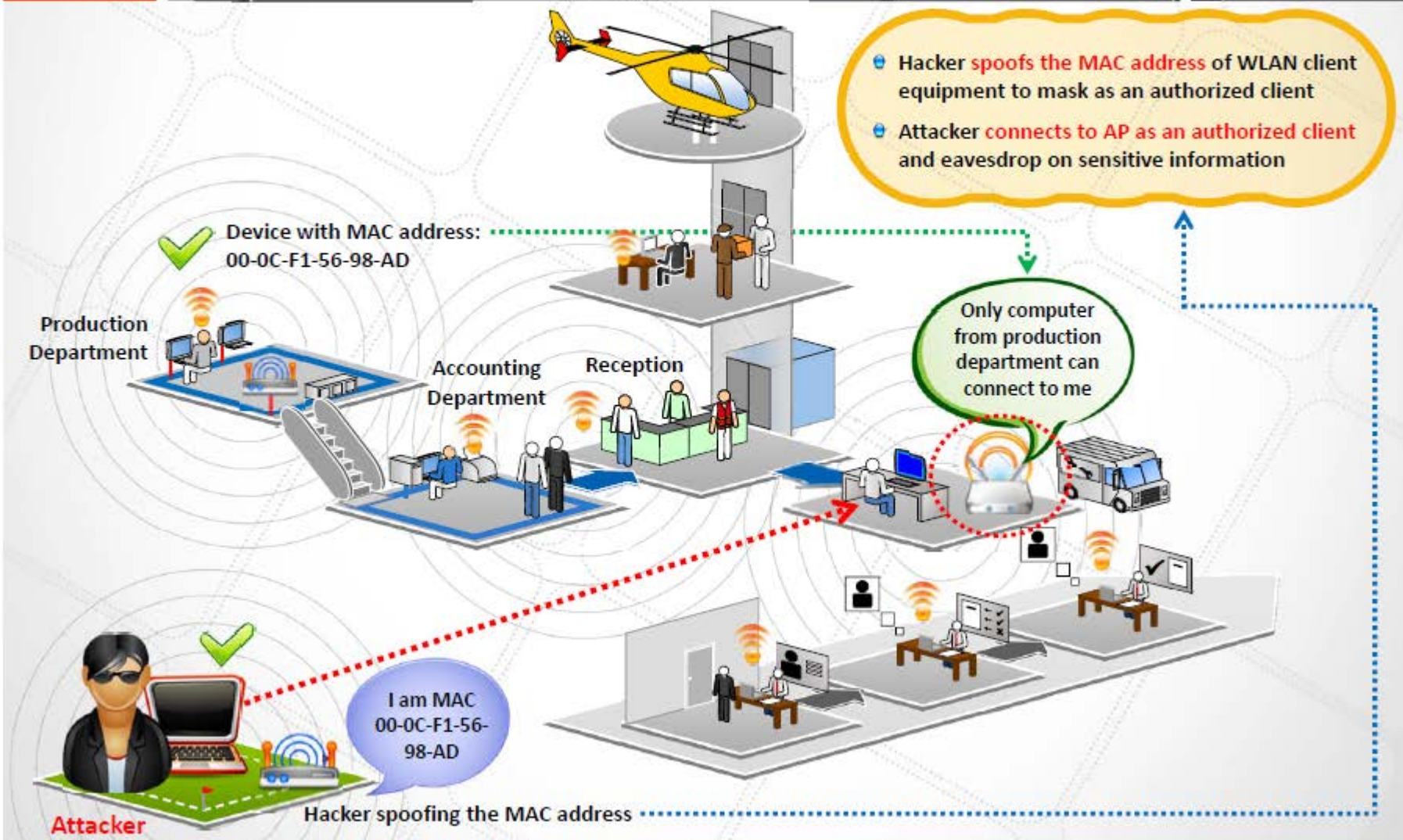
2. Ad hoc mode is inherently insecure and does not **provide strong authentication and encryption**

3. Thus attackers can easily connect to and **compromise the enterprise client operating** in ad hoc mode

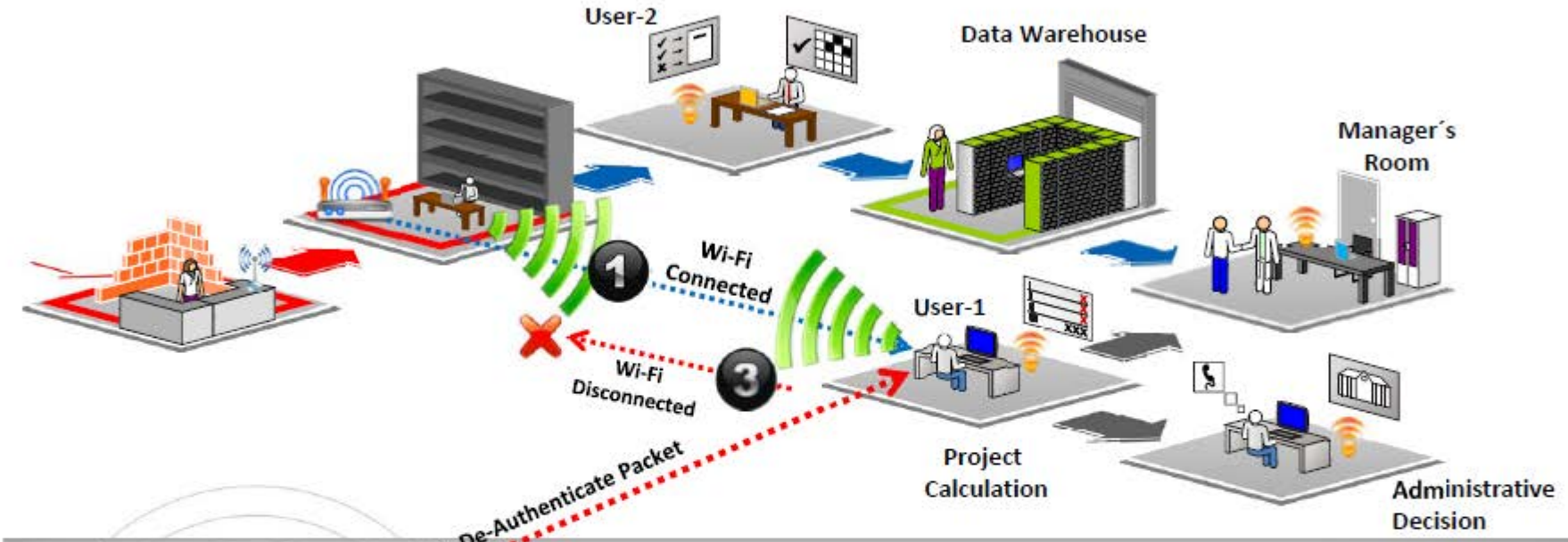
HoneySpot Access Point Attack



AP MAC Spoofing



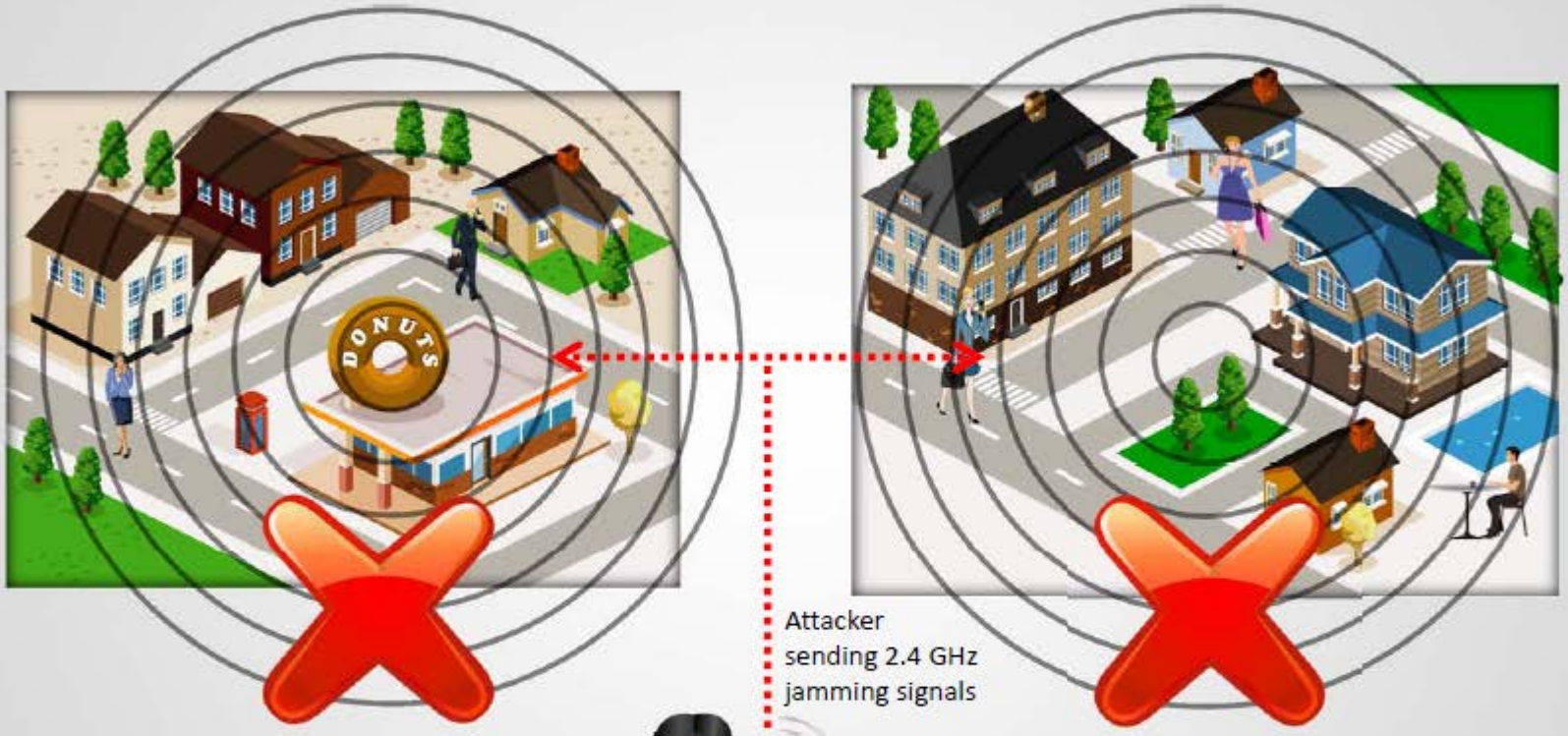
Denial-of-Service Attack



01 Wireless DoS attacks **disrupt network wireless connections** by sending broadcast "de–authenticate" commands

02 Transmitted deauthentication forces the clients to **disconnect from the AP**

Jamming Signal Attack



- An attacker stakes out the area from a nearby location with a high gain amplifier drowning out the legitimate access point
- Users simply can't get through to log in or they are knocked off their connections by the overpowering nearby signal

- All wireless networks are prone to jamming,
- This jamming signal causes a DoS because 802.11 is a CSMA/CA protocol, whose collision avoidance algorithms require a period of silence before a radio is allowed to transmit

Wi-Fi Jamming Devices

C|EH Certified Ethical Hacker

MGT- P6 GPS Jammer

Range : 10 ~ 20 meters
4 antennas
3G: 2110 ~ 2170MHz
Wi-Fi / Bluetooth: 2400 ~ 2485MHz

MGT- MP200 Jammer

Range: 50 - 75m
Barrage + DDS sweep jamming
20 to 2500 MHz.
Omni-directional antennas

MGT- 03 Jammer

Range : 0 ~ 40 meters
4 antennas
Jammed:
- CDMA: 869 ~ 894 MHz
- GSM: 925 ~ 960 MHz
- DCS: 1805 1880 MHz
- 3G: 2110 ~ 2170 MHz

MGT- P6 Wi-Fi Jammer

Range : 10 ~ 20 meters
iDen - CDMA - GSM: 850 ~ 960MHz
DCS - PCS: 1805 ~ 1990MHz
3G: 2110 ~ 2170MHz
Wi-Fi / Bluetooth: 2400 ~ 2485MHz
4 antennas

MGT- P3x13 Jammer

Range : 50 ~ 200 meters
3 frequency bands jammed:
- GSM: 925 ~ 960 Mhz
- DCS: 1805 ~ 1880 Mhz
- 3G: 2110 ~ 2170 Mhz

MGT- 04 WiFi Jammer

Range : 0 ~ 80 meters
4 Frequency bands jammed:
- GSM: 925 ~ 960 Mhz
- DCS: 1805 ~ 1880 Mhz
- 3G: 2110 ~ 2170 Mhz
- WiFi / Bluetooth: 2400 ~ 2485 MHz
4 antennas

http://www.magnumtelecom.com

Module Flow

Wireless Concepts

Wireless Encryption

Wireless Threats

Wireless Hacking Methodology

Wireless Hacking Tools

Bluetooth Hacking

Countermeasures

Wireless Security Tools

Wi-Fi Pen Testing

Wireless Hacking Methodology

The objective of the wireless hacking methodology is to compromise a Wi-Fi network in order to gain unauthorized access to network resources

1. Wi-Fi Discovery
2. GPS Mapping
3. Wireless Traffic Analysis
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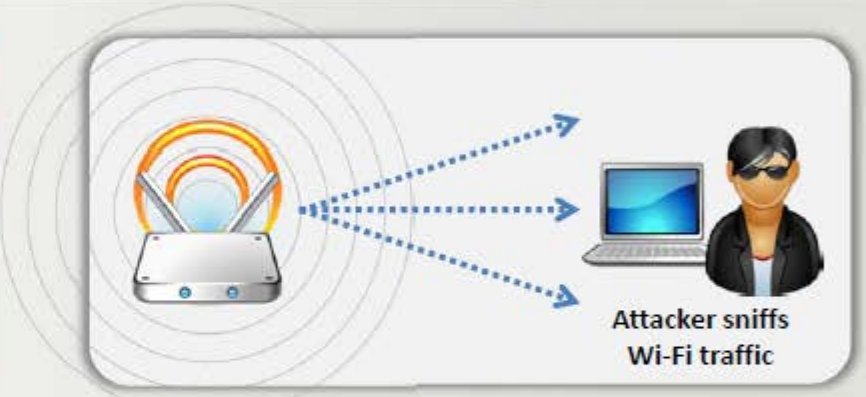
6. Compromise the Wi-Fi Network

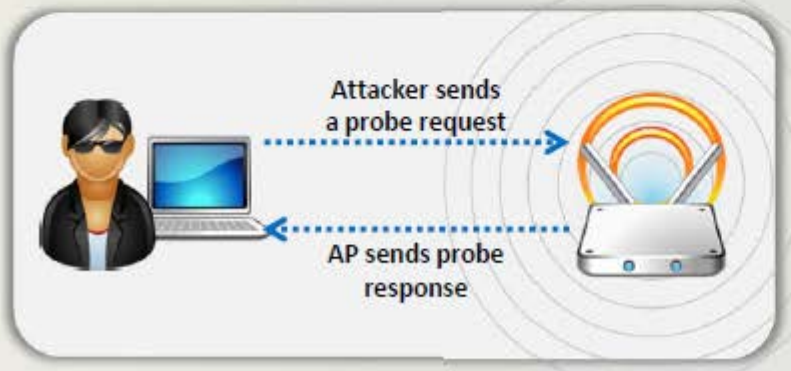
Footprint the Wireless Network

Attacking a wireless network begins with **discovering** and **footprinting** the wireless network in an active or passive way

Passive Footprinting Method

An attacker can use the passive way to **detect the existence of an AP** by sniffing the packets from the airwaves, which will reveal the AP, SSID and attacker's wireless devices that are live





Active Footprinting Method

In this method, attacker's wireless device **sends out a probe request with the SSID** to see if an AP responds. If the wireless device does not have the SSID in the beginning, it will send the probe request with an empty SSID

Find Wi-Fi Networks to Attack

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Steps

1. The first task an attacker will go through when searching for Wi-Fi targets is **checking the potential networks** that are in range to find the best one to attack
2. Drive around with **Wi-Fi enabled laptop** installed with a wireless discovery tool and map out active wireless networks

You will need these to discover Wi-Fi networks

- **Laptop with Wi-Fi Card**
- **External Wi-Fi Antenna**
- **Network Discovery Programs**

Tools Used: inSSIDer, NetSurveyor, NetStumbler, Vistumbler, etc.

Wi-Fi Discovery Tools: inSSIDer and NetSurveyor

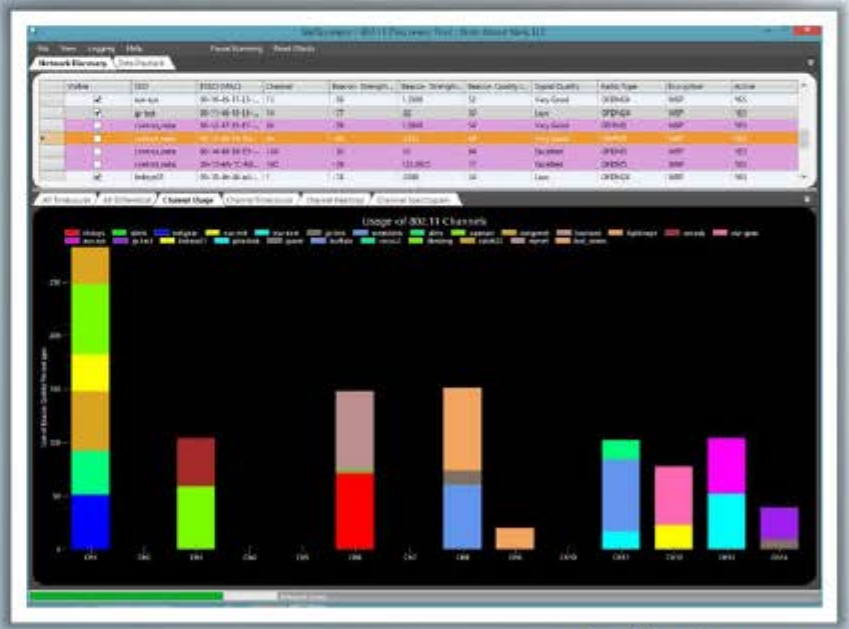
inSSIDer

- **Inspect WLAN** and surrounding networks to troubleshoot competing access points
- **Track the strength of received signal** in dBm over time and filter access points in an easy-to-use format

NetSurveyor

- NetSurveyor is a network discovery tool used to gather information about nearby **wireless access points in real time** and displays it in useful ways

http://www.inssider.com

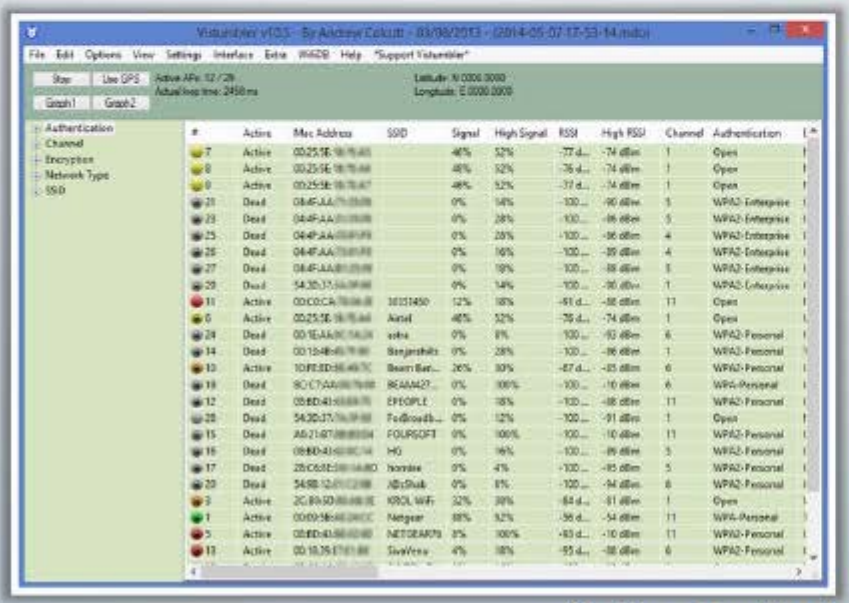


http://nutsaboutnets.com

Wi-Fi Discovery Tools: Vistumbler and NetStumbler

Vistumbler

- Finds **wireless access points**
- Uses the **Vista command** 'netsh wlan show networks mode=bssid' to get wireless information
- It supports for **GPS** and **live Google Earth tracking**



http://www.vistumbler.net

NetStumbler

- Facilitates detection of Wireless LANs using the **802.11b**, **802.11a**, and **802.11g** WLAN standards
- It is commonly used for **wardriving**, **verifying network configurations**, finding locations with poor coverage in one's WLAN, etc.

http://www.netstumbler.com

Wi-Fi Discovery Tools

WirelessMon
http://www.passmark.com

Kismet
http://www.kismetwireless.net

WiFi Hopper
http://www.wifihopper.com

Wavestumbler
http://www.cqure.net

iStumbler
http://www.istumbler.net

WiFinder
http://www.pgmsoft.com

Wellenreiter
http://wellenreiter.sourceforge.net

AirCheck Wi-Fi Tester
http://www.flukenetworks.com

AirRadar 2
http://www.koingosw.com

Xirrus Wi-Fi Inspector
http://www.xirrus.com

Mobile-based Wi-Fi Discovery Tools

WiFiFoFum - WiFi Scanner

http://www.wififofum.net

Network Signal Info

http://www.kaibits-software.com

WiFi Manager

http://kmansoft.com

OpenSignal Maps

http://opensignal.com

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GPS Mapping

Attackers create map of discovered Wi-Fi networks and **create a database** with statistics collected by Wi-Fi discovery tools such as Netsurveyor, NetStumblers, etc.

- GPS is used to **track the location** of the discovered Wi-Fi networks and the **coordinates are uploaded to sites** like WIGLE
- Attackers can **share this information** with the hacking community or sell it to make money

GPS Mapping Tool: WiGLE

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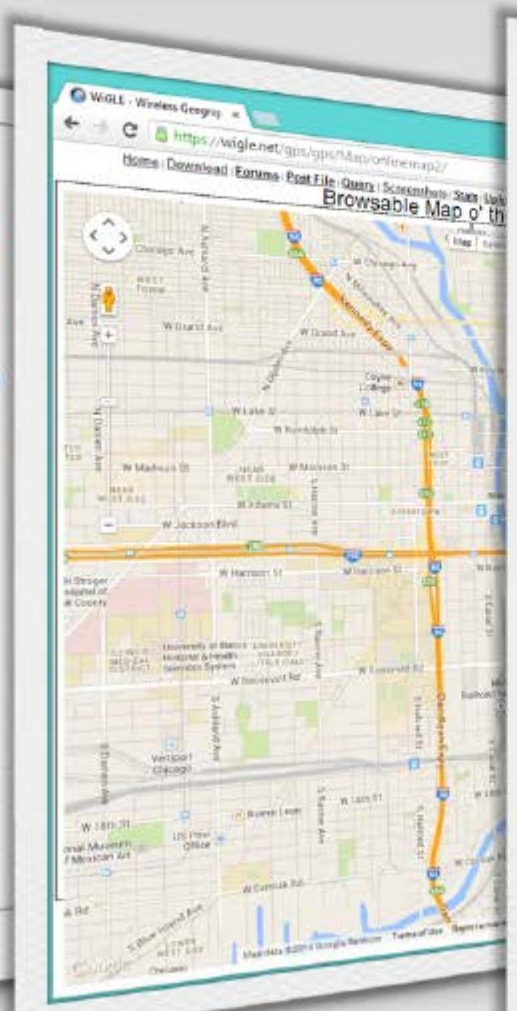
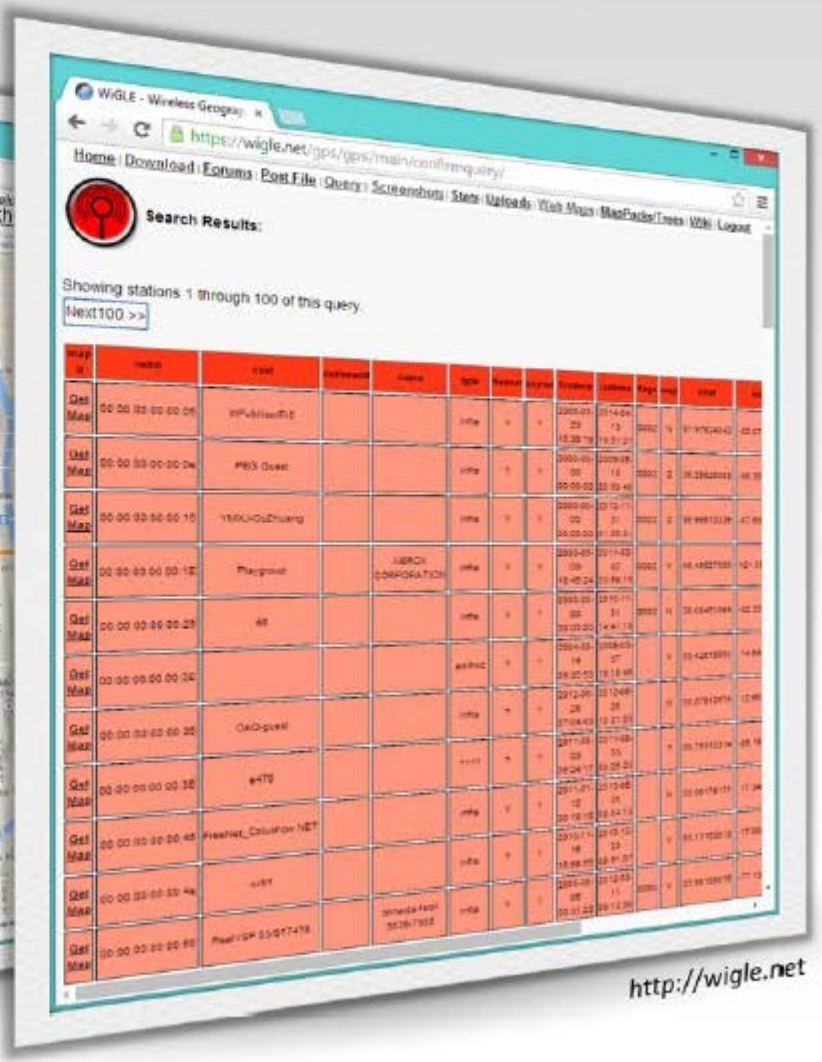
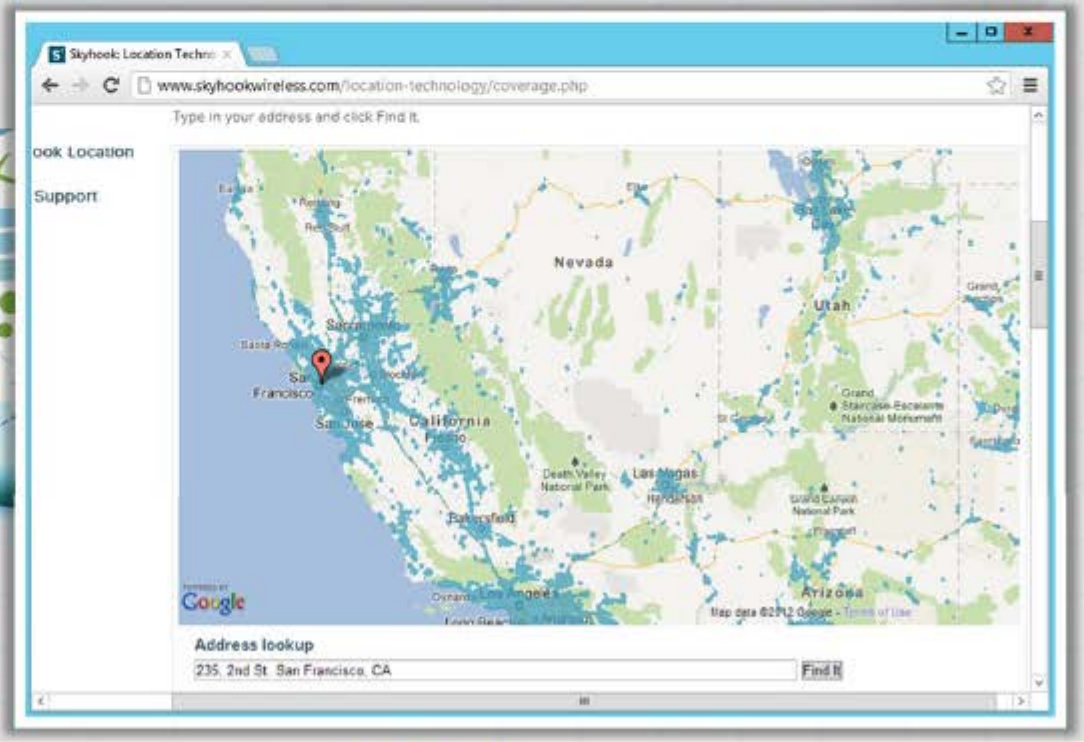
- WiGLE consolidates location and information of wireless networks world-wide to a central database, and provides user-friendly Java, Windows, and web applications that can map, query and update the database via the web
- You can add a wireless network to WiGLE from a stumble file or by hand and add remarks to an existing network





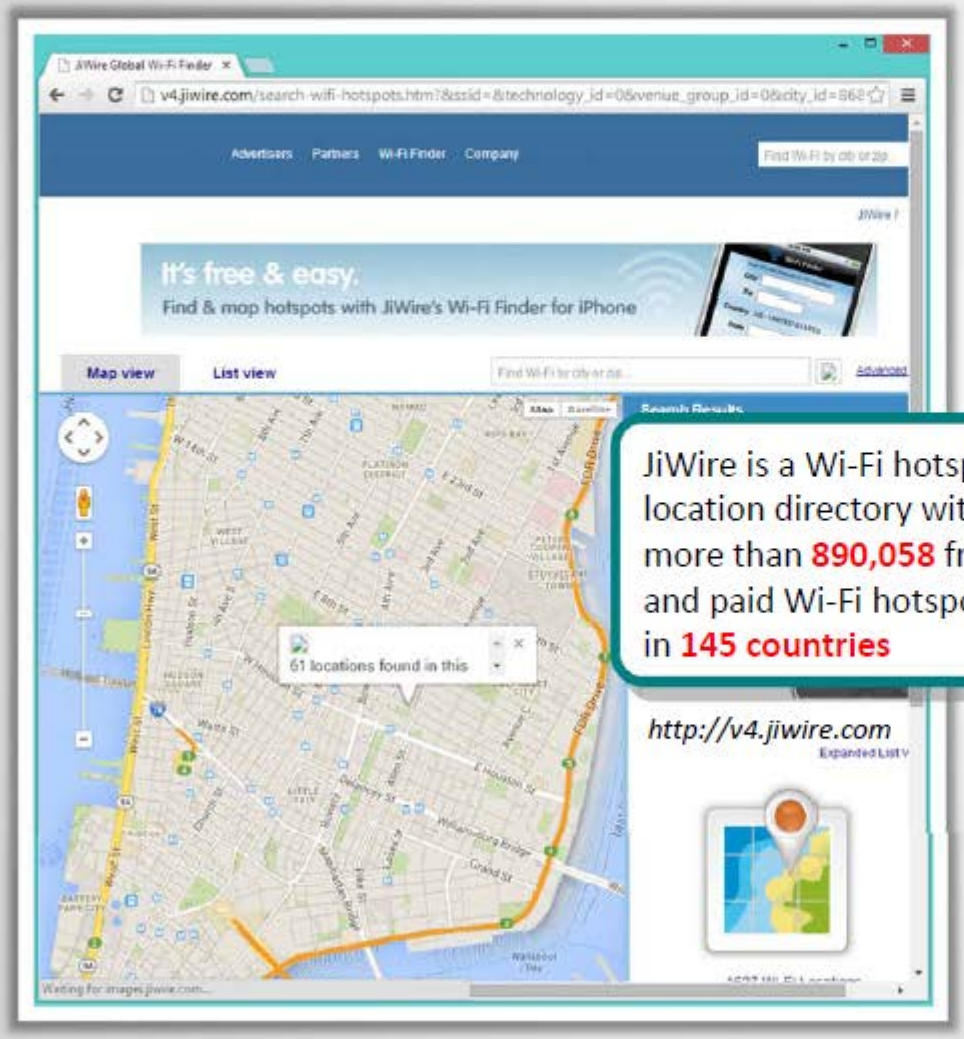
GPS Mapping Tool: Skyhook

- Skyhook's Wi-Fi Positioning System (WPS) **determines location based** on Skyhook's massive worldwide database of known Wi-Fi access points

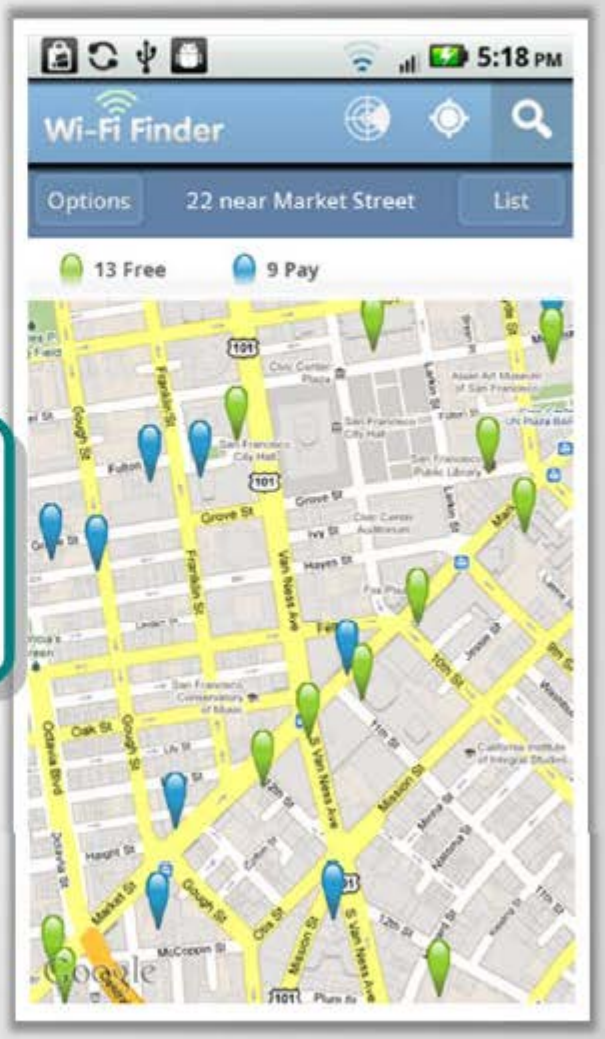


http://www.skyhookwireless.com

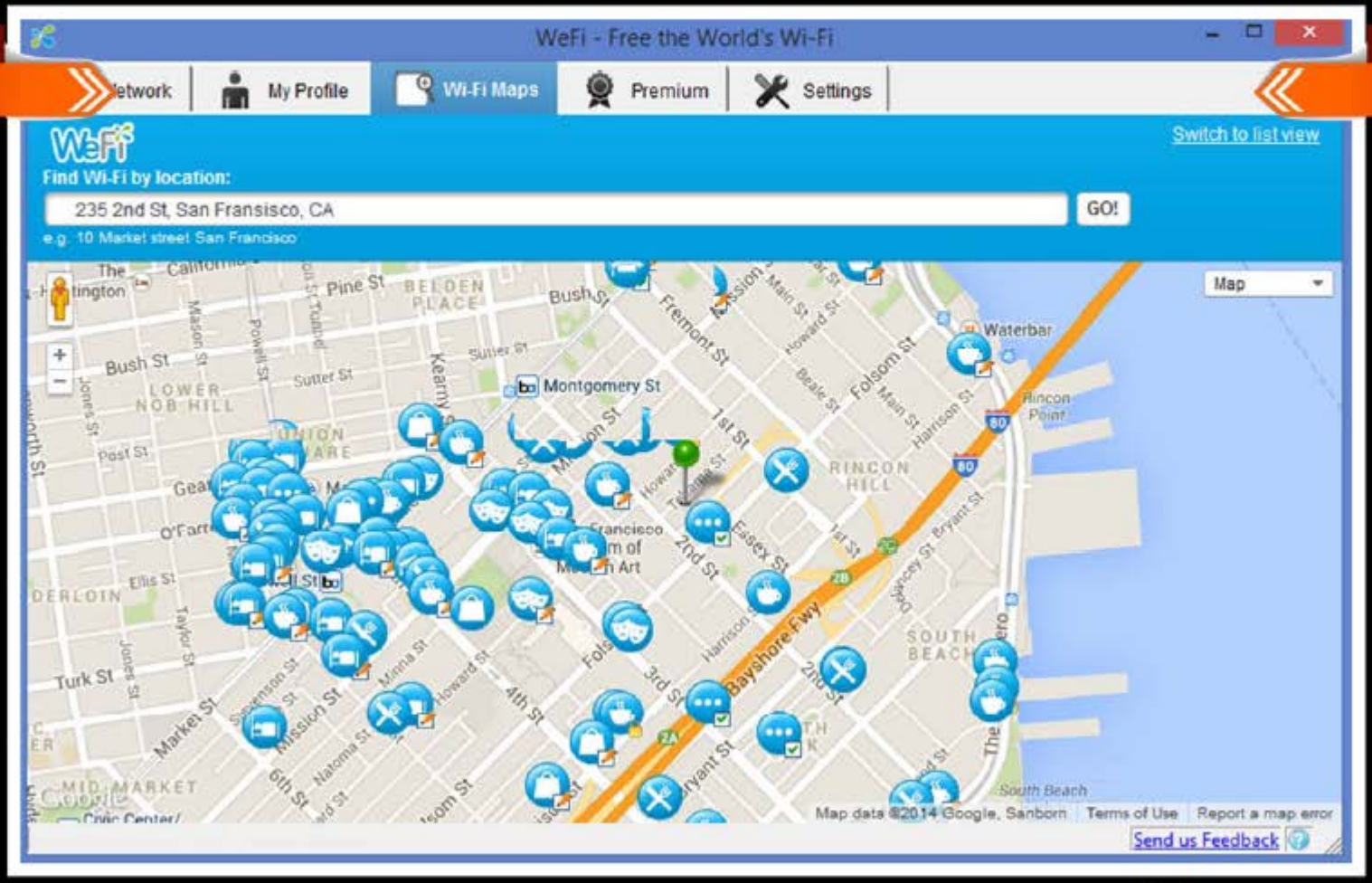
Wi-Fi Hotspot Finder: Wi-Fi Finder



JiWire is a Wi-Fi hotspot location directory with more than **890,058** free and paid Wi-Fi hotspots in **145 countries**



Wi-Fi Hotspot Finder: WeFi



http://www.wefi.com

How to Discover Wi-Fi Network Using Wardriving

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STEP 1 Register with WIGLE and download map packs of your area to view the plotted access points on a geographic map

STEP 2 Connect the antenna, GPS device to the laptop via a USB serial adapter and board on a car

STEP 3 Install and launch NetStumbler and WIGLE client software and turn on the GPS device

STEP 4 Drive the car at speeds of 35 mph or below (At higher speeds, Wi-Fi antenna will not be able to detect Wi-Fi spots)

STEP 5 Capture and save the NetStumbler log files which contains GPS coordinates of the access points

STEP 6 Upload this log file to WIGLE, which will then automatically plot the points onto a map

Wireless Hacking Methodology

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Wireless Traffic Analysis

Identify Vulnerabilities

- Wireless traffic analysis enables attackers to **identify vulnerabilities** and susceptible victims in a target wireless network
- This helps in **determining the appropriate strategy** for a successful attack
- Wi-Fi protocols are unique at Layer 2, and traffic over the air is not serialized which makes easy to **sniff and analyze wireless packets**

Wi-Fi Reconnaissance

Attackers analyze a wireless network to determine:

- Broadcasted **SSID**
- Presence of **multiple access points**
- Possibility of **recovering** SSIDs
- **Authentication method** used
- **WLAN** encryption algorithms

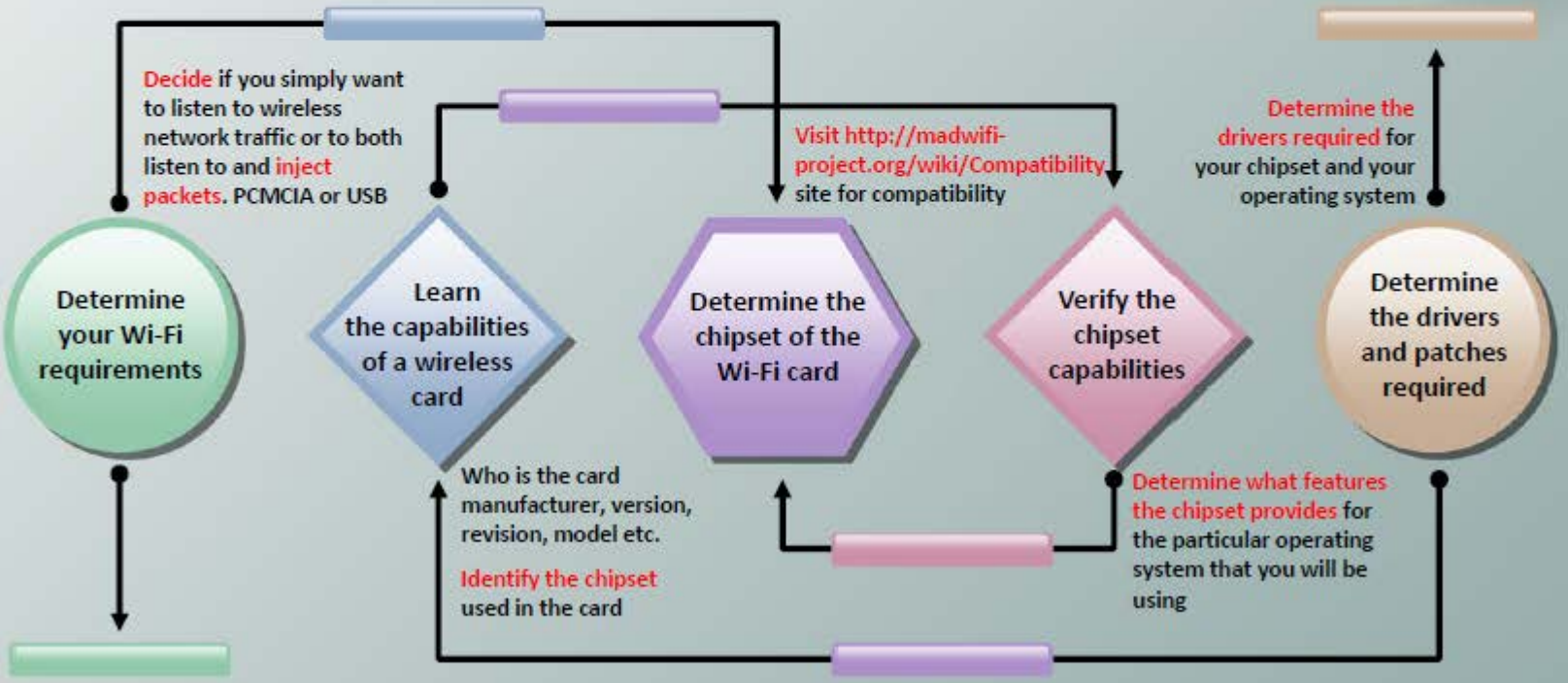
Tools

Wi-Fi packet-capture and **analysis products** come in a number of forms:

- Wireshark/Pilot Tool
- OmniPeek Tool
- CommView Tool
- AirMagnet Wi-Fi Analyzer

Wireless Cards and Chipsets

Choosing the right Wi-Fi card is very important since tools like Aircrack-ng, KisMAC only works with selected wireless chipsets



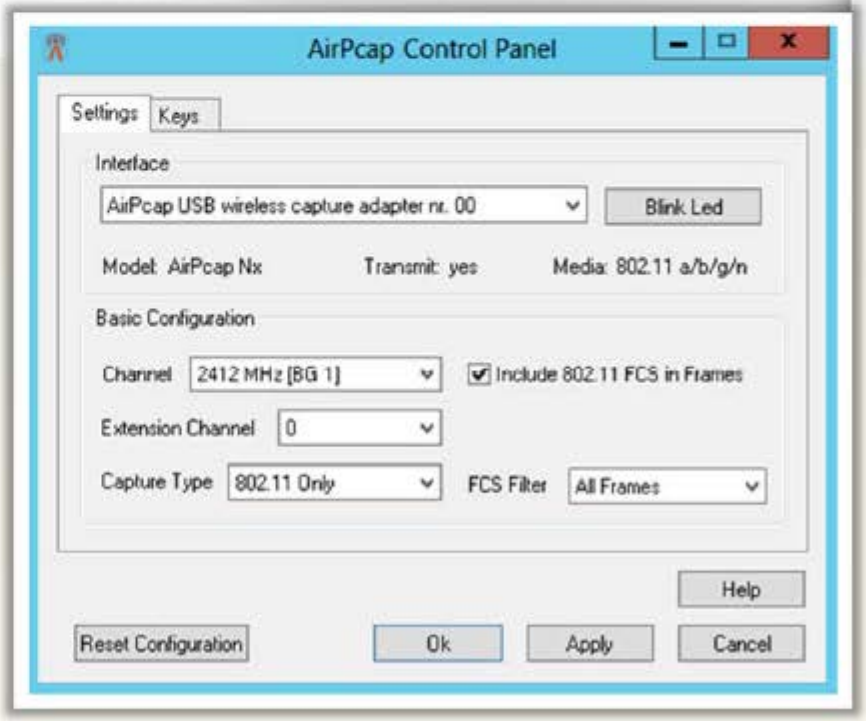
Wi-Fi USB Dongle: AirPcap

- AirPcap adapter **captures full 802.11 data, management, and control frames** that can be viewed in Wireshark for in-depth protocol dissection and analysis
- AirPcap software can be configured **to decrypt WEP/WPA-encrypted frames**

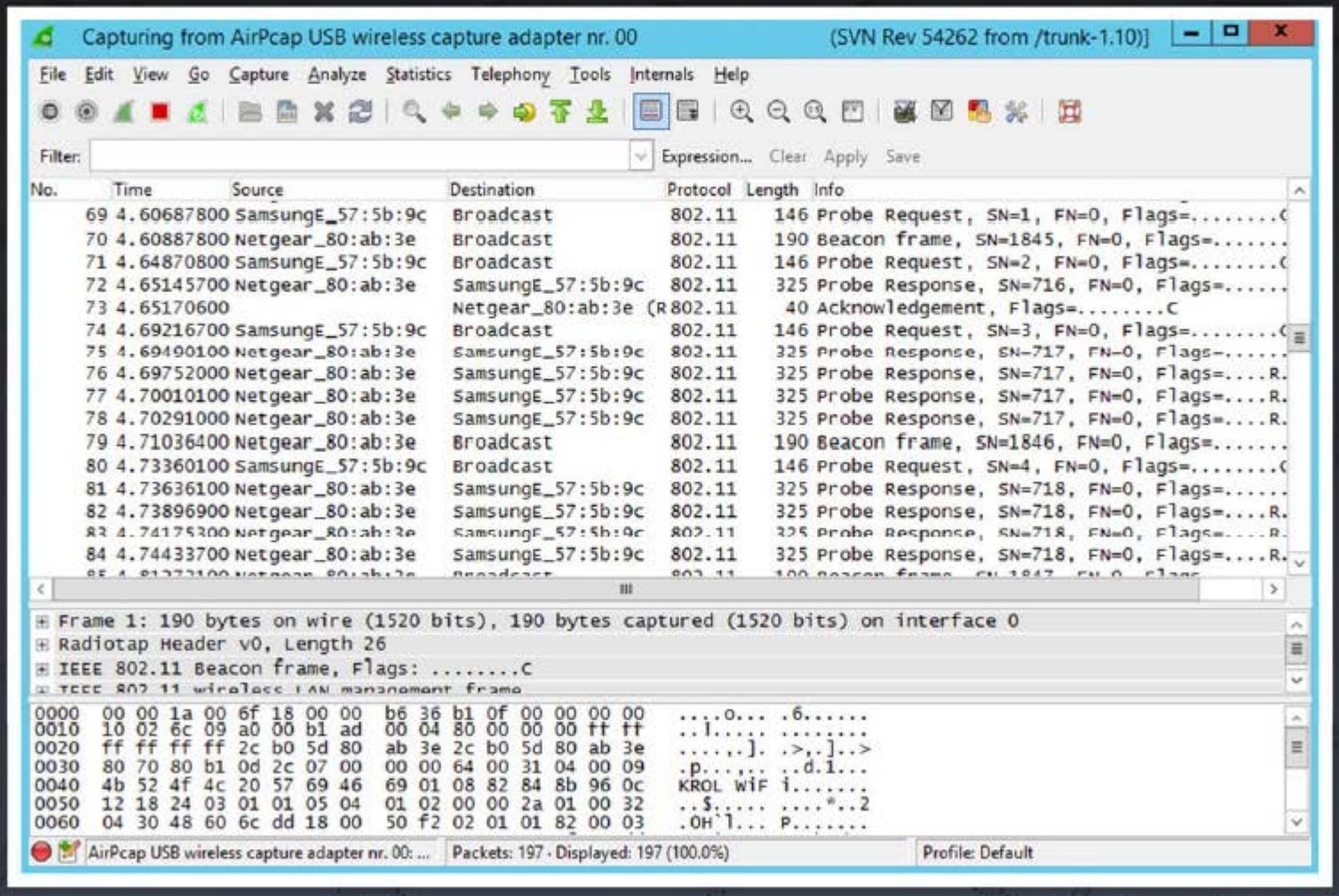
Features

- It **provides capability** for simultaneous multi-channel capture and traffic aggregation
- It can be used for **traffic injection** that help in assessing the security of a wireless network
- AirPcap is supported in **Aircrack-ng**, **Cain & Able**, and **Wireshark** tools
- **AirPcapReplay**, included in the AirPcap Software Distribution, replays 802.11 network traffic that is contained in a trace file

http://www.riverbed.com



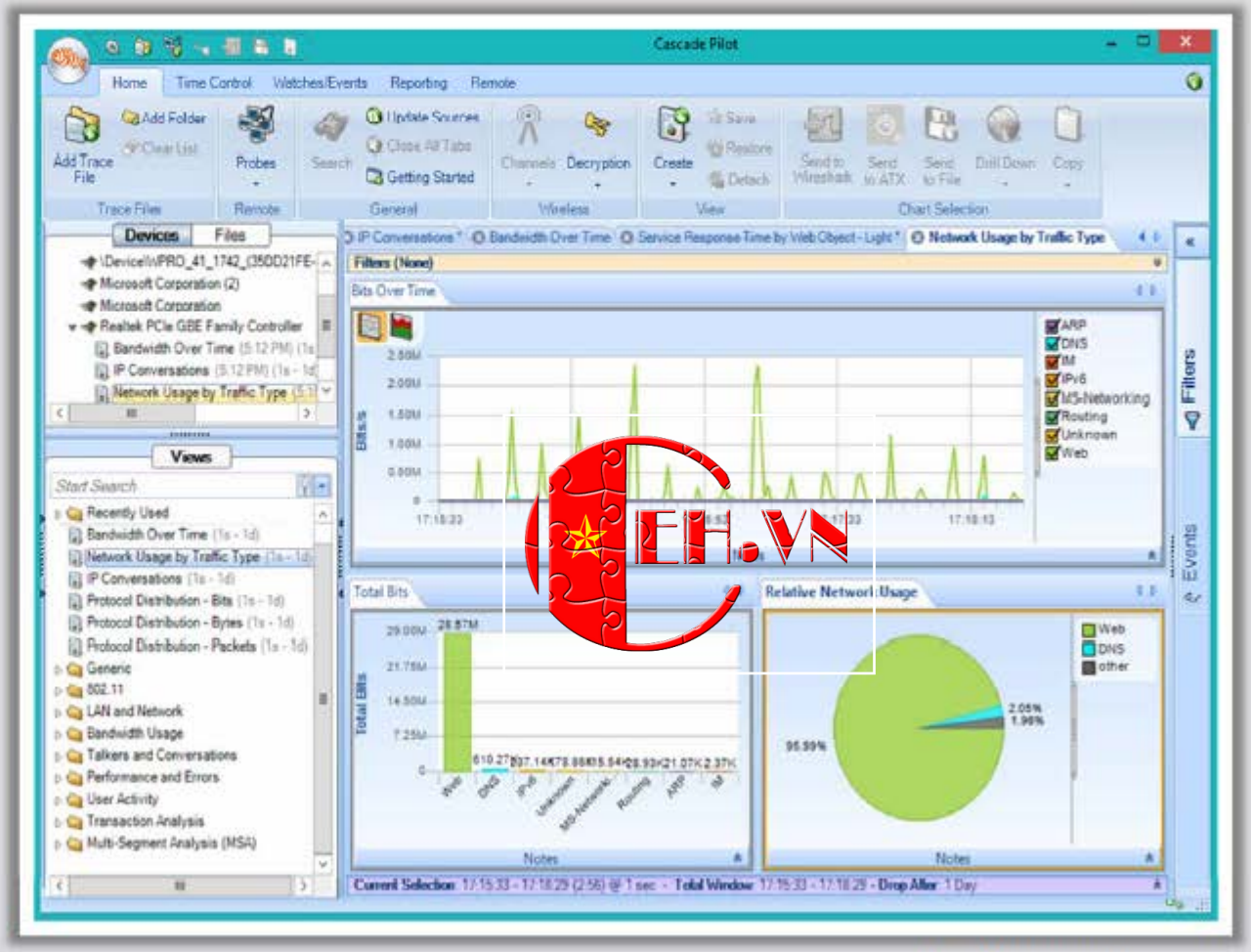
Wi-Fi Packet Sniffer: Wireshark with AirPcap



http://www.wireshark.org

Wi-Fi Packet Sniffer: SteelCentral Packet Analyzer

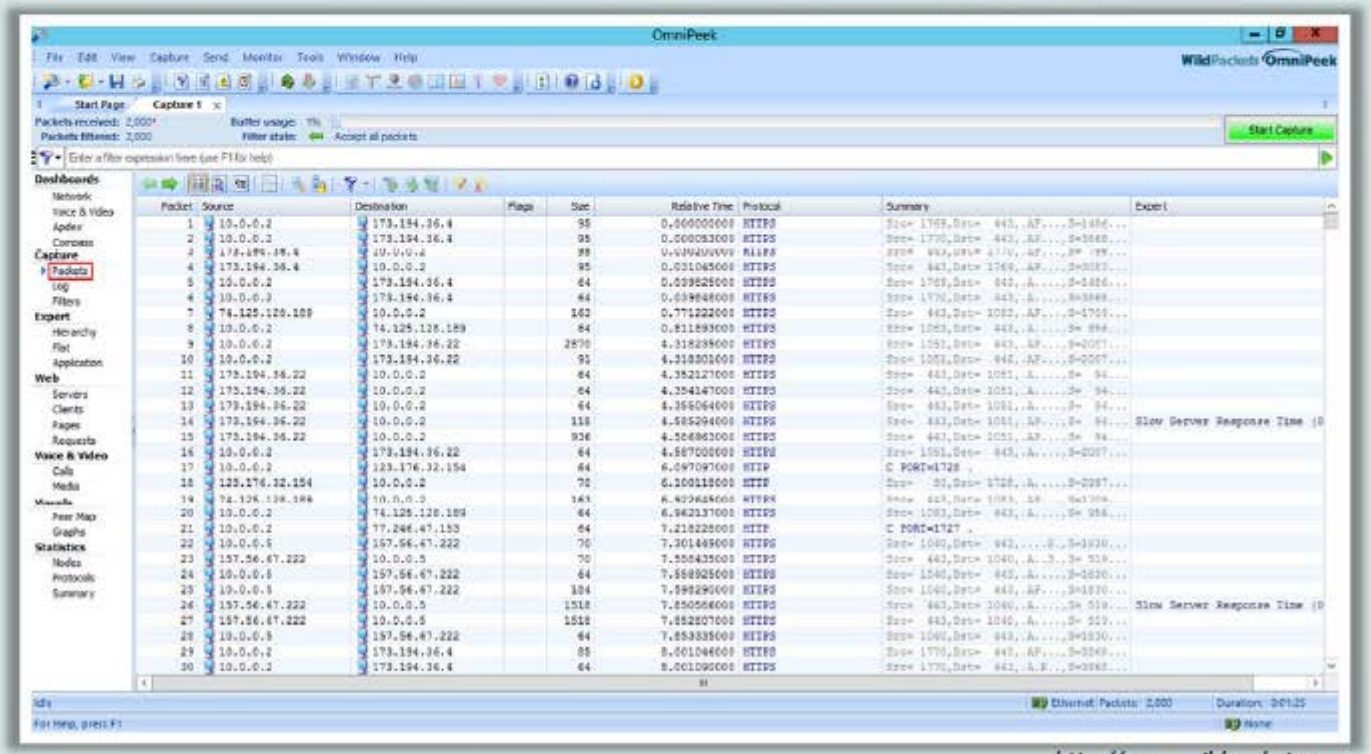
- It measures wireless channel utilization
- It helps in Identifying **rogue wireless networks** and stations
- It isolates specific packets
- It provides an interactive and visually-oriented **user interface**



http://www.riverbed.com

Wi-Fi Packet Sniffer: OmniPeek Network Analyzer

- OmniPeek Network Analyzer offers **real-time visibility and analysis** of the network traffic from a single interface, including Ethernet, 802.11a/b/g/n wireless and VoIP
- It provides a comprehensive view of all **wireless network activity** showing each wireless network, the APs comprising that network, and the users connected to each AP



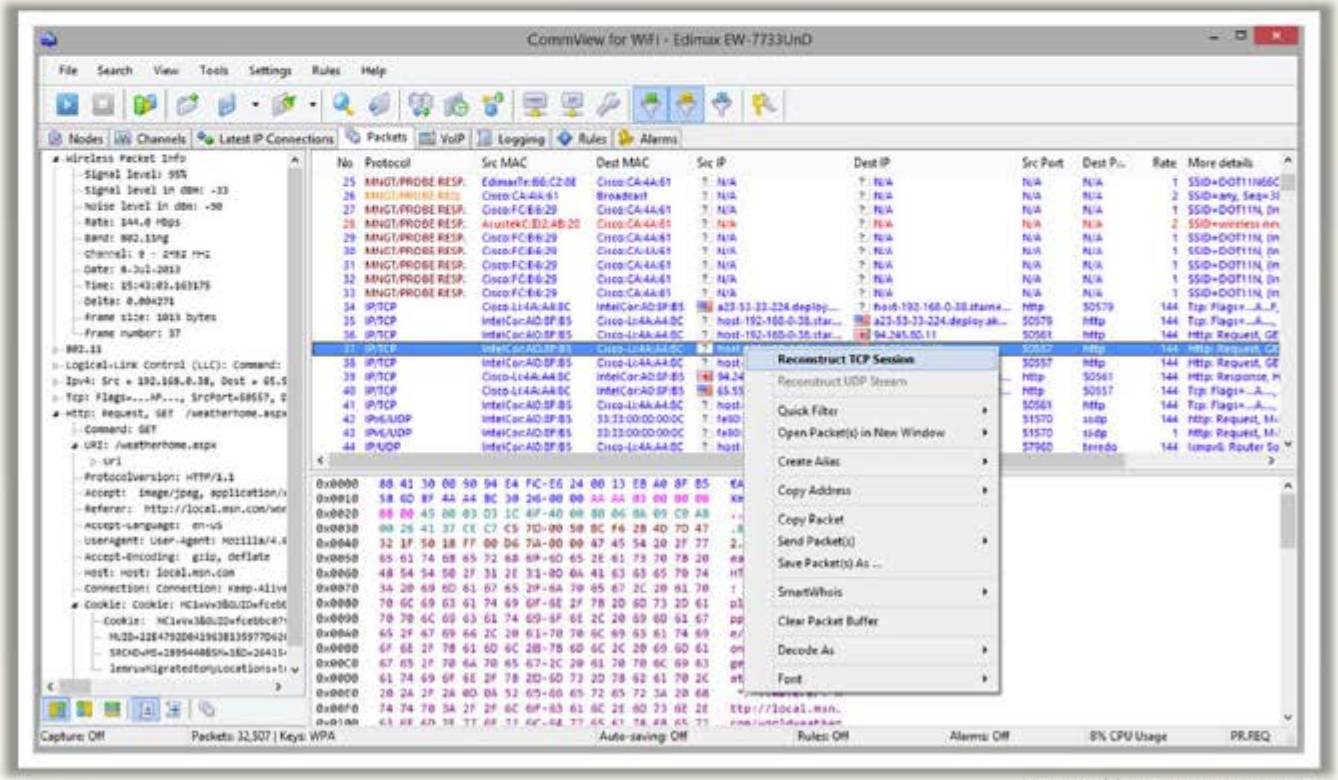
http://www.wildpackets.com

Wi-Fi Packet Sniffer: CommView for Wi-Fi

- CommView for Wi-Fi is designed for **capturing and analyzing network packets** on wireless 802.11a/b/g/n networks

Features

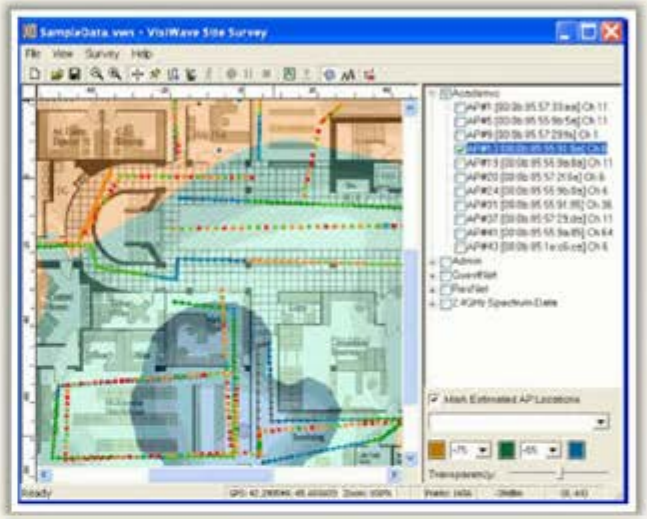
- It **gathers information** from the wireless adapter and decodes the analyzed data
- It can **decrypt packets** utilizing user-defined WEP or WPA-PSK keys and decode them to the lowest layer, with full analysis of the most widespread protocol

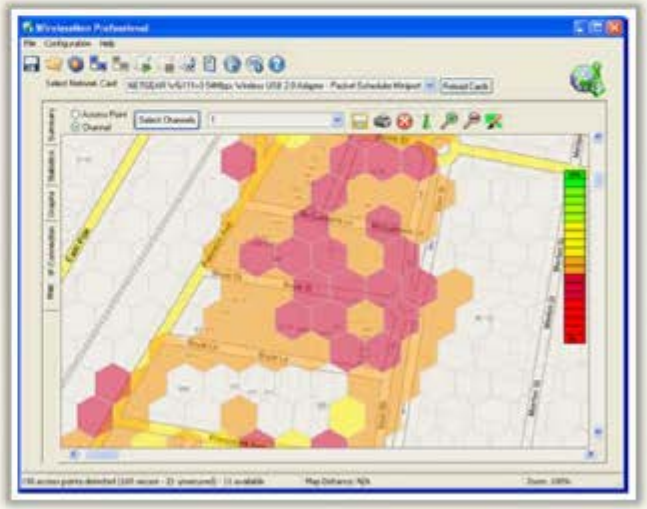


http://www.tamos.com

What is Spectrum Analysis?

- RF spectrum analyzers **examine Wi-Fi radio transmissions** and measure the power (amplitude) of radio signals and RF pulses, and transform these measurements into numeric sequences
- Spectrum analyzers **employ statistical analysis** to plot spectral usage, quantify "air quality," and isolate transmission sources
- RF spectrum analyzers are used by RF technicians to install and maintain wireless networks, and identify **sources of interference**
- Wi-Fi spectrum analysis also helps in **wireless attack detection**, including Denial of Service attacks, authentication/ encryptions attacks, network penetration attacks, etc.
- **Spectrum Analysis Tools**
  - Wi-Spy and Chanalyzer
  - AirMagnet Wi-Fi Analyzer
  - WifiEagle





Wi-Fi Packet Sniffers

Sniffer Portable Professional Analyzer
http://www.netscout.com

Capsa
http://www.colasoft.com

PRTG Network Monitor
http://www.paessler.com

ApSniff
http://www.monolith81.de

NetworkMiner
http://www.netresec.com

Airview
http://airview.sourceforge.net

Observer
http://www.networkinstruments.com

WifiScanner
http://wifiscanner.sourceforge.net

Mognet
http://www.monolith81.de

AirTraf
http://www.elixar.com

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Aircrack-ng Suite

- Aircrack-ng is a **network software suite** consisting of a detector, packet sniffer, WEP and WPA/WPA2-PSK cracker and analysis tool for 802.11 wireless networks. This program runs under Linux and Windows.

http://www.aircrack-ng.org

Airbase-ng
Captures WPA/WPA2 handshake and can act as an ad-hoc Access Point

Aircrack-ng
Defacto WEP and WPA/ WPA2-PSK cracking tool

Airdecap-ng
Decrypt WEP/WPA/ WPA2 and can be used to strip the wireless headers from Wi-Fi packets

Airdecloak-ng
Removes WEP cloaking from a pcap file

Airdriver-ng
Provides status information about the wireless drivers on your system

Airdrop-ng
This program is used for targeted, rule-based deauthentication of users

Aireplay-ng
Used for traffic generation, fake authentication, packet replay, and ARP request injection

Airgraph-ng
Creates client to AP relationship and common probe graph from airodump file

Airodump-ng
Used to capture packets of raw 802.11 frames and collect WEP IVs

Airolib-ng
Store and manage essid and password lists used in WPA/ WPA2 cracking

Airserv-ng
Allows multiple programs to independently use a Wi-Fi card via a client-server TCP connection

Airmon-ng
Used to enable monitor mode on wireless interfaces from managed mode and vice versa

Airtun-ng
Injects frames into a WPA TKIP network with QoS, and can recover MIC key and keystream from Wi-Fi traffic

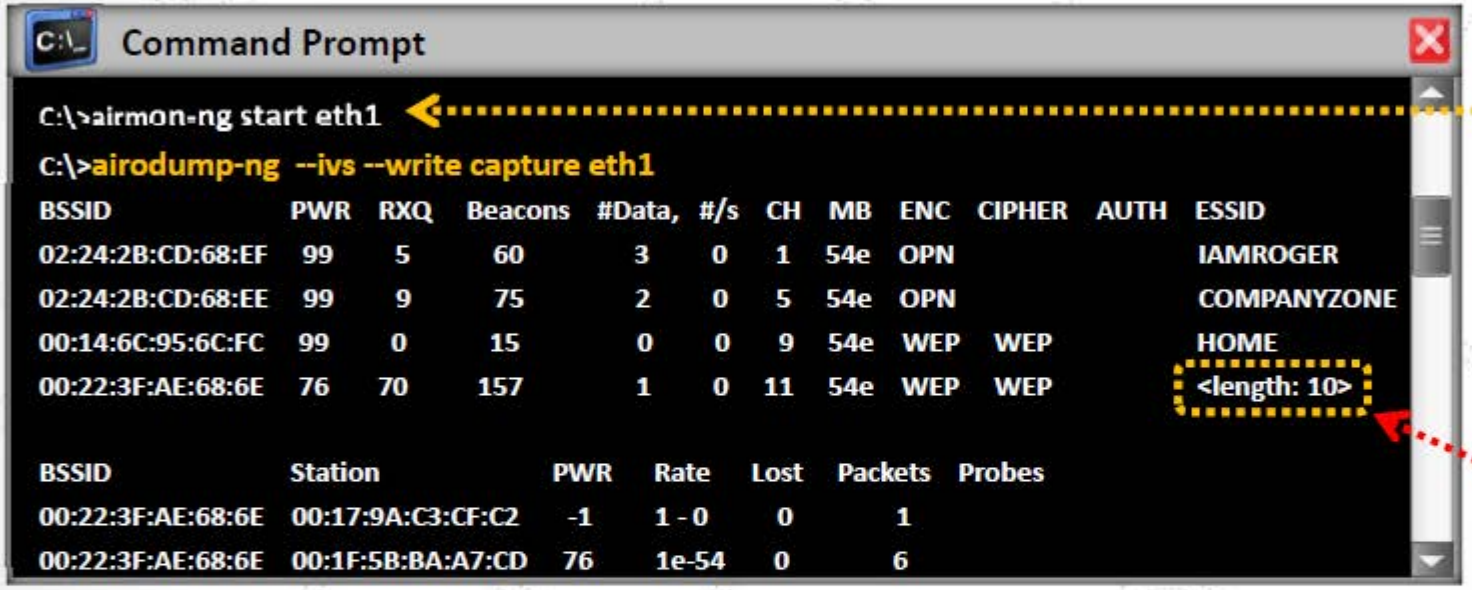
Easside-ng
Allows you to communicate via a WEP-encrypted access point (AP) without knowing the WEP key

Packetforge-ng
Used to create encrypted packets that can subsequently be used for injection

Tkiptun-ng
Creates a virtual tunnel interface to monitor encrypted traffic and inject arbitrary traffic into a network

Wesside-ng
Incorporates a number of techniques to seamlessly obtain a WEP key in minutes

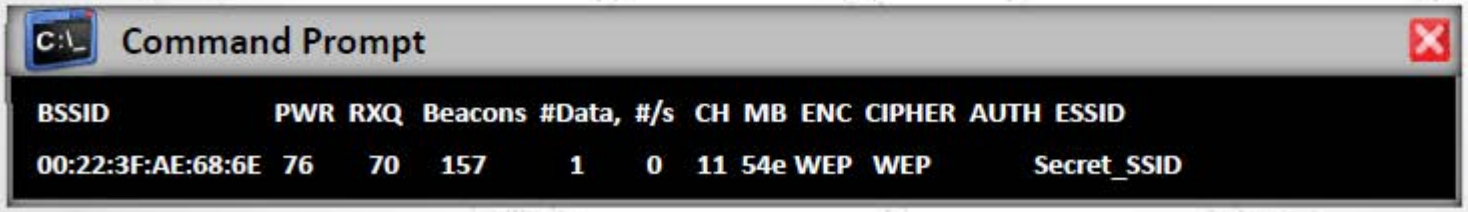
How to Reveal Hidden SSIDs



Step 1: Run airmon-ng in monitor mode

Step 2: Start airodump to discover SSIDs on interface

Step 3: De-authenticate (deauth) the client to reveal hidden SSID using Aireplay-ng



Step 4: Switch to airodump to see the revealed SSID

Fragmentation Attack

- A fragmentation attack, when successful, can obtain **1500 bytes of PRGA** (pseudo random generation algorithm)
- This attack **does not recover** the WEP key itself, but merely obtains the PRGA
- The PRGA can then be used to generate packets with **packetforge-ng** which are in turn used for various injection attacks
- It requires at least **one data packet** to be received from the access point in order to initiate the attack

Command Prompt

```
C:\>aireplay-ng -5 -b 00:14:6C:7E:40:80 -h 00:0F:B5:AB:CB:9D ath0
Waiting for a data packet...
Read 96 packets...
      Size: 120, FromDS: 1, ToDS: 0 (WEP)
      BSSID  =  00:14:6C:7E:40:80
      Dest. MAC  =  00:0F:B5:AB:CB:9D
      Source MAC  =  00:D0:CF:03:34:8C

0x0000:  0842 0201 000f b5ab cb9d 0014 6c7e 4080  .B..........l~@.
0x0010:  00d0 cf03 348c e0d2 4001 0000 2b62 7a01  ....4...@...+bz.
0x0020:  6d6d b1e0 92a8 039b ca6f cecb 5364 6e16  mm.......o..Sdn.
0x0030:  a21d 2a70 49cf eef8 f9b9 279c 9020 30c4  ..*pI.....'.. 0.
0x0040:  7013 f7f3 5953 1234 5727 146c eeaa a594  p...YS.4W'.l....
0x0050:  fd55 66a2 030f 472d 2682 3957 8429 9ca5  .Uf...G-&.9W.)..
0x0060:  517f 1544 bd82 ad77 fe9a cd99 a43c 52a1  Q .D...w.....<R.
0x0070:  0505 933f af2f 740e                      ...?./t.
Use this packet ? y
```

Command Prompt

```
Saving chosen packet in replay_src-0124-161120.cap
Data packet found!
Sending fragmented packet
Got RELAYED packet!!
Thats our ARP packet!
Trying to get 384 bytes of a keystream
Got RELAYED packet!!
Thats our ARP packet!
Trying to get 1500 bytes of a keystream
Got RELAYED packet!!
Thats our ARP packet!
Saving keystream in fragment-0124-161129.xor
Now you can build a packet with packetforge-ng out of
that 1500 bytes keystream
```

PRGA is stored in the file

Use PRGA with packetforge-ng to generate packet(s) to be used for various **injection attacks**

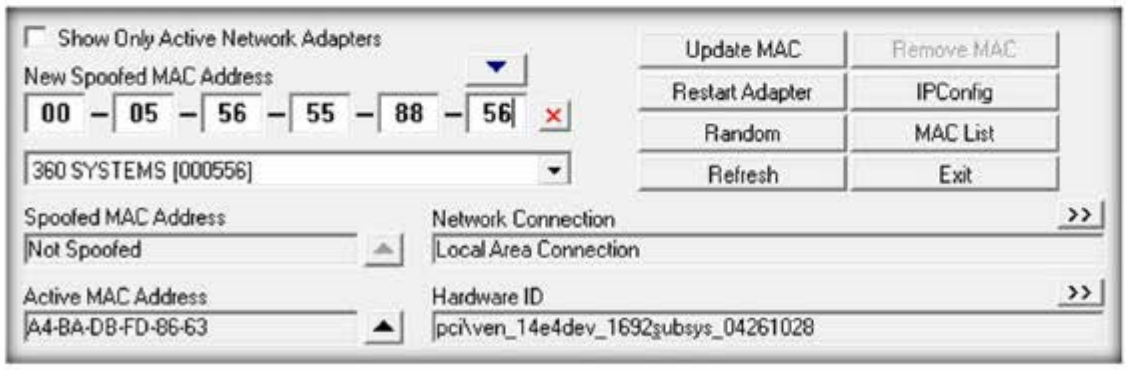
How to Launch MAC Spoofing Attack

MAC spoofing attackers **change the MAC address** to that of an authenticated user to bypass the MAC filtering configured in an access point

Linux Shell

```
[root@localhost root]# ifconfig wlan0 down
[root@localhost root]# ifconfig wlan0 hw ether 02:25:ab:4c:2a:bc
[root@localhost root]# ifconfig wlan0 up
```

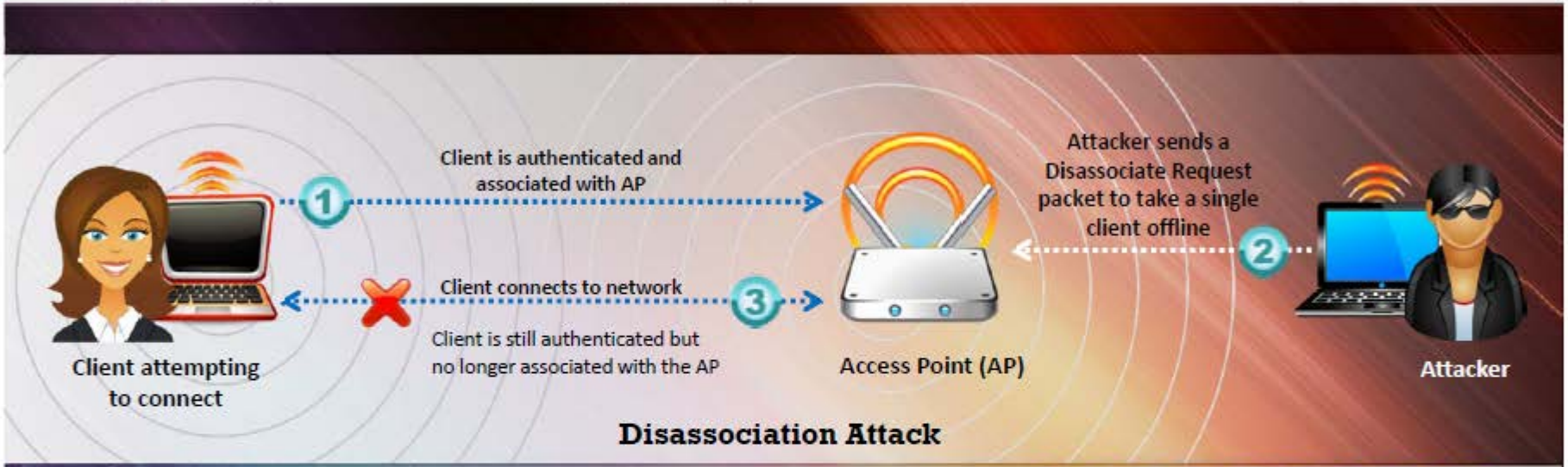
- Logging as root and disable the network interface
- Enter the new MAC address
- Bring the interface back up

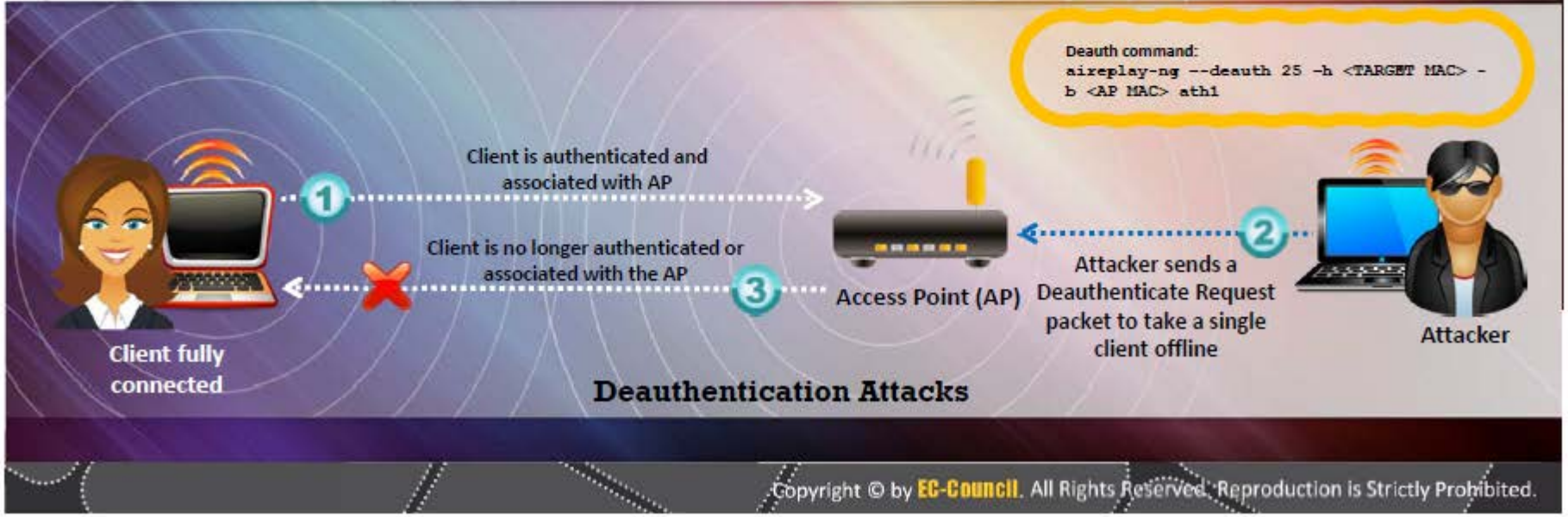


SMAC is a **MAC address changer** for Windows systems

Randomly generate any New MAC Address or based on a selected manufacturer

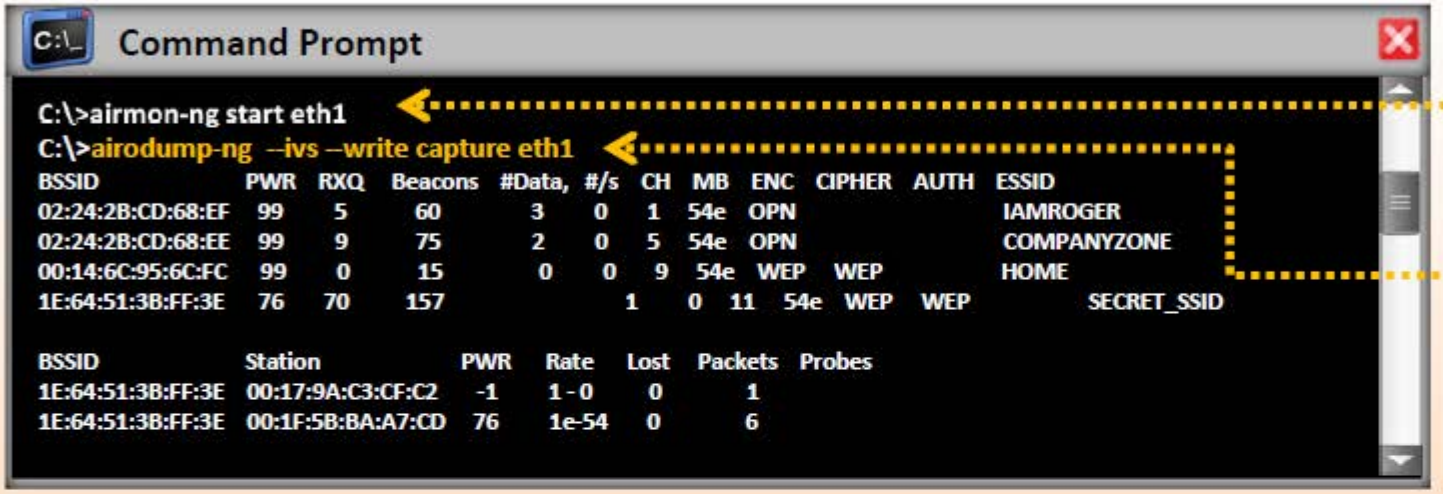
Denial of Service: Deauthentication and Disassociation Attacks





Man-in-the-Middle Attack

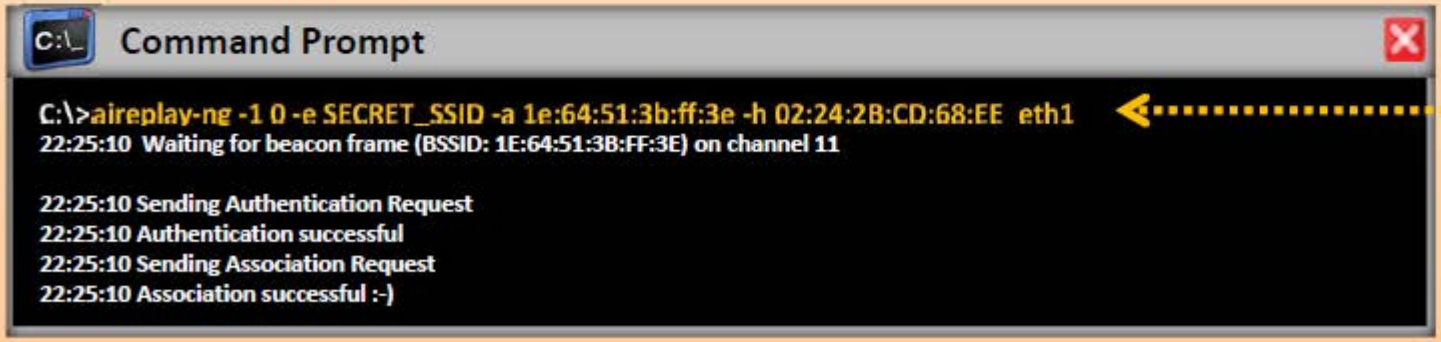
MITM Attack Using Aircrack-ng



Step 1: Run airmon-ng in monitor mode

Step 2: Start airodump to discover SSIDs on interface

Step 3: De-authenticate (deauth) the client using Aireplay-ng



Step 4: Associate your wireless card (fake association) with the AP you are accessing with aireplay-ng

Wireless ARP Poisoning Attack

1. Attacker **spoofs the MAC** address of Jessica's Wireless Laptop and attempts to authenticate to AP1

2. AP1 sends **updated MAC address** info to the network routers and switches, which in turn **update** their routing and switching tables

3. Traffic now **destined** from the network backbone to Jessica's system is no longer sent to AP2

Rogue Access Point

Compact, pocket-sized rogue AP device plugged into an Ethernet port of corporate network

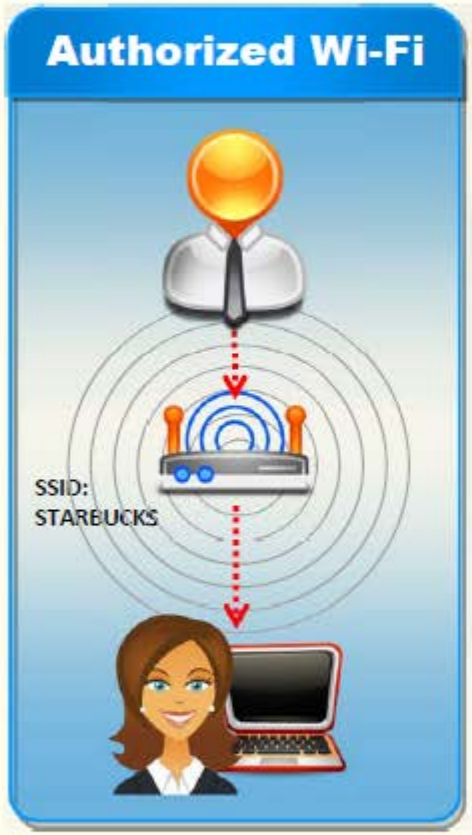
Software-based rogue access point running on a corporate Windows machine

- Choose an appropriate location to plug in your rogue access point that allows maximum coverage from your connection point
- Disable the SSID Broadcast (silent mode) and any management features to avoid detection
- Place the access point behind a firewall, if possible, to avoid network scanners
- Deploy a rogue access point for short period

Rogue access point device connected to corporate networks over a Wi-Fi link

USB-based rogue access point device plugged into a corporate machine

Evil Twin



Evil Twin is a wireless AP that pretends to be a legitimate AP by replicating another network name

Attacker sets up a rogue AP outside the corporate perimeter and lures user to sign into the wrong AP

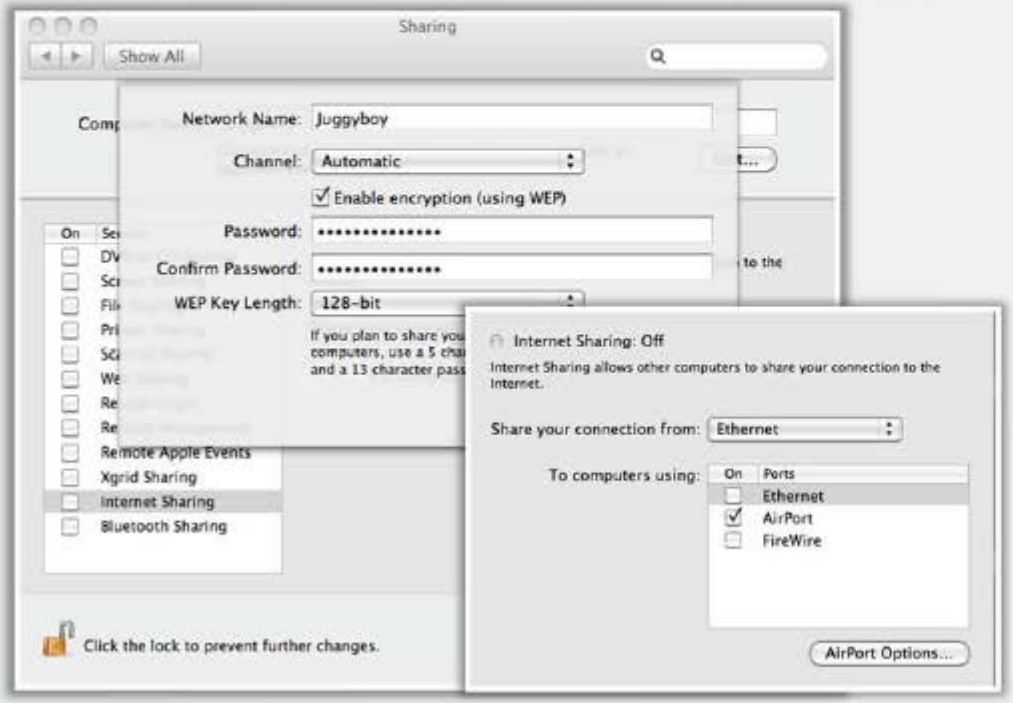
Once associated, users may bypass the enterprise security policies giving attackers access to network data

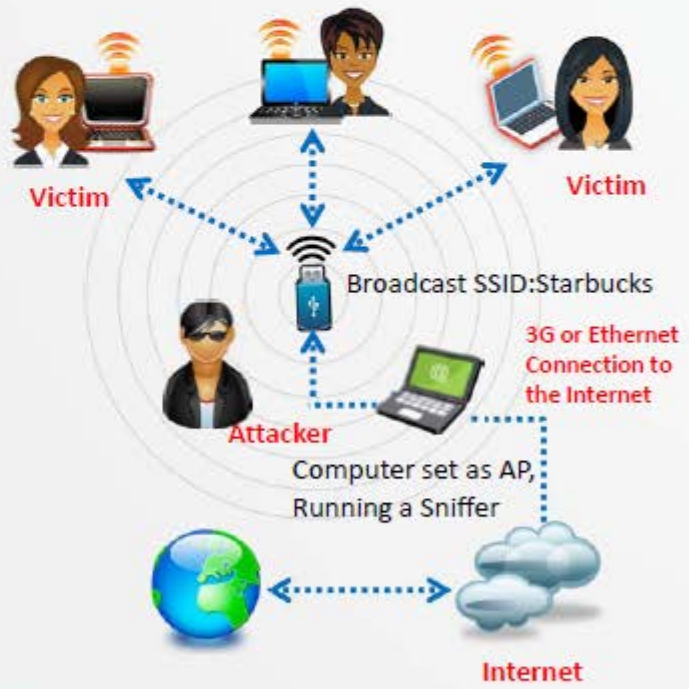
Evil Twin can be configured with a common residential SSID, hotspot SSID or SSID of a company's WLAN

Wi-Fi is everywhere these days and so are your employees. They take their laptops to Starbucks, to FedEx Office, and to the airport. How do you keep the company data safe?

How to Set Up a Fake Hotspot (Evil Twin)

- You will need a laptop with **Internet connectivity** (3G or wired connection) and a mini access point
- Enable **Internet Connection Sharing** in Windows 8 or Internet Sharing in Mac OS X
- Broadcast your Wi-Fi connection and run a **sniffer program** to capture passwords





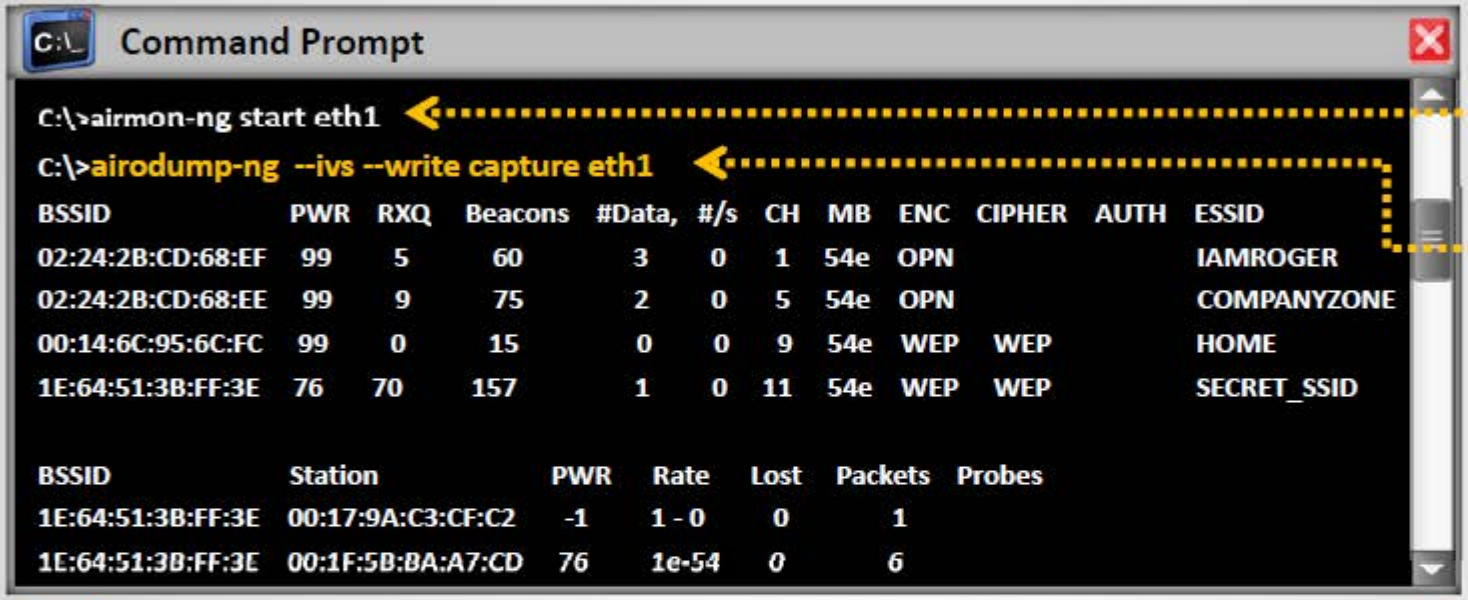
A user tries to log in and finds two access points. One is legitimate, while the other is an identical fake (evil twin). Victim picks one, if it's the fake, the hacker gets login information and access to the computer. In the meantime, the user goes nowhere. He or she probably thinks it was just a login attempt that randomly failed.

Wireless Hacking Methodology

The objective of the wireless hacking methodology is to compromise a Wi-Fi network in order to gain unauthorized access to network resources

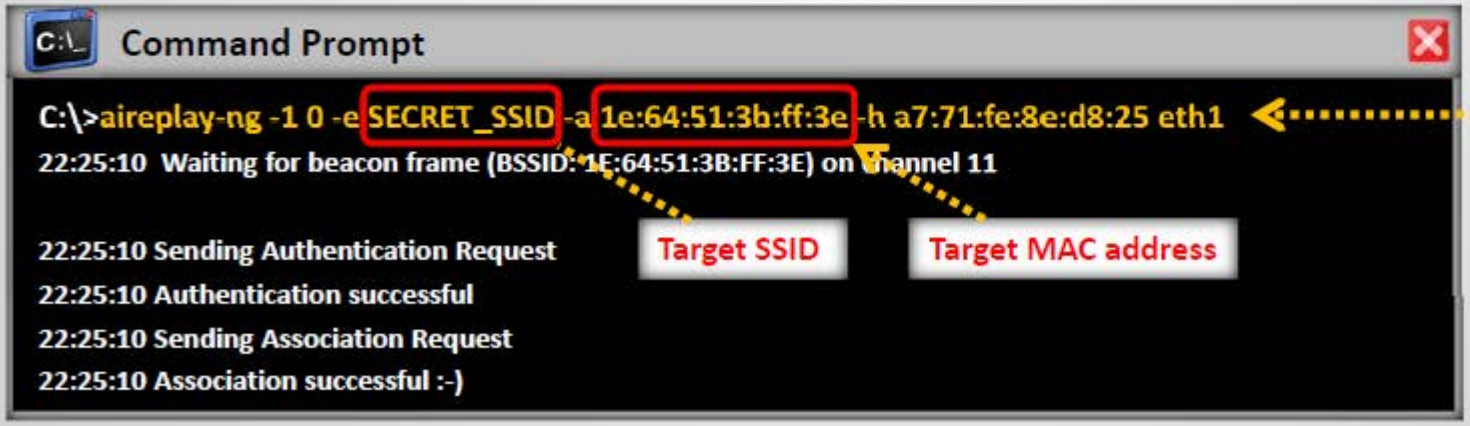
1. Wi-Fi Discovery
2. GPS Mapping
3. Wireless Traffic Analysis
4. Launch Wireless Attacks
5. Crack Wi-Fi Encryption
6. Compromise the Wi-Fi Network

How to Crack WEP Using Aircrack



Step 1: Run airmon-ng in monitor mode

Step 2: Start airodump to discover SSIDs on interface and keep it running.
Your capture file should contain more than 50,000 IVs to successfully crack the WEP key.



Step 3: Associate your wireless card with target access point

How to Crack WEP Using Aircrack (Cont'd)

Step 4: Inject packets using aireplay-ng to generate traffic on target access point

Step 5: Wait for airodump-ng to capture more than 50,000 IVs Crack WEP key using aircrack-ng.

How to Crack WPA-PSK Using Aircrack

Step 1

Monitor wireless traffic with airmon-ng

```
C:\>airmon-ng start eth1
```

Step 2

Collect wireless traffic data with airodump-ng

```
C:\>airodump-ng --write capture eth1
```

Command Prompt

```
C:\>airmon-ng start eth1
C:\>airodump-ng –write capture eth1
```

BSSID	PWR	RXQ	Beacons	#Data,	#/s	CH	MB	ENC	CIPHER	AUTH	ESSID
02:24:2B:CD:68:EF	99	5	60	3	0	1	54e	OPN			IAMROGER
02:24:2B:CD:68:EE	99	9	75	2	0	5	54e	WPA	TKIP	PSK	COMPANYZONE
00:14:6C:95:6C:FC	99	0	15	0	0	9	54e	WEP	WEP		HOME
1E:64:51:3B:FF:3E	76	70	157	1	0	11	54e	WEP	WEP		SECRET_SSID

BSSID	Station	PWR	Rate	Lost	Packets	Probes
1E:64:51:3B:FF:3E	00:17:9A:C3:CF:C2	-1	1 - 0	0	1	
1E:64:51:3B:FF:3E	00:1F:5B:BA:A7:CD	76	1e-54	0	6	

How to Crack WPA-PSK Using Aircrack (Cont'd)

Step 3: De-authenticate (deauth) the client using Aireplay-ng. The client will try to authenticate with AP which will lead to **airodump** capturing an authentication packet (WPA handshake)

Command Prompt

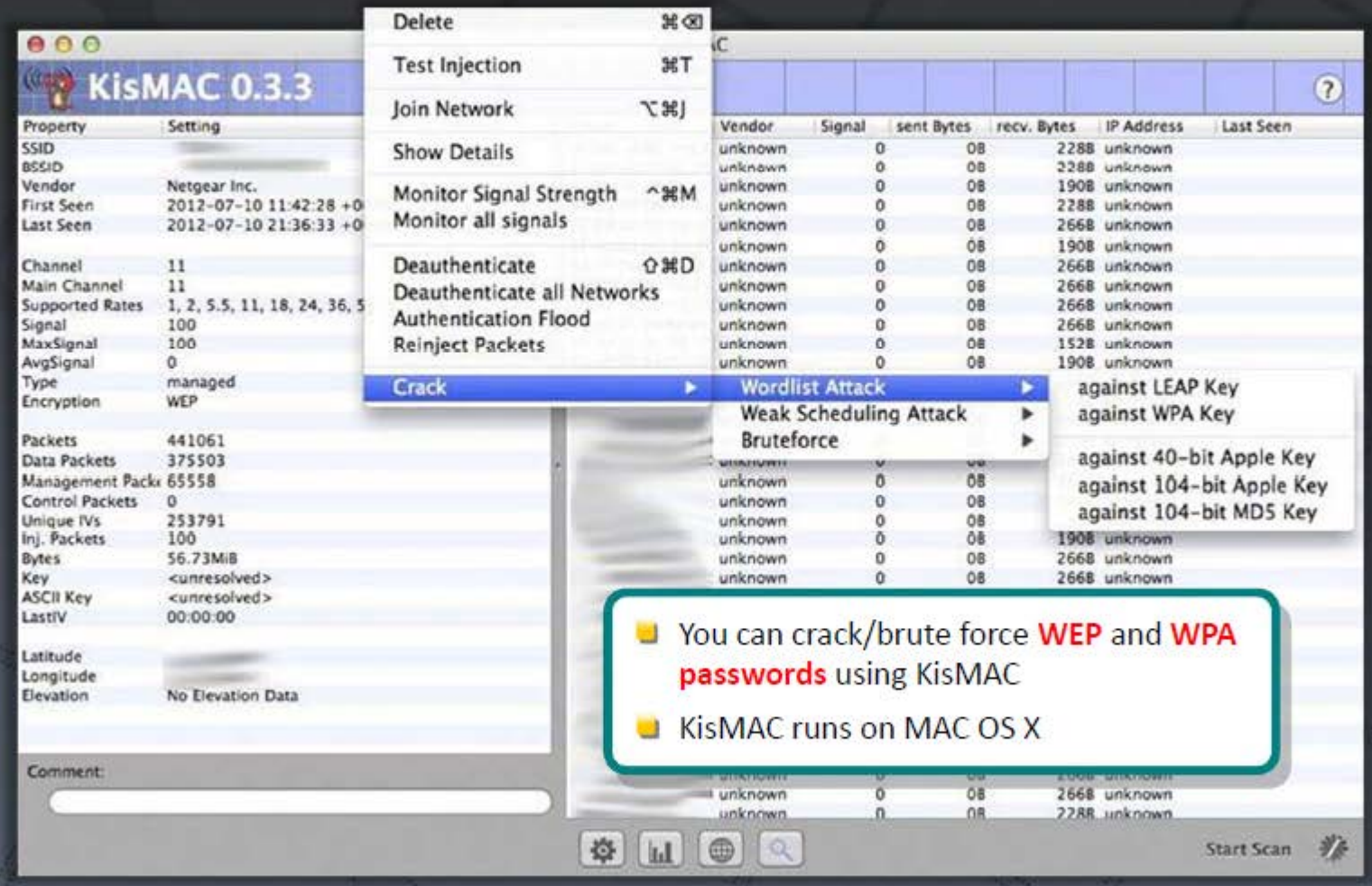
```
C:\>aireplay-ng --deauth 11 -a 02:24:2B:CD:68:EE
```

Step 4: Run the capture file through **aircrack-ng**

Command Prompt

```
C:\>aircrack-ng.exe -a 2 -w capture.cap
Opening capture.cap
Read 607 packets
# BSSIS              ESSID         Encryption
1 02:24:2B:CD:68:EE   COMPANYZONE      WPA <1 handshake>
Choosing first network as target.
Opening ../capture.cap
Pending packets, please wait...
                                Aircrack-ng 0.7 r130
                          [00:00:03] 230 keys tested (73.41 k/s)
                                KEY FOUND! [ passkey ]
      Master Key     : CD D7 9A 5A CF B0 70 C7 E9 D1 02 3B 87 02 85 D6
                       39 E4 30 B3 2F 31 AA 37 AC 82 5A 55 B5 55 24 EE
      Transcient Key : 33 55 0B FC 4F 24 84 F4 9A 38 B3 D0 89 83 D2 49
                       73 F9 DE 89 67 A6 6D 2B 8E 46 2C 07 47 6A CE 08
                       AD FB 65 D6 13 A9 9F 2C 65 E4 A6 08 F2 5A 67 97
                       D9 6F 76 5B 8C D3 DF 13 2F BC DA 6A 6E D9 62 CD
      EAPOL HMAC     : 52 27 B8 3F 73 7C 45 A0 05 97 69 5C 30 78 60 BD
```

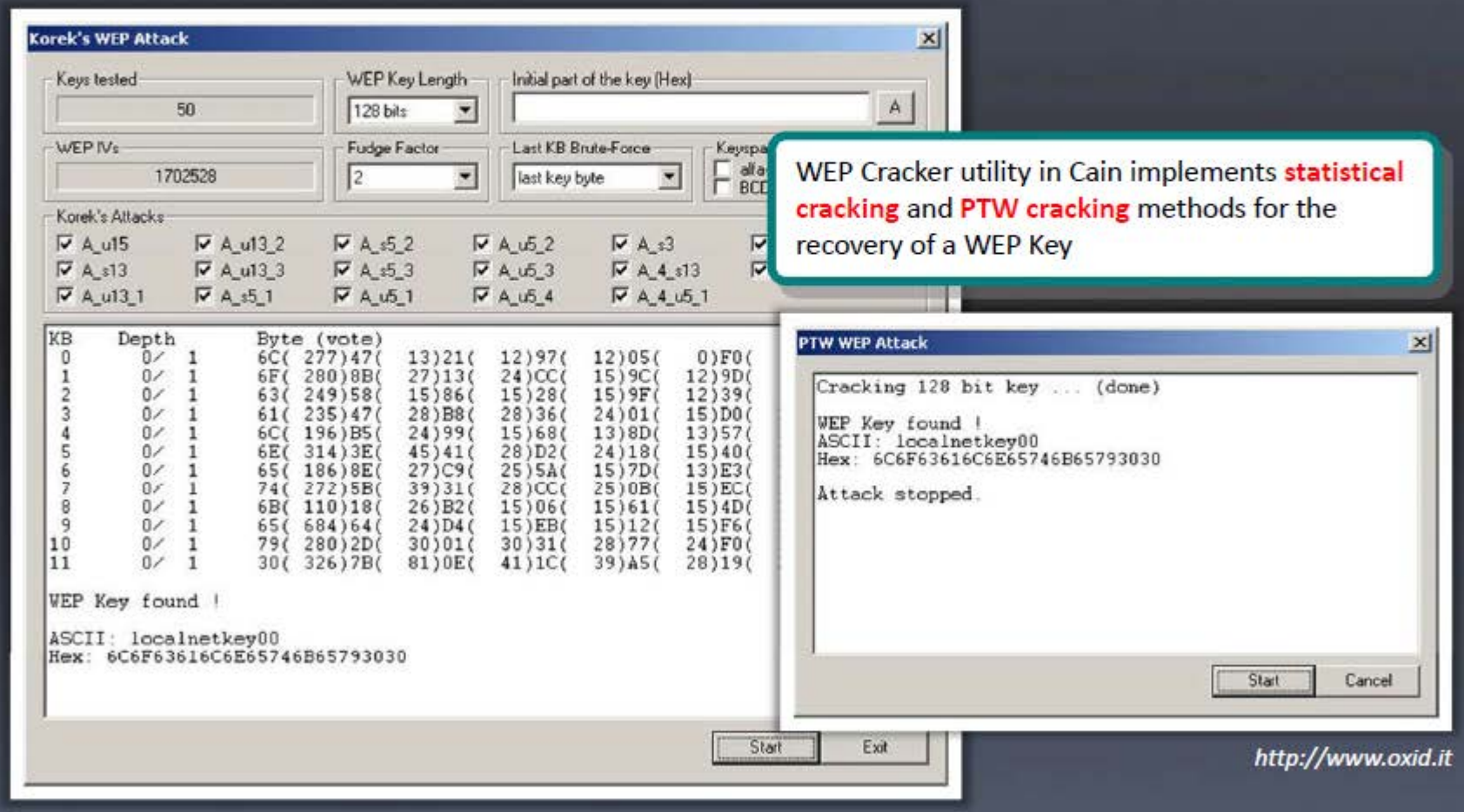
WPA Cracking Tool: KisMAC



- You can crack/brute force **WEP** and **WPA passwords** using KisMAC
- KisMAC runs on MAC OS X

http://trac.kismac-ng.org

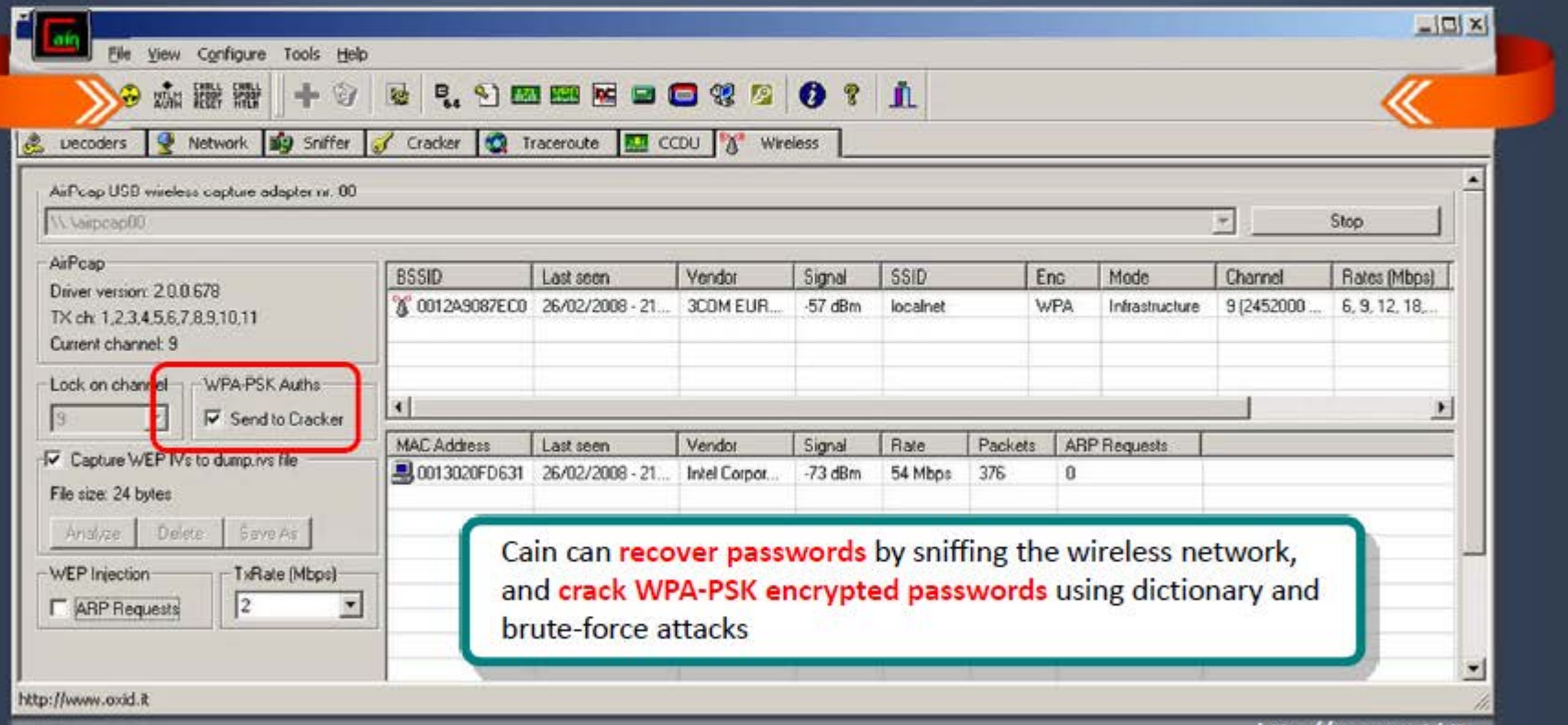
WEP Cracking Using Cain & Abel



WEP Cracker utility in Cain implements **statistical cracking** and **PTW cracking** methods for the recovery of a WEP Key

http://www.oxid.it

WPA Brute Forcing Using Cain & Abel

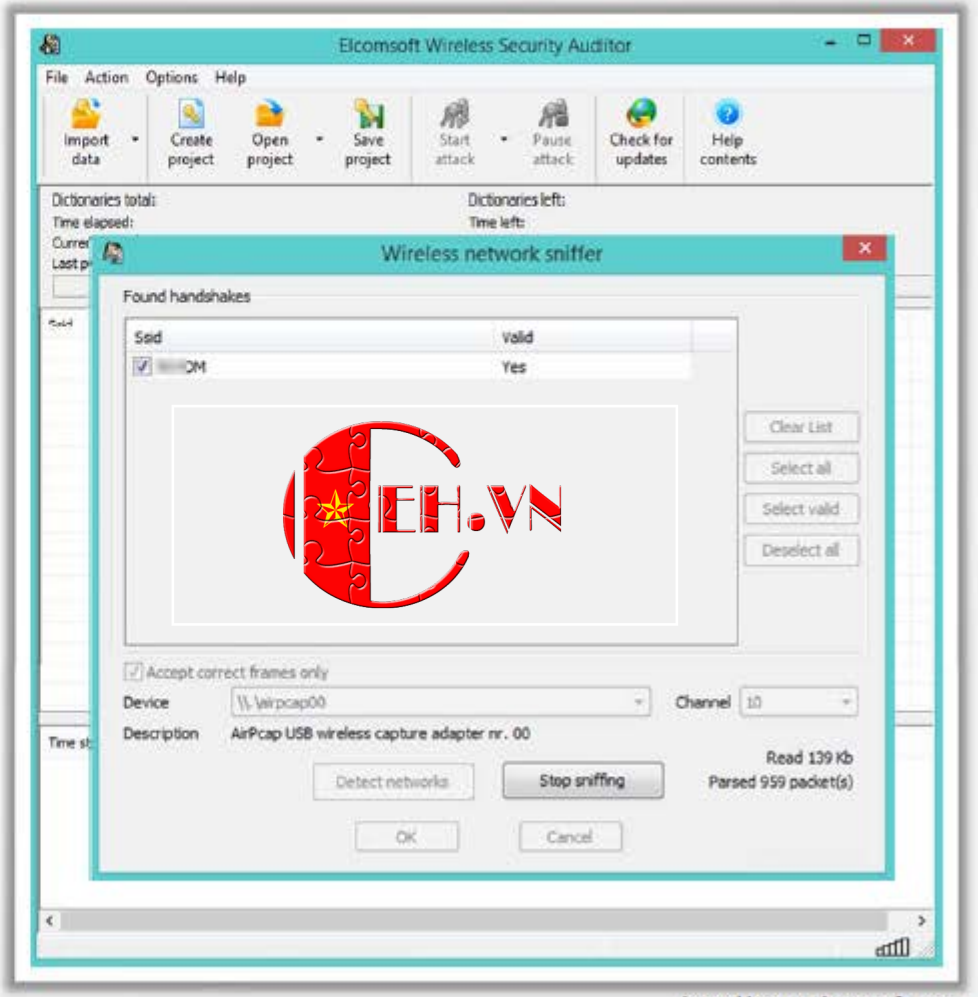


WPA Cracking Tool: Elcomsoft Wireless Security Auditor

Elcomsoft Wireless Security Auditor allows network administrators to audit accessible wireless networks

It comes with a built-in wireless network sniffer (with AirPcap adapters)

It tests the strength of WPA/WPA2-PSK passwords protecting your wireless network



http://www.elcomsoft.com

WEP/WPA Cracking Tools

C|EH Certified Ethical Hacker

WepAttack
http://wepattack.sourceforge.net

Portable Penetrator
http://www.secpoint.com

Wesside-ng
http://www.aircrack-ng.org

CloudCracker
https://www.cloudcracker.com

Reaver Pro
https://code.google.com

coWPAtty
http://wirelessdefence.org

WEPCrack
http://wepcrack.sourceforge.net

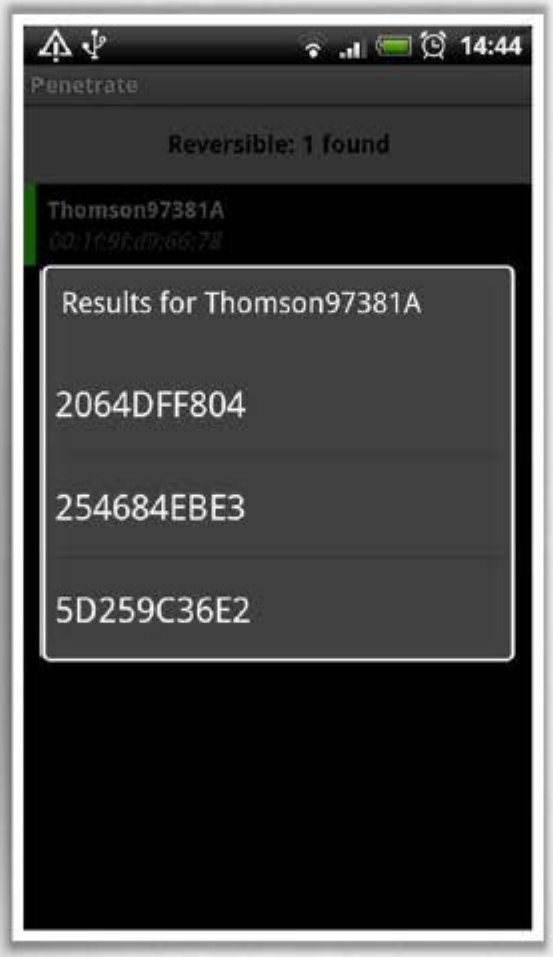
Wifite
http://code.google.com

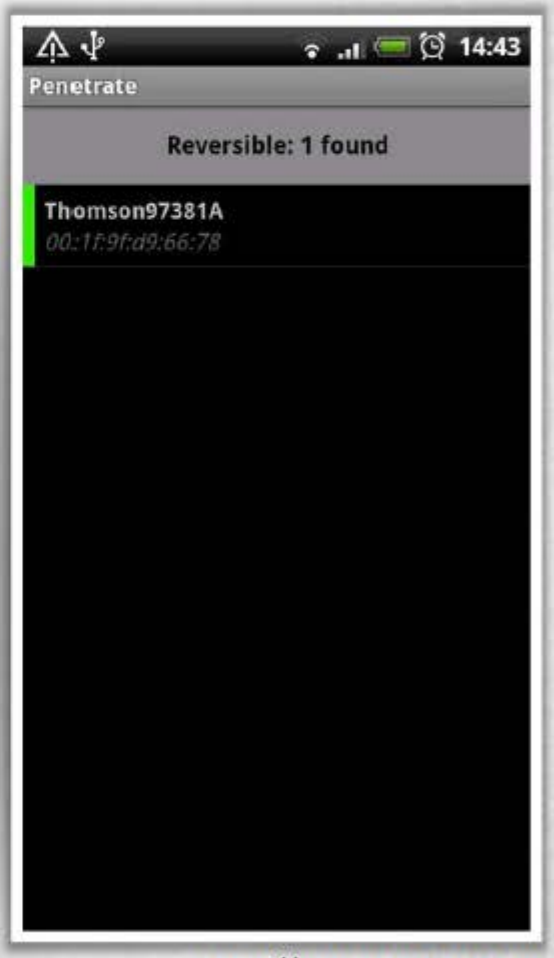
WepDecrypt
http://wepdecrypt.sourceforge.net

WepCrackGui
http://wepcrackgui.sourceforge.net

WEP/WPA Cracking Tool for Mobile: Penetrate Pro

- Penetrate Pro android app allows you to **decode and access a secure Wi-Fi network** from Android smartphone and devices
- The app **calculates WEP/WPA keys** for some Wi-Fi routers and lets you to get access by using the password
- Penetrate Pro calculates WEP/WPA keys for various wireless routers such as **Thomson**, **Discus**, **Infinitum**, BBox, DMax, Orange, SpeedTouch, DLink, Eircom, BigPond, O2Wireless routers, etc.





http://getandroidstuff.com

Module Flow

Wireless Concepts

Wireless Encryption

Wireless Threats

Wireless Hacking Methodology

Wireless Hacking Tools

Bluetooth Hacking

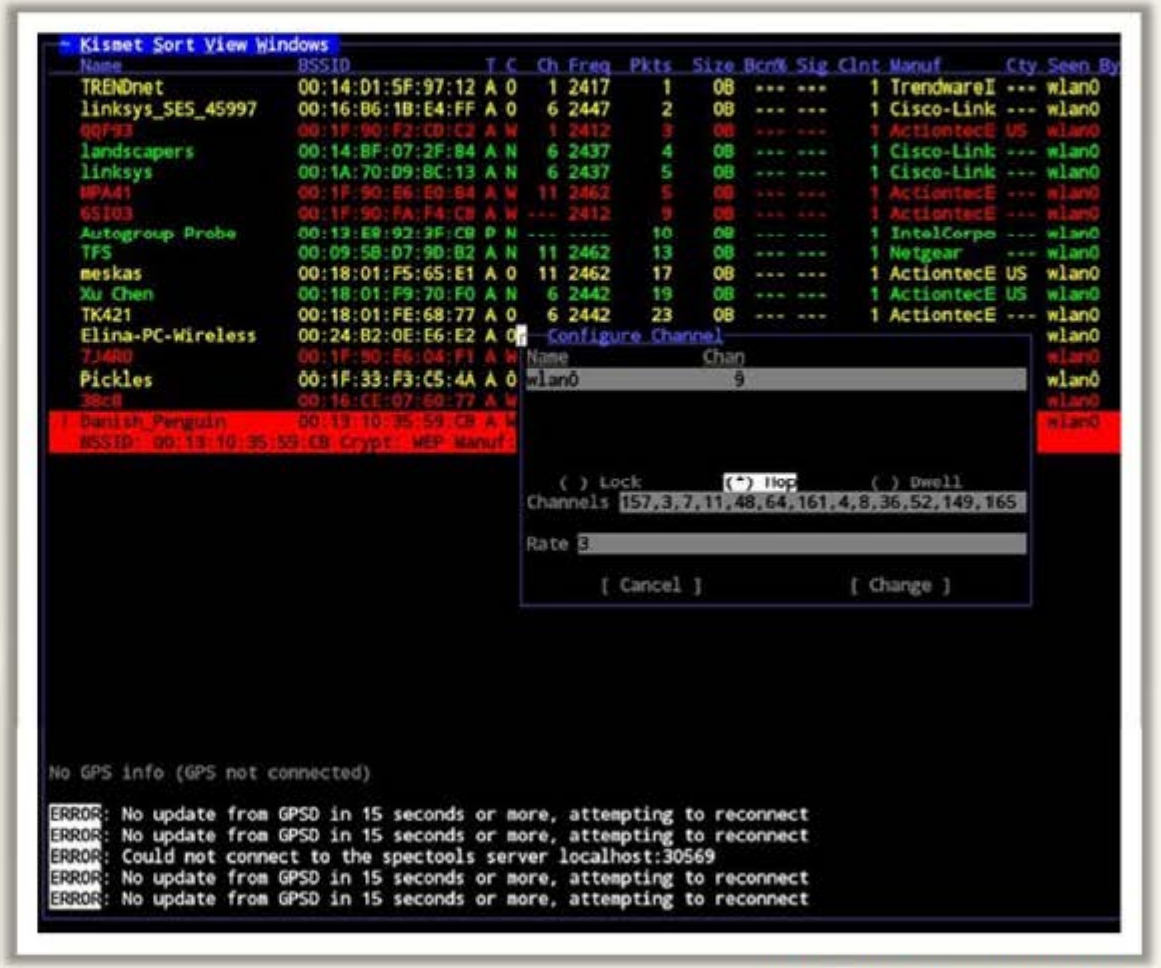
Countermeasures

Wireless Security Tools

Wi-Fi Pen Testing

Wi-Fi Sniffer: Kismet

1. It is an 802.11 Layer2 **wireless network detector**, sniffer, and intrusion detection system
2. It **identifies networks** by passively collecting packets and detecting standard named networks
3. It **detects hidden networks** and presence of nonbeaconing networks via data traffic



http://www.kismetwireless.net

Wardriving Tools

Airbase-ng
http://aircrack-ng.org

MacStumbler
http://www.macstumbler.com

ApSniff
http://www.monolith81.de

WiFi-Where
http://www.threejacks.com

WiFiFoFum
http://www.wififofum.net

AirFart
http://airfart.sourceforge.net

MiniStumbler
http://www.netstumbler.com

AirTraf
http://airtraf.sourceforge.net

WarLinux
http://sourceforge.net

802.11 Network Discovery Tools
http://wavelan-tools.sourceforge.net

RF Monitoring Tools

NetworkManager
https://wiki.gnome.org

xosview
http://xosview.sourceforge.net

KWiFiManager
http://kwifimanager.sourceforge.net

RF Monitor
http://www.newsteo.com

NetworkControl
http://www.arachnoid.com

DTC-340 RFXpert
http://www.dektec.com

Sentry Edge II
http://www.tek.com

Home Curfew RF Monitoring System
http://solutions.3m.com

WaveNode
http://www.wavenode.com

SigMon
http://www.sat.com

Wi-Fi Traffic Analyzer Tools

AirMagnet WiFi Analyzer
http://www.flukenetworks.com

OptiView® XG Network Analysis Tablet
http://www.flukenetworks.com

Observer
http://www.netinst.com

Ufasoft Snif
http://ufasoft.com

vxSniffer
http://www.cambridgevx.com

OneTouch™ AT Network Assistant
http://www.flukenetworks.com

Capsa Network Analyzer
http://www.colasoft.com

SoftPerfect Network Protocol Analyzer
http://www.softperfect.com

OmniPeek Network Analyzer
http://www.wildpackets.com

CommView for WiFi
http://www.tamos.com

Wi-Fi Raw Packet Capturing and Spectrum Analyzing Tools

Raw Packet Capturing Tools

WirelessNetView
http://www.nirsoft.net

Tcpdump
http://www.tcpdump.org

Airview
http://airview.sourceforge.net

RawCap
http://www.netresec.com

Airodump-ng
http://www.aircrack-ng.org

Spectrum Analyzing Tools

Cisco Spectrum Expert
http://www.cisco.com

AirMedic® USB
http://www.flukenetworks.com

AirSleuth-Pro
http://nutsaboutnets.com

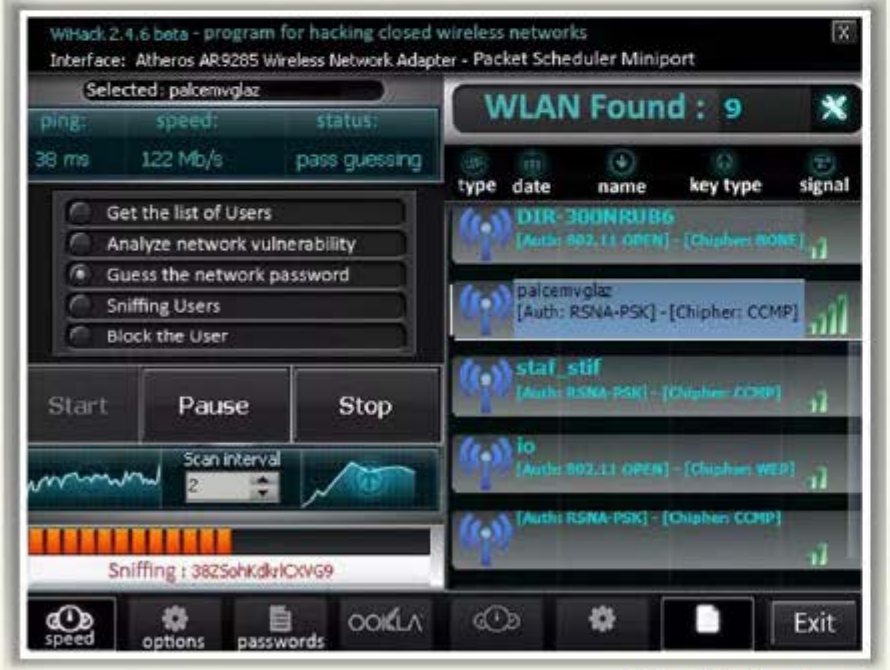
BumbleBee-LX Spectrum Analyzer
http://www.bvsystems.com

Wi-Spy
http://www.metageek.net

Wireless Hacking Tools for Mobile: WiHack and Backtrack Simulator

WiHack

- WiHack is a program for hacking Wi-Fi, which is able to crack **WPA**, **WPA2**, and **WEP keys**



https://wihack.com

Backtrack Simulator

- Backtrack Simulator is simulated with Fern Wi-Fi Cracker, Fern Wi-Fi Cracker can **crack WEP**, **WPA**, and **WPA2 secured wireless networks**

https://play.google.com

Module Flow

Wireless Concepts

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Bluetooth Hacking

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Wi-Fi Pen Testing

Bluetooth Hacking

- Bluetooth hacking refers to **exploitation of Bluetooth stack implementation vulnerabilities** to compromise sensitive data in Bluetooth-enabled devices and networks
- Bluetooth enabled devices connect and communicate wirelessly through **ad hoc** networks known as **Piconets**

Bluesmacking

DoS attack which **overflows Bluetooth-enabled** devices with random packets causing the device to crash

Bluejacking

The art of **sending unsolicited messages** over Bluetooth to Bluetooth-enabled devices such as mobile phones, laptops, etc.

Blue Snarfing

The **theft of information** from a wireless device through a Bluetooth connection

BlueSniff

Proof of concept code for a Bluetooth **wardriving** utility

Bluebugging

Remotely accessing the **Bluetooth-enabled** devices and using its features

BluePrinting

The art of collecting information about **Bluetooth-enabled devices** such as manufacturer, device model and firmware version

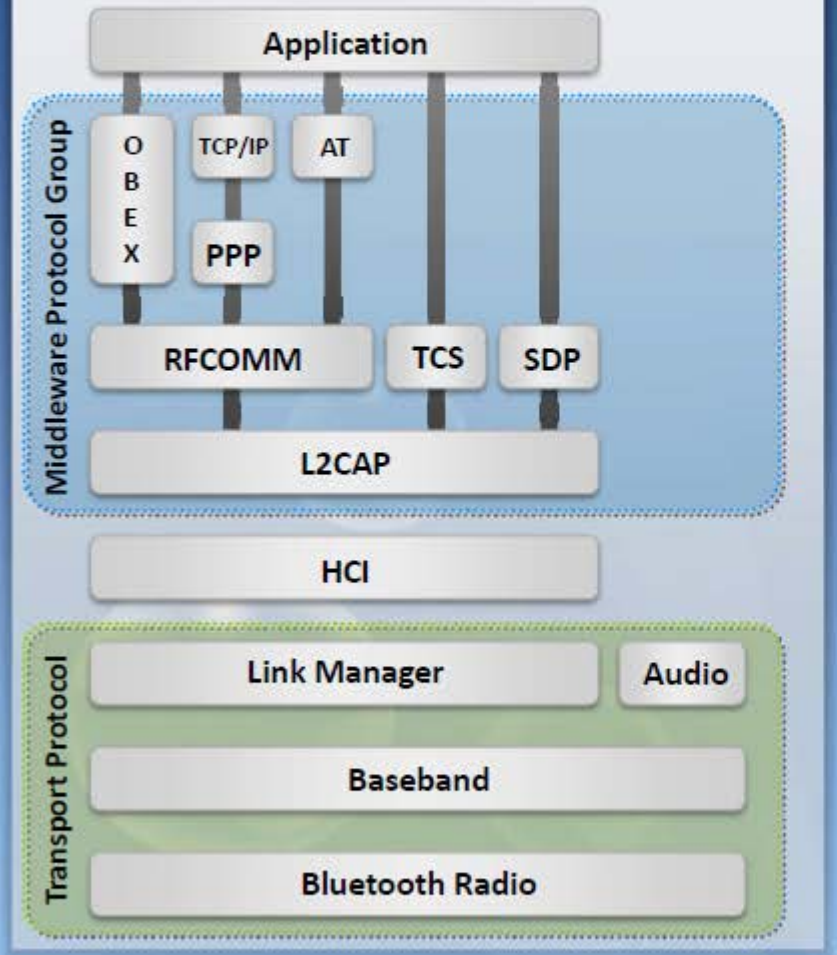
MAC Spoofing Attack

Intercepting data intended for other Bluetooth-enabled devices

Man-in-the-Middle/ Impersonation Attack

Modifying data between Bluetooth-enabled devices communicating in a Piconet

Bluetooth Stack



Bluetooth Modes

Discoverable modes

1. **Discoverable:** Sends inquiry responses to all inquiries
2. **Limited discoverable:** Visible for a certain period of time
3. **Non-discoverable:** Never answers an inquiry scan

Pairing modes

1. **Non-pairable mode:** Rejects every pairing request
2. **Pairable mode:** Will pair upon request

Bluetooth Threats

Leaking Calendars and Address Books

Attacker can steal user's personal information and can use it for malicious purposes

Remote Control

Hackers can remotely control a phone to make phone calls or connect to the Internet

Bugging Devices

Attacker could instruct the user to make a phone call to other phones without any user interaction. They could even record the user's conversation

Social Engineering

Attacker trick Bluetooth users to lower security or disable authentication for Bluetooth connections in order to pair with them and steal information

Sending SMS Messages

Terrorists could send false bomb threats to airlines using the phones of legitimate users

Malicious Code

Mobile phone worms can exploit a Bluetooth connection to replicate and spread itself

Causing Financial Losses

Hackers could send many MMS messages with an international user's phone, resulting in a high phone bill

Protocol Vulnerabilities

Attackers exploit Bluetooth parings and communication protocols to steal data, make calls, send messages, conduct DoS attacks on a device, start phone spying, etc.

How to BlueJack a Victim

- Bluejacking is the activity of sending **anonymous messages** over Bluetooth to Bluetooth-enabled devices such as laptops, mobile phones, etc. via the **OBEX** protocol

STEP 1

- Select an area with plenty of mobile users, like a café, shopping center, etc.
- Go to contacts in your address book (You can delete this contact entry later)

STEP 2

- Create a new contact on your phone address book
- Enter the message into the name field

  Ex: "Would you like to go on a date with me?"

STEP 3

- Save the new contact with the name text and without the telephone number
- Choose "send via Bluetooth". These searches for any Bluetooth device within range

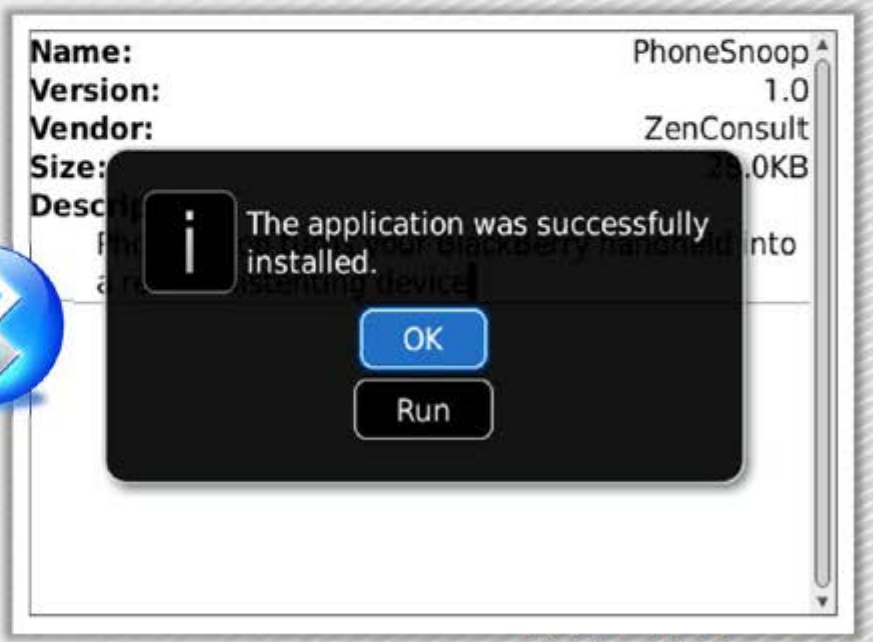
STEP 4

- Choose one phone from the list discovered by Bluetooth and send the contact
- You will get the message "card sent" and then listen for the SMS message tone of your victim's phone

Bluetooth Hacking Tool: PhoneSnoop

PhoneSnoop is **BlackBerry spyware** that enables an attacker to **remotely activate the microphone** of a BlackBerry handheld and listen to sounds near or around it, PhoneSnoop is a component of Bugs - a proof-of-concept spyware toolkit

- It exists **solely to demonstrate** the capabilities of a BlackBerry handheld when used to conduct surveillance on an individual
- It is purely a **proof-of-concept application** and does not possess the stealth or spyware features that could make it malicious



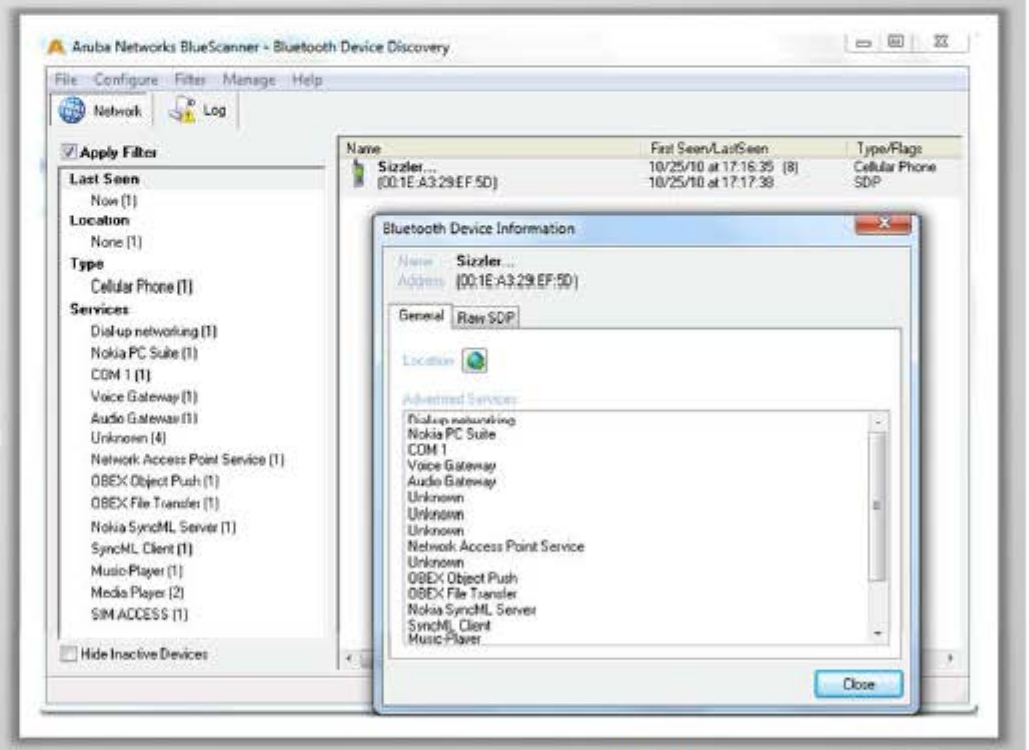
http://www.blackberryrc.com

Bluetooth Hacking Tool: BlueScanner

01 A Bluetooth **device discovery** and vulnerability assessment tool for Windows

02 Discover **Bluetooth devices type** (phone, computer, keyboard, PDA, etc.), and the services that are advertised by the devices

03 **Records all information** that can be gathered from the device, without attempting to authenticating with the remote device



http://www.arubanetworks.com

Bluetooth Hacking Tools

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BH BlueJack
http://croozeus.com

btscanner
http://www.pentest.co.uk

Bluesnarfer
http://www.alighieri.org

CIHwBT
http://sourceforge.net

btCrawler
http://www.silentservices.de

BT Audit
http://trifinite.org

Bluediving
http://bluediving.sourceforge.net

Blue Alert
http://www.bluejackingtools.com

Blooover II
http://trifinite.org

Blue Sniff
http://bluesniff.shmoo.com

Module Flow

Wireless Concepts

Wireless Encryption

Wireless Threats

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Countermeasures

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How to Defend Against Bluetooth Hacking

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Use non-regular patterns as PIN keys while pairing a device. Use those key combinations which are non-sequential on the keypad

Keep BT in the disabled state, enable it only when needed and disable immediately after the intended task is completed

Keep the device in non-discoverable (hidden) mode

DO NOT accept any unknown and unexpected request for pairing your device

Keep a check of all paired devices in the past from time to time and delete any paired device which you are not sure about

Always enable encryption when establishing BT connection to your PC

How to Defend Against Bluetooth Hacking (Cont'd)

1. Set Bluetooth-enabled device **network range to the lowest** and perform pairing only in a **secure area**

2. Install **antivirus** which support host-based security software on Bluetooth-enabled devices

3. Change the default settings of the Bluetooth-enabled device to a **best security standard**

4. Use **Link Encryption** for all Bluetooth connections

5. If multiple wireless communication is being used, make sure that **encryption is empowered** on each link in the communication chain

How to Detect and Block Rogue AP

Detecting Rogue AP

RF Scanning

Re-purposed access points that do only packet capturing and analysis (RF sensors) are plugged in all over the wired network to detect and warn the WLAN administrator about any wireless devices operating in the area

AP Scanning

Access points that have the functionality of detecting neighboring APs operating in the nearby area will expose the data through its MIBS and web interface

Using Wired Side Inputs

Network management software uses this technique to detect rogue APs. This software detects devices connected in the LAN, including Telnet, SNMP, CDP (Cisco discovery protocol) using multiple protocols

Blocking Rogue AP

- Deny wireless service to new clients by launching a **denial-of-service attack** (DoS) on the rogue AP
- **Block the switch port** to which AP is connected or manually locate the AP and pull it physically off the LAN

Wireless Security Layers

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Wireless Signal Security

RF Spectrum Security, Wireless IDS

Data Protection

WPA2 and AES

Connection Security

Per-Packet Authentication, Centralized Encryption

Network Protection

Strong Authentication

Device Security

Vulnerabilities and Patches

End-user Protection

Stateful Per User Firewalls

How to Defend Against Wireless Attacks

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Configuration Best Practices

SSID Settings Best Practices

Authentication Best Practices

Change the default SSID after WLAN configuration	Disable remote router login and wireless administration
Set the router access password and enable firewall protection	Enable MAC Address filtering on your access point or router
Disable SSID broadcasts	Enable encryption on access point and change passphrase often

How to Defend Against Wireless Attacks (Cont'd)

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Configuration Best Practices | **SSID Settings Best Practices** | Authentication Best Practices

- Use SSID cloaking to keep certain default wireless messages from broadcasting the ID to everyone
- Do not use your SSID, company name, network name, or any easy to guess string in passphrases
- Place a firewall or packet filter in between the AP and the corporate Intranet
- Limit the strength of the wireless network so it cannot be detected outside the bounds of your organization
- Check the wireless devices for configuration or setup problems regularly
- Implement an additional technique for encrypting traffic, such as IPSEC over wireless

How to Defend Against Wireless Attacks (Cont'd)

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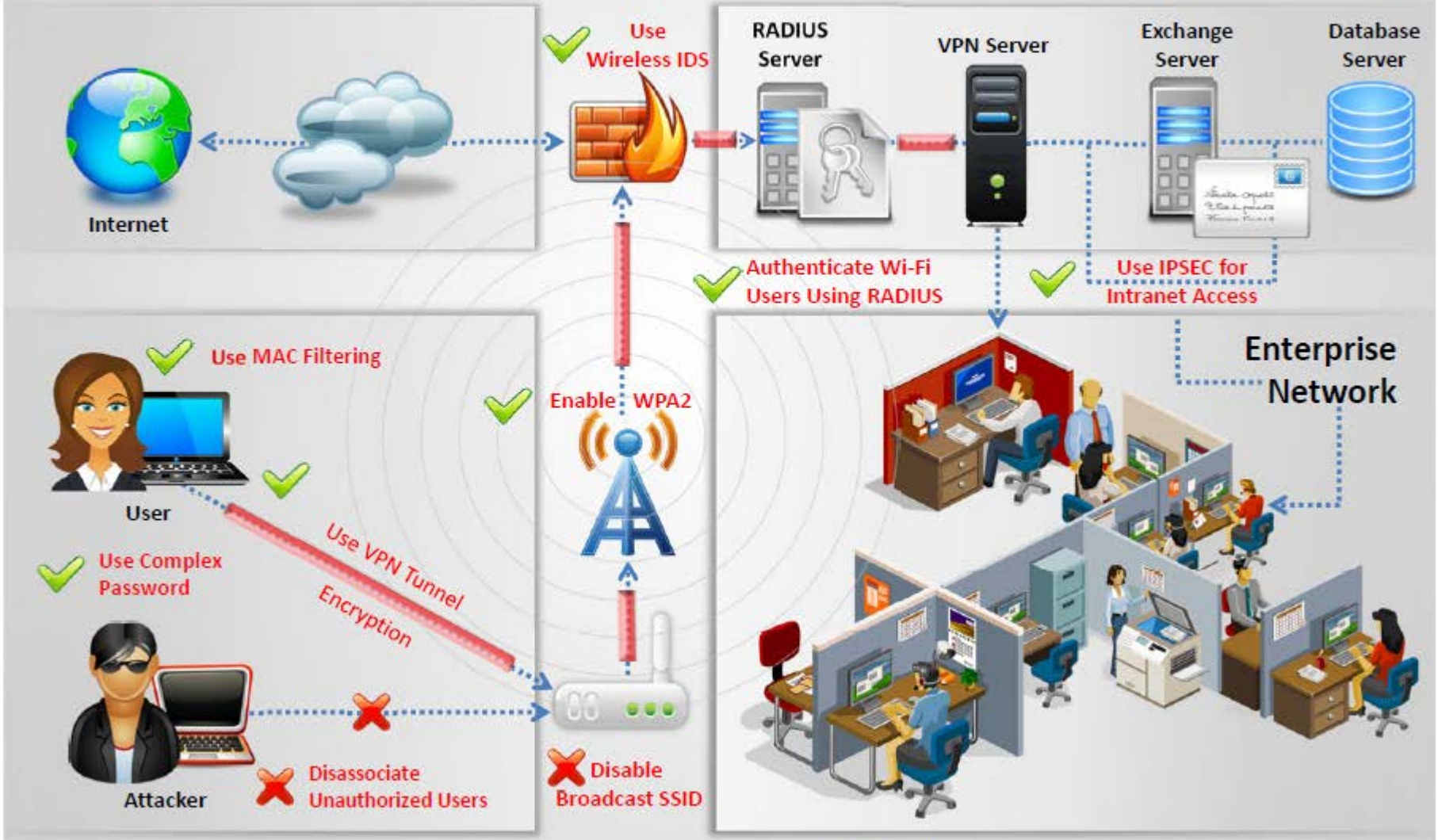
Configuration Best Practices | SSID Settings Best Practices | **Authentication Best Practices**

- Choose Wi-Fi Protected Access (WPA) instead of WEP
- Implement WPA2 Enterprise wherever possible
- Disable the network when not required
- Place wireless access points in a secured location
- Keep drivers on all wireless equipment updated
- Use a centralized server for authentication

How to Defend Against Wireless Attacks (Cont'd)



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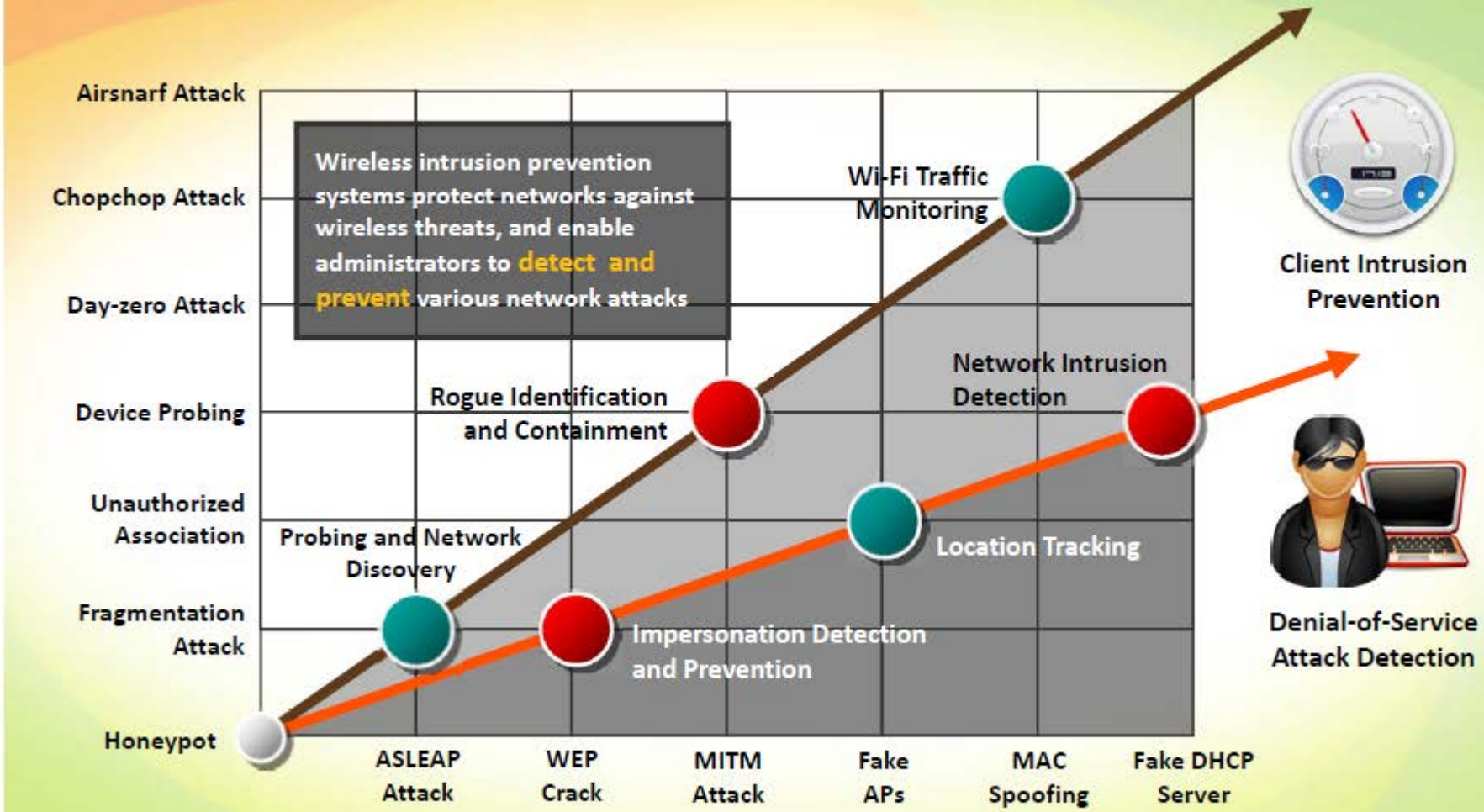
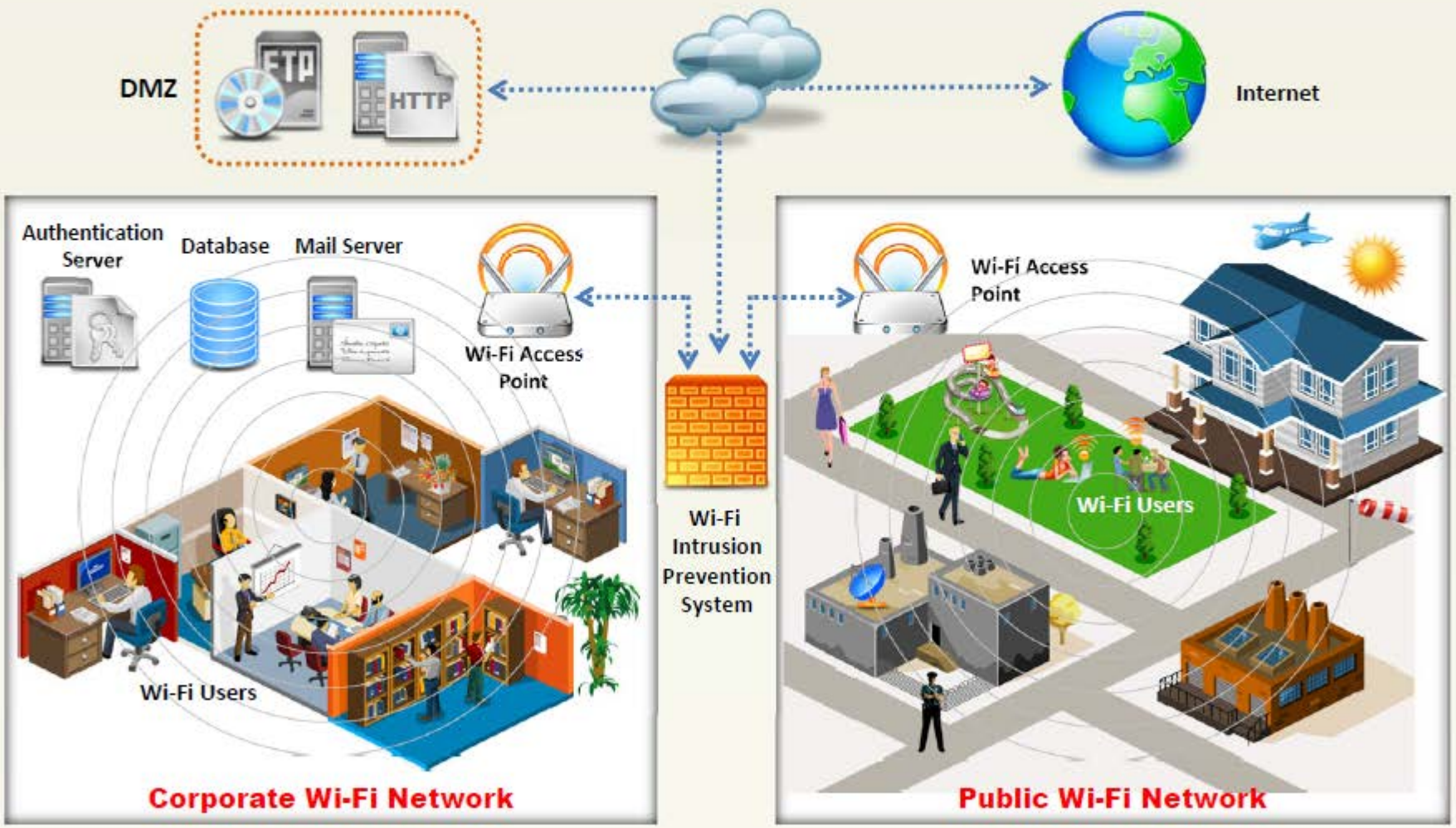
Wireless Intrusion Prevention Systems

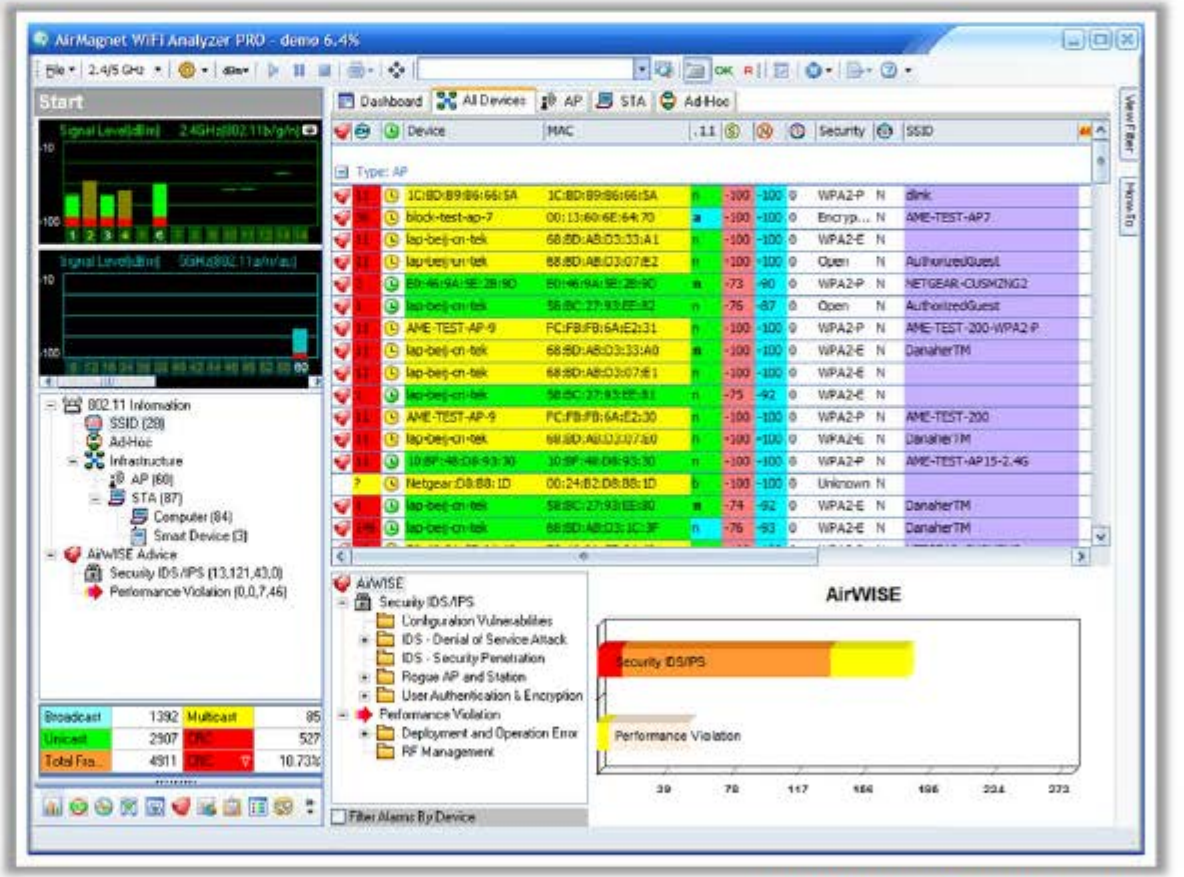


Wireless IPS Deployment



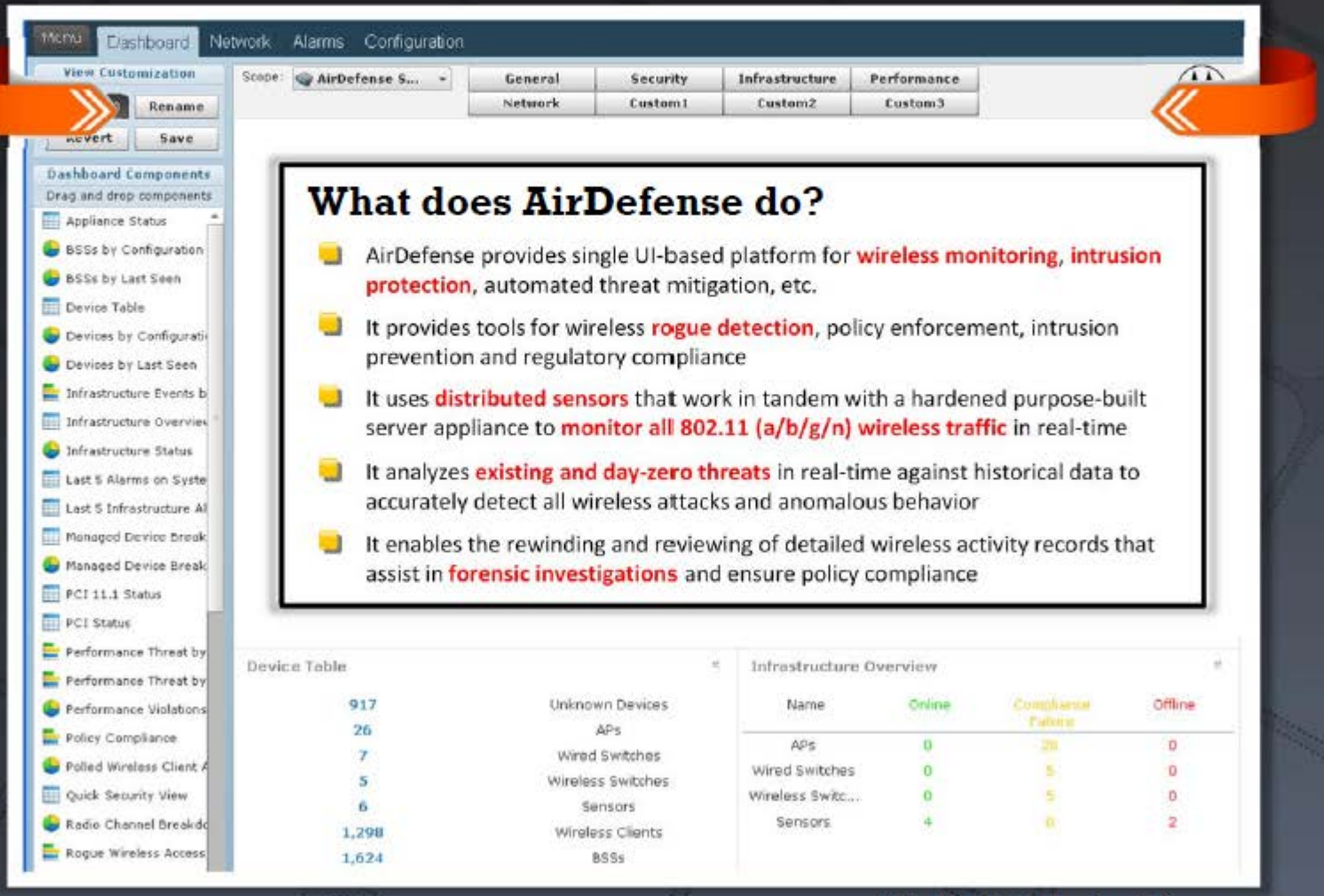
Wi-Fi Security Auditing Tool: AirMagnet WiFi Analyzer

- It is a Wi-Fi networks **auditing** and **troubleshooting** tool
- Automatically **detects security threats** and other wireless network vulnerabilities
- It **detects Wi-Fi attacks** such as Denial of Service attacks, authentication/ encryptions attacks, network penetration attacks, etc.
- It can **locate unauthorized (rogue) devices** or any policy violator



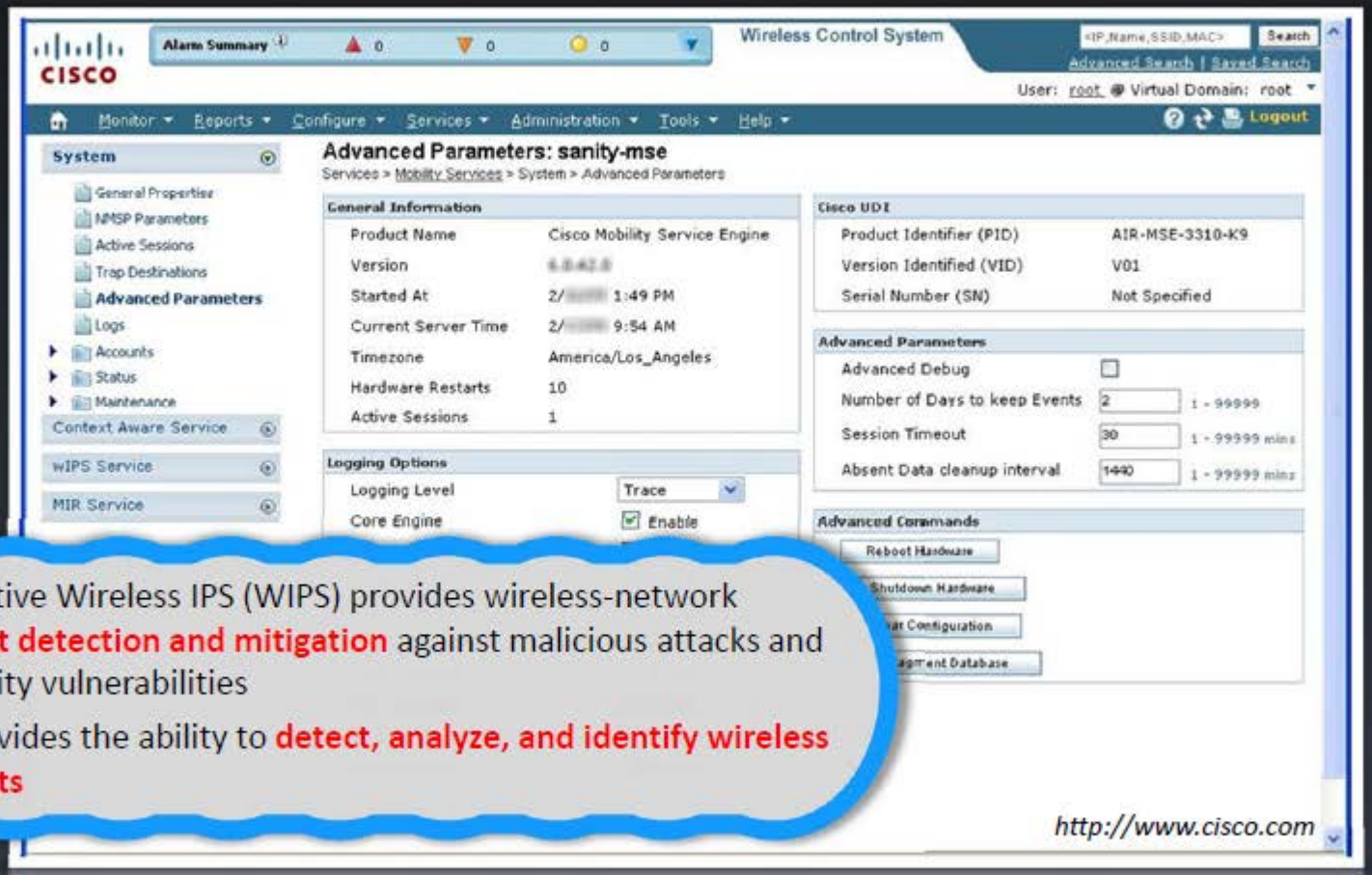
http://www.flukenetworks.com

Wi-Fi Security Auditing Tool: Motorola's AirDefense Services Platform (ADSP)



http://www.motorolasolutions.com

Wi-Fi Security Auditing Tool: Adaptive Wireless IPS



- Adaptive Wireless IPS (WIPS) provides wireless-network **threat detection and mitigation** against malicious attacks and security vulnerabilities
- It provides the ability to **detect, analyze, and identify wireless threats**

Wi-Fi Security Auditing Tool: Aruba RFProtect

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Integrated wireless intrusion detection and prevention

Automatic threat mitigation for centrally evaluating forensic data, and actively containing rogues and locking down device configuration

Automated compliance reporting to meet policy mandates for PCI, HIPAA, DoD 8100.2, and GLBA with automated report distribution that is tailored to specific audit requirements

http://www.arubanetworks.com

Wi-Fi Intrusion Prevention System

Extreme Networks Intrusion Prevention System
http://www.extremenetworks.com

AirMagnet Enterprise
http://www.flukenetworks.com

Dell SonicWALL Clean Wireless
http://www.sonicwall.com

HP TippingPoint NX Platform NGIPS
http://www8.hp.com

AirTight WIPS
http://www.airtightnetworks.com

Network Box IDP
http://www.network-box.com

AirMobile Server
http://www.airmobile.se

Wireless Policy Manager (WPM)
http://www.airpatrolcorp.com

ZENworks® Endpoint Security Management
http://www.novell.com

FortiWiFi
http://www.fortinet.com

Wi-Fi Predictive Planning Tools

AirMagnet Planner
http://www.flukenetworks.com

Connect EZ Predictive RF CAD Design
http://www.connect802.com

Cisco Prime Infrastructure
http://www.cisco.com

Ekahau Site Survey (ESS)
http://www.ekahau.com

AirTight Planner
http://www.airtightnetworks.com

ZonePlanner
http://www.ruckuswireless.com

LANPlanner
http://www.motorolasolutions.com

Wi-Fi Planning Tool
http://www.aerohive.com

RingMaster
http://www.juniper.net

TamoGraph Site Survey
http://www.tamos.com

Wi-Fi Vulnerability Scanning Tools

Zenmap
http://nmap.org

Nessus
http://www.tenable.com

OSWA-Assistant
http://securitystartshere.org

Network Security Toolkit
http://networksecuritytoolkit.org

Nexpose Community Edition
http://www.rapid7.com

WiFish Finder
http://www.airtightnetworks.com

Penetrator Vulnerability Scanning Appliance
http://www.secpoint.com

SILICA
http://www.immunityinc.com

WebSploit
http://sourceforge.net

Airbase-ng
http://www.aircrack-ng.org

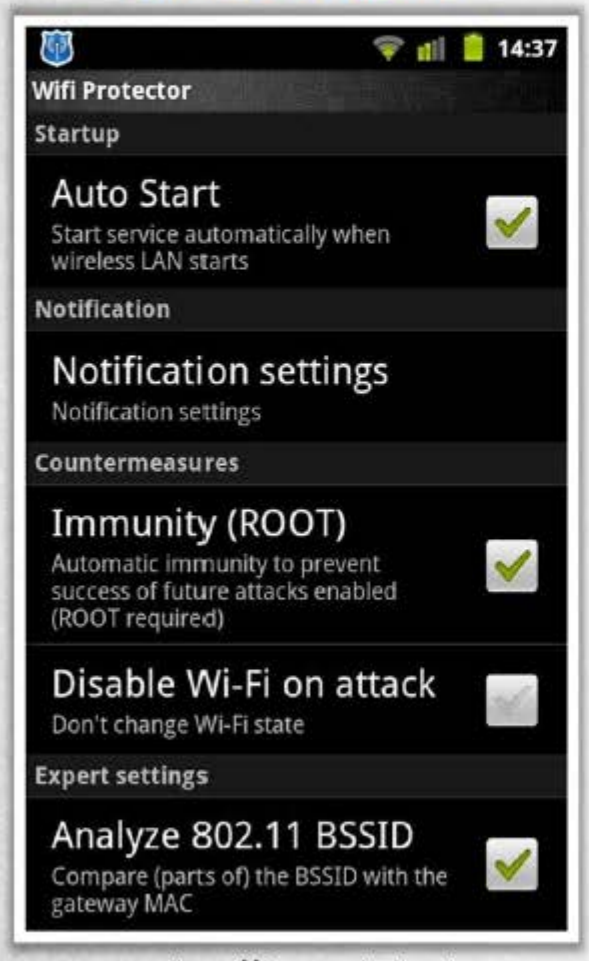
Bluetooth Security Tool: Bluetooth Firewall

- FruitMobile Bluetooth Firewall protects your android device against all sorts of **bluetooth attack** from devices around you
- It **displays alerts** when bluetooth activities takes place
- You can also **scan your device and detect apps** with bluetooth capabilities

http://www.fruitmobile.com

Wi-Fi Security Tools for Mobile: Wifi Protector, WiFiGuard, and Wifi Inspector

Wifi Protector



http://forum.xda-developers.com

WiFiGuard

https://play.google.com

Wifi Inspector

https://play.google.com

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Wi-Fi Pen Testing

Wireless Penetration Testing

- The process of actively **evaluating information security measures** implemented in a wireless network to analyze design weaknesses, technical flaws and vulnerabilities
- A comprehensive report in **detail about the findings** along with the suite of **recommended countermeasures** is delivered to the executive, management, and technical audiences

Threat Assessment

Identify the wireless threats facing an organization's information assets

Security Control Auditing

To test and validate the efficiency of wireless security protections and controls

Upgrading Infrastructure

Change or upgrade existing infrastructure of software, hardware, or network design

Data Theft Detection

Find streams of sensitive data by sniffing the traffic

Risk Prevention and Response

Provide comprehensive approach of preparation steps that can be taken to prevent inevitable exploitation

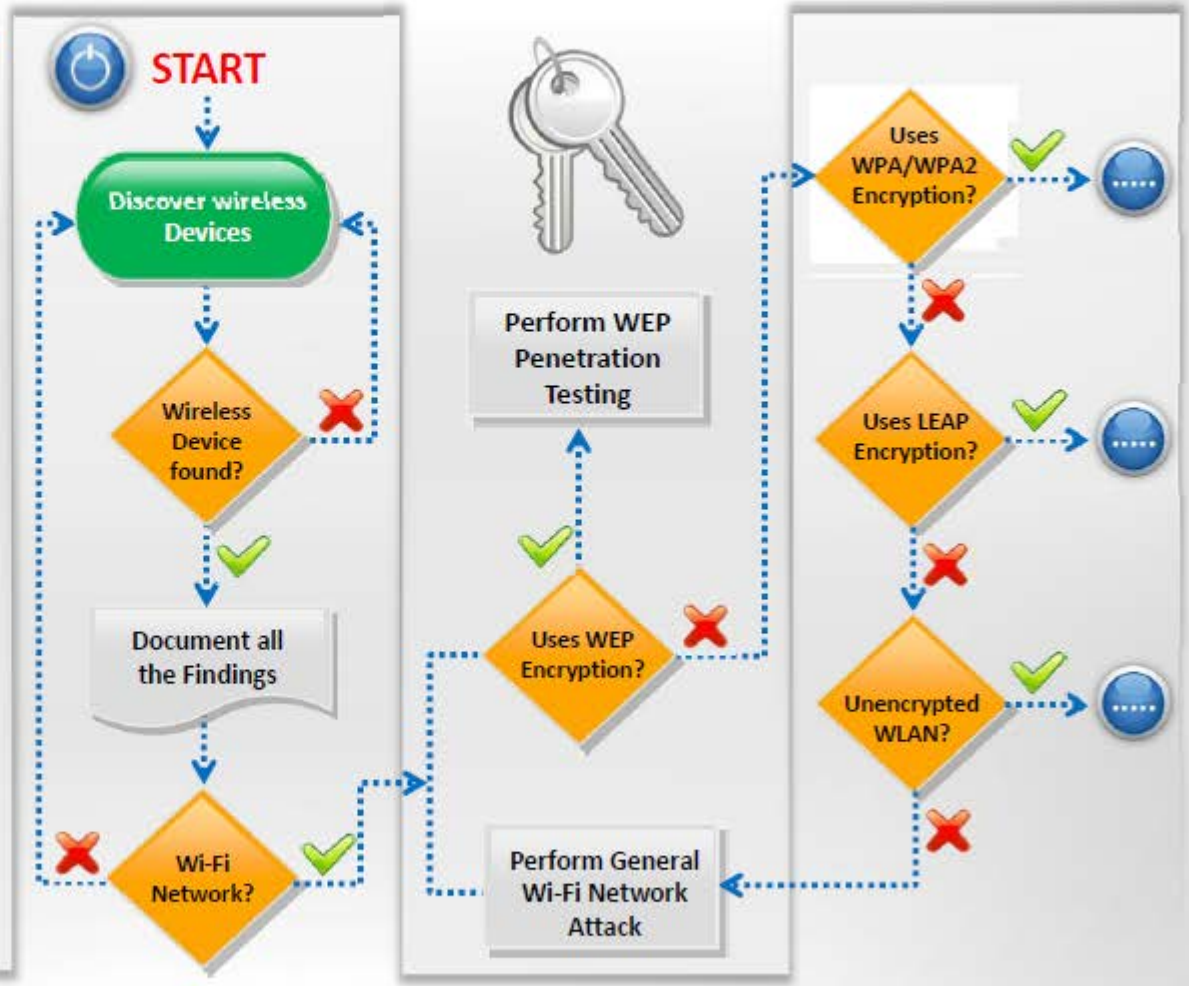
Information System Management

Collect information on security protocols, network strength and connected devices

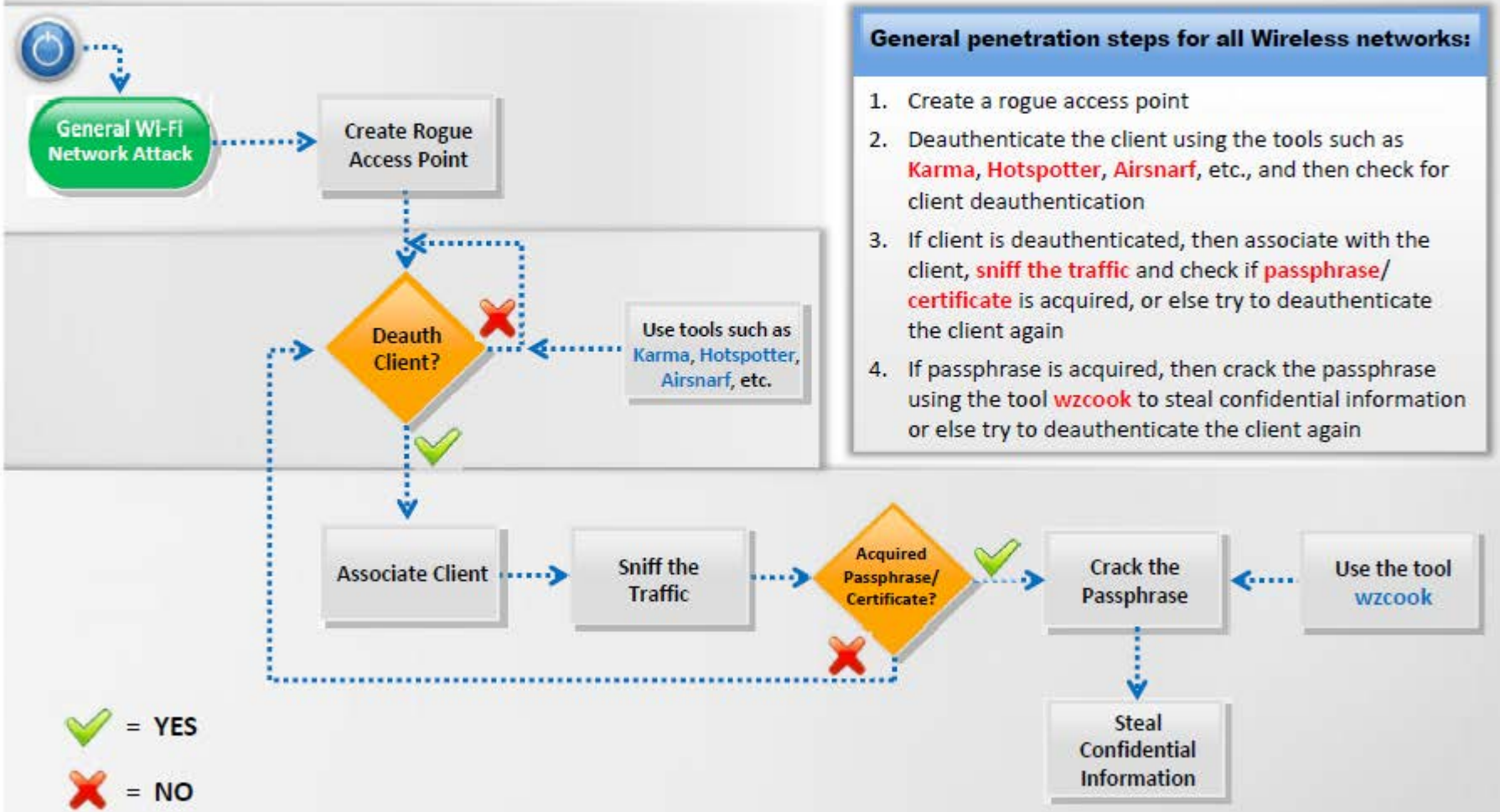
Wireless Penetration Testing Framework

Wireless Pen Testing Framework

- Discover wireless devices
- If wireless device is found, document all the findings
- If the wireless device found using Wi-Fi network, then perform general Wi-Fi network attack and check if it uses WEP encryption
- If WLAN uses WEP encryption, then perform WEP encryption pen testing or else check if it uses WPA/WPA2 encryption
- If WLAN uses WPA/WPA2 encryption, then perform WPA/WPA2 encryption pen testing or else check if it uses LEAP encryption
- If WLAN uses LEAP encryption, then perform LEAP encryption pen testing or else check if WLAN is unencrypted
- If WLAN is unencrypted, then perform unencrypted WLAN pen testing or else perform general Wi-Fi network attack



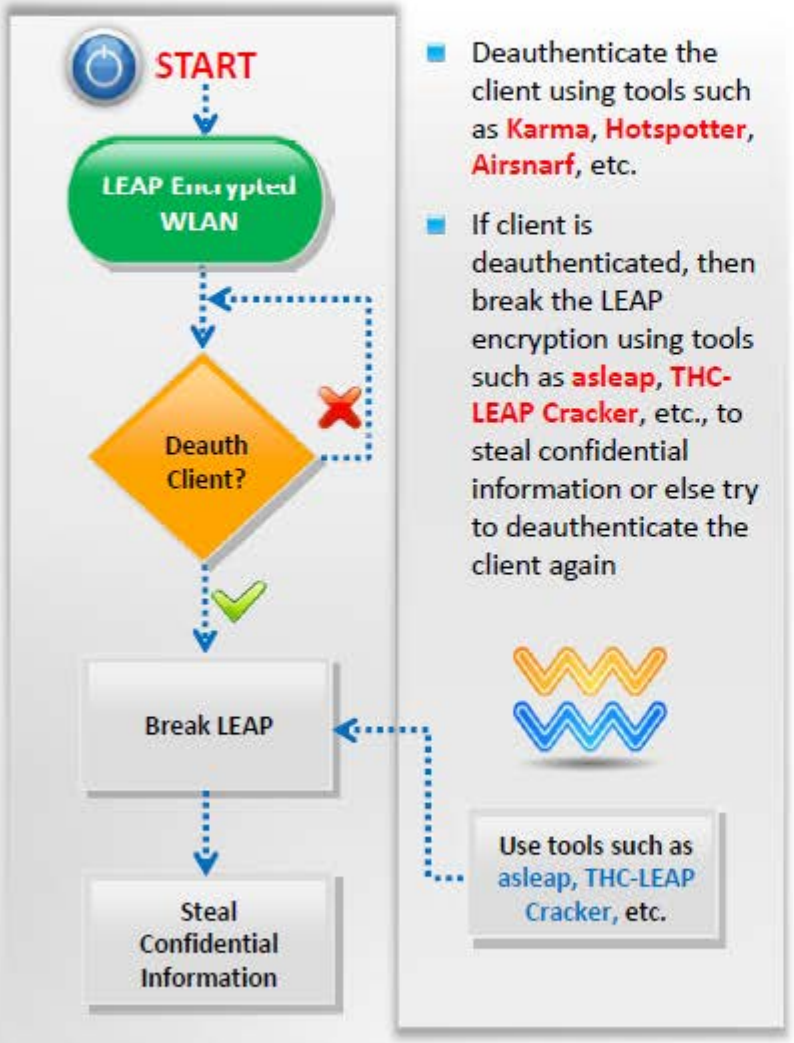
Wi-Fi Pen Testing Framework



General penetration steps for all Wireless networks:

1. Create a rogue access point
2. Deauthenticate the client using the tools such as Karma, Hotspotter, Airsnarf, etc., and then check for client deauthentication
3. If client is deauthenticated, then associate with the client, sniff the traffic and check if passphrase/ certificate is acquired, or else try to deauthenticate the client again
4. If passphrase is acquired, then crack the passphrase using the tool wzcook to steal confidential information or else try to deauthenticate the client again

Pen Testing LEAP Encrypted WLAN

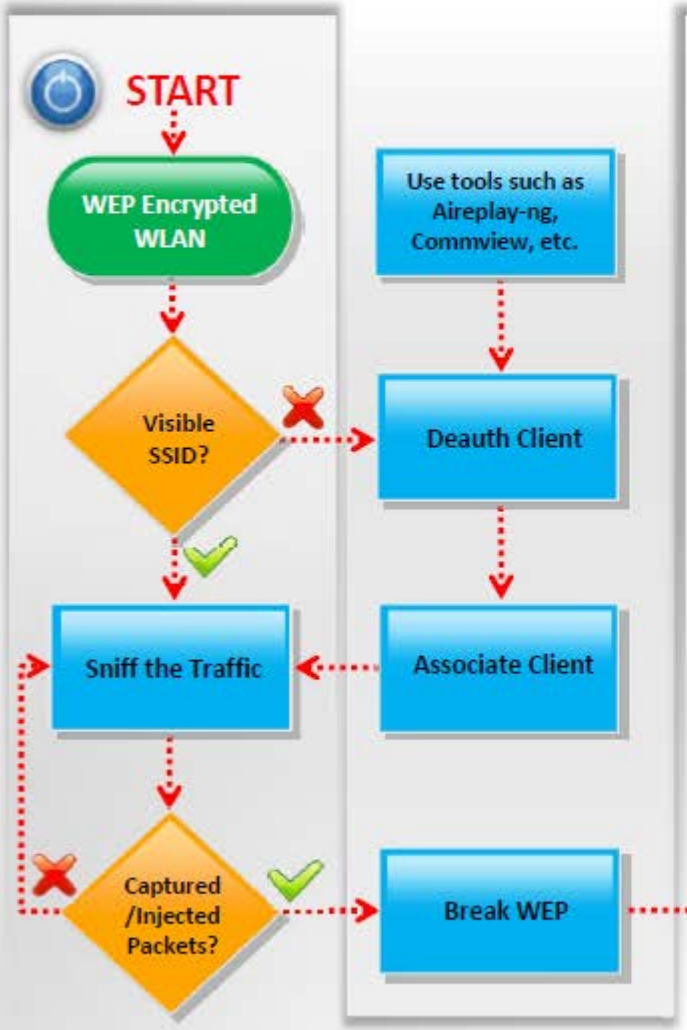


- Deauthenticate the client using tools such as **Karma**, **Hotspotter**, **Airsnarf**, etc.
- If client is deauthenticated, then break the LEAP encryption using tools such as **asleap**, **THC-LEAP Cracker**, etc., to steal confidential information or else try to deauthenticate the client again

Pen Testing WPA/WPA2 Encrypted WLAN

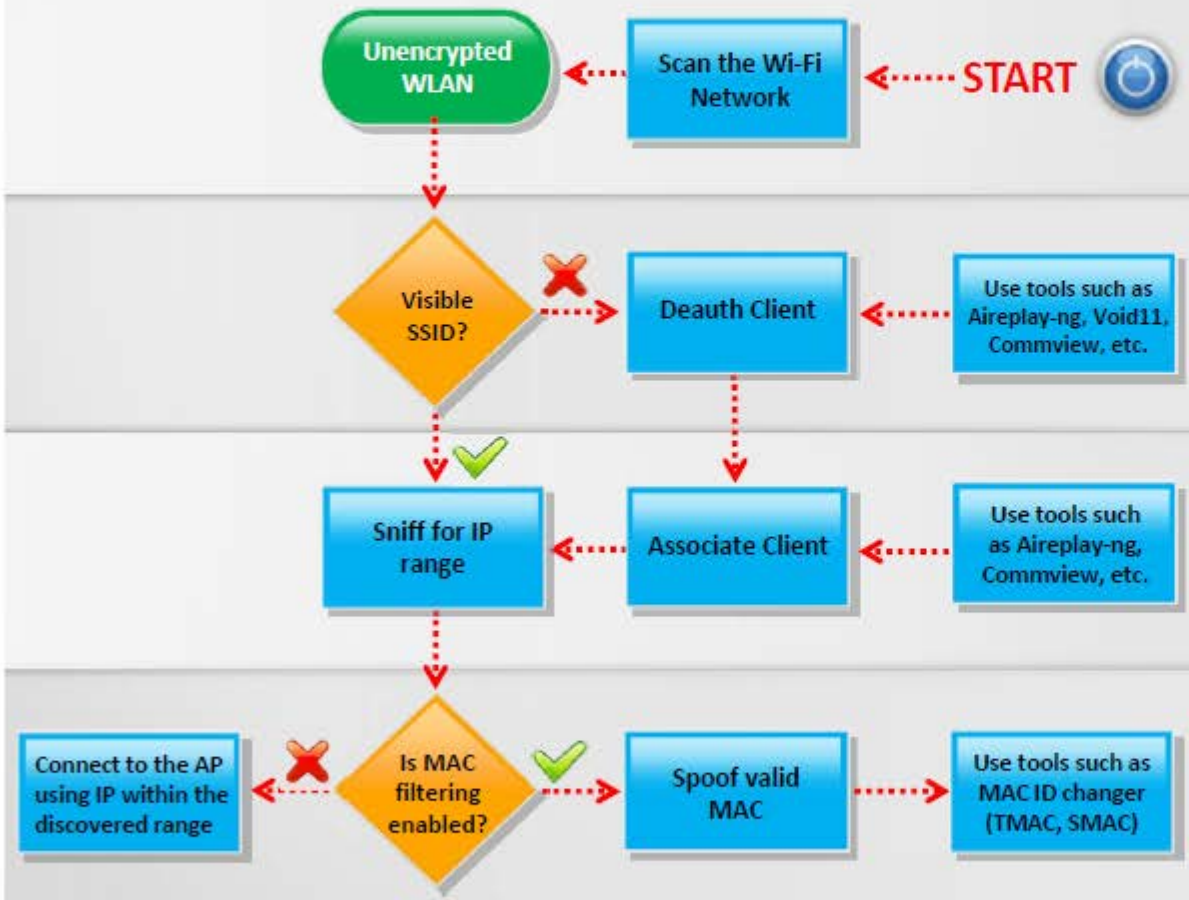
- Deauthenticate the client using tools such as Karma, Hotspotter, Airsnarf, etc.
- If client is deauthenticated, sniff the traffic and then check the status of capturing EAPOL handshake or else try to deauthenticate the client again
- If EAPOL handshake is captured, then perform PSK dictionary attack using tools such as coWPAtty, Aircrack-ng, etc. to steal confidential information or else try to deauthenticate the client again

Pen Testing WEP Encrypted WLAN



- Check if the SSID is visible or hidden
- If SSID is visible, sniff the traffic and then check the status of packet capturing
- If the packets are captured/injected, then break the WEP key using tools such as Aircrack-ng, Airsnort, WEPcrack, etc., or else sniff the traffic again
- If SSID is hidden, then deauthenticate the client using tools such as Aireplay-ng, Commview, etc., associate the client and then follow the procedure of visible SSID

Pen Testing Unencrypted WLAN



- Check if the SSID is visible or hidden
- If SSID is visible, sniff for IP range and then check the status of MAC filtering
- If MAC filtering is enabled, spoof valid MAC using tools such as SMAC or connect to the AP using IP within the discovered range
- If SSID is hidden, discover the SSID using tools such as Aireplay-ng, and follow the procedure of visible SSID

Module Summary

- IEEE 802.11 standards based Wi-Fi networks are widely used for communication and data transfer across a radio network
- A Wi-Fi infrastructure generally consists of hardware components such as wireless routers and APs, antennas, relay towers and authentication servers, and software components such as encryption algorithms, key management and distribution mechanisms
- Most widely used wireless encryption mechanisms include WEP, WPA and WPA2, of which, WPA2 is considered most secure
- WEP uses 24-bit initialization vector (IV) to form stream cipher RC4 for confidentiality, and the CRC-32 checksum for integrity of wireless transmission
- WPA uses TKIP which utilizes the RC4 stream cipher encryption with 128-bit keys and 64-bit keys for authentication whereas WPA2 encrypts the network traffic using a 256 bit key with AES encryption
- WEP is vulnerable to various analytical attack that recovers the key due to its weak IVs whereas WPA is vulnerable to password brute forcing attacks
- Wi-Fi networks are vulnerable to various access control, integrity, confidentiality, availability and authentication attacks
- Wi-Fi attack countermeasures include configuration best practices, SSID settings best practices, authentication best practices and wireless IDS systems