Ethical Hacking and Countermeasures

Version 6

Module XX

Hacking Wireless Networks

Scenario

Clients of Xbrokerage Inc. are furious. None of them are able to logon to its portal. Xbrokerage had recently introduced this portal as an add-on service through which clients could track their shares and trade online.

Being a customer-friendly firm, Xbrokerage allowed wireless access within its office premises.

- Are wireless networks more prone to attacks?
- What could have been a vulnerable point?

Wi-fi users, beware

Hackers prowl public hot spots in order to steal your valuable data

By Joseph De Avila
THE WALL STREET JOURNAL
Monday, February 4, 2008

Next time you are sitting in a hotel lobby checking e-mail on your laptop, be careful: The "businessman" in the next lounge chair may be tracking your every move.

Many Wi-Fi users don't know that hackers posted at hot spots can steal personal information out of the air relatively easily. And savvy criminal hackers aren't settling for just access to credit cards, bank accounts and other personal financial information; they love to sneak into your company's network, too.

Whether you're using a Wi-Fi hot spot at a hotel, airport or cafe, "you've got to assume that anything you are doing is being monitored," said Shawn Henry, the deputy assistant director of the FBI's cybercrimes division.

Home Wi-Fi networks are vulnerable, too, but it is far more fruitful for a hacker to pitch his tent in a busy hotel lobby or convention-center lounge where he can collect data from dozens of users. And Wi-Fi hot spots have proliferated, multiplying the potential targets for hackers. There were 66,921 hot spots in the United States last year, up 56 percent from 2006, according to JiWire Inc, an advertising cmpany. T-Mobile USA Inc. has 8,700 hot spots across the nation in such places as Starbucks and Borders Books & Music. AT&T Inc. has 10,000 hot spots in such places as McDonald's, Barnes & Noble and Coffee Bean & Tea Leaf.

Henry said that businesses that offer Wi-Fi, such as hotels, often don't know that their networks have been breached and many times don't report incidents they know about for fear of bad publicity. Users are frequently unaware they have been hacked. As a result, there aren't solid figures on the number of wireless-hacking incidents. But the FBI for several years has received reports from educational institutions, private security companies, and other federal and local law-enforcement agencies about such attacks.

While the chances any one person will be hacked aren't high, the payoff for criminals can be great, said Tom Brennan, a manager for AccessIT Group, which assesses companies' security vulnerabilities.

In early 2006, when he was working for a different company, Brennan helped a financial institution determine how its data network had been breached. An employee working on a laptop in Midtown Manhattan's Bryant Park used what he thought was a publicly available Wi-Fi signal to get Internet access. But the signal he used had been set up by a hacker. When the employee reached his company's network, the hacker nabbed the employee's corporate user name and password.

Source: *http://www.journalnow.com/*

The Register » Security » Enterprise Security »

Original URL: http://www.theregister.co.uk/2007/10/18/cafe_latte_wi-fi_attack/

Cafe Latte attack steals credentials from Wi-Fi clients

By John Leyden
Published Thursday 18th October 2007 18:40 GMT

Hackers have refined a new technique for breaking into Wi-Fi networks protected by the aging Wired Equivalent Privacy (WEP).

The so-called 'Cafe Latte' attack aims to retrieve the WEP keys from the PCs of road warriors. The approach concentrates its attack on wireless clients, as opposed to earlier attacks that cracked the key on wireless networks after sniffing a sufficient amount of traffic on a network.

"At its core, the attack uses various behavioral characteristics of the Windows wireless stack along with already known flaws in WEP," explains Vivek Ramachandran, a security researcher at AirTight Networks, who will demonstrate (http://toorcon.org/2007/event.php?id=25) the approach at the Toorcon hacking conference in San Diego this weekend (19-21 October). "Depending upon the network configuration of the authorised network we will show that it is possible to recover the WEP key from an isolated Client within a time slot ranging between just a few minutes to a couple of hours."

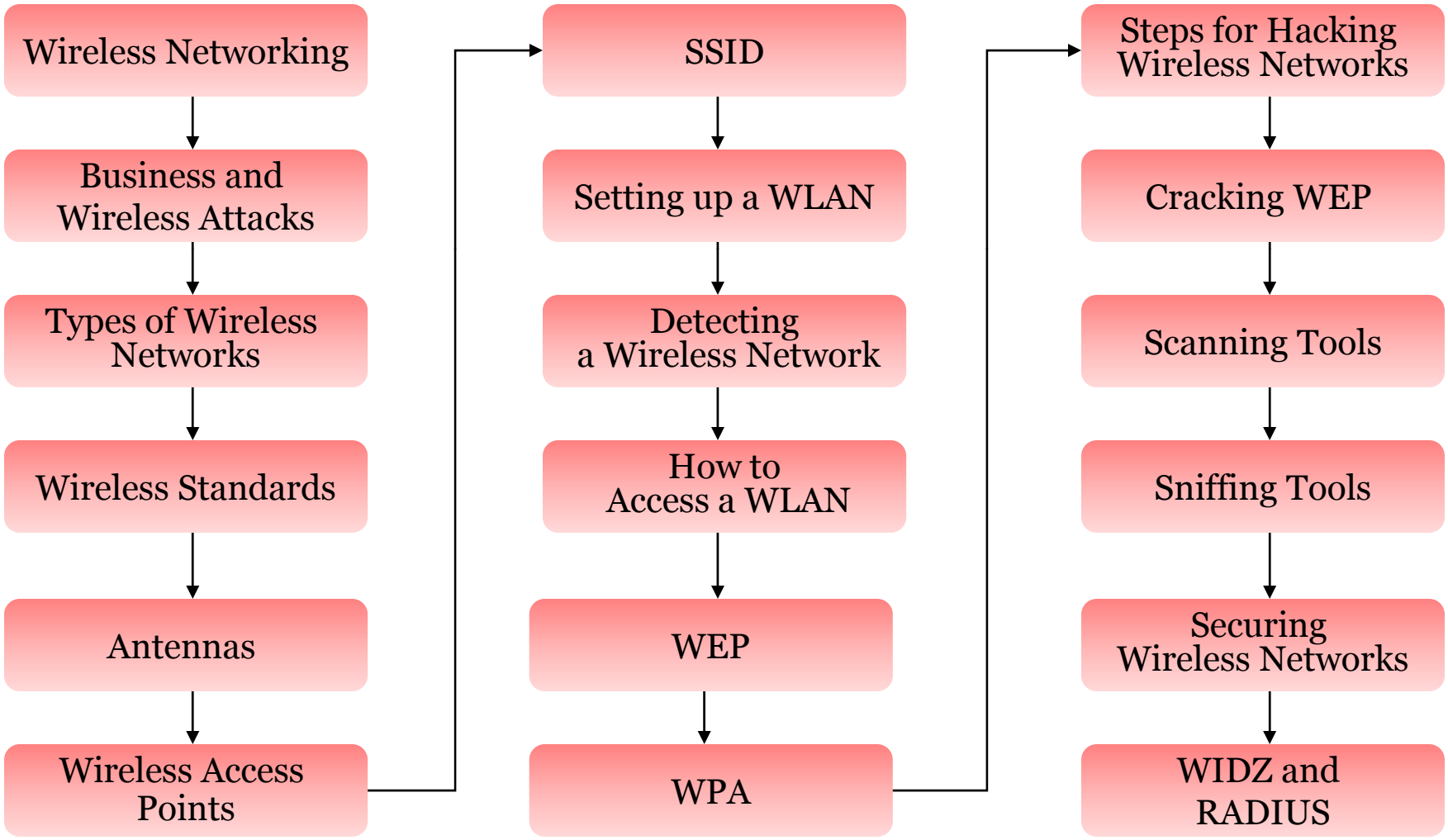
Source: *http://www.theregister.co.uk/*

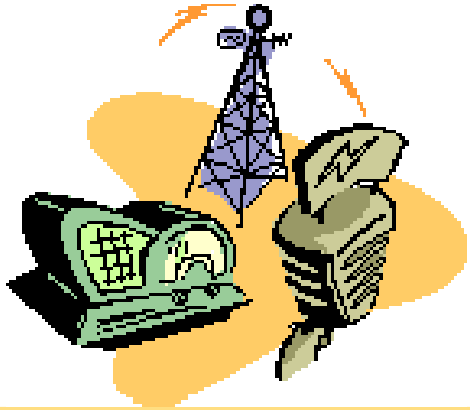
Module Objective

This module will familiarize you with :

- Concept of Wireless Networking
- Effects of Wireless Attacks on Business
- Types of Wireless Networks
- Wireless Standards
- Antennas
- Wireless Access Points
- SSID
- Setting up a WLAN
- Detecting a Wireless Network
- How to Access a WLAN
- Wired Equivalent Privacy
- Wi-Fi Protected Access
- Steps for Hacking Wireless Networks
- Cracking WEP
- Tools for Scanning
- Tools for Sniffing
- Securing Wireless Networks
- WIDZ and RADIUS

Module Flow





Introduction to Wireless

Introduction to Wireless Networking

Wireless networking technology is becoming increasingly popular and at the same time has introduced several security issues

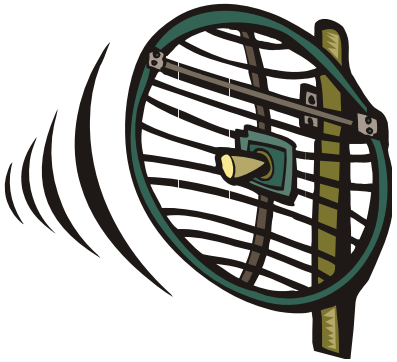
The popularity of wireless technology is driven by two primary factors: convenience and cost

A Wireless Local Area Network (WLAN) allows workers to access digital resources without being locked to their desks

Laptops can be carried to meetings, or even to Starbucks, and connected to a wireless network. This convenience has become more affordable

Wired Network vs. Wireless Network

- Wired networks offer more and better security options than wireless
- More thoroughly established standards with wired networks
- Wireless networks are much more equipment-dependent than wired networks
- It is easier to implement security policies on wired networks



Effects of Wireless Attacks on Business

As more and more firms adopt wireless networks, security becomes more crucial

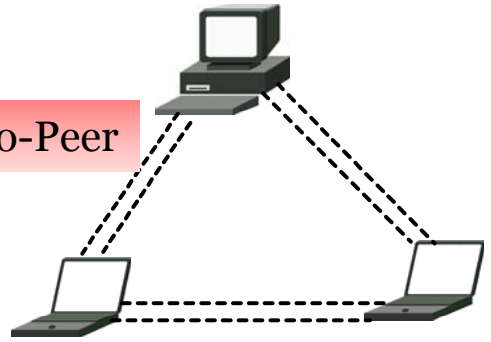
Business is at high risk from whackers (wireless hackers) who do not require physical entry into a business network to hack, but can easily compromise the network with the help of freely available tools

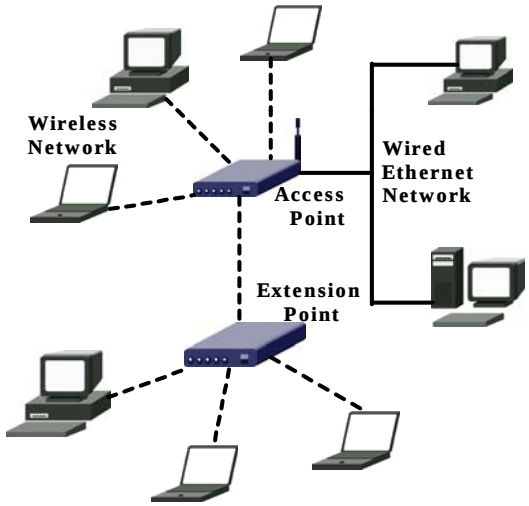
Warchalking, Wardriving, and Warflying are some of the ways in which a whacker can assess the vulnerability of a firm's network

Types of Wireless Network

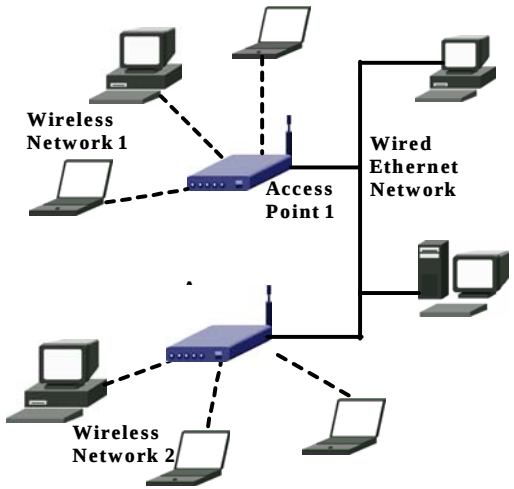
There are four basic types:

Peer-to-Peer

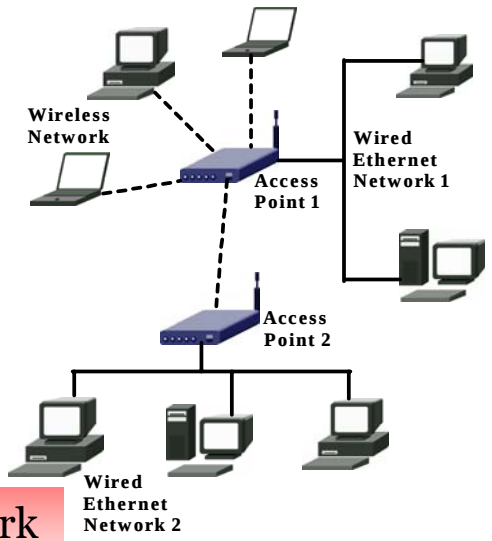




Extension to a wired network



Multiple access points



LAN-to-LAN wireless network

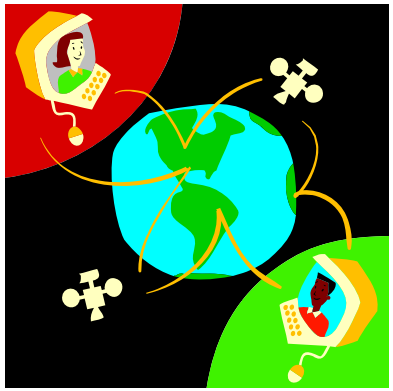
Advantages and Disadvantages of a Wireless Network

Advantages:

- Mobility (easy)
- Cost-effective in the initial phase
- Easy connection
- Different ways to transmit data
- Easy sharing

Disadvantages:

- Mobility (insecure)
- High cost post-implementation
- No physical protection of networks
- Hacking has become more convenient
- Risk of data sharing is high



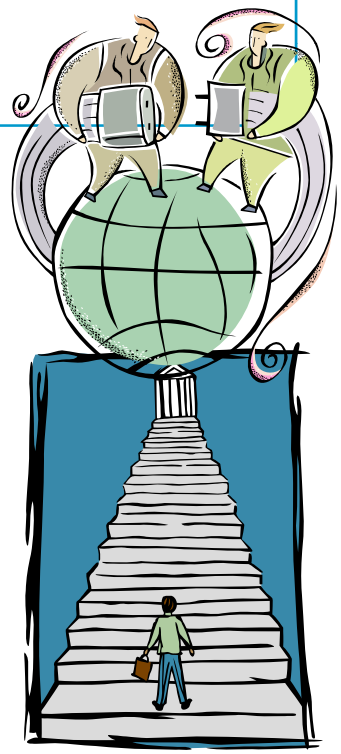
Wireless Standards

Wireless Standards

The first wireless standard was 802.11

It defines three physical layers:

- Frequency Hopping Spread Spectrum (FHSS)
- Direct Sequence Spread Spectrum (DSSS)
- Infrared



802.11a: More channels, high speed, and less interference

802.11b: Protocol of Wi-Fi revolution, de facto standard

802.11g: Similar to 802.11b, only faster

802.11i: Improves WLAN security

802.16: Long distance wireless infrastructure

Bluetooth: Cable replacement option

900 MHz: Low speed, coverage, and backward compatibility

Wireless Standard: 802.11a

- 802.11a works at 40mhz in the 5g hz range
- It's theoretical transfer rate is of up to 54 mpbs
- It's actual transfer rates is of about 26.4 mbps
- It is limited in use because it is almost a line of sight transmittal that necessitates multiple WAPs (wireless access points)
- It cannot operate in same range as 802.11b/g
- It is absorbed more easily than other wireless implementations

Wireless Standard: 802.11b – "WiFi"

WiFi operates at 20 MHz in the 2.4 GHz range

It is the most widely used and accepted form of wireless networking

It has theoretical speeds of upto 11 mbps

Actual speeds depend on implementation:

- 5.9 mbps when TCP (Transmission Control Protocol) is used (error checking)
- 7.1 mbps when UDP (User Datagram Protocol) is used (no error checking)

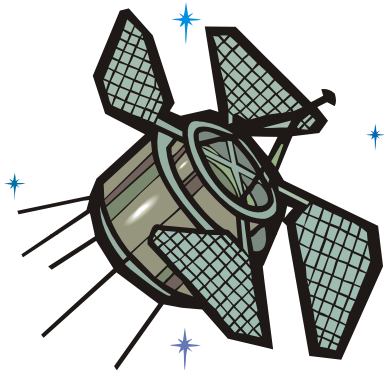
It can transmit upto 8 kms in the city

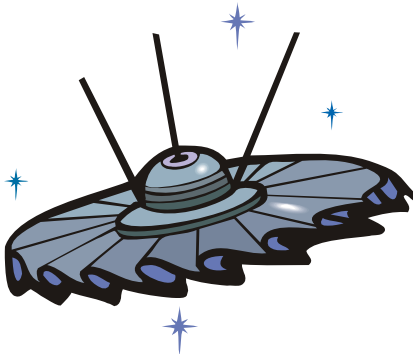
Wireless Standard: 802.11b – "WiFi" (cont'd)

802.11b – "WiFi" is not as easily absorbed as 802.11a signal

It can cause or receive interference from:

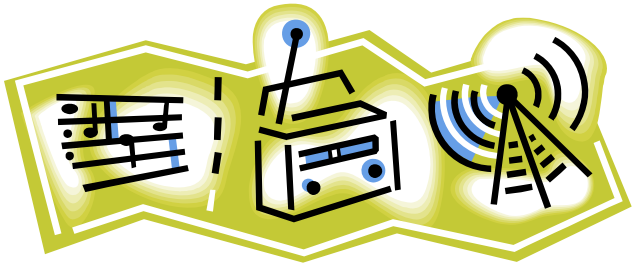
- Microwave ovens (microwaves in general)
- Wireless telephones
- Other wireless appliances operating in the same frequency





Wireless Standard: 802.11g

- 802.11g operates at the same frequency range as 802.11b
- It has theoretical throughput of 54 Mpbs
- Actual transmission rate is dependent on several factors, but averages 24.7 mbps
- Logical upgrade from 802.11b wireless networks – backwards compatibility
- It suffers from same limitations as 802.11b network
- System may suffer significant decrease in network speeds if network is not completely upgraded from 802.11b



Wireless Standard: 802.11i

802.11i is a standard for wireless local area networks that provides improved encryption for networks that use the popular 802.11a, 802.11b & 802.11g standards

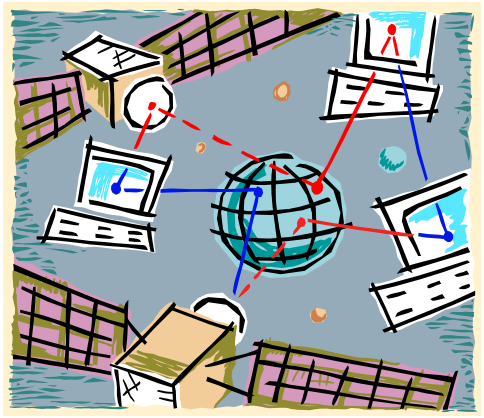
The 802.11i standard was officially ratified by the IEEE in June, 2004

Security is made up of three factors:

- 802.1x for Authentication (EAP and Authentication Server)
- Robust Security Network (RSN) to keep track of associations
- Counter-Mode/CBC-Mac Protocol (CCMP) to provide confidentiality, integrity, and origin authentication

Wireless Standard: 802.11n

The 802.11n standard, which will be based on multiple-in/multiple out (MIMO) technology, is expected to boost throughput to potentially well over 100 Mbps



Wireless Concepts and Devices

Related Technology and Carrier Networks

- CDPD: Cellular Digital Packet Data (TDMA)
- 1xRTT on CDMA (Code Division Multiple Access): Mobile phone carrier networks
- GPRS: General Packet Radio Service on GSM (Global System for Mobile Communications)
- FRS (Family Radio Service) and GMRS (General Mobile Radio Service): Radio services
- HPNA (Home Phone Networking Alliance) and Powerline Ethernet: Non-traditional networking protocols
- 802.1x: Port security for network communications
- BSS (Basic Service Set): Access point ~ bridges wired and wireless network
- IBSS (Independent Basic Service Set): Peer-to-peer or ad-hoc operation mode

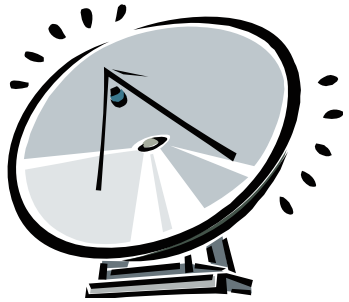
Antennas

Antennas are important for sending and receiving radio waves

They convert electrical impulses into radio waves and vice versa

There are two types of antennas:

- Omni-directional antennas
- Directional antennas



Can antennas are also popular in the wireless community and are used mostly for personal use

Cantenna

Super Cantenna™
Wireless Network Antenna

What's a Cantenna | How to use it | More Answers | Cantenna Store

What is a Cantenna?

If you've never heard of a Cantenna, don't worry your not alone. A Cantenna is simply an inexpensive version of the long range antennas used by wireless internet providers and mobile phone companies. It is ideally suited for sending or receiving wireless signals in the 2.4 GHz ISM band (802.11b). Now, with your own Cantenna you can extend the range of your wireless network or connect to other wireless networks in your neighborhood.

FEATURES:

The Can
Our engineers have optimized can length and diameter for maximum signal strength and distance. Made from light-weight metal.

Connector (n-female)
Connect to your Super Cantenna with industry standard cables and connectors.

Mounting Socket
Cantenna is designed with a socket for easy mounting on camera tripods and other mouting hardware.

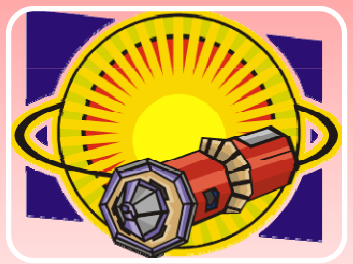
Includes instructions and red plastic protection lid.

BUY IT NOW!

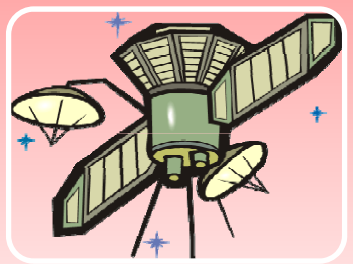
Above, a side-by-side photograph of the Super Cantenna and Pringles can is shown.

Increase the range of your wireless connection with the Super Cantenna. All Cantenna parts are engineered to be compatible with 802.11b Wireless Networks.

Wireless Access Points



An access point is a piece of wireless communications hardware that creates a central point of wireless connectivity



Similar to a "hub," the access point is a common connection point for devices in a wireless network

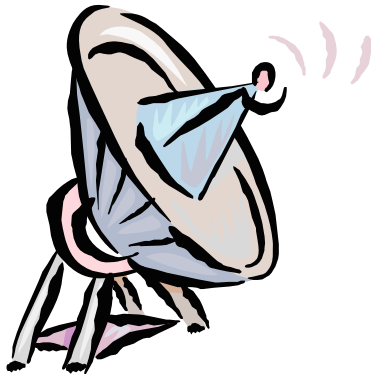
Wireless access points must be deployed and managed in common areas of the campus, and they must be coordinated with telecommunications and network managers

SSID

The SSID is a unique identifier that wireless networking devices use to establish and maintain wireless connectivity

An SSID acts as a single shared identifier between access points and clients

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



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”

Beacon Frames

Beacon frames broadcast the SSID:

- Helps users to locate available networks
- Layer 2 management frames
- Networks without BFs are called “closed networks”:
  - Simply means that the SSID is not broadcast anymore
  - Weak attempt at security through obscurity, to make the presence of the network less obvious
  - BSSIDs are revealed as soon as a single frame is sent by any member station
  - Mapping between SSIDs and BSSIDs is revealed by several management frames that are not encrypted

Is the SSID a Secret

Stations looking for an access point send the SSID they are looking for in a "probe request"

Access points answer with a "probe reply" frame, which contains the SSID and BSSID pair

Stations wanting to become part of a BSS send an association request frame, which also contains the SSID/BSSID pair in cleartext:

- As do reassociation requests (see next slides) and their response

Therefore, the SSID remains secret only on closed networks with no activity

Closed networks are mainly inconvenient to legitimate users

Setting up a WLAN

The channel and service set identifier (SSID) must be configured when setting up a WLAN in addition to traditional network settings such as IP address and a subnet mask

The channel is a number between 1 and 11 (between 1 and 13 in Europe) and it designates the frequency on which the network will operate

The SSID is an alphanumeric string that differentiates networks operating on the same channel

It is essentially a configurable name that identifies an individual network. These settings are important factors when identifying WLANs and sniffing traffic

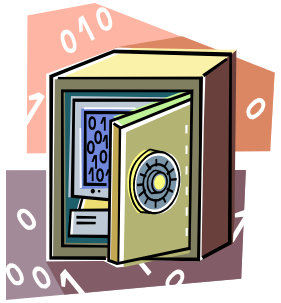
Authentication and Association

To become part of a BSS, a station must first authenticate itself to the network:

- Then, it will request association to a specific access point

The access point is in charge of authentication and is accepting the association of the station:

- Unless an add-on authentication system (e.g., Radius) is used



MAC address is trusted as giving the correct identity of the station or access point:

- How can this be abused?

Authentication Modes

Authentication is done by:

- A station providing the correct SSID
- Or, through "the shared key authentication:
  - Access point and all base stations share a secret encryption key which is:
    - Difficult to deploy
    - Difficult to change
    - Difficult to keep secret
    - No accountability
  - A station encrypting with **WEP;** a challenge text provided by the access point
  - An eavesdropper gaining both the plaintext and the cyphertext by:
    - Performing a known plaintext attack
    - This authentication which helps to crack WEP encryption

The 802.1X Authentication Process

For 802.1X authentication to work on a wireless network, AP must be able to securely identify traffic from a particular wireless client

This identification is accomplished by using authentication keys that are sent to the AP and the wireless client from the RADIUS server

When a wireless client (802.1X supplicant) comes within the range of the AP (802.1X authenticator), the simplified process as given in the next slide occurs:

The 802.1X Authentication Process (cont'd)

1. The AP point issues a challenge to the wireless client
2. The wireless client responds with its identity
3. The AP forwards the identity to the RADIUS server using the uncontrolled port
4. The RADIUS server sends a request to the wireless station via the AP specifying the authentication mechanism to be used
5. The wireless station responds to the RADIUS server with its credentials via the AP
6. The RADIUS server sends an encrypted authentication key to the AP if the credentials are acceptable
7. The AP generates a multicast/global authentication key encrypted with a per-station unicast session key, and transmits it to the wireless station

WEP and WPA

Wired Equivalent Privacy (WEP)

WEP is a component of the IEEE 802.11 WLAN standards

Its primary purpose is to provide confidentiality of the data on wireless networks at a level equivalent to wired LANs

Wired LANs typically employ physical controls to prevent unauthorized users from connecting to the network and viewing data

In a wireless LAN, the network can be accessed without physically connecting to the LAN

IEEE chose to employ encryption at the data link layer to prevent unauthorized eavesdropping on a network

- This is accomplished by encrypting data with the RC4 encryption algorithm

Wired Equivalent Privacy (cont'd)

Cryptographic mechanism is used to defend against threats

It is developed without :

- Academic or public review
- Review from cryptologists

It has significant vulnerabilities and design flaws

Only about a quarter to a third of wireless access points use WEP:

- Tam et al. 2002
- Hamilton 2002
- Pickard and Cracknell 2001, 2003

Wired Equivalent Privacy (cont'd)

WEP is a stream cipher:

- It uses RC-4 to produce a stream of bytes that are XORed with the plaintext
- The input to the stream cipher algorithm is an "initial value" (IV) sent in plaintext and a secret key
- IV is 24 bits long
- Length of the secret is either 40 or 104 bits, for a total length for the IV and secret of 64 or 128 bits
- Marketing publicized the larger number, implying that the secret was a 64 or 128 bit number, in a classical case of deceptive advertising:
  - How else can you call a protection that is 16.8 million times weaker than advertised?

WEP Issues

CRC32 is not sufficient to ensure complete cryptographic integrity of a packet

- By capturing two packets, an attacker can reliably flip a bit in the encrypted stream, and modify the checksum so that the packet is accepted

IV's are 24 bits

- An AP broadcasting 1500 byte packets at 11 Mb/s would exhaust the entire IV Space in five hours

Known Plaintext Attacks

- When there is IV Collision, it becomes possible to reconstruct the RC4 keystream based on the IV and the decrypted payload of the packet

WEP Issues (cont'd)

Dictionary Attacks

- WEP is based on a password

Denial of Services

- Associate and Disassociate messages are not authenticated

Eventually, an attacker can construct a decryption table of reconstructed key streams

- With about 24 GB of space, an attacker can use this table to decrypt WEP Packets in real-time

WEP Issues (cont'd)

A lack of centralized key management makes it difficult to change WEP keys with any regularity

IV is a value that is used to randomize the key stream value and each packet has IV value

- The standard only allows 24 bits, which can be used within hours at a busy AP
- IV values will be reused

The standard does not dictate that each packet must have a unique IV, so vendors use only a small part of the available 24-bit possibilities

- A mechanism that depends on randomness is not random at all and attackers can easily figure out the key stream and decrypt other messages

WEP - Authentication Phase

When a wireless station wants to access a network, it sends a probe request packet on all channels so that any AP in range will respond

The AP responds with packets containing the AP's SSID and other network information

- When open system authentication (OSA) is configured, the station will send an authentication request to the AP and the AP will make an access decision based on its policy
- When shared key authentication (SKA) is configured, the AP will send a challenge to the station and the station encrypts it with its WEP key and sends it back to the AP
  - If the AP obtains the challenge value, the station is authorized

WEP - Shared Key Authentication

The Requesting Station sends the challenge text

The Receiving Station:

- Decrypts the challenge using the same shared key
- Compares it to the challenge text sent earlier
- If they match, an acknowledgement is sent
- If they do not match, a negative authentication notice is sent

Once acknowledged, the transmission is sent

WEP - Association Phase

After the authentication phase, the station will send an association request packet to the AP

If the AP has a policy to allow this station to access the network, it will associate the station to itself by placing the station in its association table

A wireless device has to be associated with an AP to access network resources, and not just authenticated

The authentication and association phases authorize the device, and not the user

There is no way to know if an unauthorized user has stolen and is using an authorized device

WEP Flaws

Two basic flaws undermine its ability to protect against a serious attack:

No defined method for encryption key distribution

- Pre-shared keys were set once at installation and are rarely (if ever) changed

Use of RC4 which was designed to be a one-time cipher and not intended for multiple message use

- As the pre-shared key is rarely changed, the same key is used over and over
- An attacker monitors traffic and finds enough examples to work out the plaintext from message context and with knowledge of the ciphertext and plaintext, he/she can compute the key

What is WPA

- WPA is not an official IEEE standard, but will be compatible with the upcoming 802.11i security standard
- It (Wi-Fi Protected Access) is a data encryption method for 802.11 WLANs
- It resolves the issue of weak WEP headers, which are called initialization vectors (IVs)
- It is designed to be a software upgrade
- With WPA, the rekeying of global encryption keys is required

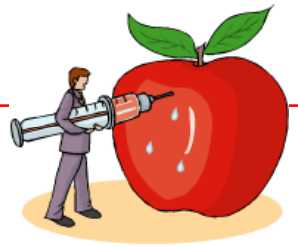
WPA (cont'd)

Wi-Fi Protected Access:

- Stop-gap solution that solves issues related to the WEP encryption itself:
  - IVs are larger (48 bits instead of 24)
  - Shared key is used more rarely:
    - Used to negotiate and communicate "temporal keys"
  - "Temporal keys" are used to encrypt packets instead
- Does not solve issues with the management frames
- Collision avoidance mechanism can still be exploited
- Can be supported by most of the 802.11b hardware

WPA Vulnerabilities

Denial-of-service attack:



- Attacker injects or corrupts packets
- IV and message hash are checked before MIC to reduce the number of false positives
- Only way around this is to use WEP

Pre-shared key dictionary attack:

- Weak passphrase is used to generate pre-shared key
- Comprises of 14 characters or less that form words
- More than 14 characters that do not form words are almost impossible to crack

WEP, WPA, and WPA2

WEP is weak and fails to meet any of its goals

WPA fixes most of WEP's problems, but adds some new vulnerabilities

WPA2 is expected to make wireless networks as secure as wired networks

WPA2 Wi-Fi Protected Access 2

WPA2 is compatible with the 802.11i standard

It provides government grade security by implementing the National Institute of Standards and Technology (NIST) FIPS 140-2 compliant AES encryption algorithm

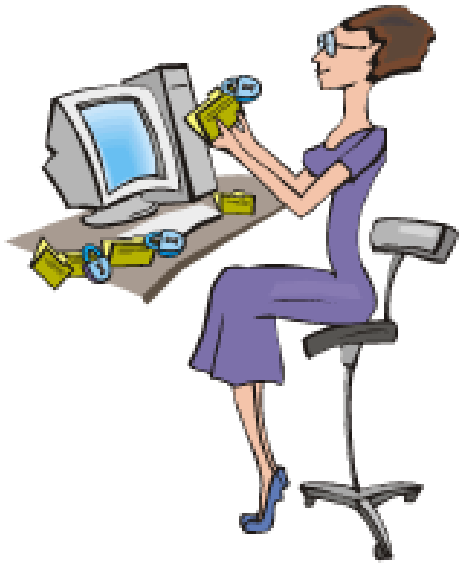
It offers two modes of operation:

- Enterprise: Verifies network users through a server
- Personal: Protects unauthorized network access by utilizing a set-up password

WPA2 Wi-Fi Protected Access 2 (cont'd)

Features:

- WPA2 authentication
- WPA2 key management
- Temporal Key management
- Michael Algorithm
- AES support
- Supporting a mixture of WPA and WEP wireless clients



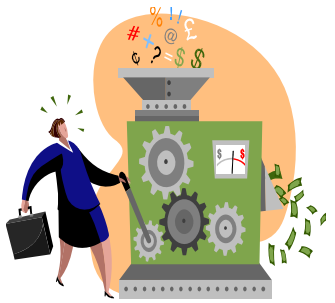
Attacks and Hacking Tools

Terminologies

WarWalking – Walking around to look for open wireless networks

Wardriving – Driving around to look for open wireless networks

WarFlying – Flying around to look for open wireless networks

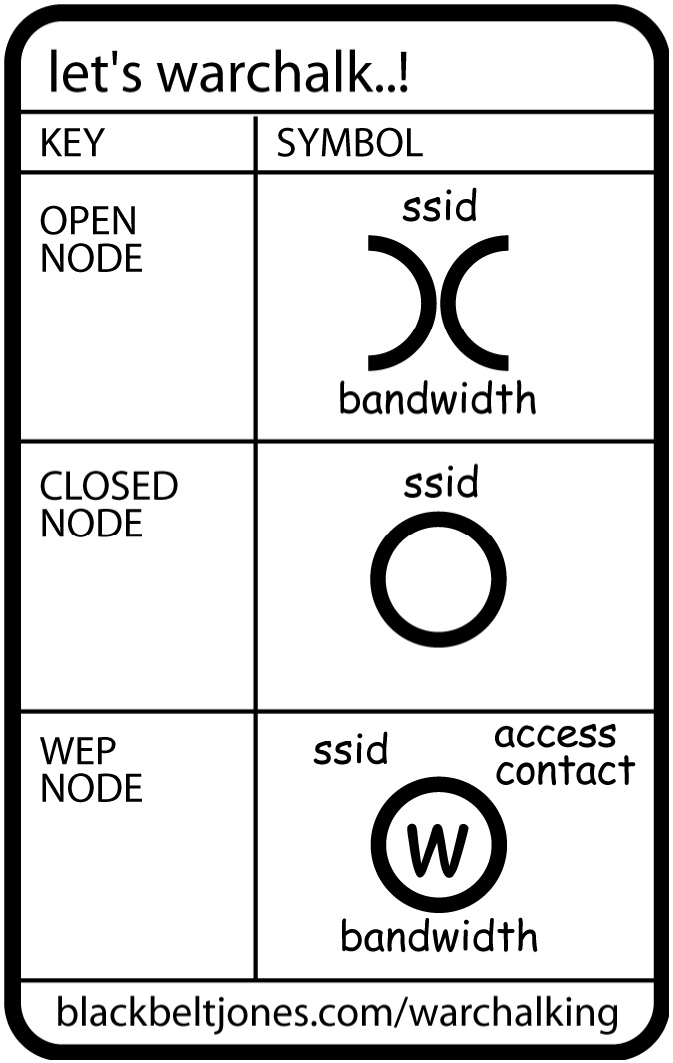


WarChalking – Using chalk to identify available open networks

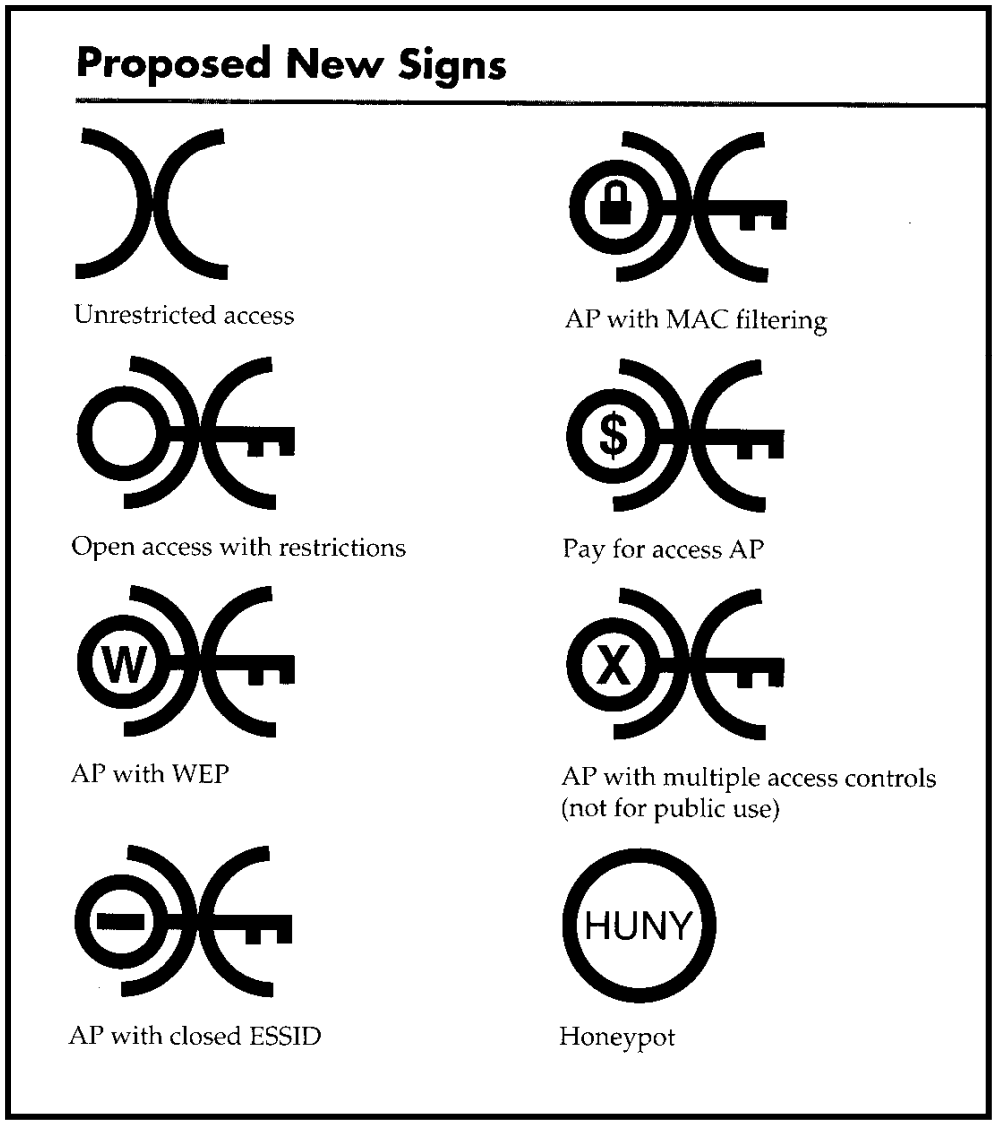
Blue jacking – Temporarily hijacking another person's cell phone using Bluetooth technology

Global Positioning System (GPS) – It can be used to help map the open networks that are found

WarChalking



WarChalking



WarChalking

WarChalking

Authentication and (Dis)Association Attacks

Any station can impersonate another station or access point and attack or interfere with the authentication and association mechanisms:

- As these frames are not encrypted, the difficulty is trivial

Disassociation and deauthentication frames:

- A station receiving one of those frames must redo the authentication and association processes
- With a single short frame, an attacker can delay the transmission of data and require the station and real access point to redo these processes:
  - This takes several frames to perform

WEP Attack

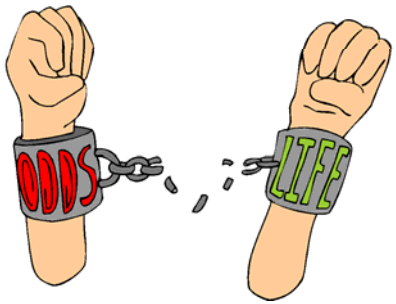
WEP attack takes at least 10,000 packets to discover the key

- A large amount of known data is the fastest way of determining as many key streams as possible

Wep Weggie (part of BSD-Airtools) can be used to generate a large number of small packets:

- The information may be as innocuous as the fields in the protocol header or the DNS name query
- Monitoring is passive and therefore undetectable
- Simple tools and instructions are readily available to recover the key

Cracking WEP



Passive attacks:

- The presence of the attacker does not change traffic, until WEP has been cracked

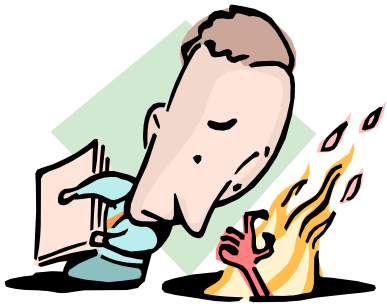
Active attacks:

- Active attacks increase the risk of being detected, but are more capable
- If an active attack is reasonable (i.e., the risk of detection is disregarded), the goal is to stimulate traffic:
  - Collects more pads and uses of weak IVs
  - Some attacks require only one pad

Weak Keys (a.k.a. Weak IVs)

Some IVs can reveal information about the secret key depending upon how RC4 is used in WEP:

- Mathematical details out of the scope of this material



Attack

- FMS (Fluhrer et al. 2001) cryptographic attack on WEP
- Practicality demonstrated by Stubblefield et al. (2001)
- Collection of the first encrypted octet of several million packets
- Exploits:
  - WEPcrack (Rager 2001)
  - Airsnort (Bruestle et al. 2001)
- Key can be recovered within a second (after collecting the data)

Problems with WEP's Key Stream and Reuse

- Secret key never changes, only the initialization vectors
- Initialization vectors are sent unencrypted
- If two messages with the same initialization vector are intercepted it is possible to obtain the plaintext
- Initialization vectors are commonly reused
- Initialization vectors can be used up in less than 1 hour
- Attackers can inject a known plaintext and re-capture the ciphertext
- It leaves WEP susceptible to replay attacks

Automated WEP Crackers

AiroPeek (Commercial)	• Easy-to-use, flexible, and sophisticated analyzer
WEPCrack, AirSnort	• Implementations of the FMA attack
NetStumbler	• This is a popular network discovery tool, with GPS support. It does not perform any cracking. A Mac OS equivalent is named "iStumbler"
KisMAC	• This is a Mac OS X tool for network discovery and cracking WEP with several different methods
Kismet	• Swiss-army knife

Pad-Collection Attacks

There is (should be) a different pad for every encrypted packet that is sent between an AP and a station

By mapping pads to IVs, you can build up a table and skip the RC4 step:

- The stream is never longer than 1500 bytes (the maximum Ethernet frame size)
- The 24 bit-IV provides 16,777,216 (256^3) possible streams, so all the pads can fit inside 25,165,824,000 bytes (23.4 GB)

You never have to have the WEP key:

- Once you have a complete table, it is as good as having the WEP key

XOR Encryption

```
0 XOR 0 = 0
1 XOR 0 = 1
1 XOR 1 = 0
(z XOR y) XOR z = y
(z XOR y) XOR y = z
```

Works independently when z or y is the "plaintext," "pad", or "ciphertext"

	1101	Plaintext
XOR	1001	Keystream
	0100	Ciphertext

Stream Cipher

Given an IV and secret key, the stream of bytes (pad) produced is always the same:

- Pad XOR plaintext = ciphertext

If an IV is ever reused, then the pad is the same

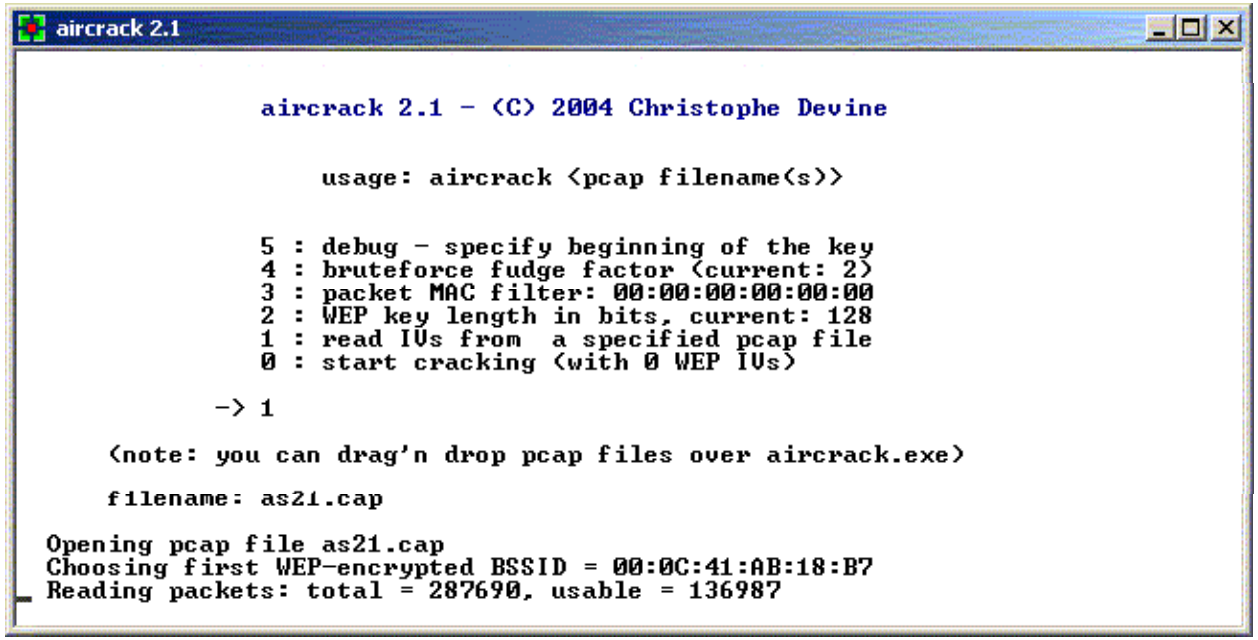
Knowing all pads is equivalent to knowing the secret

Application to WEP:

- The pad is generated from the combination between the IV and the WEP key passed through RC4
- Knowing all pads is equivalent to knowing the 40 or 104-bit secret:
  - "Weak" IVs reveal additional information about the secret

WEP Tool: Aircrack

- Aircrack is a 802.11 sniffer and WEP key cracker
- It recovers 40-bit or 104-bit WEP key
- It implements FMS attack with some new attacks
- It supports Windows, Linux, and Mac OS



Aircrack-ng

Aircrack-ng is an 802.11 WEP and WPA-PSK keys cracking program which recovers keys when the data packets are captured

The features of Aircrack-ng are:

- Better documentation(wiki, manpages) and support
- More cards/drivers supported
- More OS and platforms supported
- WEP dictionary attack
- Improved cracking speed
- Optimizations, other improvements, and bug fixing

WEP Tool: AirSnort

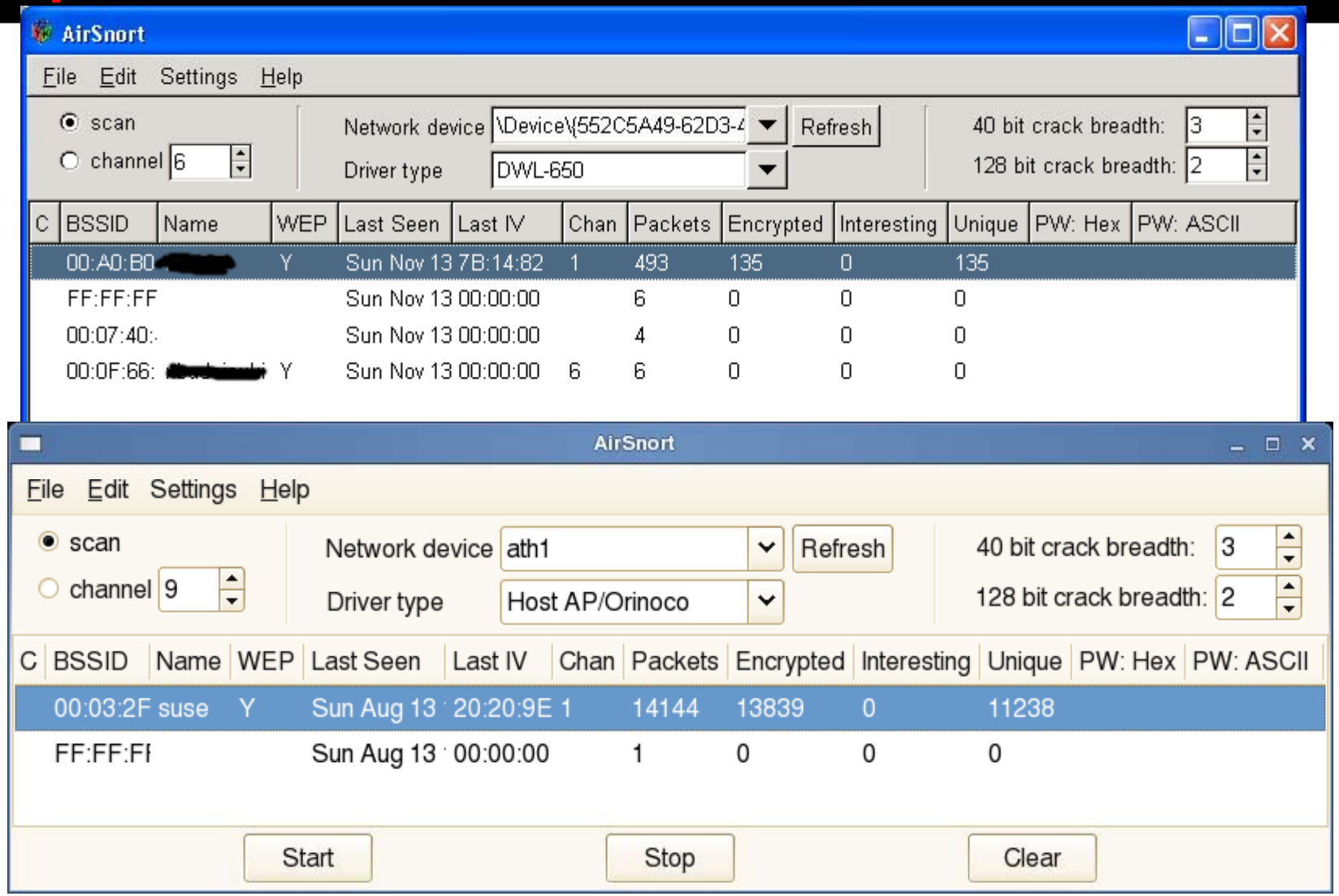
AirSnort is a wireless LAN (WLAN) tool that recovers encryption keys on 802.11b WEP networks

It operates by passively monitoring transmissions and computing the encryption key when enough packets have been gathered

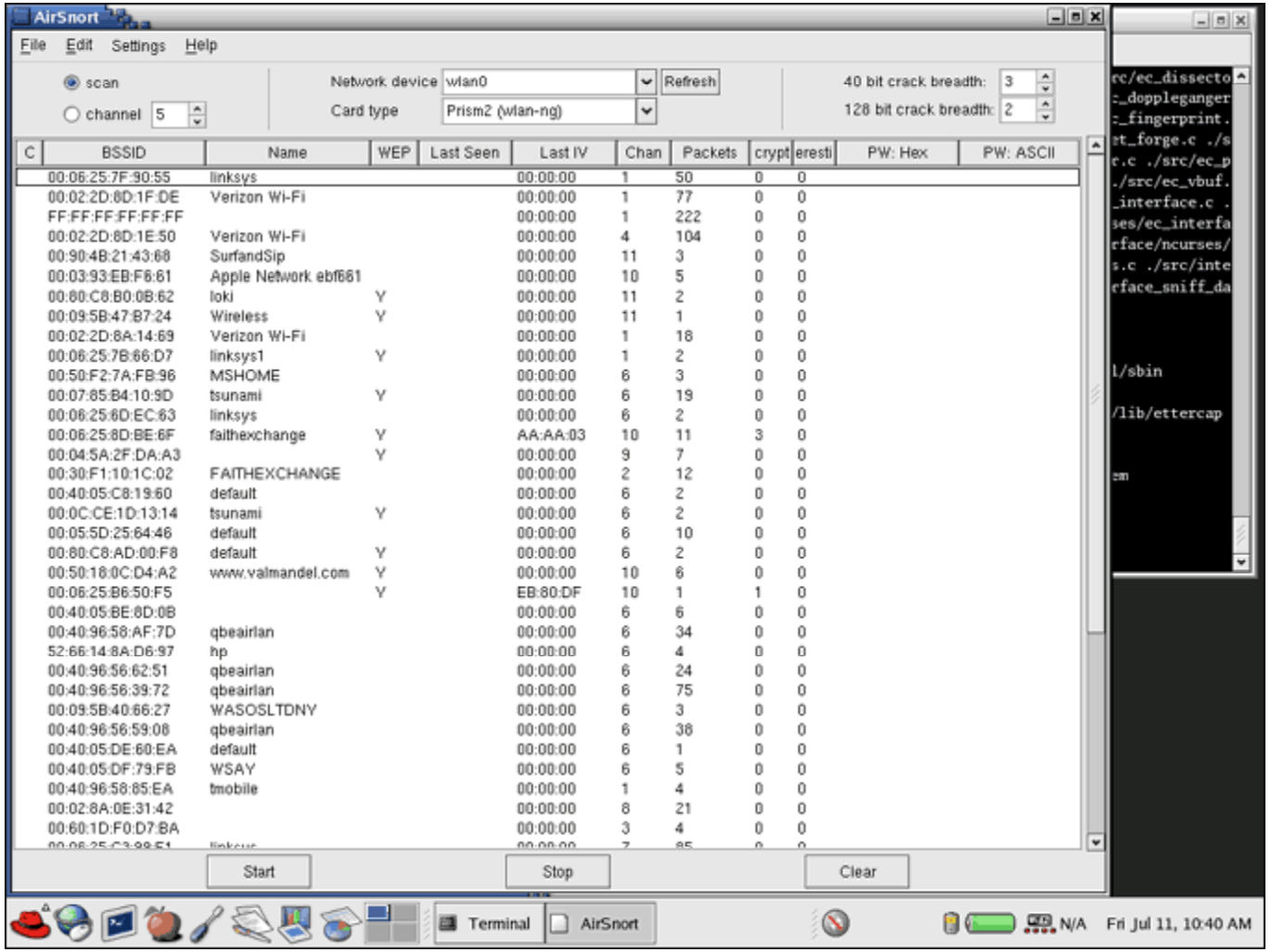
It runs under Linux, and requires that the wireless NIC be capable of rf monitor mode, and that it passes monitor mode packets up via the PF_PACKET interface

Source: *http://airsnort.shmoo.com/*

AirSnort: Screenshot 1



AirSnort: Screenshot 2



WEP Tool: WEPCrack

WEPCrack is an open source tool for breaking 802.11 WEP secret keys

This tool is an implementation of the attack described by Fluhrer, Mantin, and Shamir in the paper "*Weaknesses in the Key Scheduling Algorithm of RC4*"

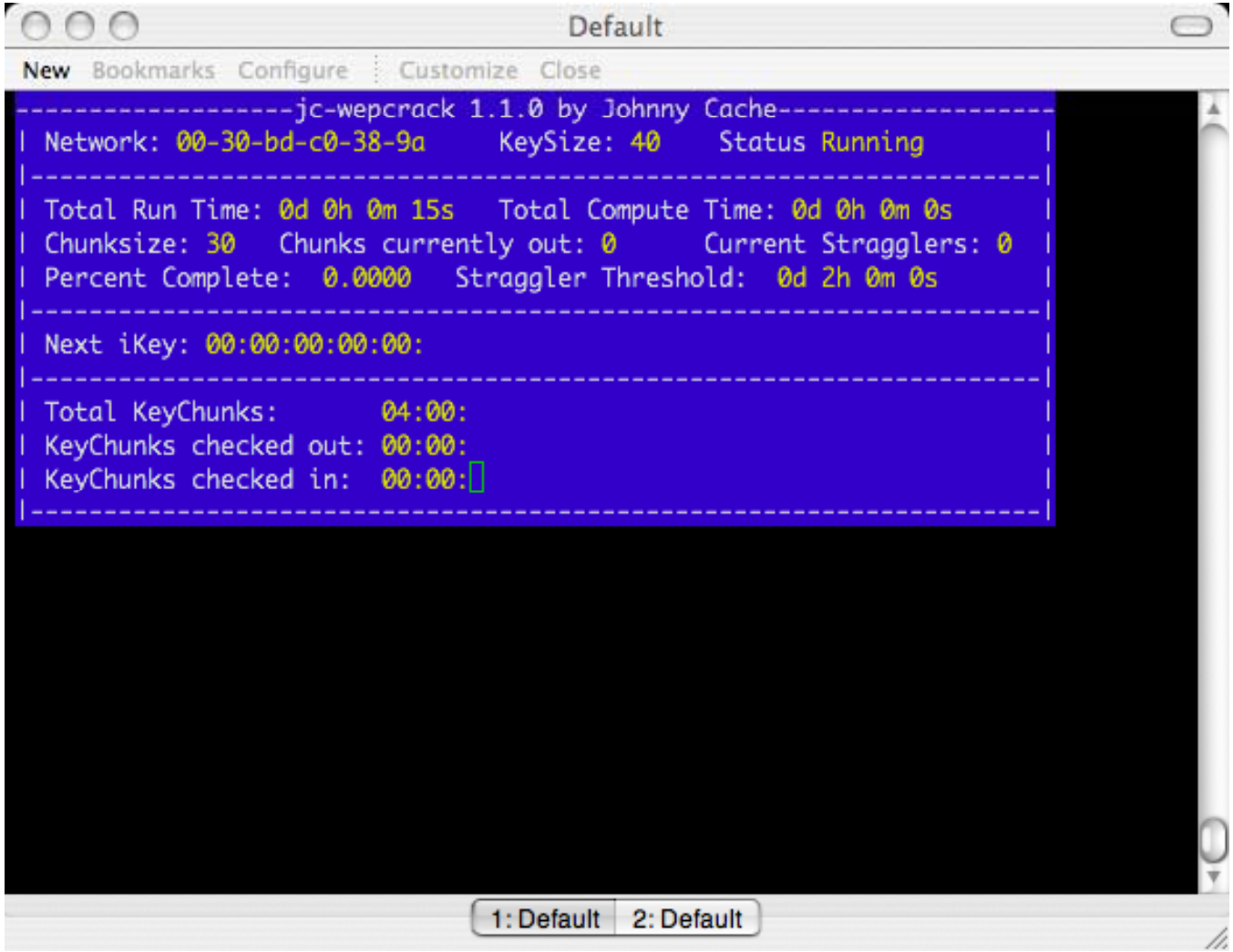
While AirSnort has captured the media attention, WEPCrack was the first publicly available code that demonstrated the above attack

The current tools are Perl-based and are composed of the following scripts:

- WeakIVGen.pl
- prism-getIV.pl
- WEPCrack.pl

Source: *wepcrack.sourceforge.net*

WEPCrack: Screenshot



WEP Tool: WepLab

WepLab is a tool designed to teach how WEP works, what different vulnerabilities it has, and how they can be used in practice to break a WEP protected wireless network

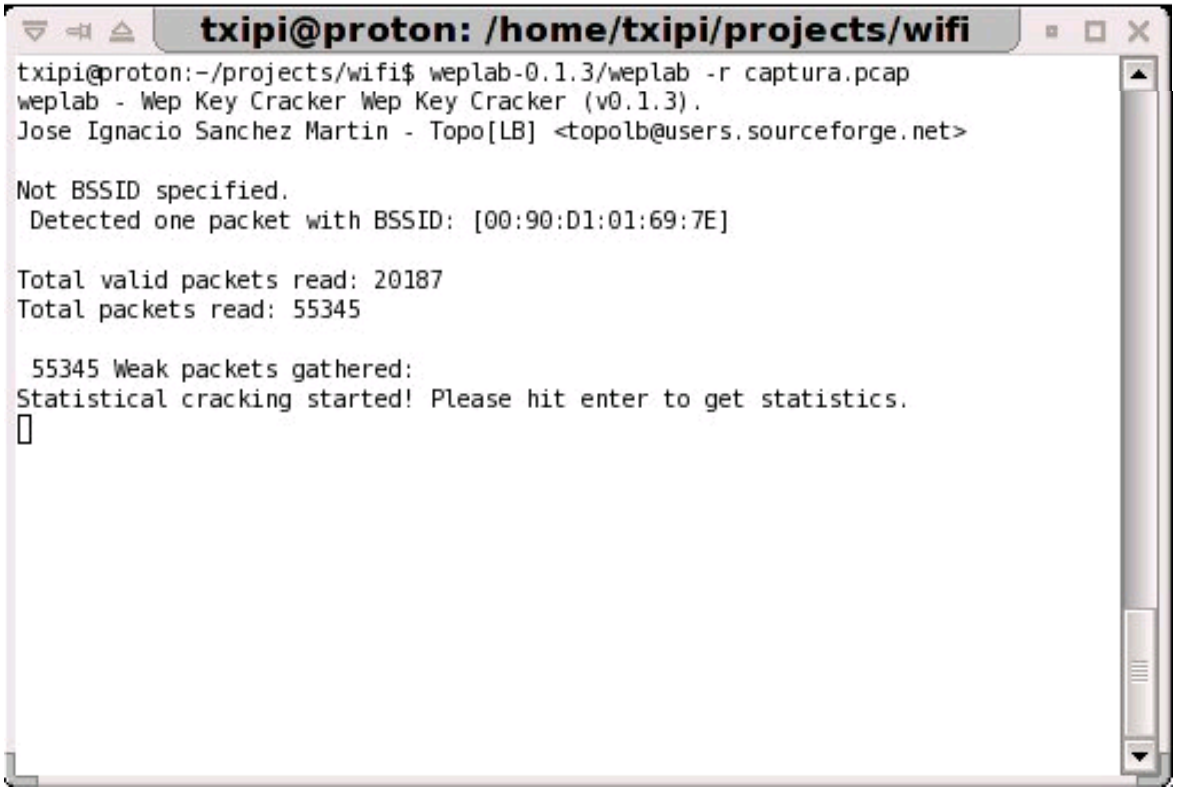
WepLab acts as a WEP Security Analyzer and a WEP Key Cracker

WepLab tries to break the WEP key using several known attacks:

- Bruteforce
- Dictionary
- Statistical attacks

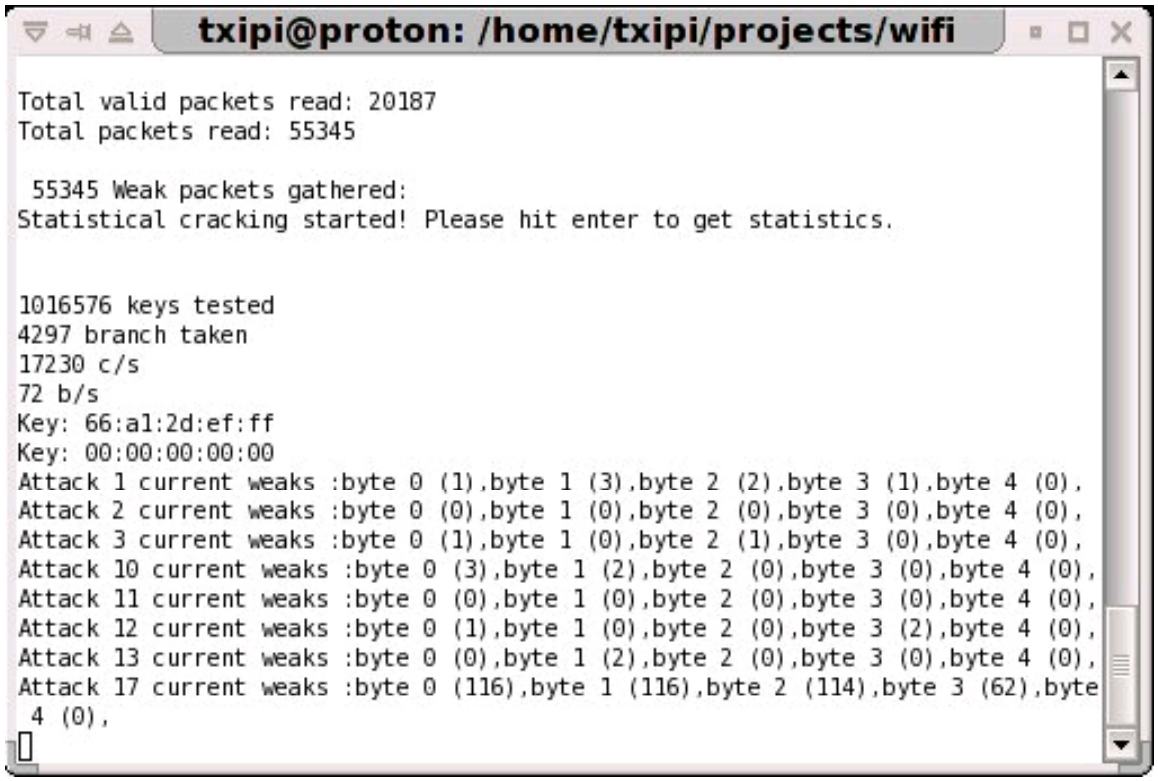
WepLab: Screenshot 1

WepLab starting to crack a pcap file by a statistical attack



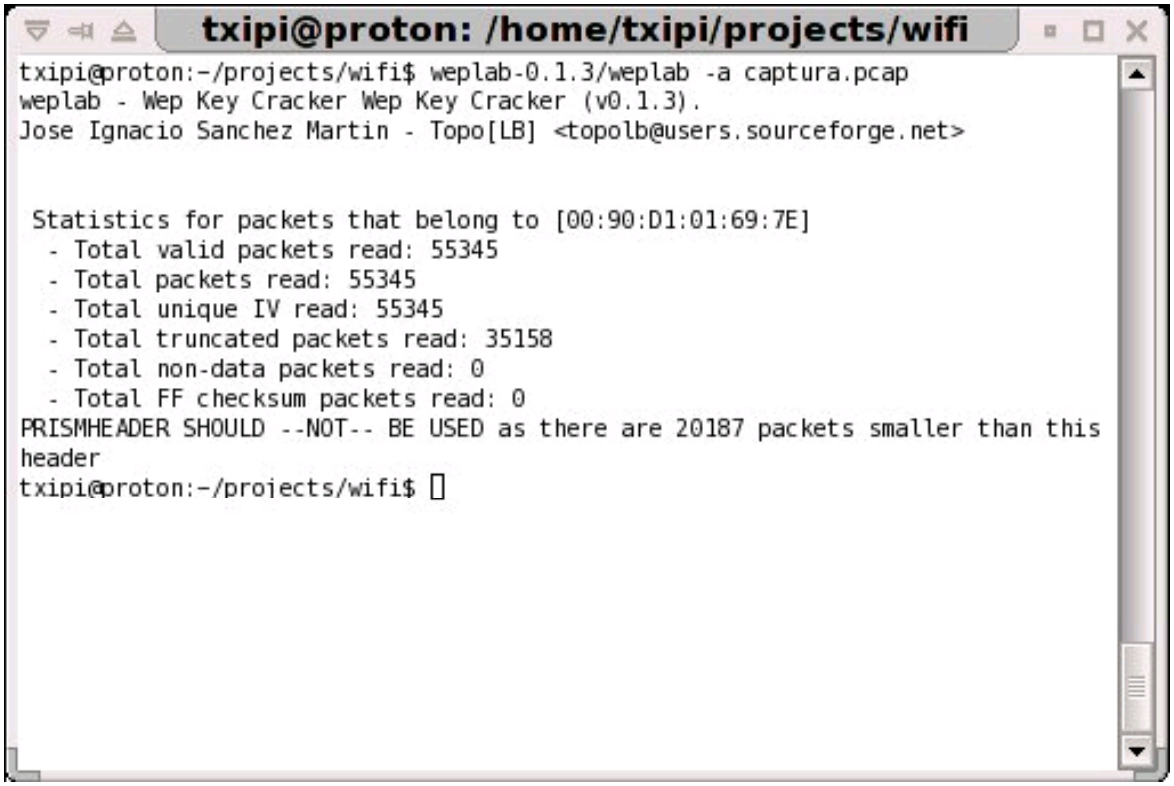
WepLab: Screenshot 2

WepLab showing progress information in a statistical attack



WepLab: Screenshot 3

WepLab showing analyzing process information of a pcap file



Attacking WPA Encrypted Networks

WPA utilizes a 256-bit pre-shared key or a passphrase that can vary in length from eight to sixty-three bytes

Short passphrase-based keys (less than 20 bytes) are vulnerable to the offline dictionary attack

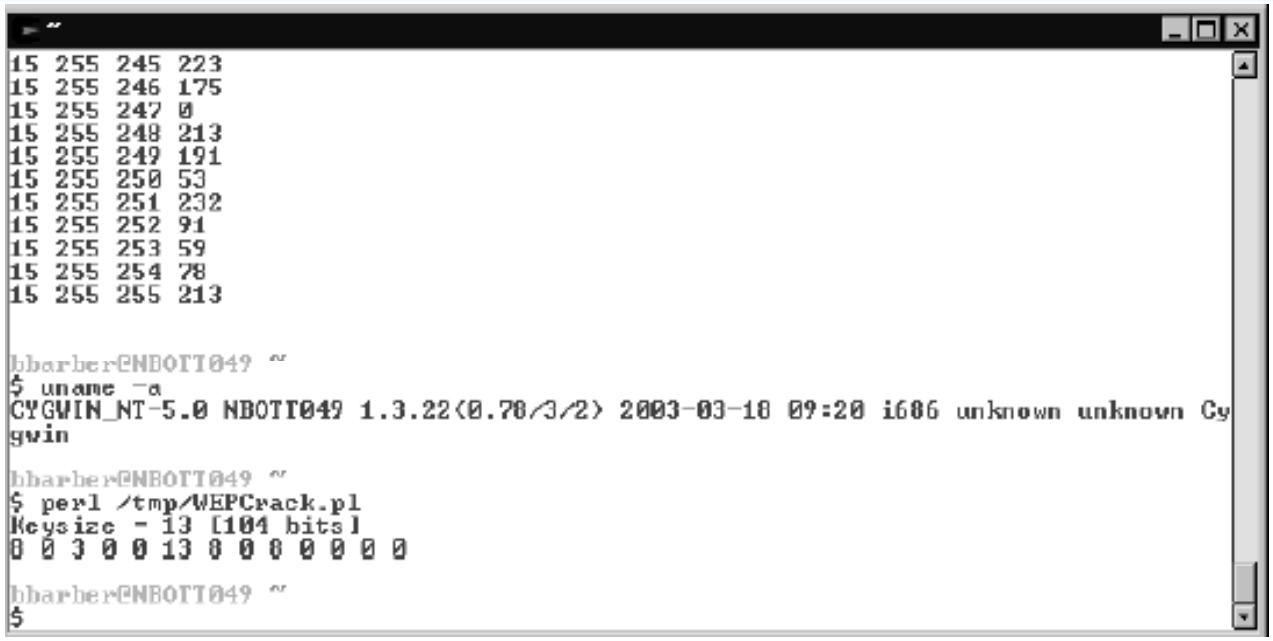
The pre-shared key that is used to set up the WPA encryption can be captured during the initial communication between the access point and the client card

After capturing pre-shared key, it is easy to "guess" the WPA key using the same concepts that are used in any password dictionary attack

Attacking WEP with WEPCrack on Windows using Cygwin

WEPCrack is a set of Open Source PERL scripts intended to break 802.11 WEP secret keys

Cygwin is a Linux-like environment for Windows that consists of a DLL (cygwin1.dll)



Executing WEPCrack.pl in Cygwin

Attacking WEP with WEPCrack on Windows using PERL Interpreter

ActiveState ActivePerl (www.activestate.com), provides a robust PERL development environment that is native to Windows

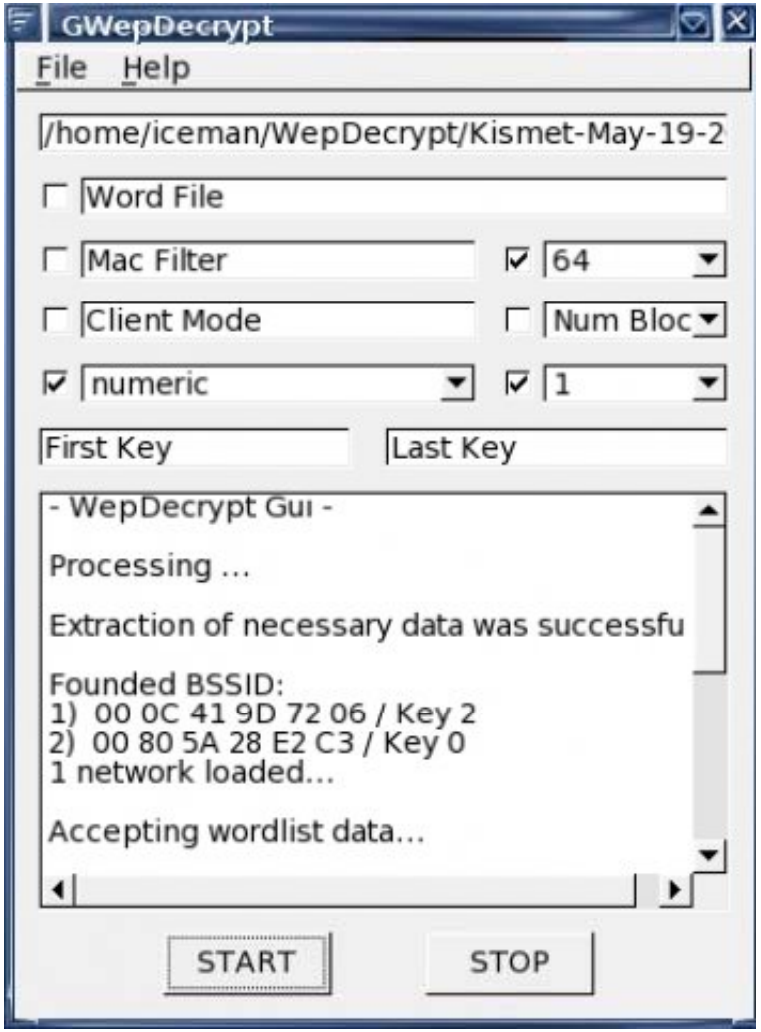
WEPCrack was written so that it could be ported to any platform that has a PERL interpreter without modification

Executing WEPCrack.pl at the Windows Command Prompt

Tool: Wepdecrypt

- Wepdecrypt is a Wireless LAN Tool
- It guesses the WEP keys based on the active dictionary attack, key generator, and distributed network attack
- It implements packet filters
- It starts cracking with only one crypted packet
- It has its own key generator
- A dumpfile can be cracked over a network
- It can act as both server and client

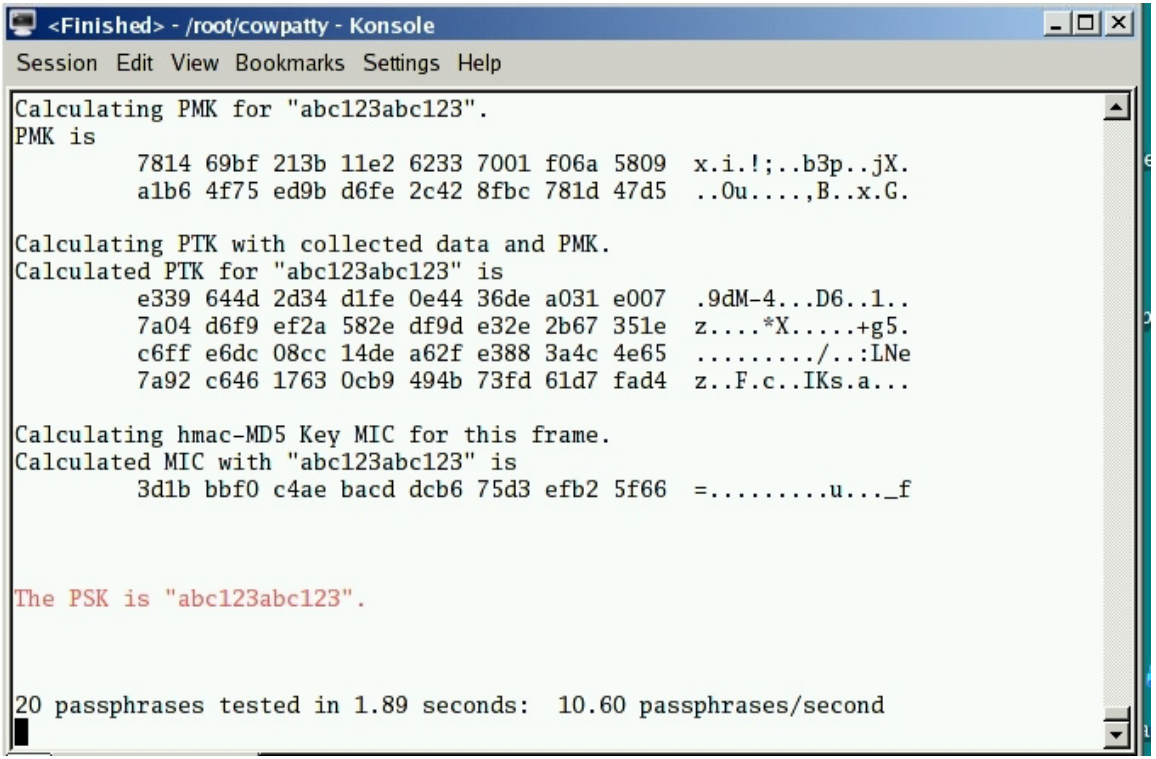
Wepdecrypt: Screenshot



WPA-PSK Cracking Tool: CowPatty

CowPatty tool is used as a brute force tool for cracking WPA-PSK, considered the "New WEP" for home Wireless Security

This program simply tries a bunch of different options from a dictionary file to see if one ends up matching what is defined as the Pre-Shared Key



802.11 Specific Vulnerabilities

Default SSIDs

- Many people fail to change the default SSID set by manufactures
- Hackers recognize it and can assume that administrator has not given much time for securing wireless network

Beacon Broadcast

- Base stations regularly broadcast its existence for end users to listen and negotiate a session
- Signals can be captured by anyone
- Wireless network SSID are known while connecting to the station

Evil Twin: Attack

Evil twin is a home-made wireless access point which masquerades as a legitimate one to gather personal or corporate information without the end-user's knowledge

Attacker positions himself in the vicinity of a legitimate Wi-Fi access point and lets his computer discover what name and radio frequency the legitimate access point uses

Attacker then sends out his own radio signal, using the same name

Rogue Access Points

A rogue/unauthorized access point is one that is not authorized for operation by a particular firm or network

Tools that can detect rogue/unauthorized access points include NetStumbler and MiniStumbler

The two basic methods for locating rogue access points are:

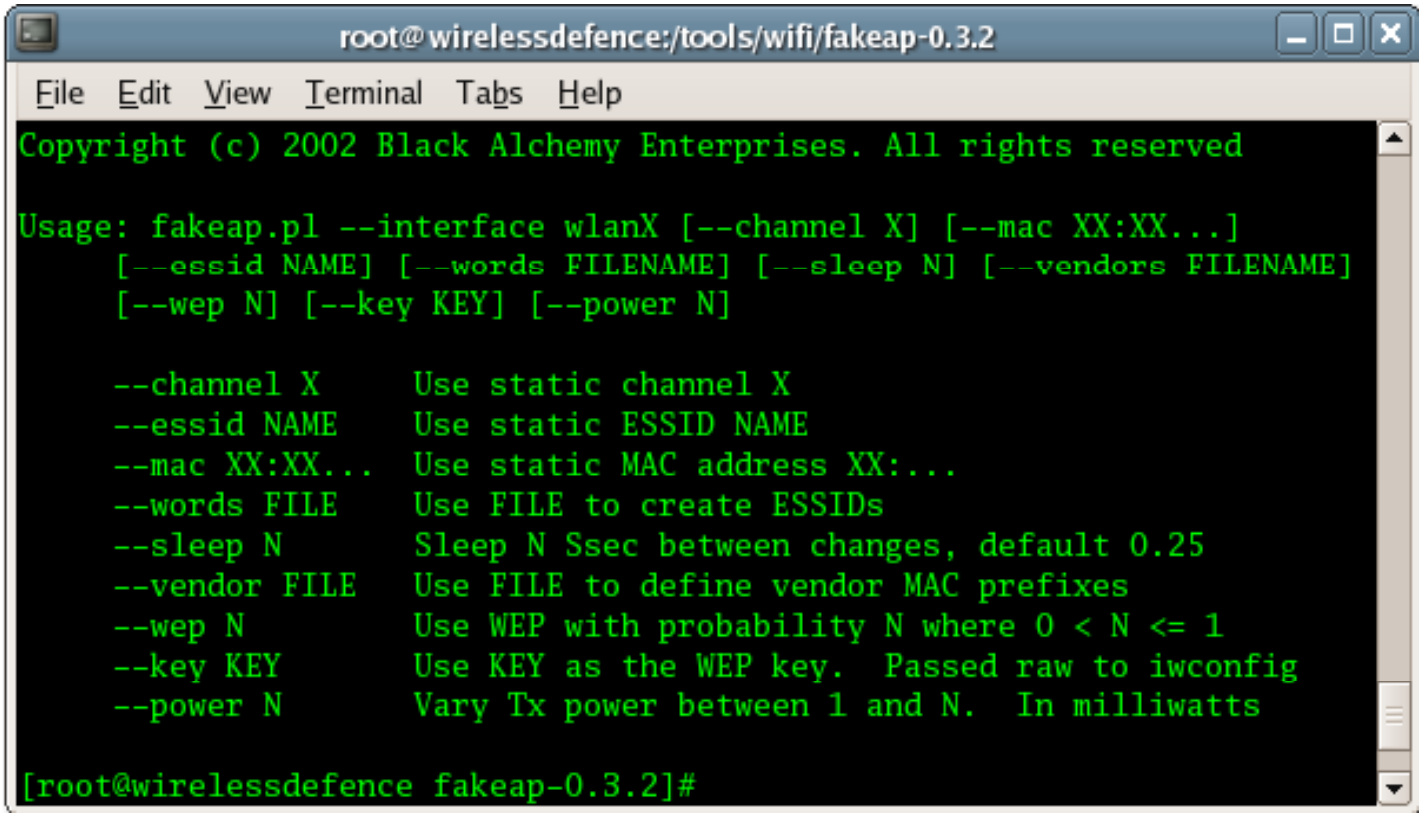
- Beaconing/requesting a beacon
- Network sniffing: Looking for packets in the air

Tools to Generate Rogue Access Points: Fake AP

- Fake AP provides the means of hiding in plain sight, making it unlikely for an organization to be discovered
- It confuses Wardrivers, NetStumblers, Script Kiddies, and other undesirables
- Black Alchemy's Fake AP generates thousands of counterfeit 802.11b access points
- It is a proof of concept released under the GPL
- It runs on Linux and BSD versions

Source: *http://www.blackalchemy.to/*

Fake AP: Screenshot



Tools to Detect Rogue Access Points: Netstumbler

NetStumbler is a Windows utility for WarDriving written by MariusMilner

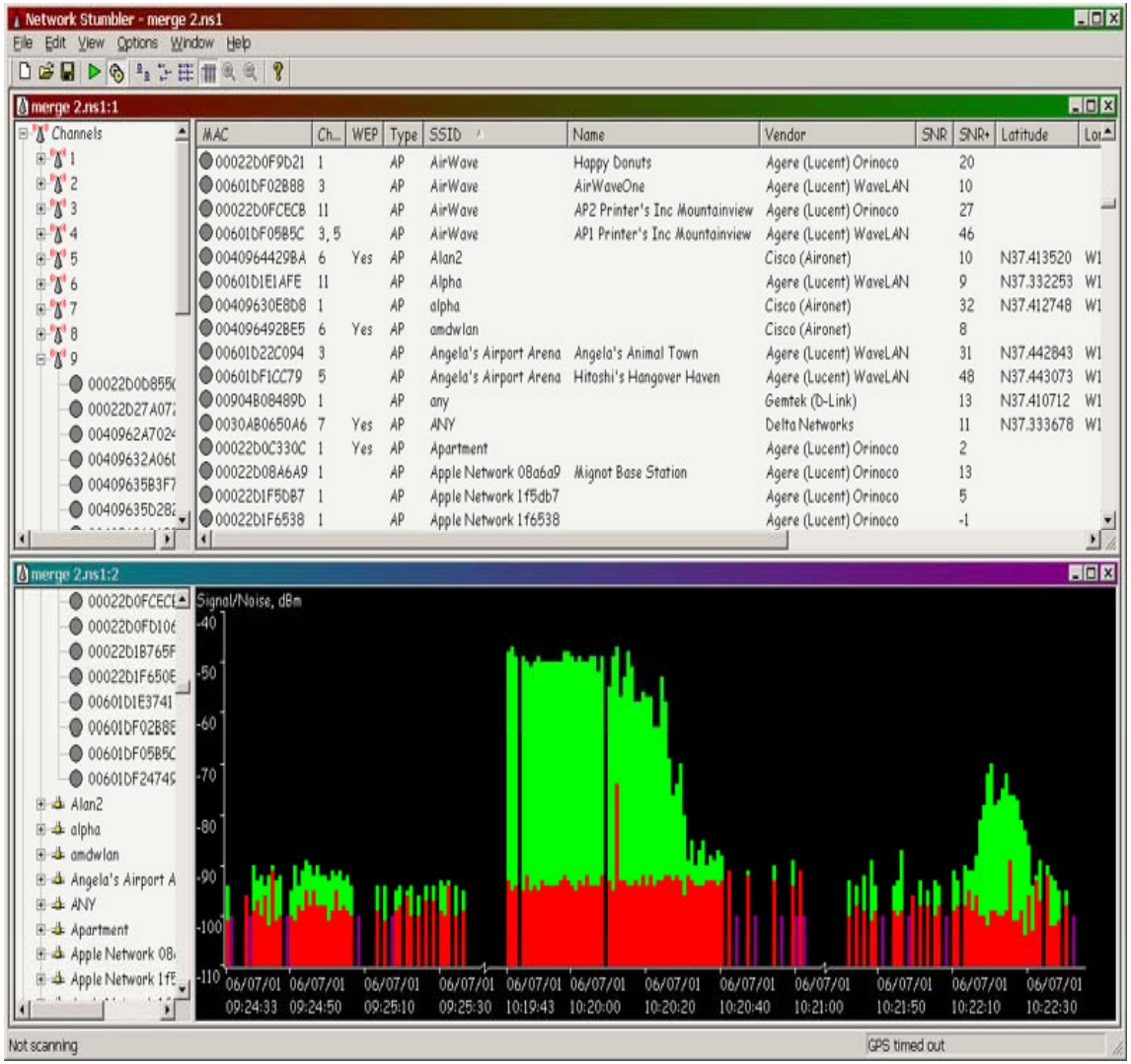
Netstumbler is a high-level WLAN scanner. It operates by sending a steady stream of broadcast packets on all possible channels

Access points (APs) respond to broadcast packets to verify their existence, even if beacons have been disabled

NetStumbler displays:

- Signal Strength
- MAC Address
- SSID
- Channel details

Netstumbler: Screenshot

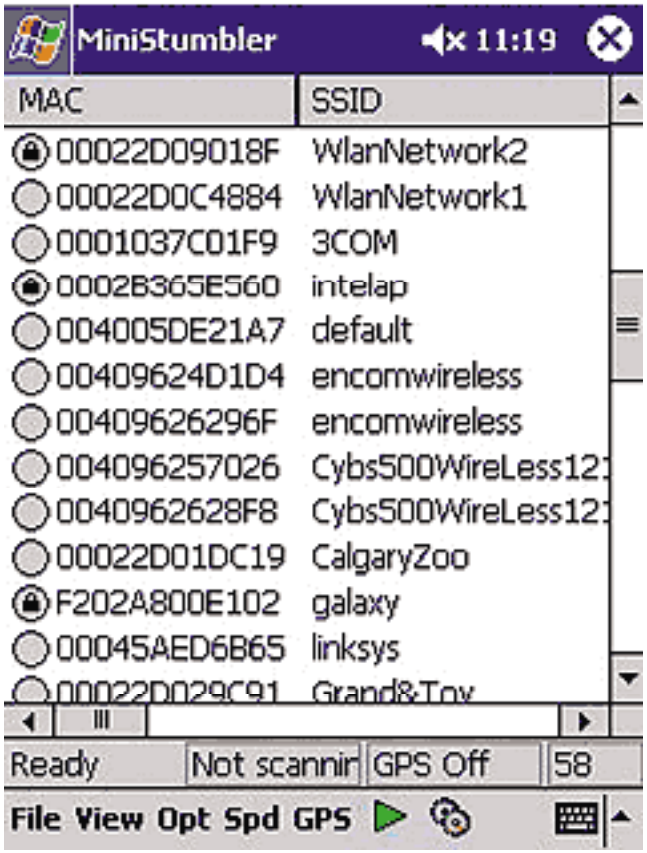


Tools to Detect Rogue Access Points: MiniStumbler

MiniStumbler is the smaller sibling of a free product called NetStumbler

By default, most WLAN access points (APs) broadcast their Service Set Identifier (SSID) to anyone who will listen. This flaw in WLAN is used by MiniStumbler

It can connect to a global positioning system (GPS)

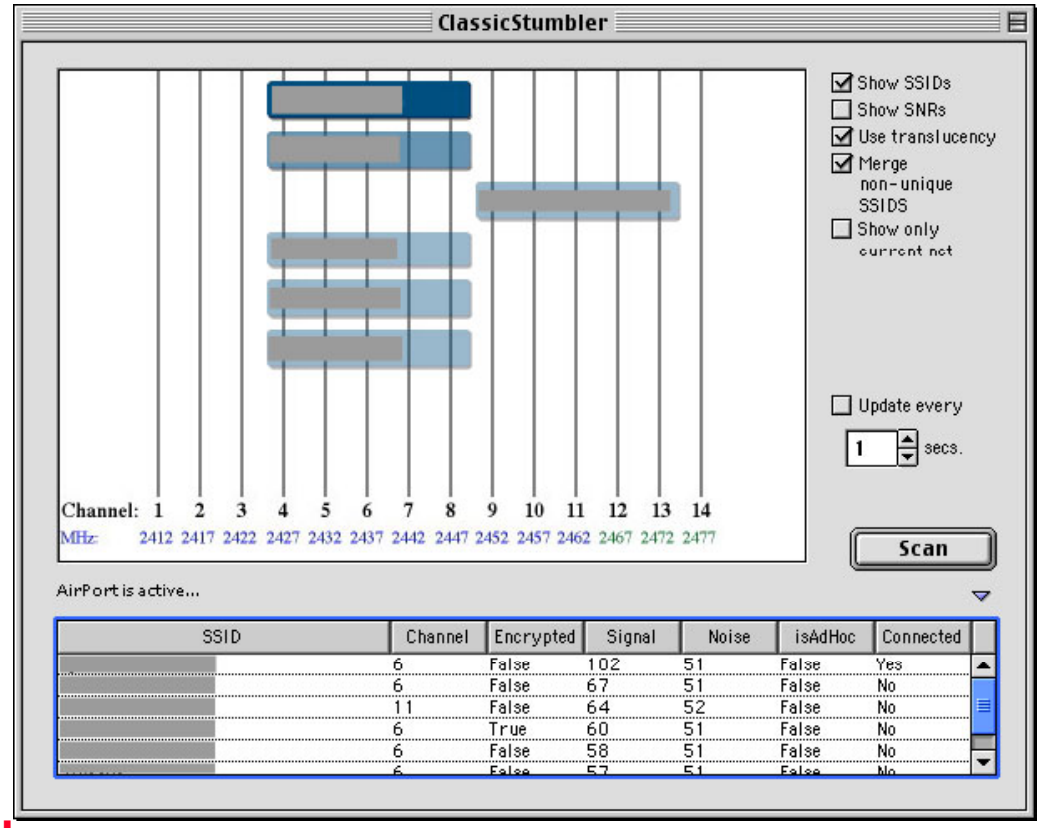


Source: *www.netstumbler.com*

ClassicStumbler

ClassicStumbler scans and displays the wireless access points information within range

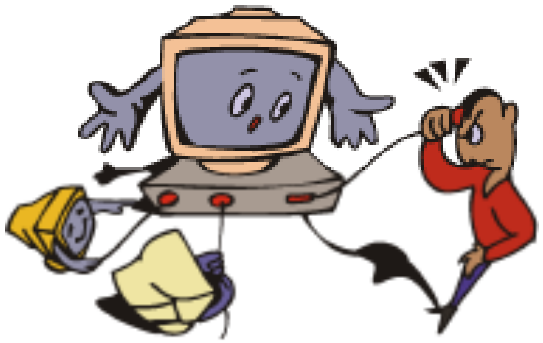
It displays the information about the signal strength, noise strength, signal to noise ratio, and channel of the access point



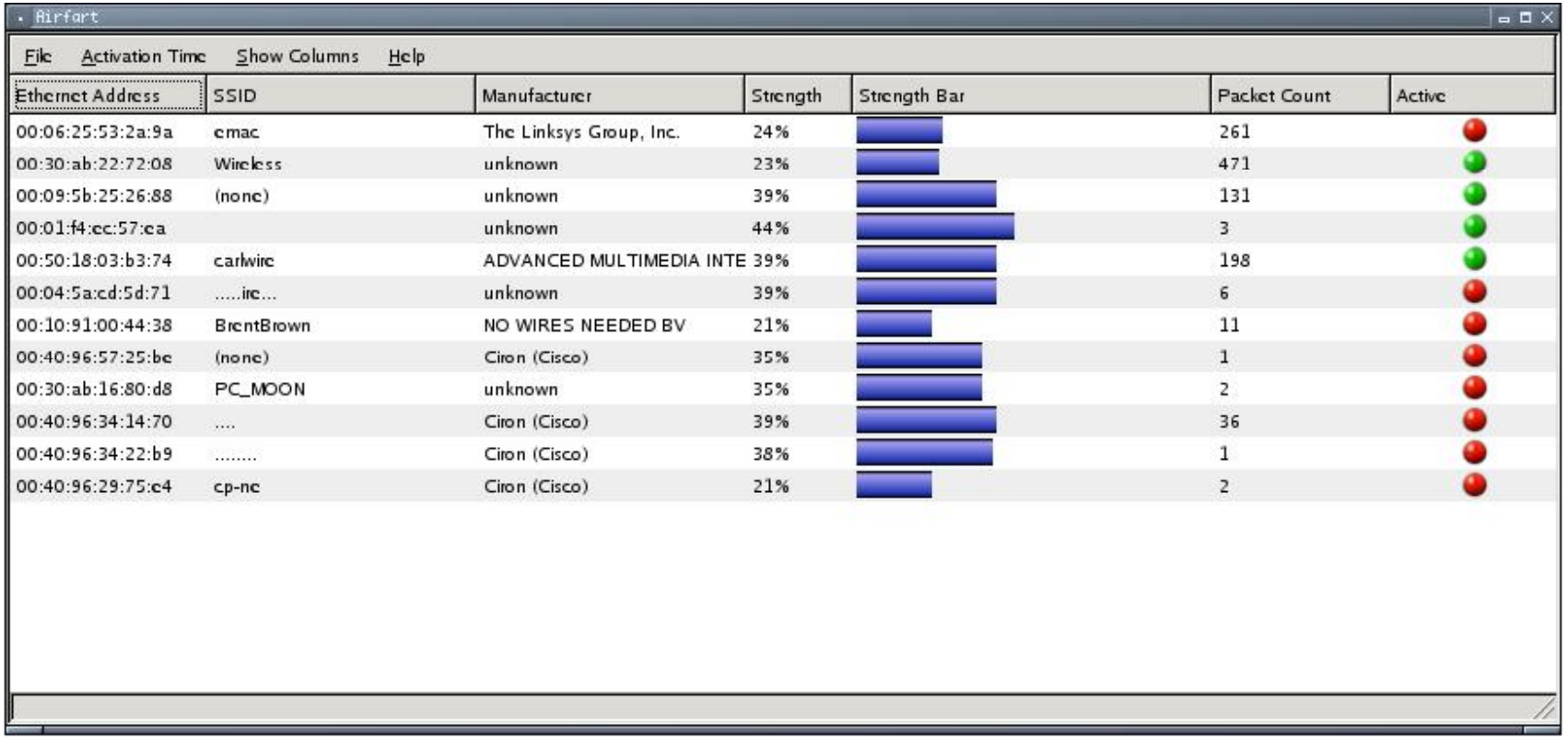
AirFart

AirFart is used to detect wireless devices and calculate their signal strength

It implements a modular n-tier architecture with the data collection at the bottom tier and a graphical user interface at the top



AirFart: Screenshot

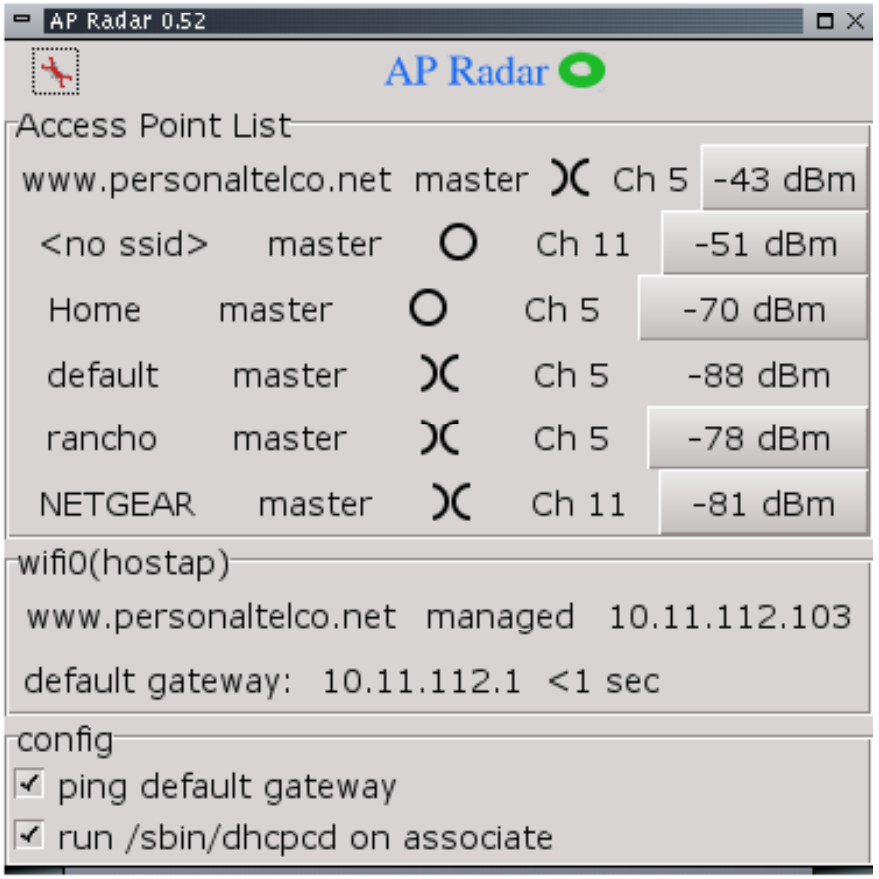


AP Radar

AP Radar is a wireless profile manager which is based on Linux/GTK+ graphical netstumbler

It is meant to replace the manual process of running iwconfig and dhclient

AP Radar can be used to reconfigure different APs with ease



Hotspotter

Hotspotter is an automatic wireless client penetration tool

It monitors the network passively for probe request frames to identify the preferred networks of Windows XP clients

Then hotspotter compares it to a list of common hotspot network names

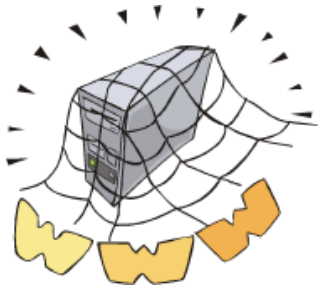
It allows the client to authenticate when matched to a common hotspot name

Cloaked Access Point

Wireless network administrators 'Cloak' their access points by putting them in 'Stealth' mode

Cloaked access points are not detected by active scanners like NetStumbler

The only way to detect cloaked access point is by passive scanners like Kismet or Airsnort

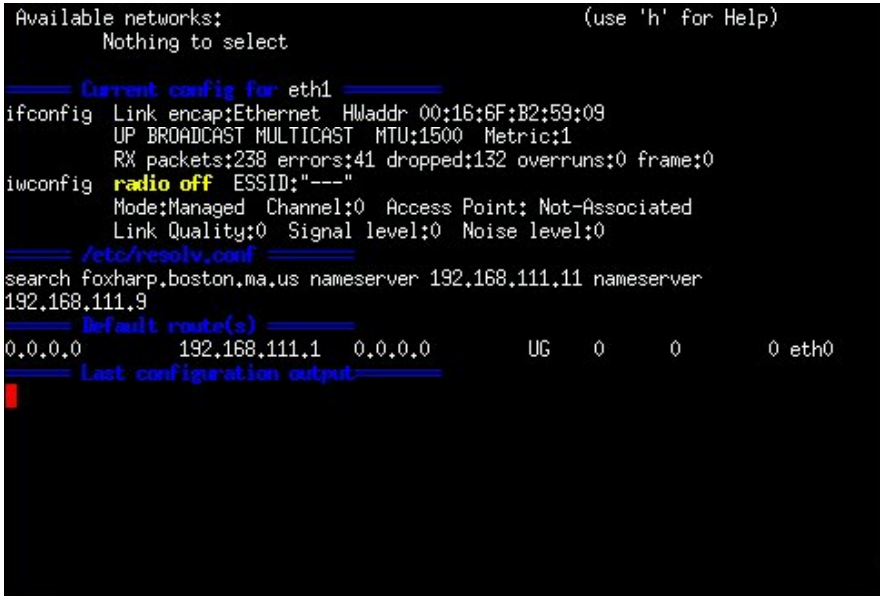


WarDriving Tool: Shtumble

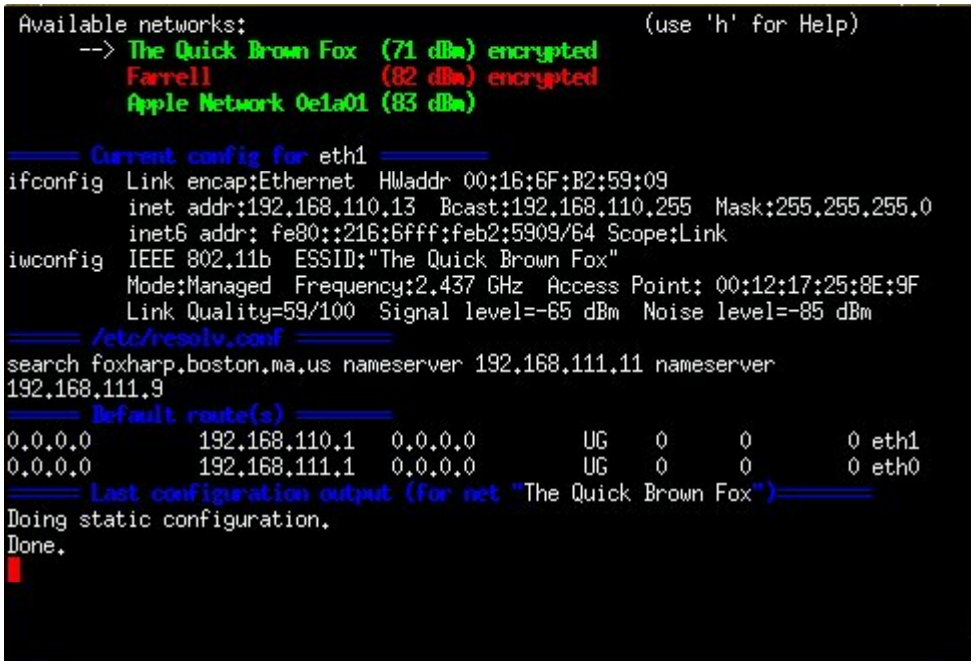
shtumble detects nearby access points, allows to select one, starts DHCP if appropriate (usually), and performs WEP or WPA or other custom config for known networks

```
shtumble help          Use 'q' to leave this help screen.

 Use the up and down arrows (or 'j' and 'k') to move among the available
 networks.  Select one with the Enter key.

 Green networks are open, or are known to you,
 Yellow networks are open, but have a relatively weak
 signal.  Red networks are encrypted, and you don't know
 (or haven't configured)  the encryption key.

'r' will toggle the wireless radio on and off.
'd' will disconnect the wireless interface.
'l' will toggle whether all hidden nets will be listed, or only
    those which have been connected to before, and are in range now.
'c' will bring up an editor on the global config file.
'e' will bring up an editor for the selected network's config file.
'n' will bring up an editor for a new network's config file, after
    prompting you for its name.
'x' will let you delete an existing network configuration.  This
    is rarely necessary.
'q' will quit the program.  Network will remain connected.


 shtumble is:
   Copyright 2004,2007 by Paul Fox, and is released under the GNU General
   Public License, Version 2.  A copy of GPLv2 is included in the shtumble
   source script.

:
```

Shtumble: Screenshot



Radio off, no networks in view



Associated, and a few networks available

Temporal Key Integrity Protocol (TKIP)

- Secret key is created during 4-way handshake authentication
- It dynamically changes secret key
- Function is used to create new keys based on the original secret key created during authentication
- Initialization vectors increases to 48 bits
- First 4 bits indicate QoS traffic class
- Remaining 44 bits are used as a counter
- Over 500 trillion key streams are possible
- Initialization vectors are hashed
- It is harder to detect key streams with the same initialization vectors

LEAP: The Lightweight Extensible Authentication Protocol

Proprietary, closed solution:

- LEAP was started (without many details) by Cisco as unaffected by WEP vulnerabilities (Cisco 2002)

LEAP conducts mutual authentication:

- Client is assured that the access point is an authorized one
- Uses per-session keys that can be renewed regularly:
  - Makes the collection of a pad or weak IVs more difficult
  - Secret key can be changed before the collection is complete
- The user is authenticated, instead of the hardware:
  - MAC address access control lists are not needed
- LEAP requires an authentication server (RADIUS) to support the access points

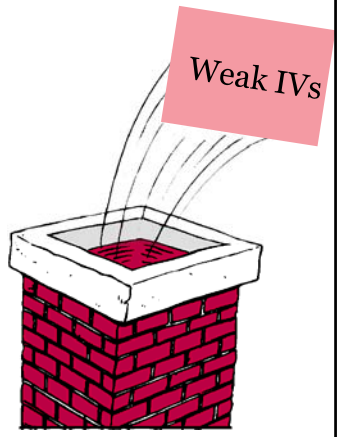
LEAP Attacks

Dictionary attacks

- Password-based scheme
- Passwords should be guessable (**Joshua Wright** 2003)

LEAP access points do not use weak IVs

- Use MS-CHAP v2, show the same weaknesses as MS-CHAP (Wright 2003)
- There are many variants of the Extensible Authentication Protocol, such as EAP-TLS and PEAP



LEAP Attack Tool: ASLEAP

ASLEAP is an hacking tool, released as a proof-of-concept to demonstrate weakness in LEAP and uses off-line dictionary attack to break LEAP passwords

Features:

- Recovers weak LEAP passwords (duh)
- Can read live from any wireless interface in RFMON mode
- Can monitor a single channel, or perform channel hopping to look for targets
- Handles dictionary and genkeys files up to 4 TB in size

Working of ASLEAP

This tool works as follows:

Scans the 802.11 packets by putting the wireless interface in RFMON mode

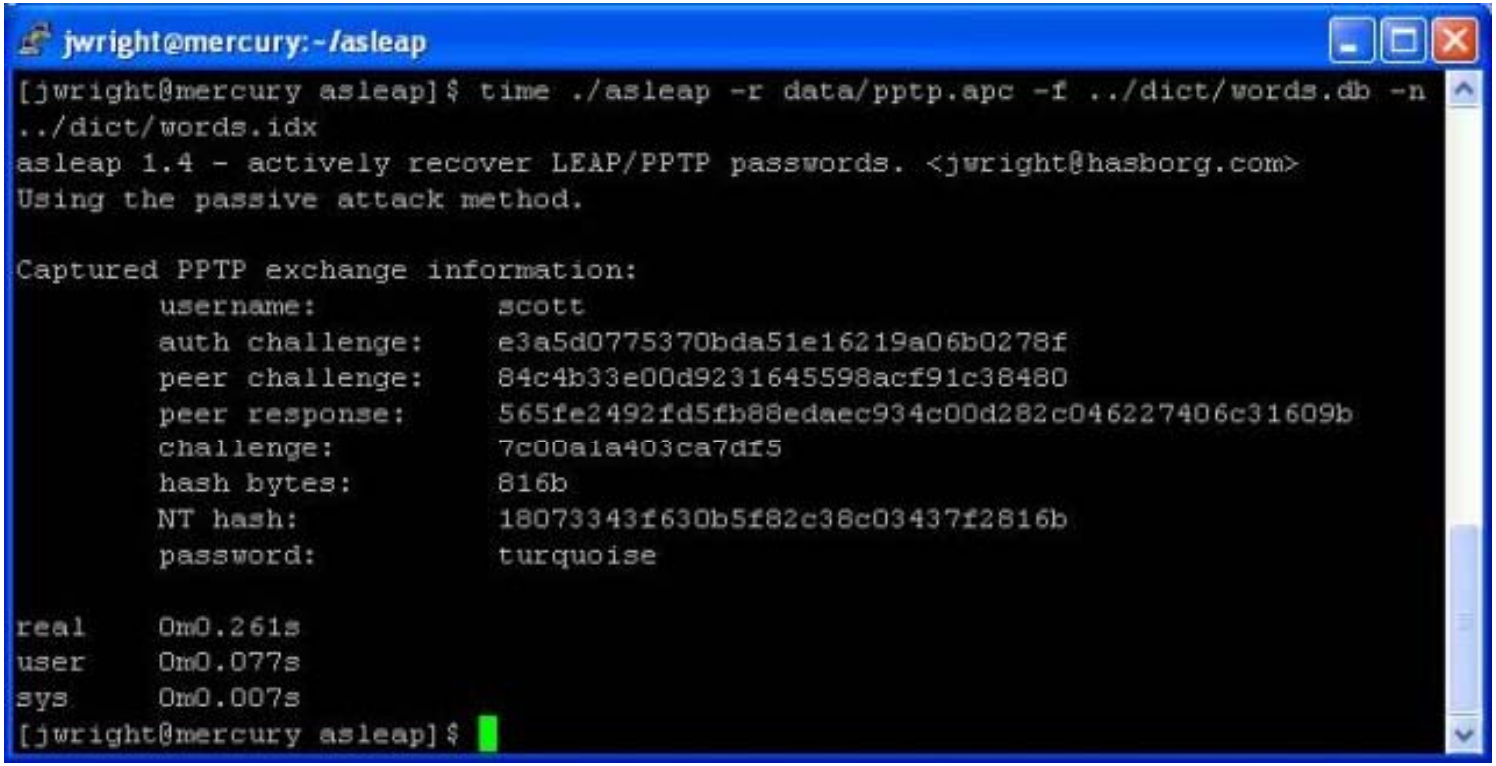
Hops channels to look for targets (WLAN networks that uses LEAP)

De-authenticates the users on LEAP networks forcing them to re-authenticate by providing their user name and password

Records the LEAP exchange information to a libcap file

The information captured above is then analyzed offline and compared with values in dictionary to guess the password

ASLEAP: Screenshot



Tool: Cain & Abel

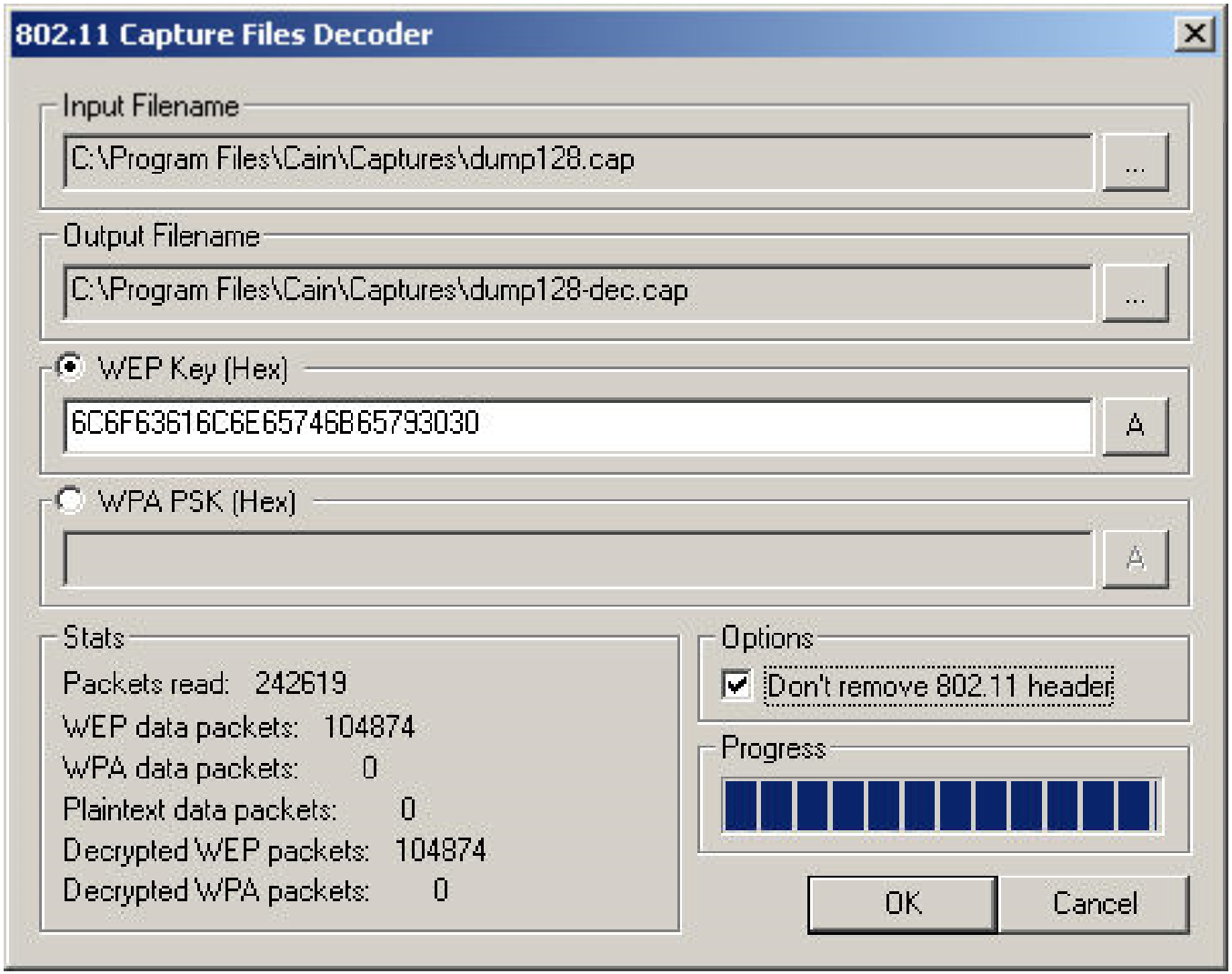
Cain & Abel is a password recovery tool for Microsoft Operating Systems

It allows recovery of several kind of wireless network keys

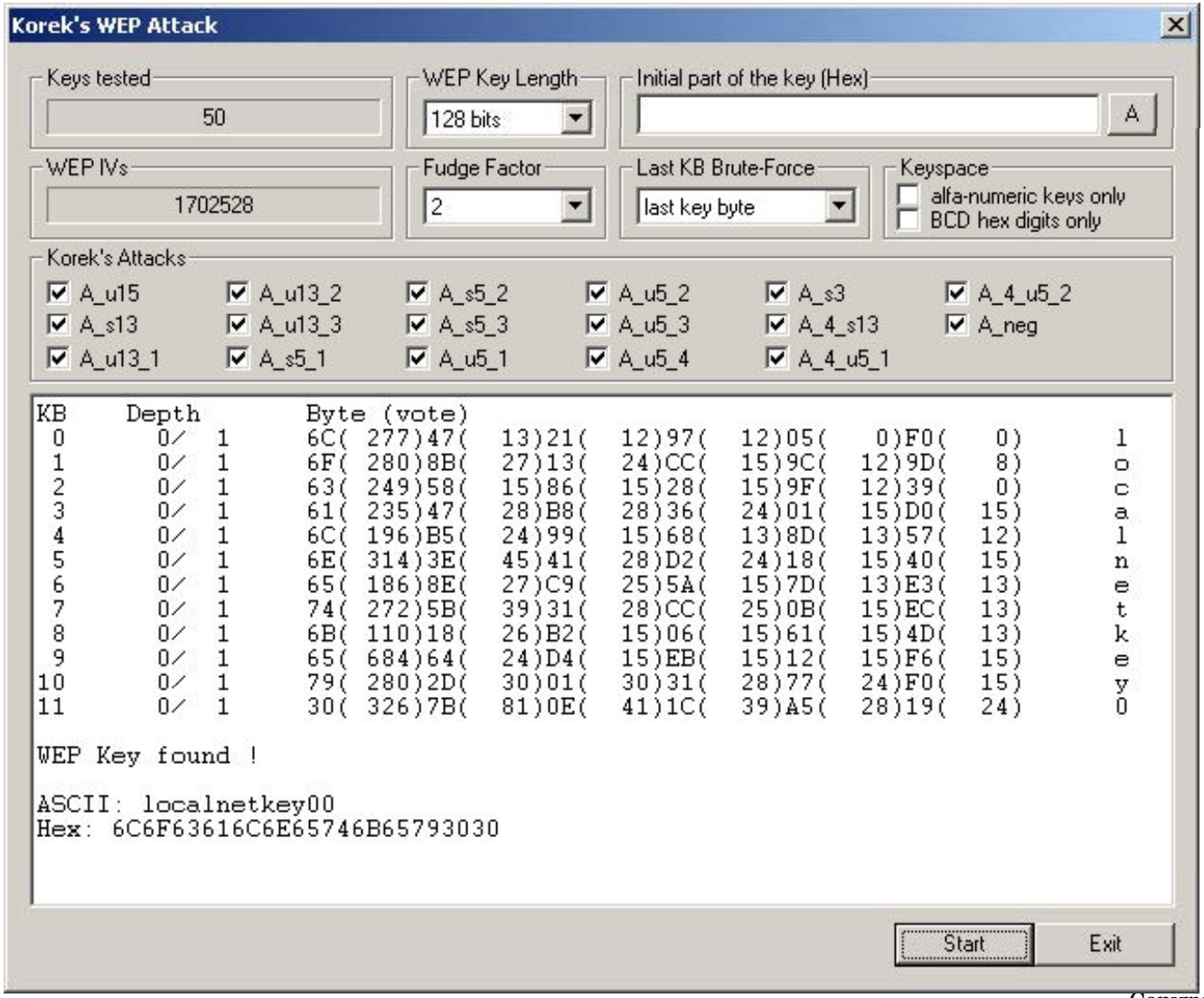
Features:

- Password decoders to immediately decode encrypted passwords from several sources
- WEP Cracker can quickly recover 64-bit and 128-bit WEP keys if enough unique WEP IVs are available
- Wireless Scanner detects Wireless Local Area Networks (WLANs) using 802.11x
- 802.11 capture files decoder can decode wireless capture files from Wireshark and/or Airodump-ng containing WEP or WPA-PSK encrypted 802.11 frames
- Wireless zero configuration password dumper

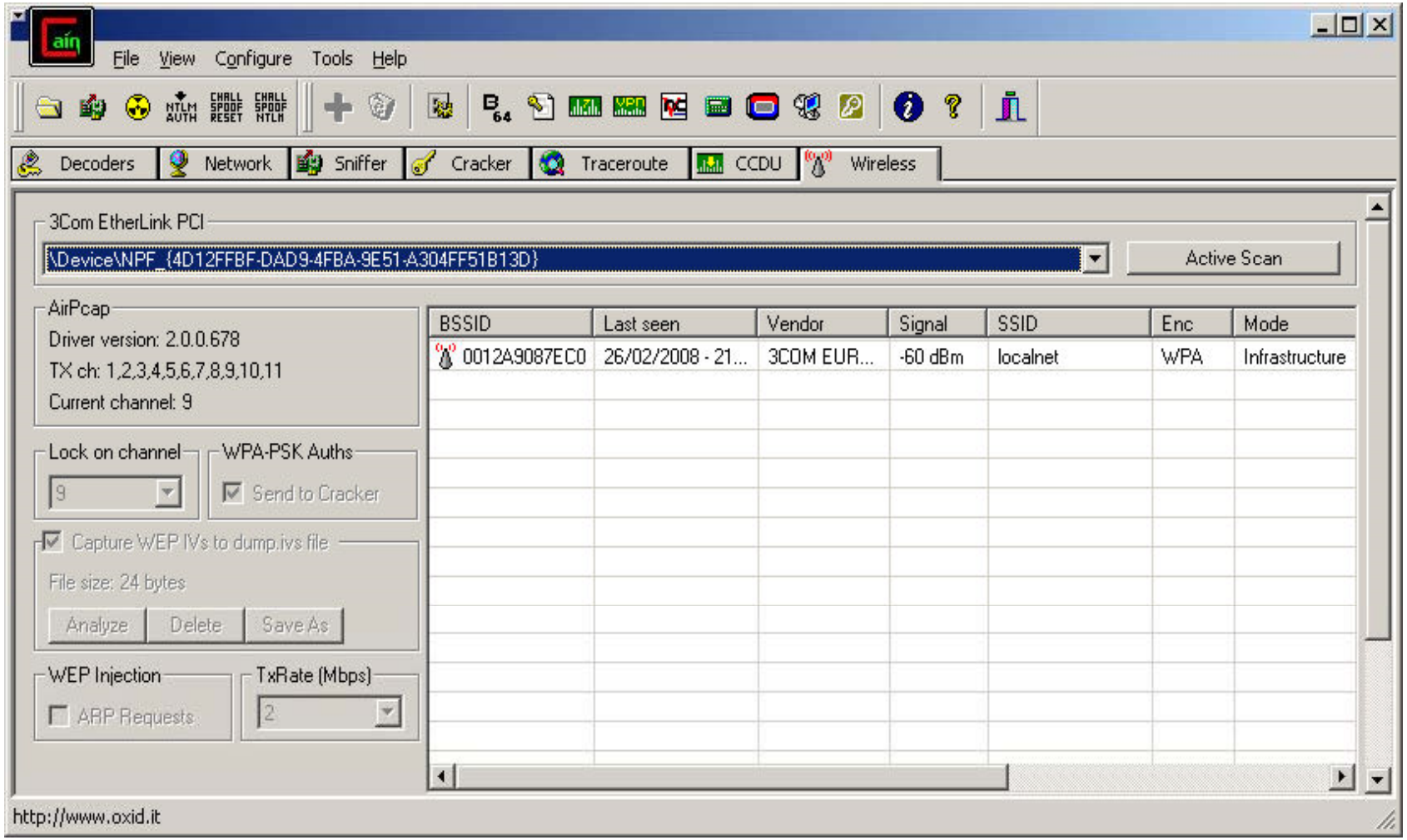
Cain & Abel: Screenshot 1



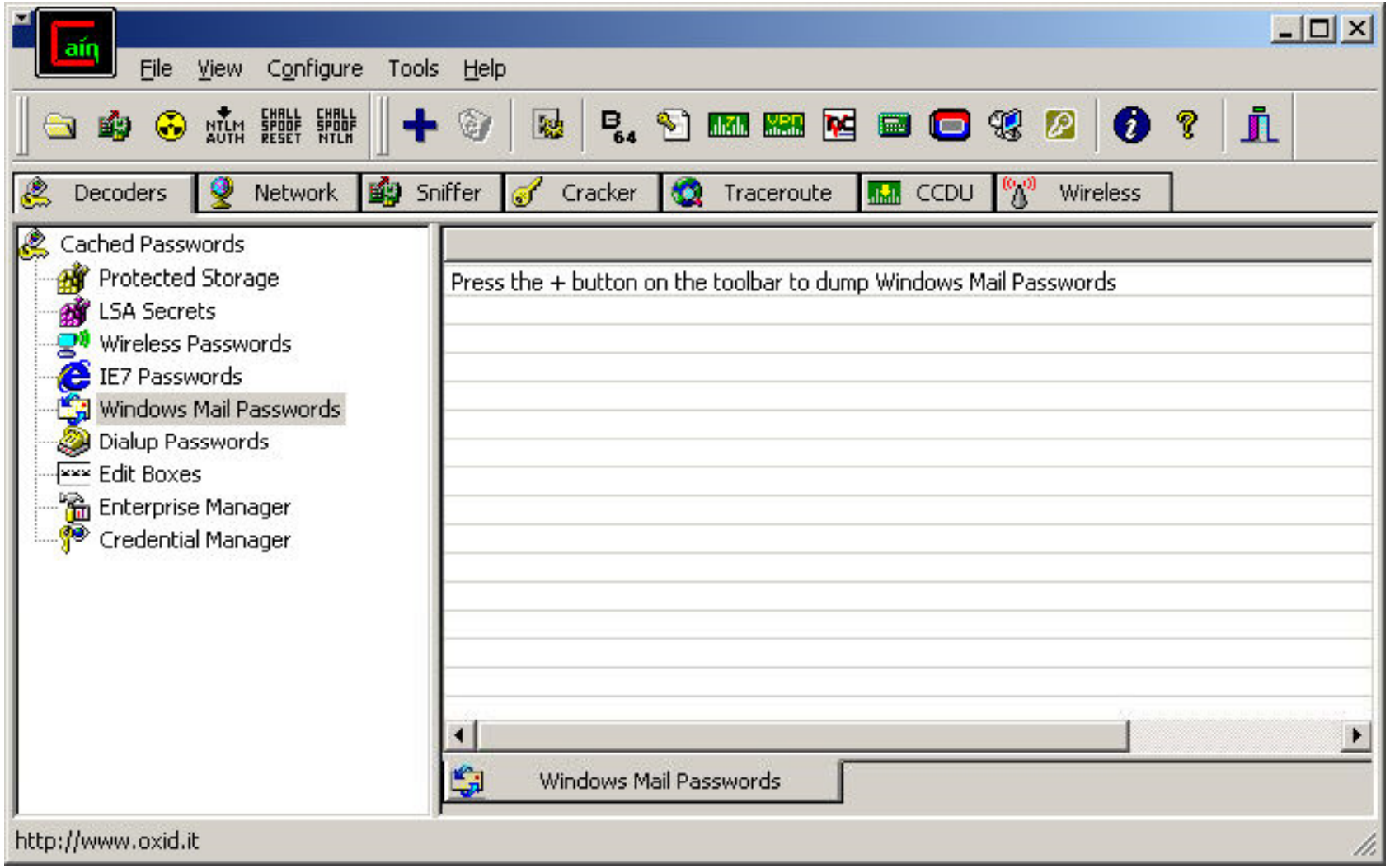
Cain & Abel: Screenshot 2



Cain & Abel: Screenshot 3



Cain & Abel: Screenshot 4



MAC Sniffing and AP Spoofing

Attackers can easily sniff MAC addresses because they must appear in the clear even when WEP is enabled

Attackers can use those advantages in order to masquerade as a valid MAC address by programming the wireless card and getting into the wireless network and using the wireless pipes

Spoofing MAC addresses is easy. Using packet-capturing software, attackers can determine a valid MAC address using one packet

To perform a spoofing attack, an attacker must set up an access point (rogue) near the target wireless network or in a place where a victim may believe that wireless Internet is available

Defeating MAC Address Filtering in Windows

Changing MAC address is an easy job in Windows

Mostly wireless networking equipments send the MAC address as a clear text even if WEP is enabled

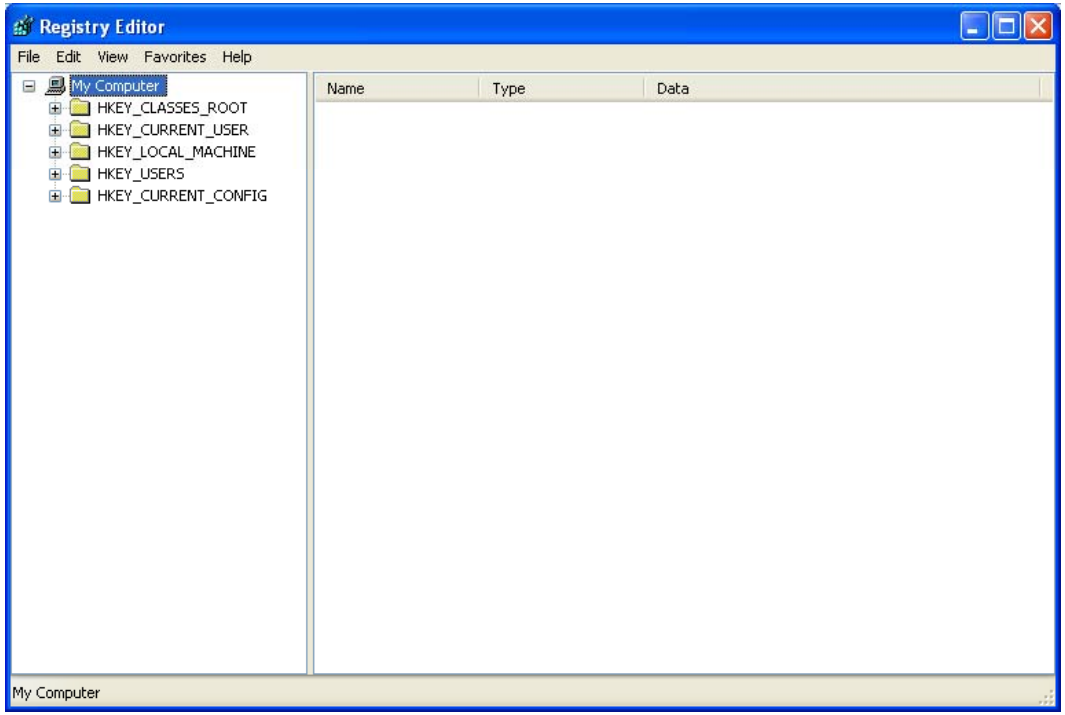
MAC address of machines in the wireless network can be sniffed using WireShark

Next thing is to change your MAC address to the one in the 'allowed access' list

Manually Changing the MAC Address in Windows XP and 2000

MAC address in Windows XP or 2000 can be changed by modifying Windows registry

Go to Start >>Run and type in regedit. It will start the Registry Editor



Manually Changing the MAC Address in Windows XP and 2000 (cont'd)

Expand the HKEY_LOCAL_MACHINE>>System>>CurrentControlSet>>Control folders

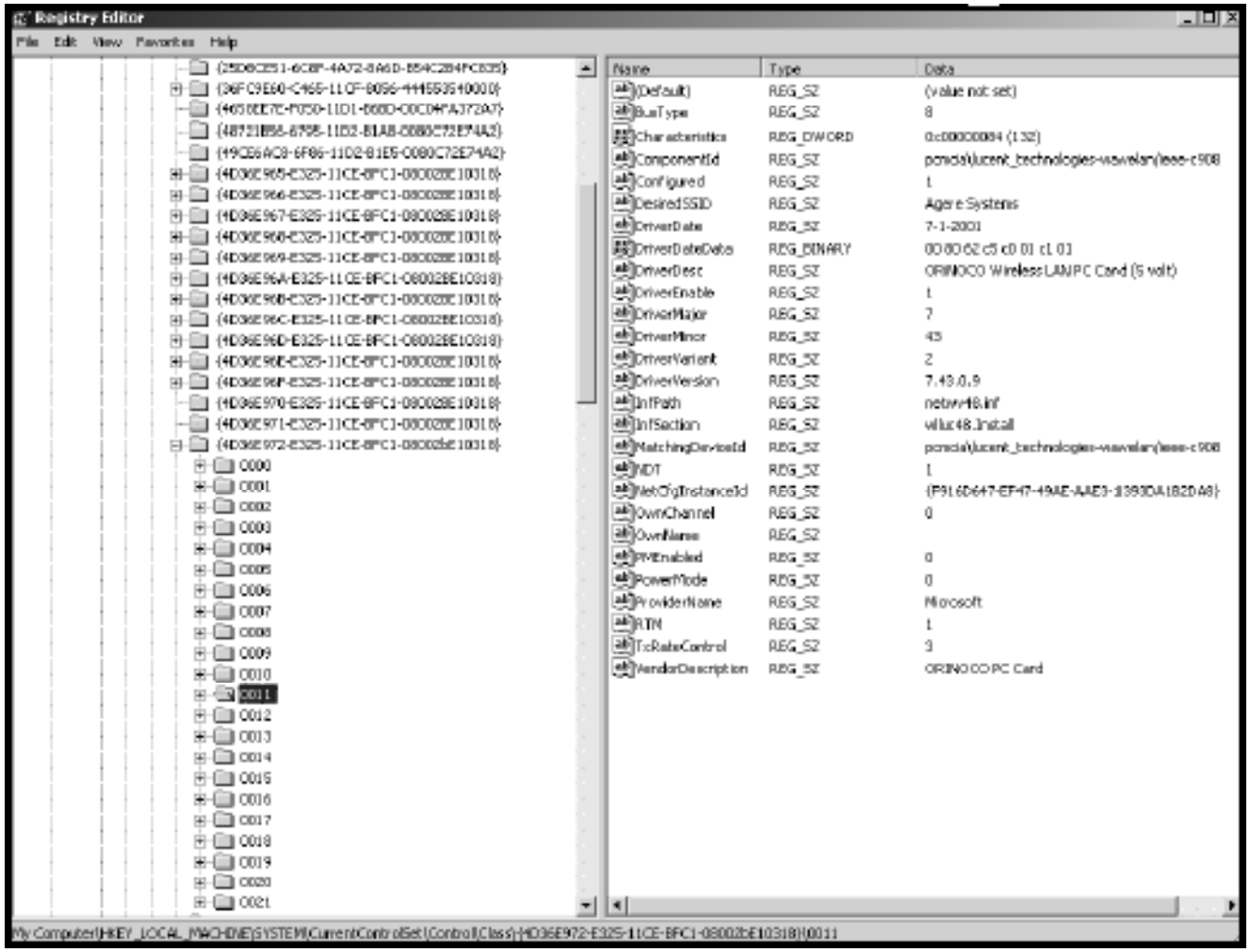
Scroll down to the Class folder and expand it

Next, scroll down to the {4D36E972-E325-11CE-BFC1-08002bE10318} folder and expand it

This folder contains the Windows XP Registry information regarding network adapters installed on your system

Scroll through each folder until you find your wireless network adapter

Manually Changing the MAC Address in Windows XP and 2000 (cont'd)



Manually Changing the MAC Address in Windows XP and 2000 (cont'd)

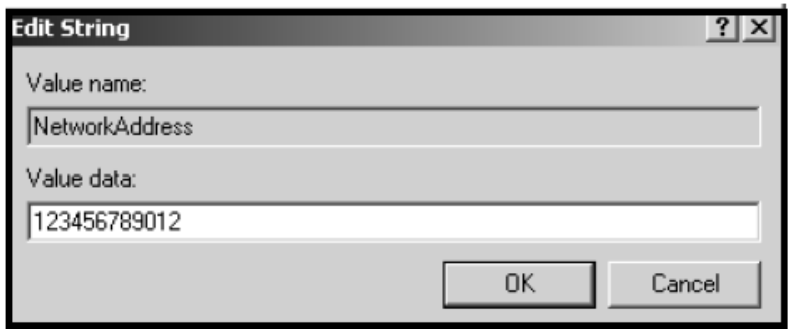
Choose Edit>>New >>String Value

This creates a new REG_SZ string and prompts for a value. Type NetworkAddress

Right-click the NetworkAddress key that was just created and choose Modify

Enter the new MAC address you want to use in the Value Data field and click OK

The new MAC address is assigned as the system starts. Verify this by typing `ipconfig /all`

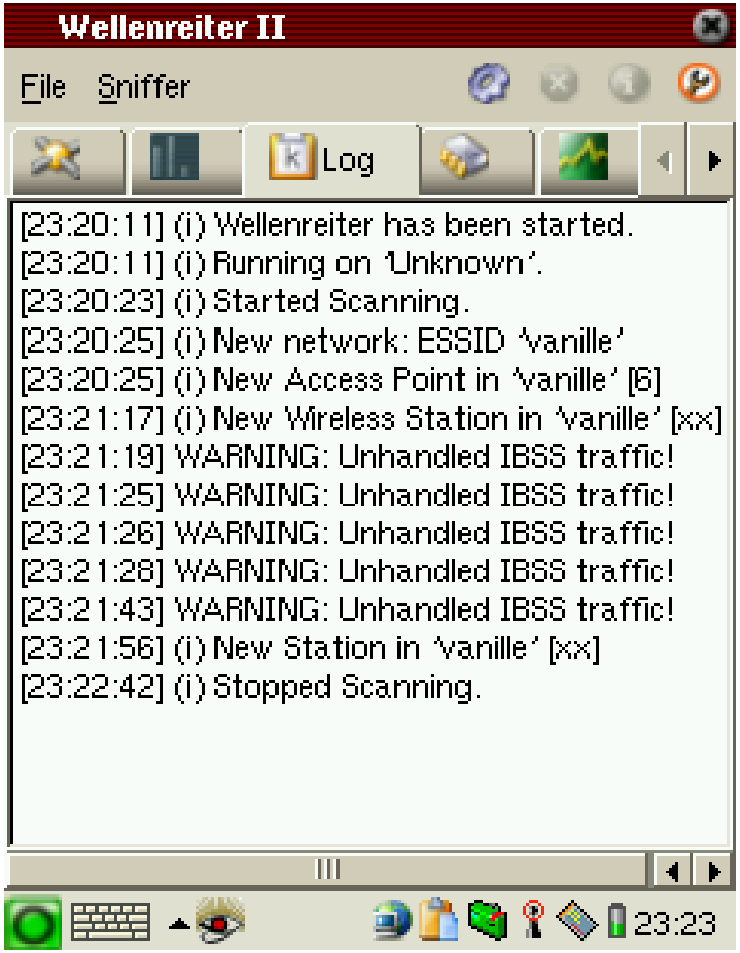


Tool to Detect MAC Address Spoofing: Wellenreiter

Wellenreiter is a wireless network discovery and auditing tool

It can discover networks (BSS/IBSS) and detect ESSID broadcasting or non-broadcasting networks and their WEP capabilities and the manufacturer automatically

It also identifies traffic that is using a spoofed MAC address without relying on the MAC OUI information



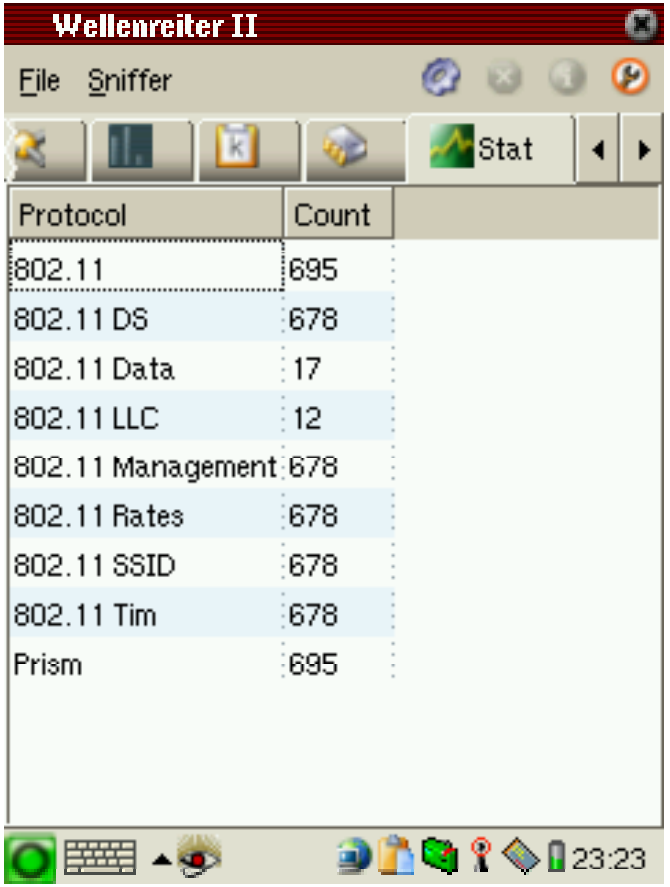
Source: *http://www.wellenreiter.net/*

Tool to Detect MAC Address Spoofing: Wellenreiter (cont'd)

DHCP and ARP traffic is decoded and displayed to give further information about the networks

An WireShark/tcpdump-compatible dumpfile and an application savefile are automatically created

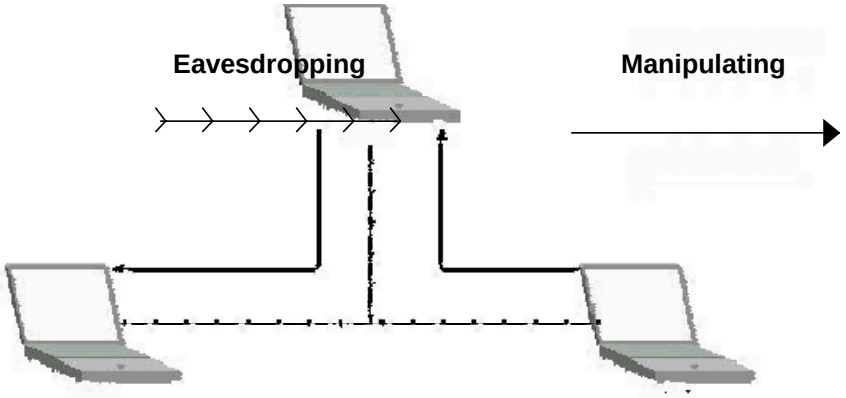
Using a supported GPS device and the gpsd location of the discovered networks can be tracked



Man-in-the-Middle Attack (MITM)

Two types of MITM:

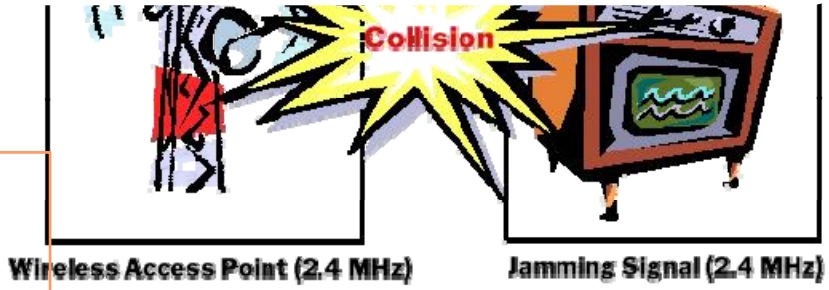
- Eavesdropping:
  - Happens when an attacker receives a data communication stream
  - Not using security mechanisms such as Ipsec, SSH, or SSL makes data vulnerable to an unauthorized user
- Manipulation:
  - An extended step of eavesdropping
  - Can be done by ARP poisoning



Denial-of-Service Attacks

Wireless LANs are susceptible to the same protocol-based attacks that plague wired LANs

WLANs send information via radio waves on public frequencies, making them susceptible to inadvertent or deliberate interference from traffic using the same radio band



Types of DoS attacks:

- Physical Layer
- Data-Link Layer
- Network Layer

DoS Attack Tool: Fatajack

Fatajack is a modified WLAN Jack that sends a deauth instead of an auth

This tool highlights poor AP security and works by sending authentication requests to an AP with an inappropriate authentication algorithm and status code. This causes most to drop the relevant associated session

Hijacking and Modifying a Wireless Network

TCP/IP packets go through switches, routers, and APs

Each device looks at the destination IP address and compares it with the local IP addresses

If the address is not in the table, the device hands the packet to its default gateway

This table is a dynamic one that is built up from traffic passing through the device and through Address Resolution Protocol (ARP) notifications from new devices joining the network

Hijacking and Modifying a Wireless Network (cont'd)

There is no authentication or verification of the validity of request received by the device

A malicious sends messages to routing devices and APs stating that his MAC address is associated with a known IP address

All traffic that goes through that device destined for the hijacked IP address will be handed off to the hacker's machine

Phone Jammers

- A cell-phone jammer transmits radio frequency signals similar to that used by cellular devices to cut off communications between cell phones and cell base stations
- Jammer's signal has enough high power to cancel out cellular signals
- Some of the high-end jammers block all frequency signals disabling switching over different network types
- Range of the jammer depends on its power and the local environment (≈9m-1.6km)
- Phone jamming is also known as Denial-of-service

Phone Jammers (cont'd)

Jammers typically consists of:

- Antenna
- Circuitry
  - Voltage-controlled oscillator
  - Tuning circuit
  - Noise generator
  - RF amplification (gain stage)
- Power supply

Phone Jammers (cont'd)

Phone jammers provide solution for areas where cellular communications may cause inconvenience and violation of security policies as:

- Theatres and museums
- Lecture rooms, libraries, schools, and Universities
- Restaurants and public transport
- Places of Worship
- Recording studios
- Businesses (conferences, board of directors rooms, seminars, and meeting rooms)
- Government building and Government complexes
- Law enforcement facilities
- Police stations
- Drug enforcement facilities
- Prison facilities, jails, etc.
- Courts of law and court houses
- Military installations, military complexes, and military training centers

Phone Jammers: Illustration

Phone Jammer: Mobile Blocker

Mobile Blocker is an easy to use cost-effective solution for mobile communications control

Features:

- LED On/Off power indicator
- Accessory antennas for omnidirectional or bi-directional blockage
- Optional remote switch enables immediate On/Off control of the transmitter

Pocket Cellular Style Cell Phone Jammer

A pocket sized cell phone jammer

It can be used discreetly whilst in a pocket, bag, or even placed for others to see without alerting suspicion

It has an effective range of up to 20 metres

2.4Ghz Wi-Fi & Wireless Camera Jammer

Jammer for Wireless cctv cameras, Wi fi, Bluetooth. 100mw total output, range up to 10m

It is a 2.4 GHz jamming device utilizes unique and intelligent technology that will block video, the signals of wireless cameras, wireless LANs, and Bluetooth

Features:

- Palm sized and portable
- Built-in rechargeable battery which can be used for upto 1.5 hours outdoors
- AC adaptor input for indoor use

3 Watt Digital Cell Phone Jammer

3 Watt Digital Cell Phone Jammer is a CXT-5 cell phone jammer

It prevents anyone in the surrounding area from operating a mobile phone

It achieves this by blocking BCCH between the handset and receiver of the system provider

3 Watt Digital Cell Phone Jammer is powered by a 12 volt mains adaptor

It can be used with a battery pack to enable the portable device and is simple to operate

3 Watt Quad Band Digital Cellular Mobile Phone Jammer

Features:

- Strong, tough, robust, and high power output for industrial commercial usage
- Blocks noise or disturbance from unexpected cellular phone calls or text messages (SMS)
- Worldwide compatible
- Paralyzes cellular phone communication links within an effective area
- For use in meeting rooms, conference rooms, museums, galleries, theatres, concert halls etc
- Easy to install and operate
- Indoor and outdoor usage (not splash proof)
- Can be housed in a plastic container

20W Quad Band Digital Cellular Mobile Phone Jammer

Features

- Strong, tough, robust, die-cast aluminum casing
- High power output for industrial commercial usage
- Blocks noise or disturbance from unexpected cellular phone calls or text messages (SMS)
- Worldwide compatible
- Paralyzes cellular phone communication links within an effective area
- Sphere coverage area with a radius of its effective distance
- For use in meeting rooms, conference rooms, museums, and galleries
- Easy to install and operate
- Indoor and outdoor usage
- Directional high gain patch antenna
- Anti-tamper proof antenna

40W Digital Cellular Mobile Phone Jammer

Features

- Ultimate power phone jammer
- Strong, tough, robust, and die-cast aluminum casing
- High power output for industrial commercial usage
- Blocks noise or disturbance from unexpected cellular phone calls or text messages (SMS)
- Worldwide compatible
- Paralyze cellular phone communication links within an effective area
- Sphere coverage area with a radius of its effective distance
- For use in museums, galleries, theatres, concert halls etc.
- Easy to install and operate; plug and play
- Weatherproof high gain base station type antenna
- Dual inter cooler for ultimate performance

Detecting a Wireless Network

Using an operating system, such as Windows XP or Mac with Airport, to detect available networks

Using handheld PCs (Tool: MiniStumbler)

Using passive scanners (Tool: Kismet, KisMAC)

Using active beacon scanners (Tool: NetStumbler, MacStumbler, iStumbler)

Scanning Tools

Scanning Tools

- Kismet
- PrismStumbler
- MacStumbler
- Mognet
- WaveStumbler
- StumbVerter
- AP Scanner
- Wireless Security Auditor
- AirTraf
- Wifi Finder
- eEye Retina WiFI

Scanning Tool: Kismet

Kismet is completely passive, capable of detecting traffic from APs and wireless clients alike (including NetStumbler clients) as well as closed networks

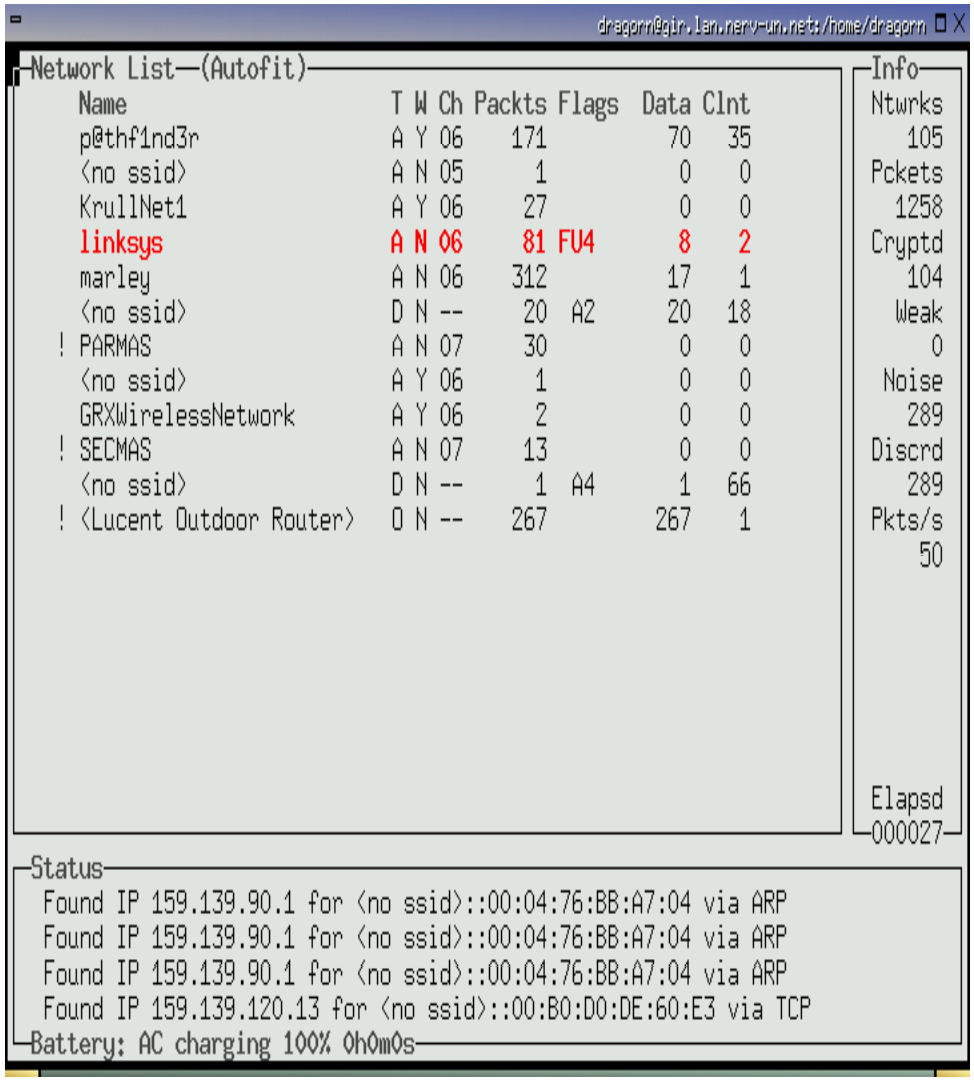
It requires 802.11b capable of entering RF monitoring mode. Once in RF monitoring mode, the card is no longer able to associate with a wireless network

It needs to run as root, but can switch to lesser privileged UID as it begins to capture

To hop across channels, run *kismet_hopper –p*

Closed network with no clients authenticated is shown by <nossid> and is updated when client logs on

Kismet: Screenshot



Source: *www.kismetwireless.net*

Scanning Tool: Prismstumbler

Prismstumbler is a wireless LAN (WLAN) that scans for beacon frames from access points

It operates by constantly switching channels and monitors any frames received on the currently selected channel

The program was created by using ideas and codesnippets from prismdump, AirSnort, and WireShark

Prismstumbler will also find private networks. Because the method used in Prismstumbler is receive only, it can also find networks with weaker signals and discover more networks

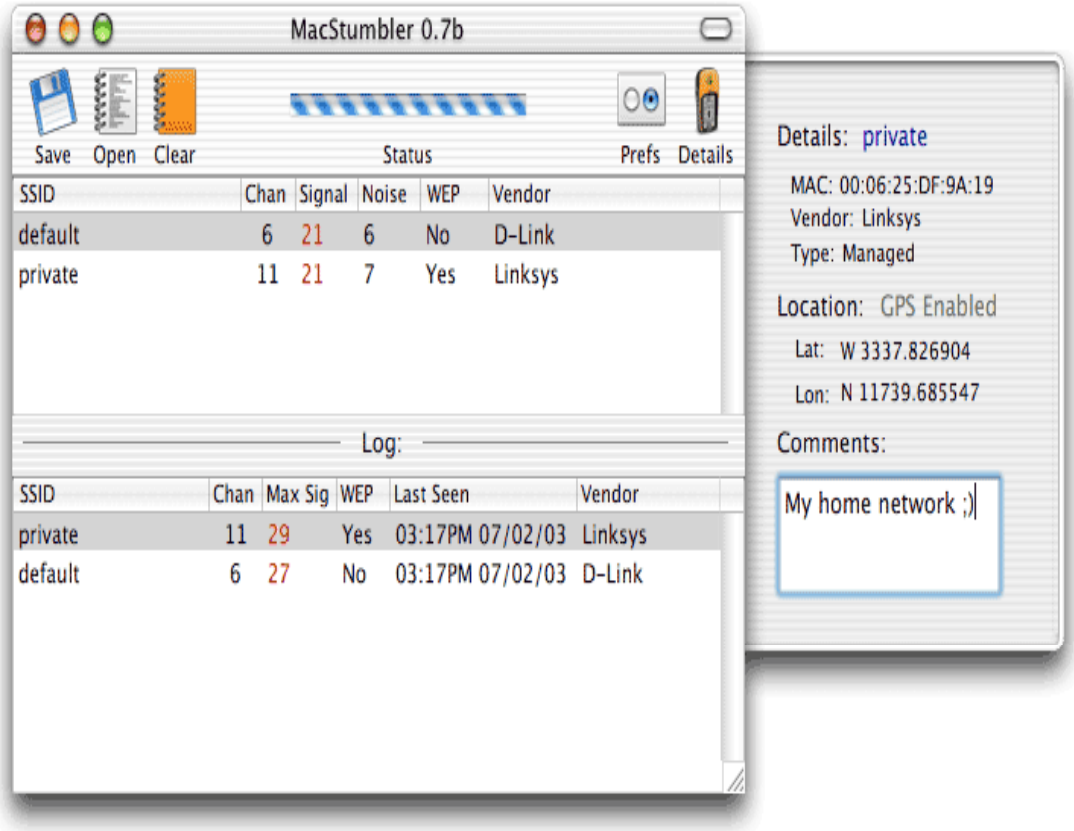
Source: *http://prismstumbler.sourceforge.net/*

Scanning Tool: MacStumbler

MacStumbler is a utility used to display information about nearby 802.11b and 802.11g wireless access points

It is mainly designed to be a tool to help find access points while traveling or to diagnose wireless network problems

MacStumbler requires an Apple Airport Card and MacOS 10.1 or greater. MacStumbler does not currently support any kind of PCMCIA or USB wireless device



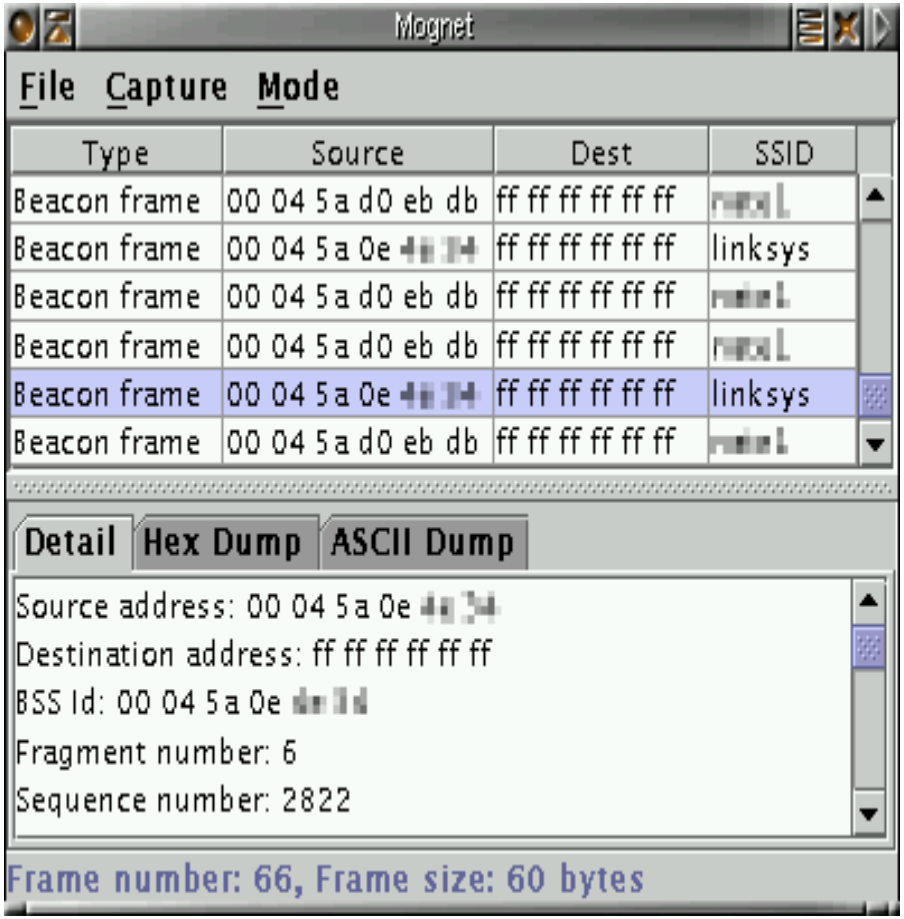
Source: *http://www.macstumbler.com/*

Scanning Tool: Mognet

Mognet is a simple, lightweight 802.11b sniffer written in Java and available under the GPL

It features real-time capture output, support for all 802.11b generic and frame-specific headers, easy display of frame contents in hex or ASCII, text mode capture for GUI-less devices, and loading/saving capture sessions in libpcap format

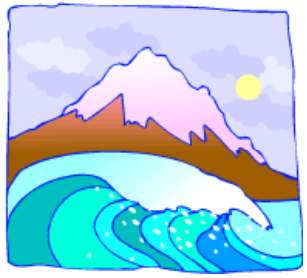
Mognet requires a Java Development Kit 1.3 or higher and a working C compiler for native code compilation



Source: *http://www.node99.org//*

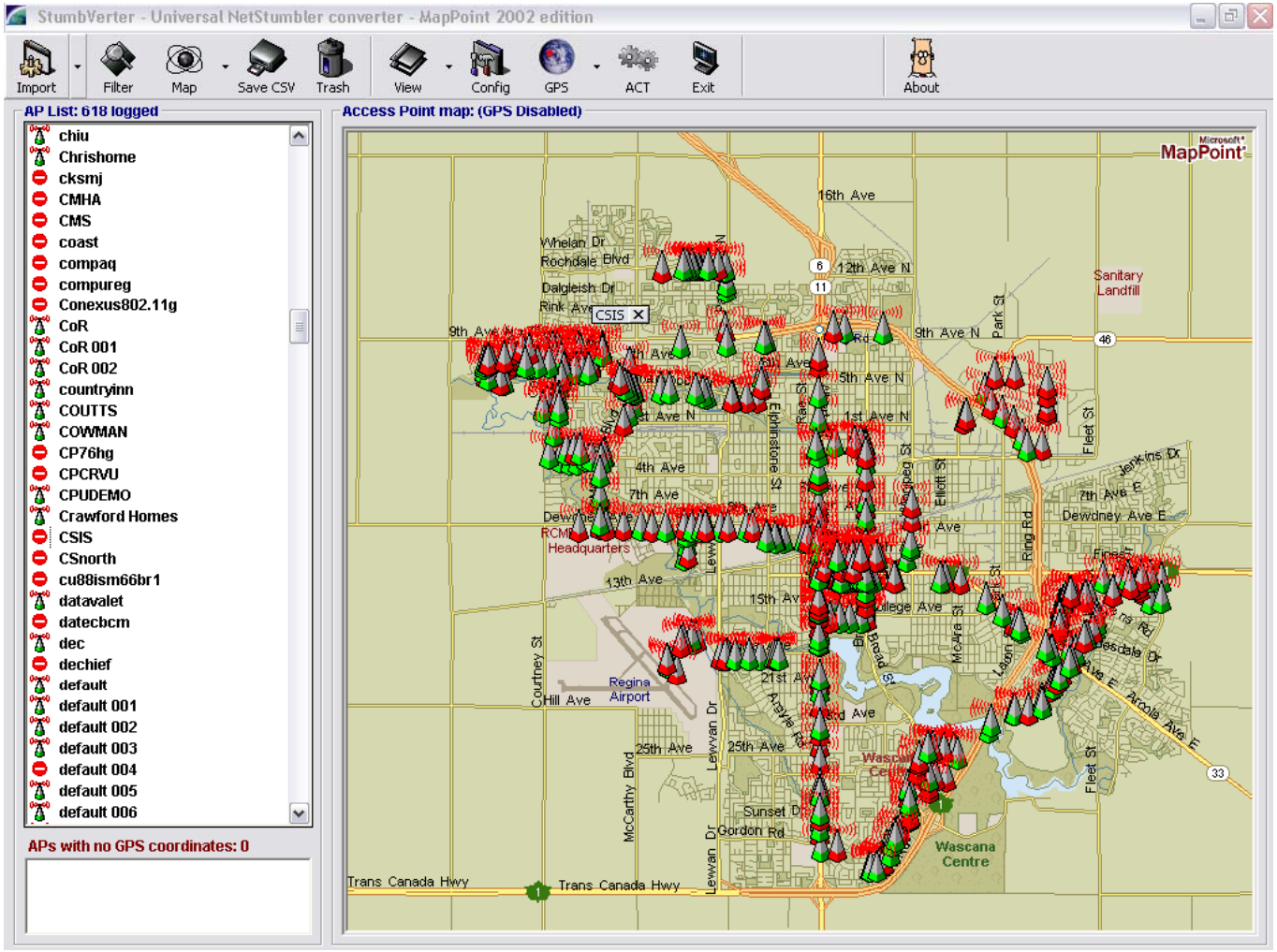
Scanning Tool: WaveStumbler

- WaveStumbler is a console-based 802.11 network mapper for Linux
- It reports the basic AP information like channel, WEP, ESSID, and MAC
- It consists of a patch against the kernel driver, orinoco.c, which makes it possible to send the scan command to the driver via the /proc/hermes/ethX/cmds file
- The answer is then sent back via a netlink socket
- WaveStumbler listens to this socket and displays the output data on the console



Source: *http://www.cqure.net/*

Stumbverter: Screenshot



Scanning Tool: Netchaser for Palm Tops

Find and easily connect to WiFi hotspots with your Palm handheld computer

Access Point Info:

- AP MAC address
- AP SSID
- Signal strength
- Channel
- Loss-of-signal time and date display
- Latitude and longitude of strongest signal

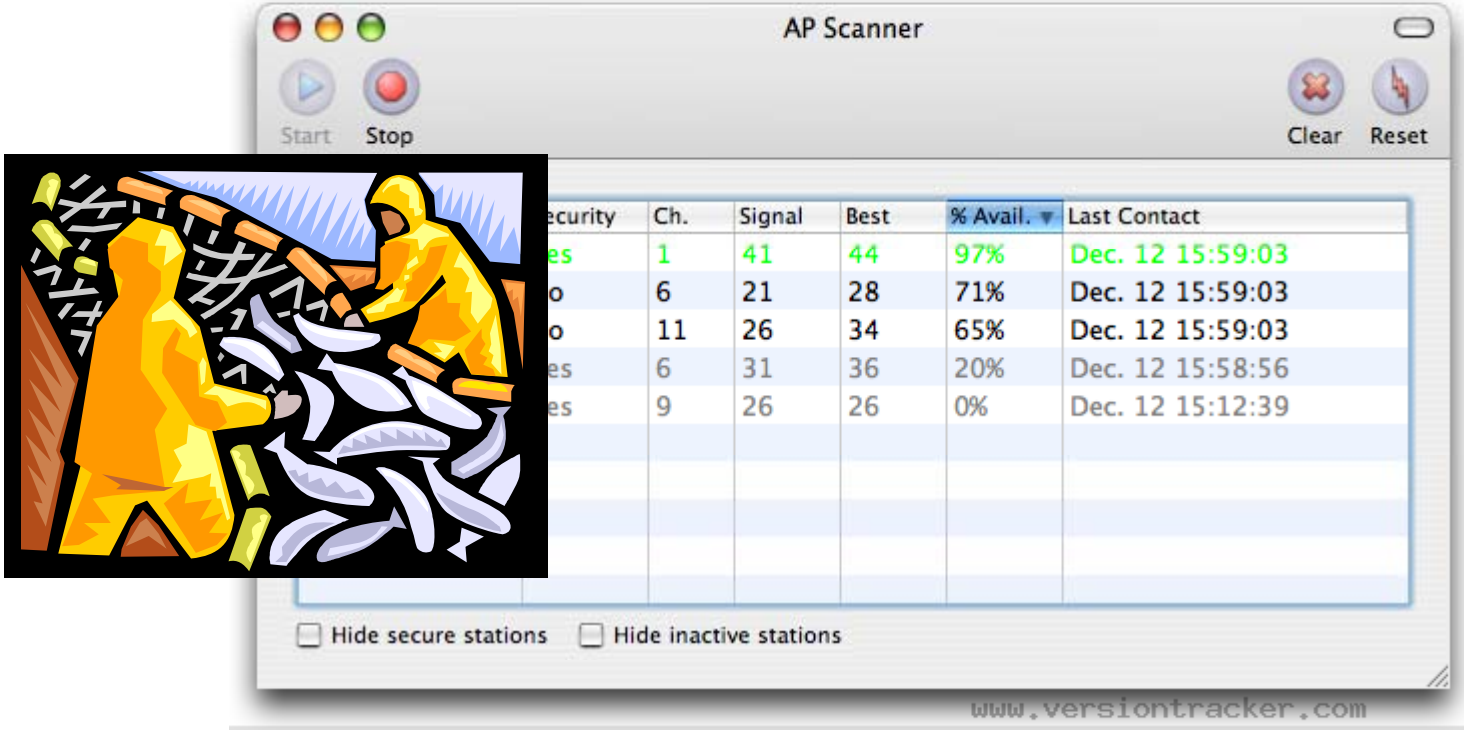
Full Logging Support:

- Log all access point data to a file for post-processing
- CSV standard file suitable for import into any database or spreadsheet

Source: *http://www.bitsnbolts.com/*

Scanning Tool: AP Scanner

AP Scanner is an application that shows a graph of the channel usage of all open wireless access points within range



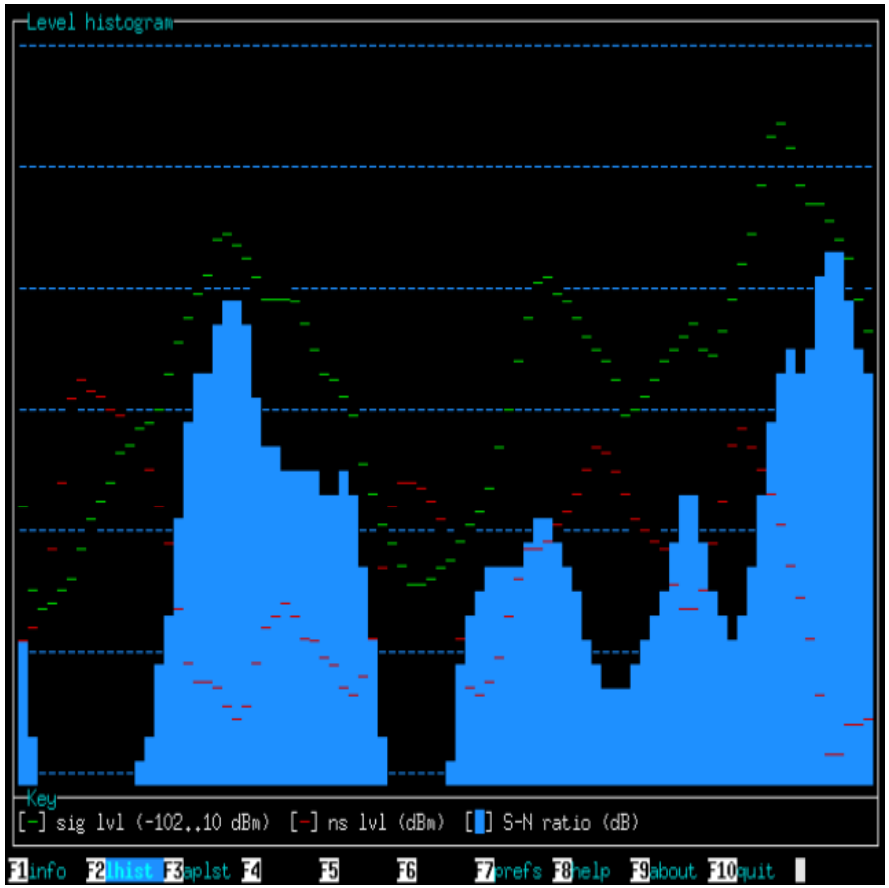
Source: *http://www.versiontracker.com/*

Scanning Tool: Wavemon

Wavemon is a ncurses-based monitor for wireless devices

Wavemon allows watching of signal and noise levels, packet statistics, device configuration, and network parameters of hardware or a wireless network

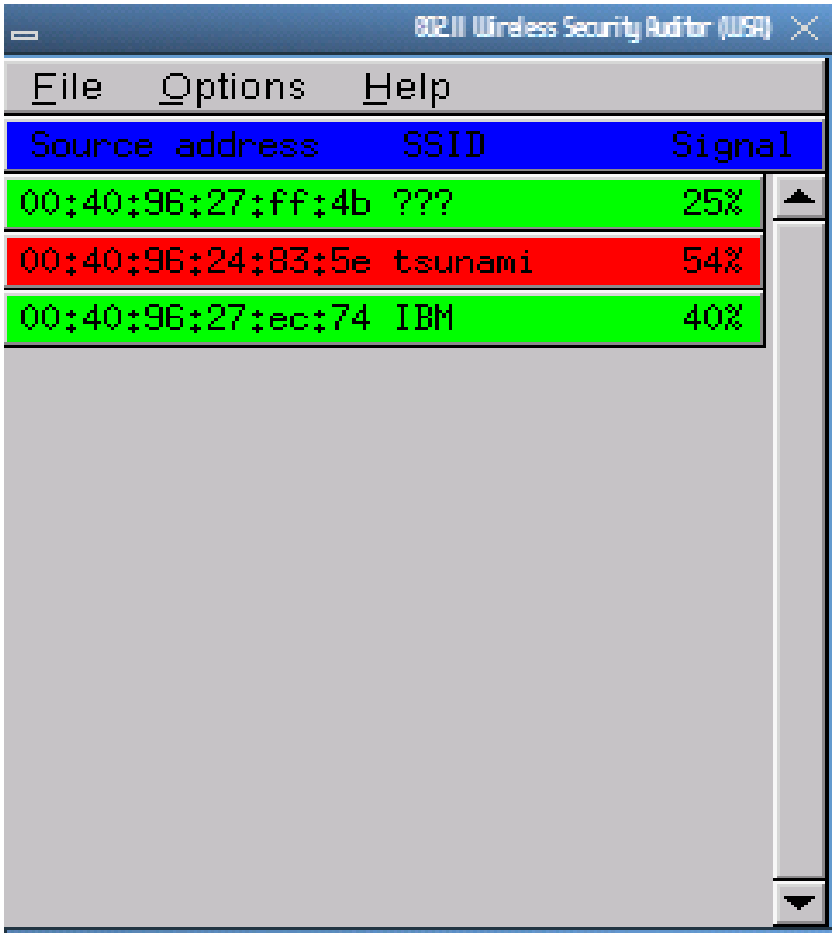
It has currently only been tested with the Lucent Orinoco series of cards, although it should work (with varying features) with all devices supported by the wireless kernel extensions written by Jean Tourrilhes



Source: *http://freshmeat.net/*

Scanning Tool: Wireless Security Auditor (WSA)

- An IBM research prototype of an 802.11
- A wireless LAN security auditor, running on Linux or an iPAQ PDA
- WSA helps network administrators by auditing the wireless network for security
- Vulnerabilities in the network can be discovered before hackers break in the network



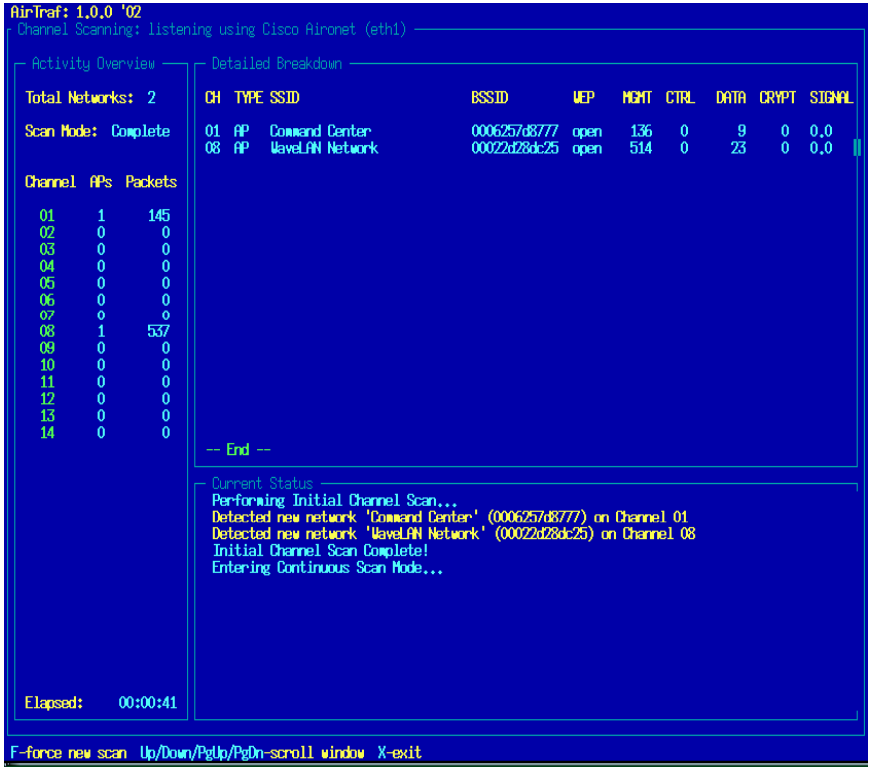
Source: *http://www.research.ibm.com/*

Scanning Tool: AirTraf

AirTraf is a wireless sniffer that can detect and determine exactly what is being transmitted over 802.11 wireless networks

It is developed as an open source program

It tracks and identifies legitimate and rogue access points, keeps performance statistics on a by-user and by-protocol basis, measures the signal strength of network components, and more



Source: *www.elixar.com*

Scanning Tool: WiFi Finder

WiFi Finder checks for 802.11b and 802.11g signals without a computer or PDA

The user interface consists of a single button and three LEDs that indicate available signal strength

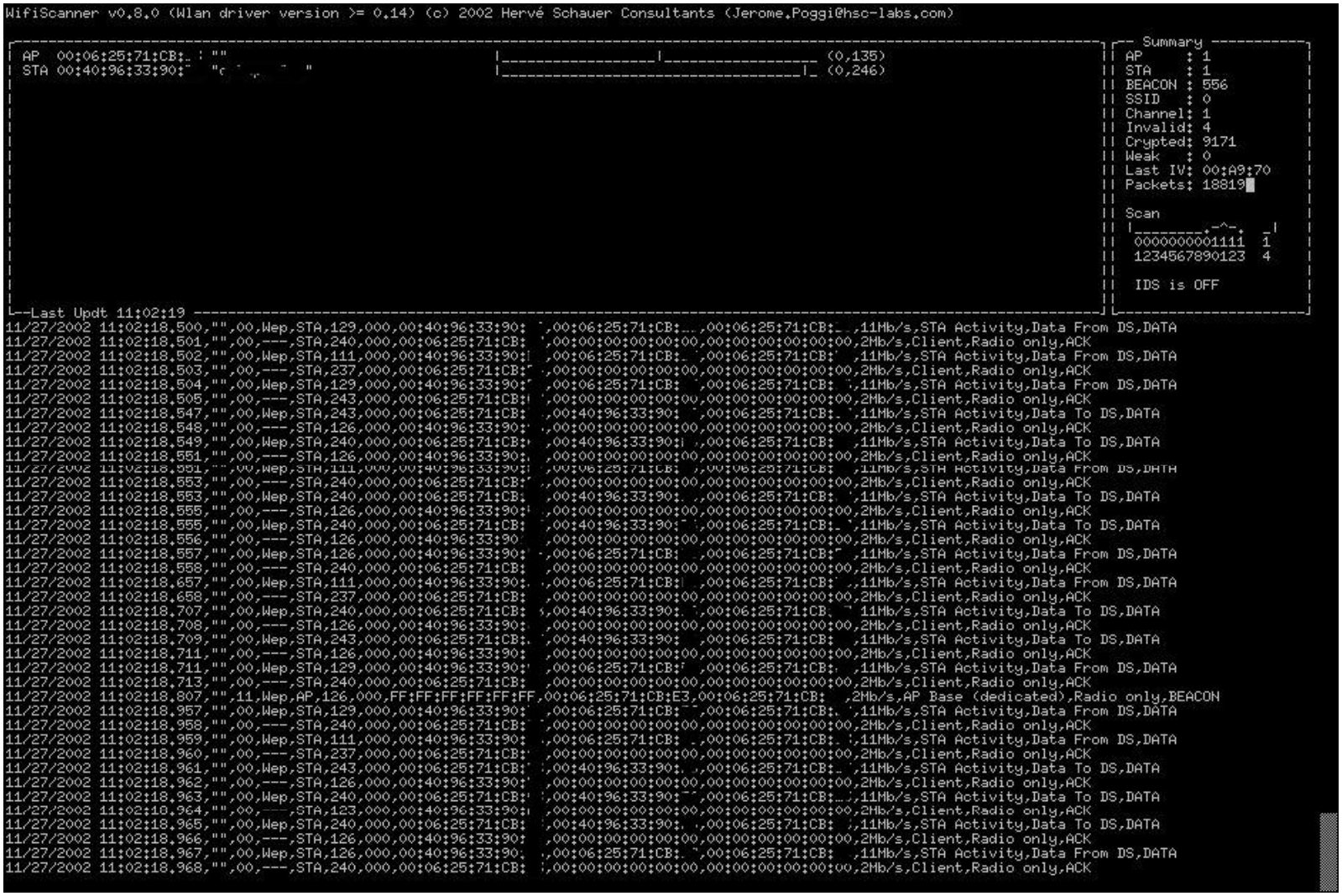
Source: *http://www.kensington.com/*

Scanning Tool: WifiScanner

WifiScanner is designed to discover wireless node

It dumps the traffic in realtime and the sniffed channels can be changed

WifiScanner: Screenshot



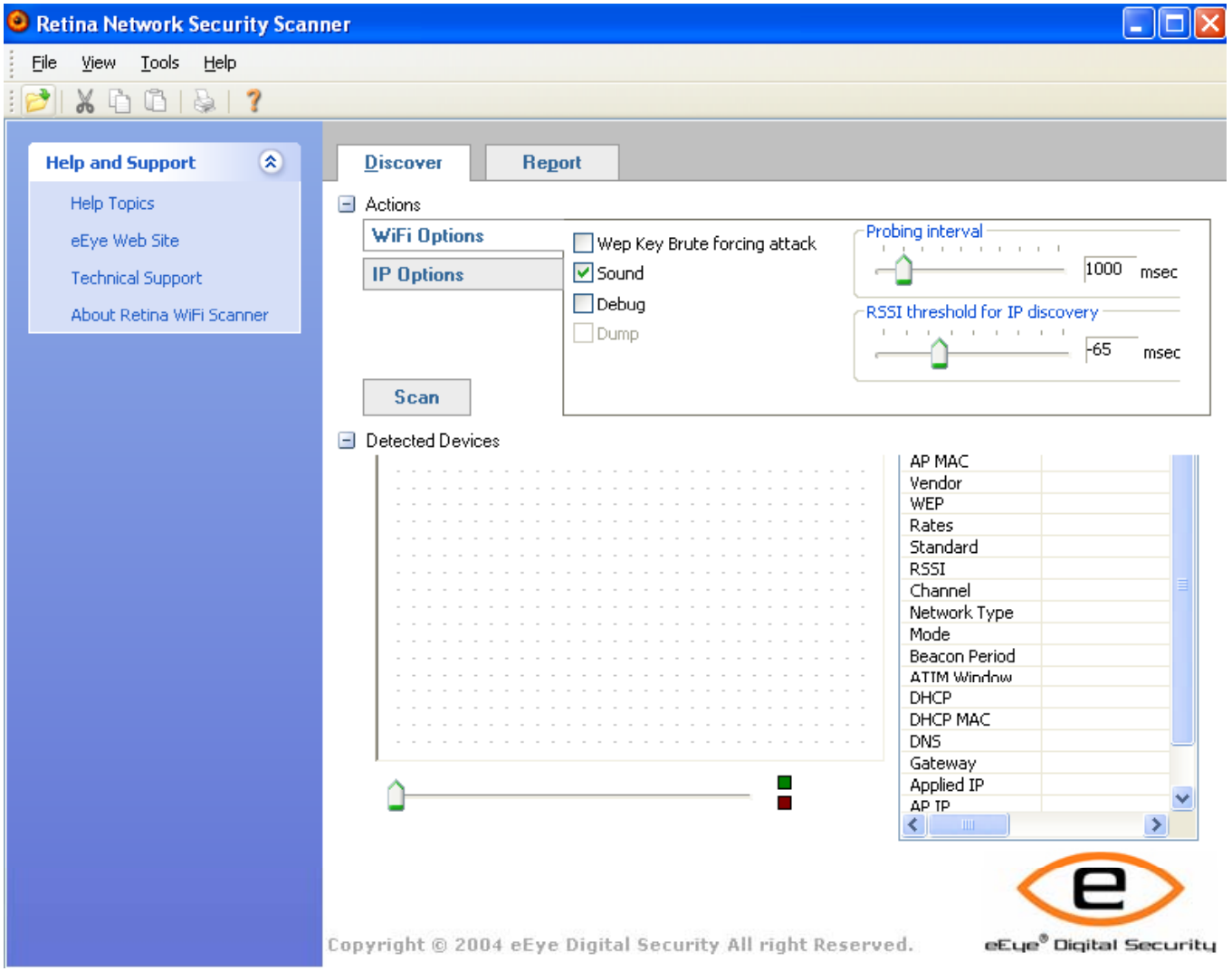
eEye Retina WiFI

eEye Retina WiFI does not scan your eye, but it does scan the area and detects the presence of wireless devices located within a network or connected wirelessly to the network

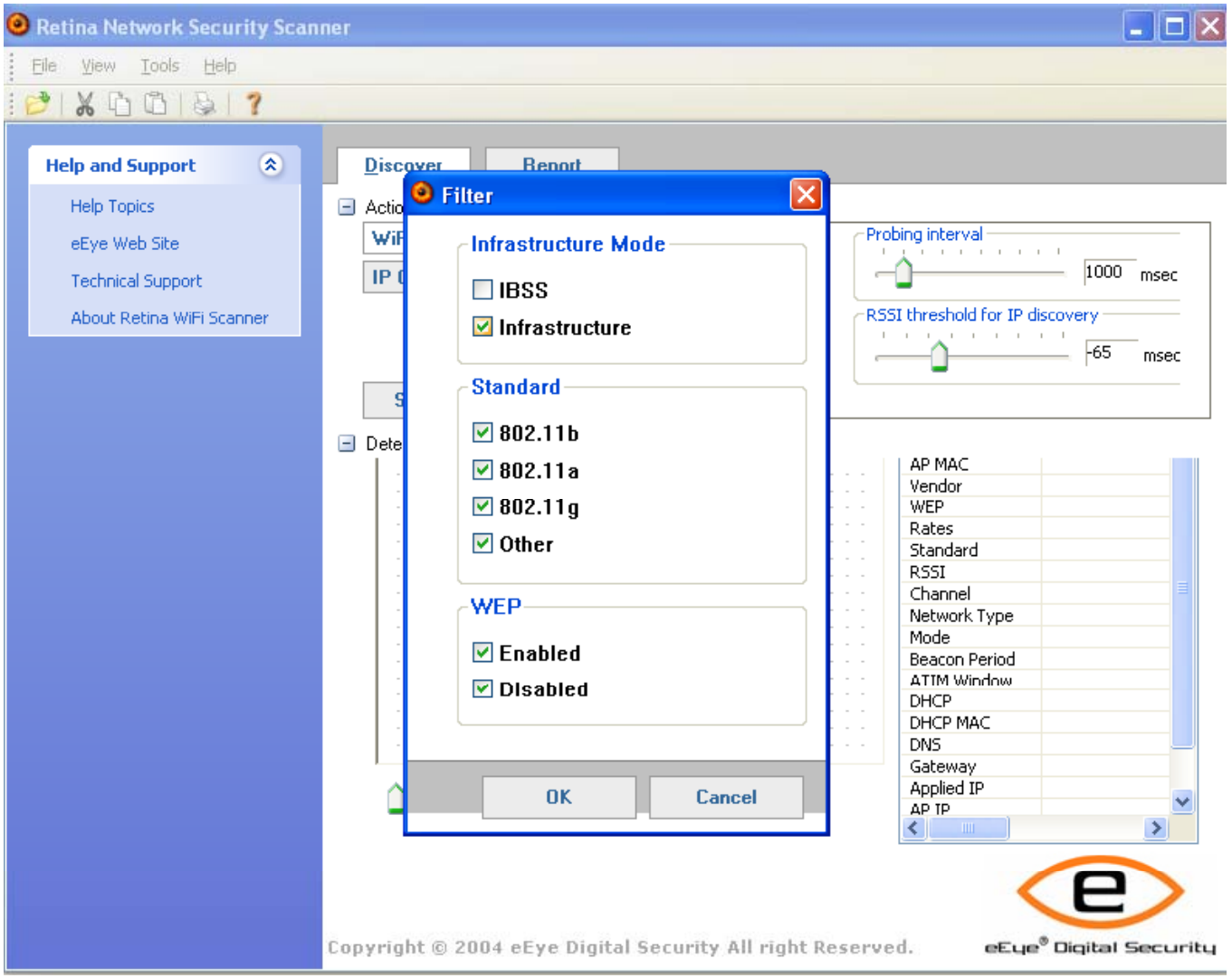
This tool detects rogue mobile devices and transmitting laptops

eEye's Retina WiFi Scanner enables a company to ensure their customers' networks are secure

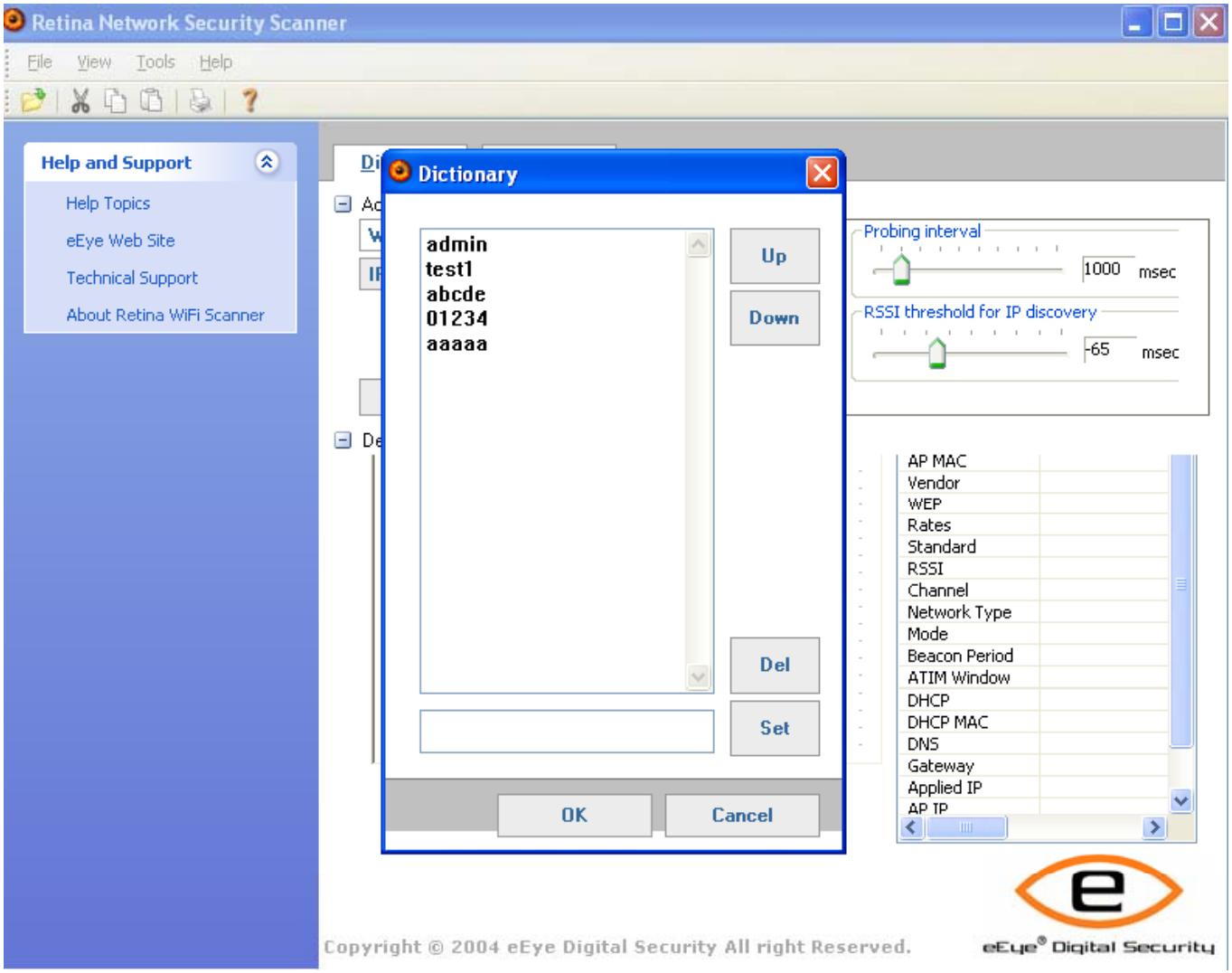
eEye Retina WiFI: Screenshot 1



eEye Retina WiFI: Screenshot 2



eEye Retina WiFI: Screenshot 3



Simple Wireless Scanner

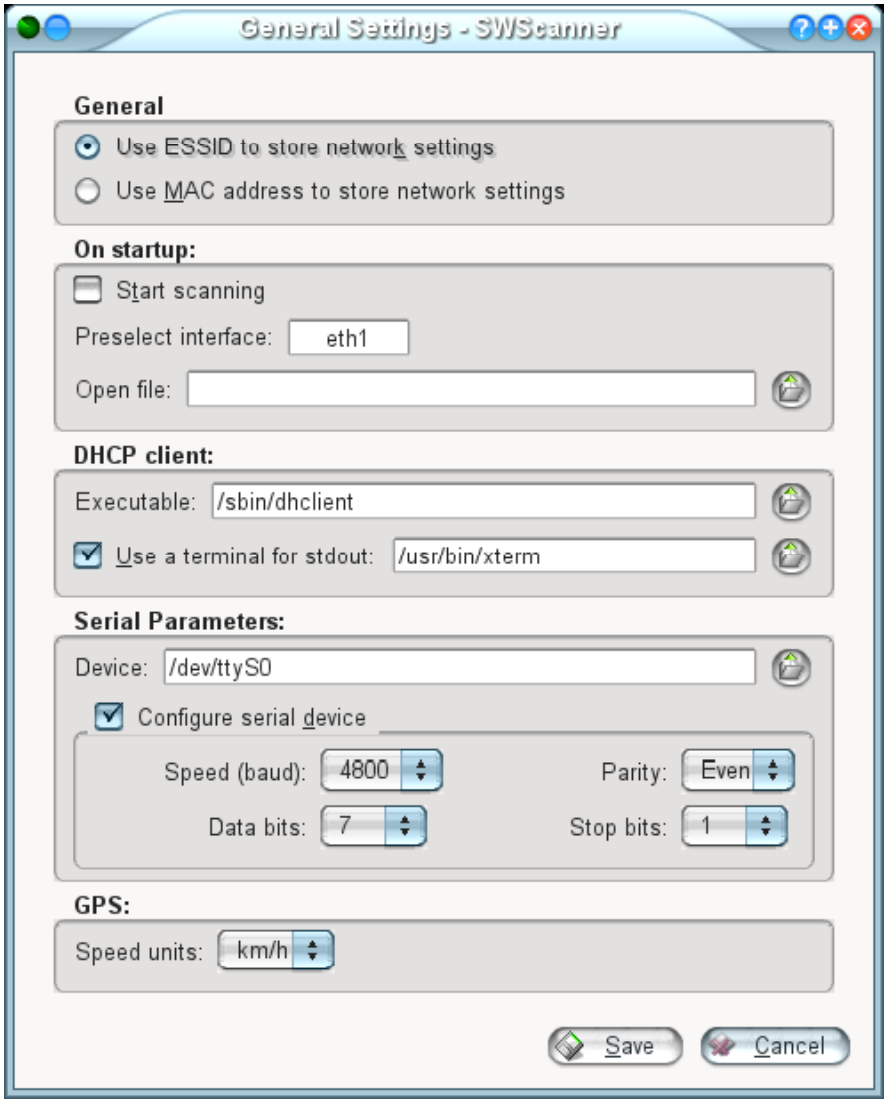
Simple Wireless Scanner (SWScanner) is an application for Linux environments designed for scanning, configuring, and managing wireless networks

SWScanner is a wardriving tool, and has a high level of compatibility with NetStumbler

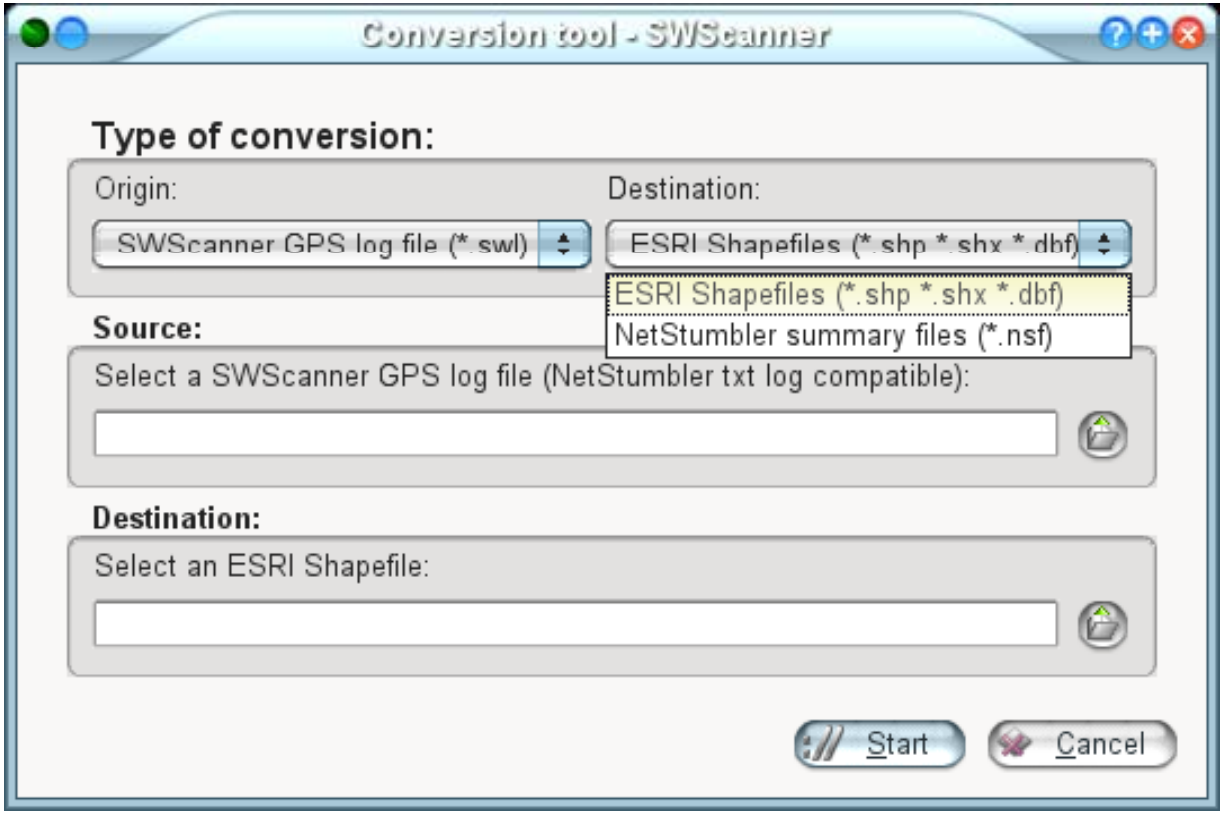
Features:

- SWScanner uses wireless-extensions
- Has detailed and updated information of signal, noise, and other wireless network parameters of the selected interface
- Has GPS integration
- Has the possibility of storing network settings of the detected access points
- It simplifies the asociating/deasociating process to an access point
- Has possibility of storing scanned data
- It simplifies wardriving
- Combatible log data between NetStumbler and SWScanner; i.e.: it is possible to open a text or summary file produced with *NS*. *NS* will also recognize log files produced by SWScanner
- Conversion of log (text or summary) files (from *NS* or SWScanner) to the well-known widely used ESRI Shapefile format

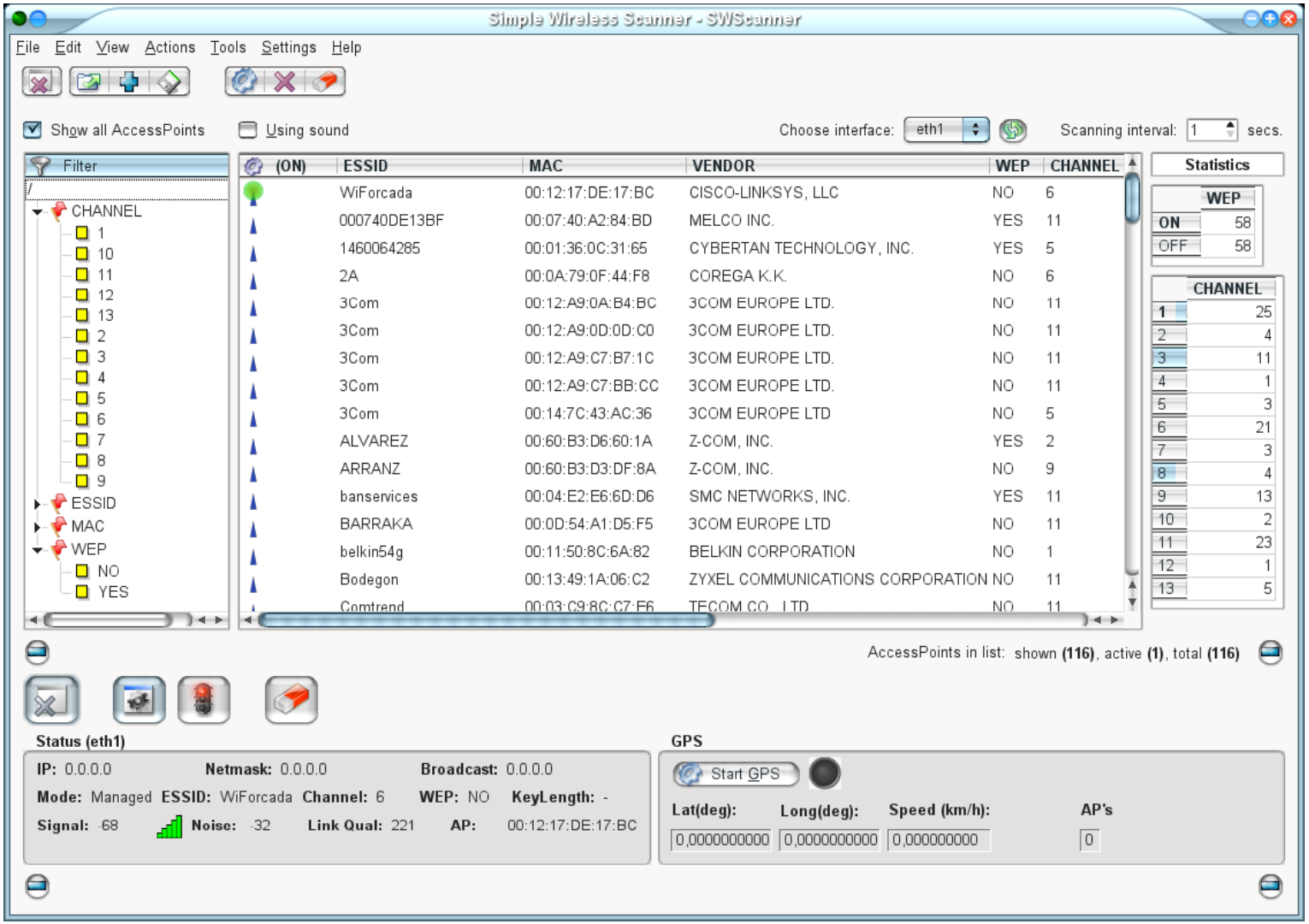
Simple Wireless Scanner: Screenshot 1



Simple Wireless Scanner: Screenshot 2

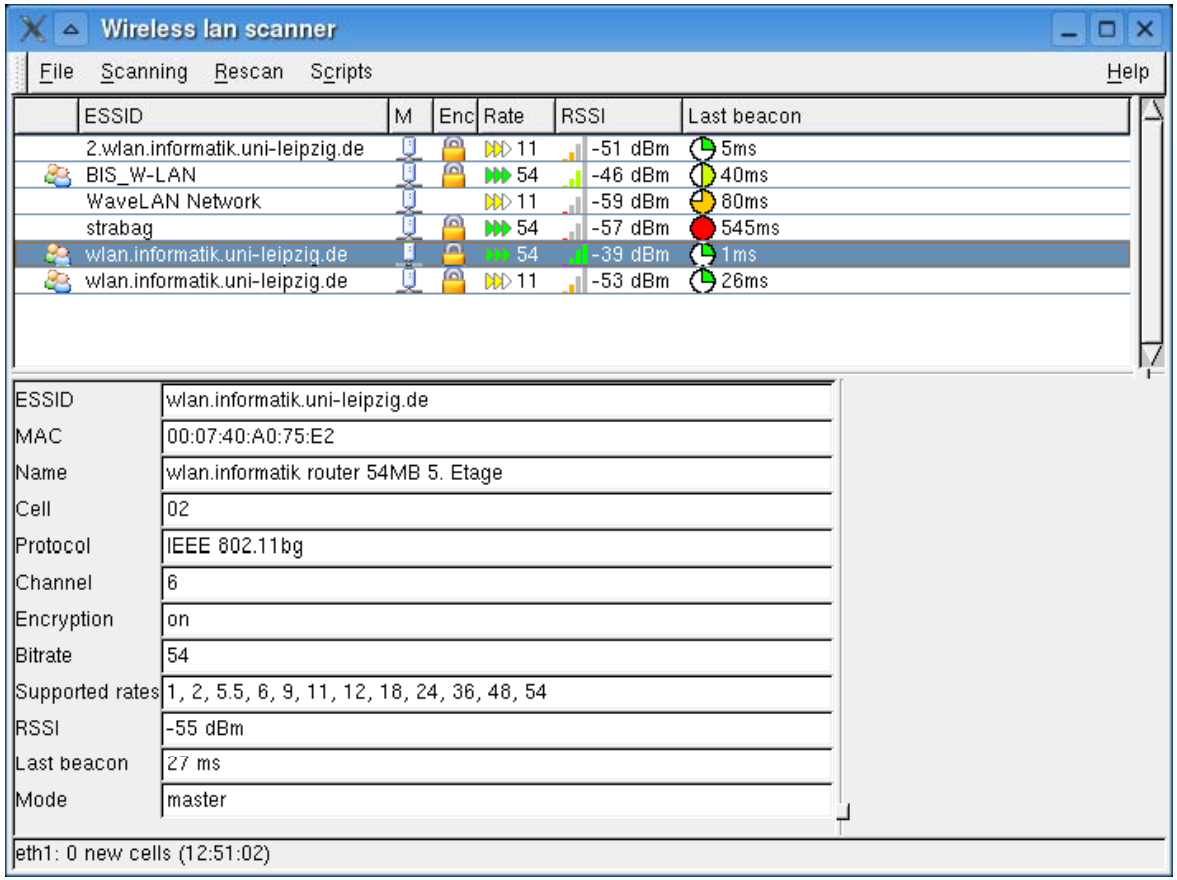


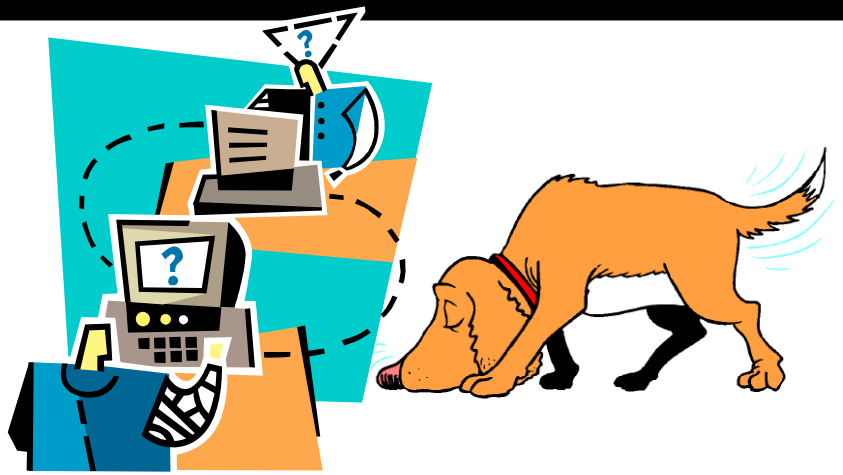
Simple Wireless Scanner: Screenshot 3



wlanScanner

Lists available networks, with data like signal strength, encryption status, and connection speed





Sniffing Tools

Sniffing Tools

- AiroPeek
- NAI Wireless Sniffer
- WireShark
- VPNmonitorl
- Aerosol
- vxSniffer
- EtherPEG
- DriftNet
- WinDump
- ssidsniff

Sniffing Tool: AiroPeek

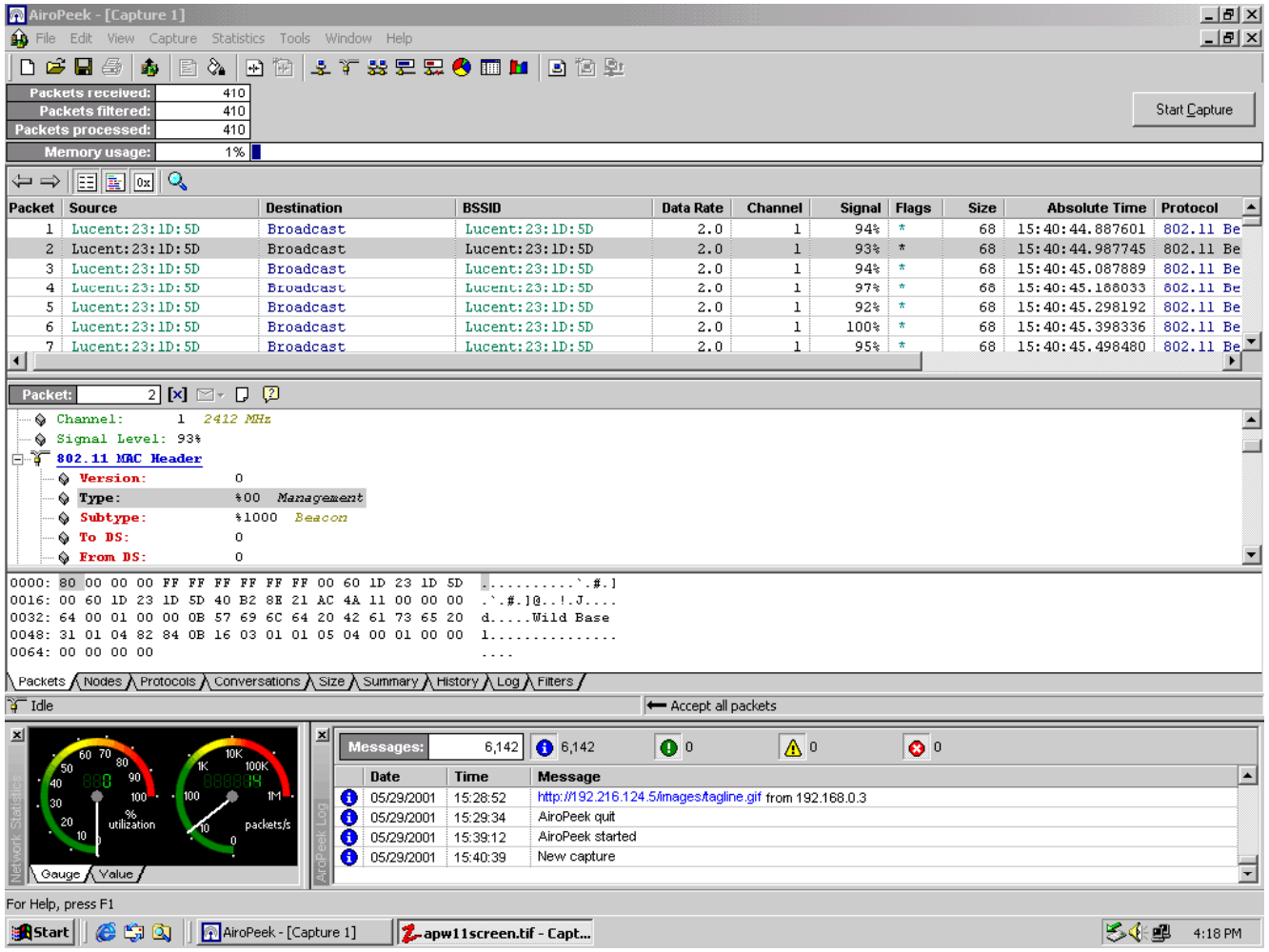
A wireless management tool needed to deploy, secure, and troubleshoot the wireless LAN

It covers the whole wireless LAN management, including site surveys, security assessments, client troubleshooting, WLAN monitoring, remote WLAN analysis, and application layer protocol analysis

It has an enhanced analysis of VoIP

Source: *http://www.wildpackets.com/*

AiroPeek: Screenshot

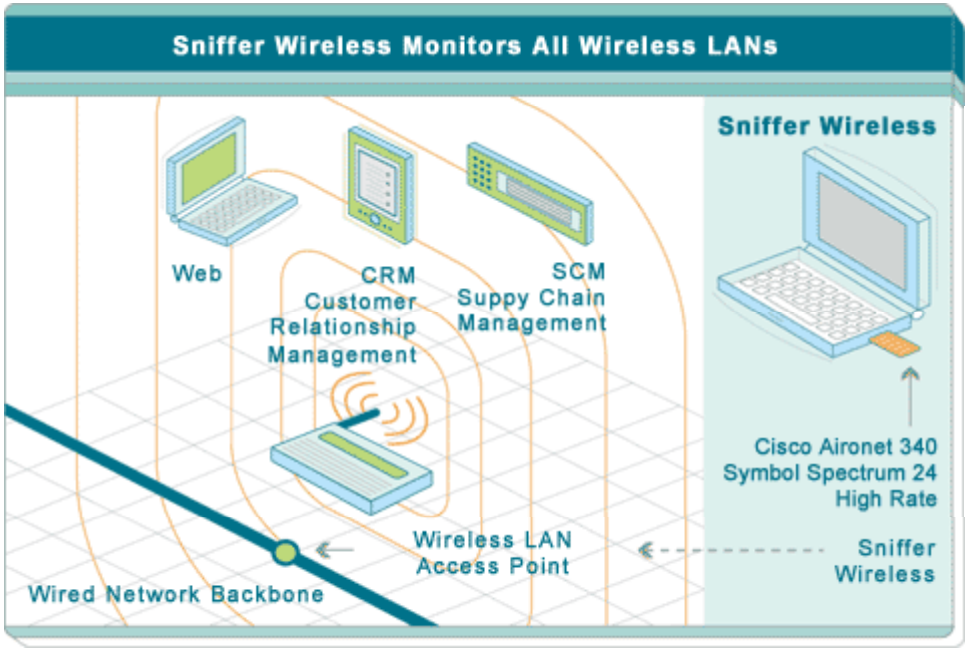


Sniffing Tool: NAI Wireless Sniffer

NAI Wireless Sniffer is developed by Network Associates, Inc

It is used for rogue mobile unit detection

It gathers a list of all the wireless devices, whether they are access units or mobile devices, and labels them as such

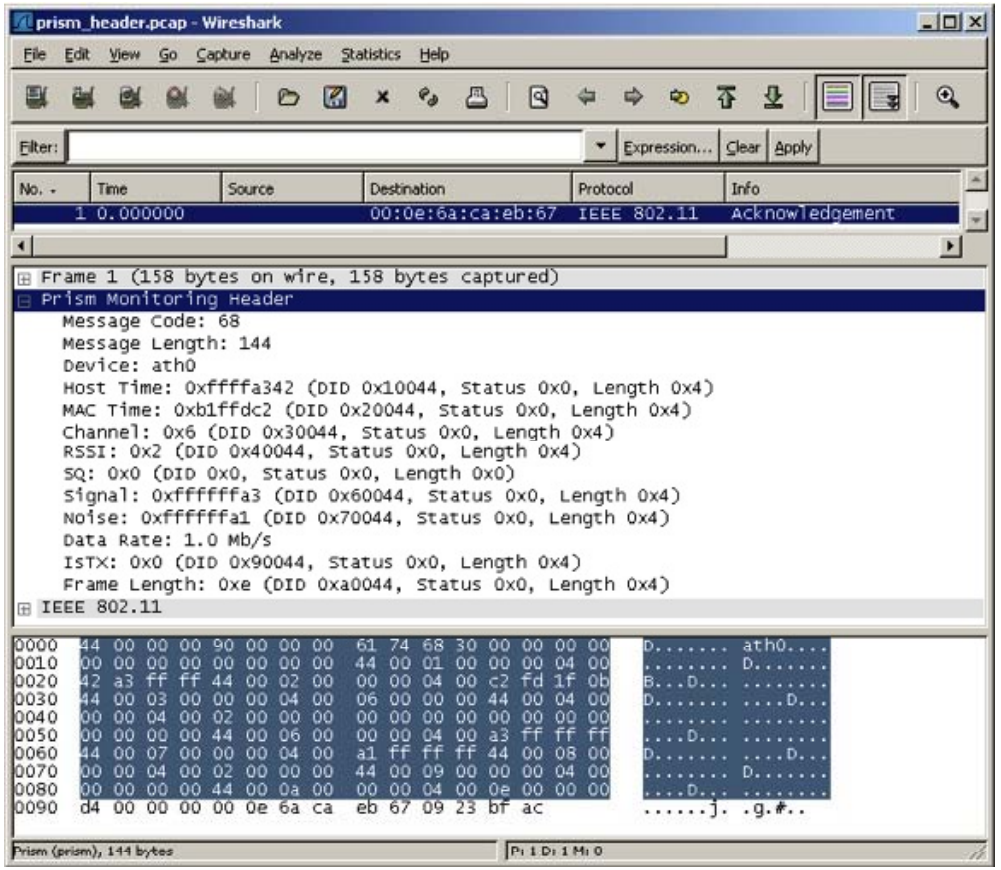


MAC Sniffing Tool: WireShark

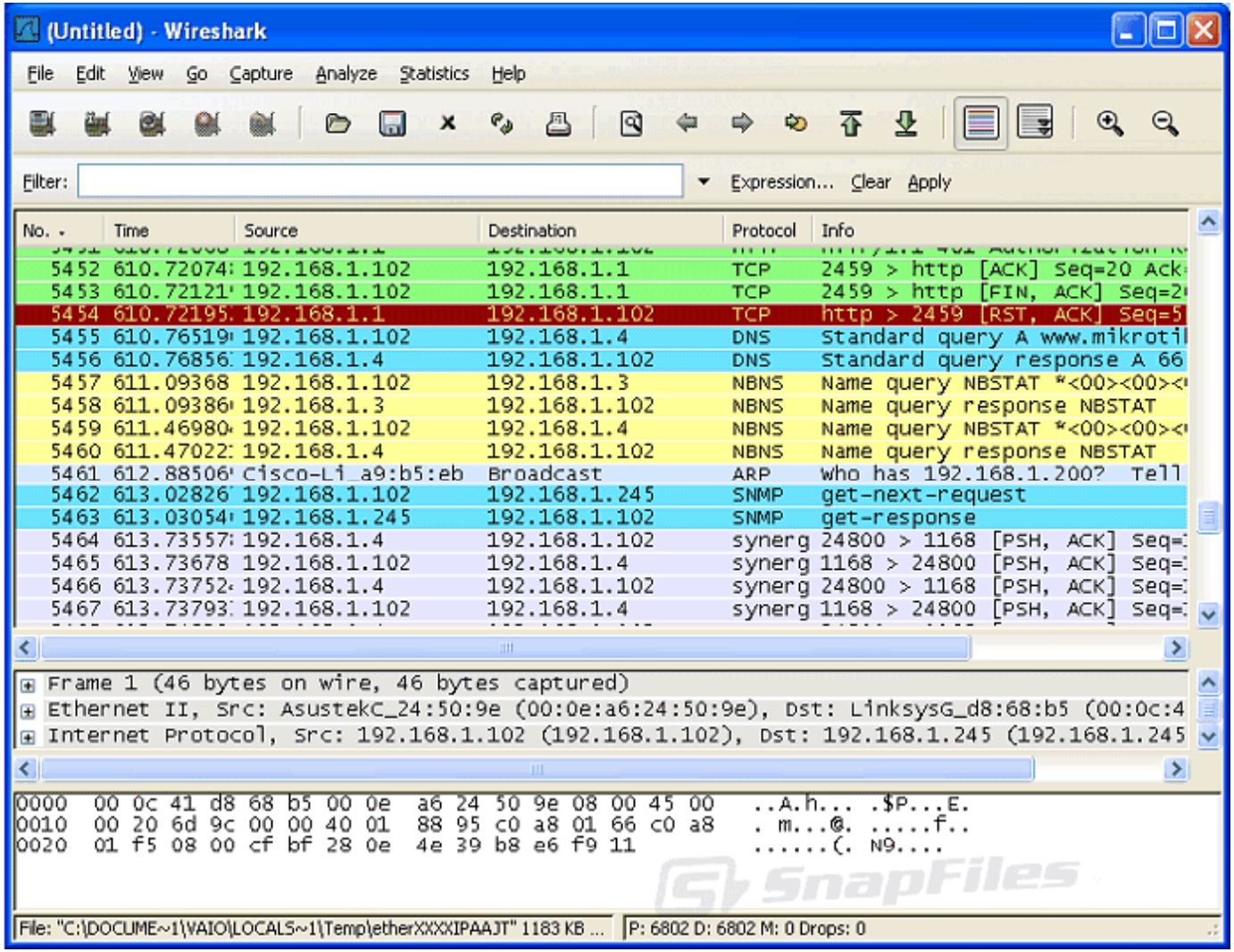
WireShark is a free network protocol analyzer for Unix and Windows

It allows examination of data from a live network or from a captured file on disk

It has several powerful features, including a rich display filter language and the ability to view the reconstructed stream of a TCP session



WireShark: Screenshot



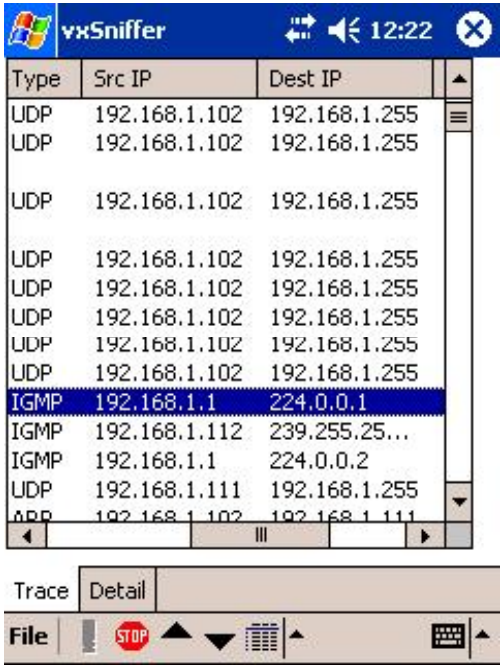
Sniffing Tool: vxSniffer

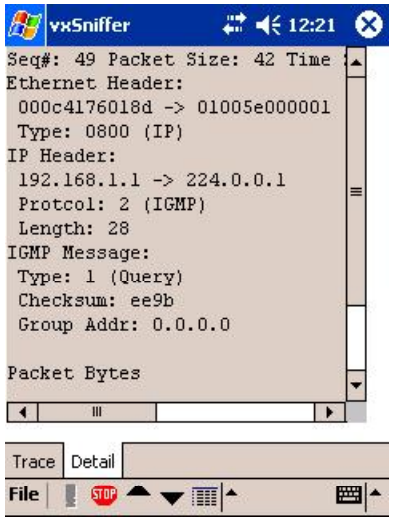
vxSniffer is a complete network monitoring tool for Windows CE-based devices

It operates on all handheld 2000 HPCs, pocket PCs, Pocket PC 2002s, and Windows Mobile 2003s

It requires an Ethernet adapter with an NDIS-compatible driver

vxSniffer is a licensed software





Source: *http://www.cam.com/vxSniffer.html*

Sniffing Tool: Etherpeg

Etherpeg watches the local network for traffic, reassembles out-of-order TCP streams, and scans the result for data that looks like a GIF or JPEG

It is a simple but effective hack that indiscriminately shows all image data that it can assemble

The source code is freely available and compiles easily with a simple make from the terminal window

Source: *http://www.etherpeg.org/*

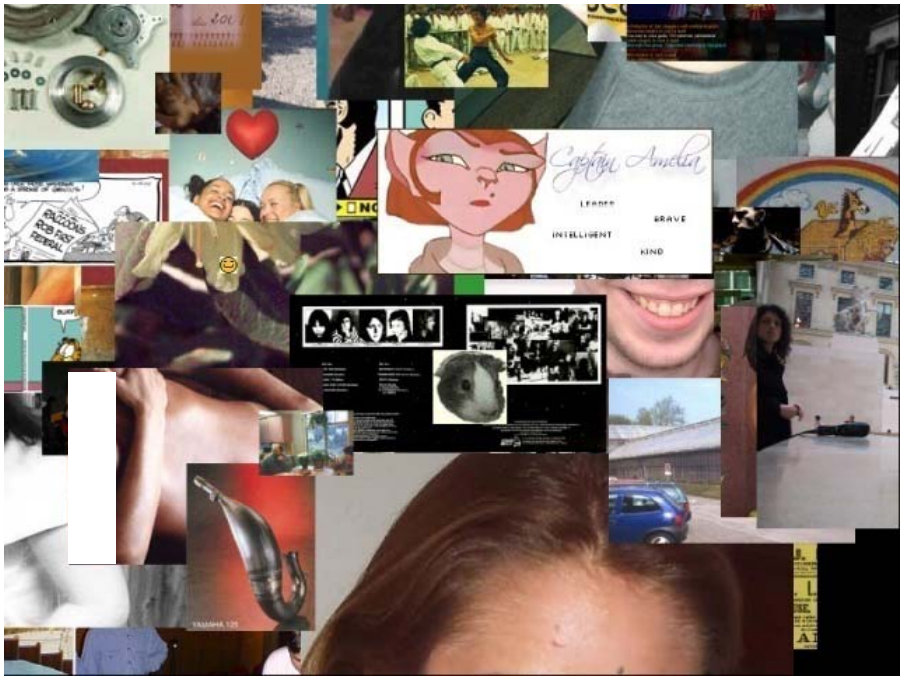
Etherpeg: Screenshot

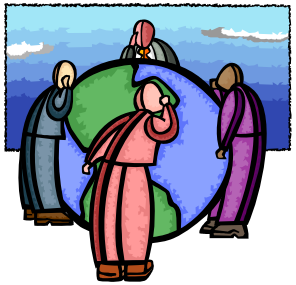
Sniffing Tool: Drifnet

Drifnet is based on the lines of EtherPEG

It is a program that listens to network traffic and picks out images from TCP streams it observes

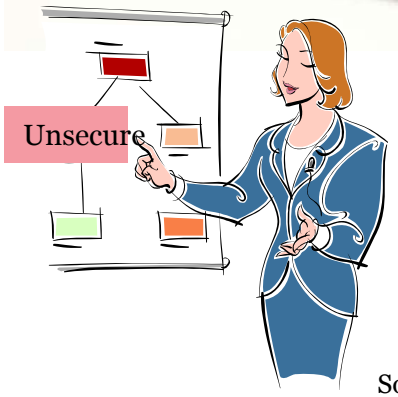
In the beta version, driftnet picks out MPEG audio streams from network traffic and tries to play them





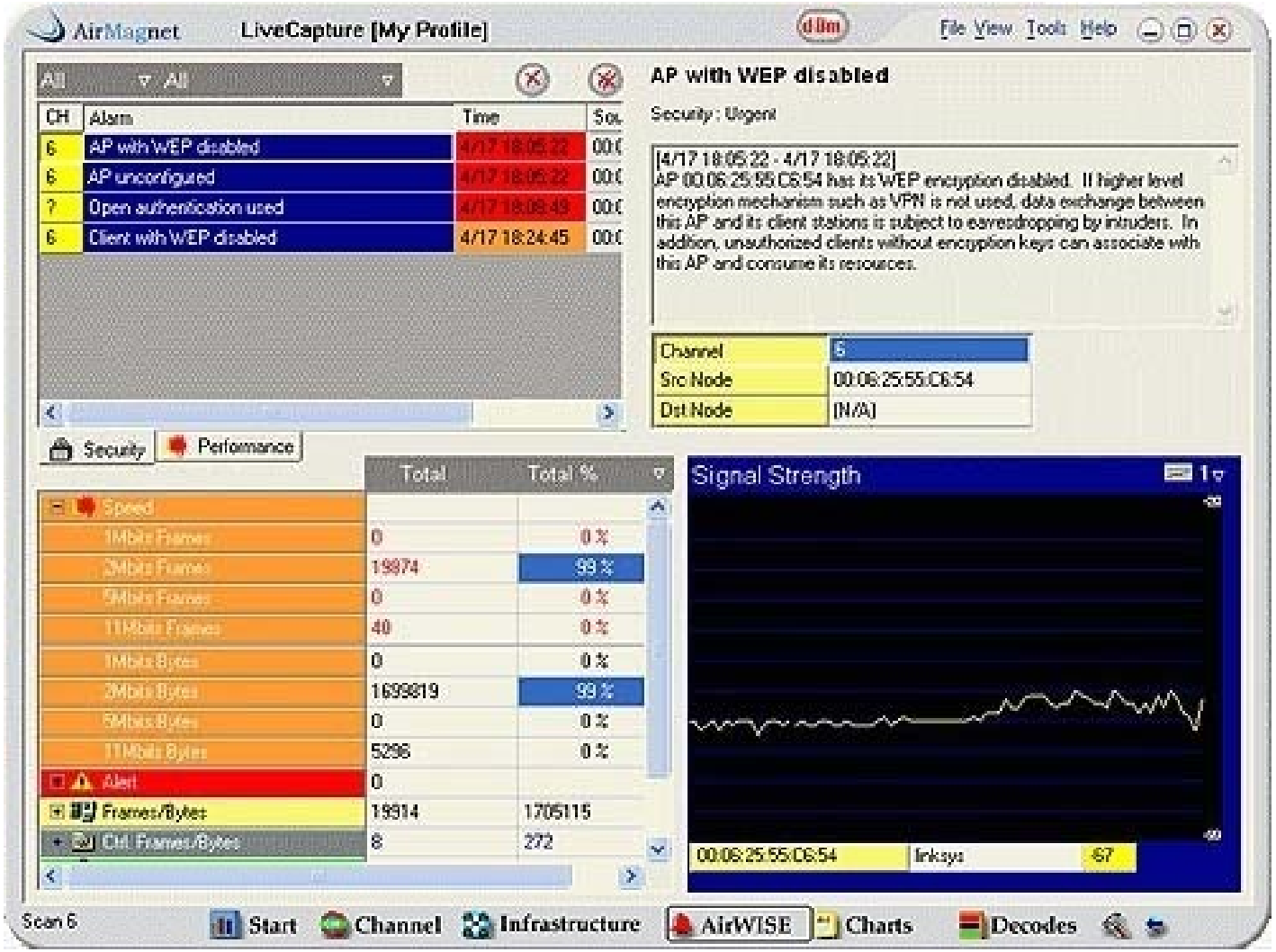
Sniffing Tool: AirMagnet

- AirMagnet v1.2 is a new tool from AirMagnet
- It is similar to MiniStumbler, except it has a GPS option
- This tool is used not only for sniffing out wireless networks, but for the deployment and administration of WLANs in organizations
- It uses many levels of graphics and animations to display real-time statistics of WLANs in the area
- It not only displays the unsecured networks, but also gives a list of possible security holes and configuration problems with WLANs in the area



Source: *http://www.airmagnet.com*

AirMagnet: Screenshot



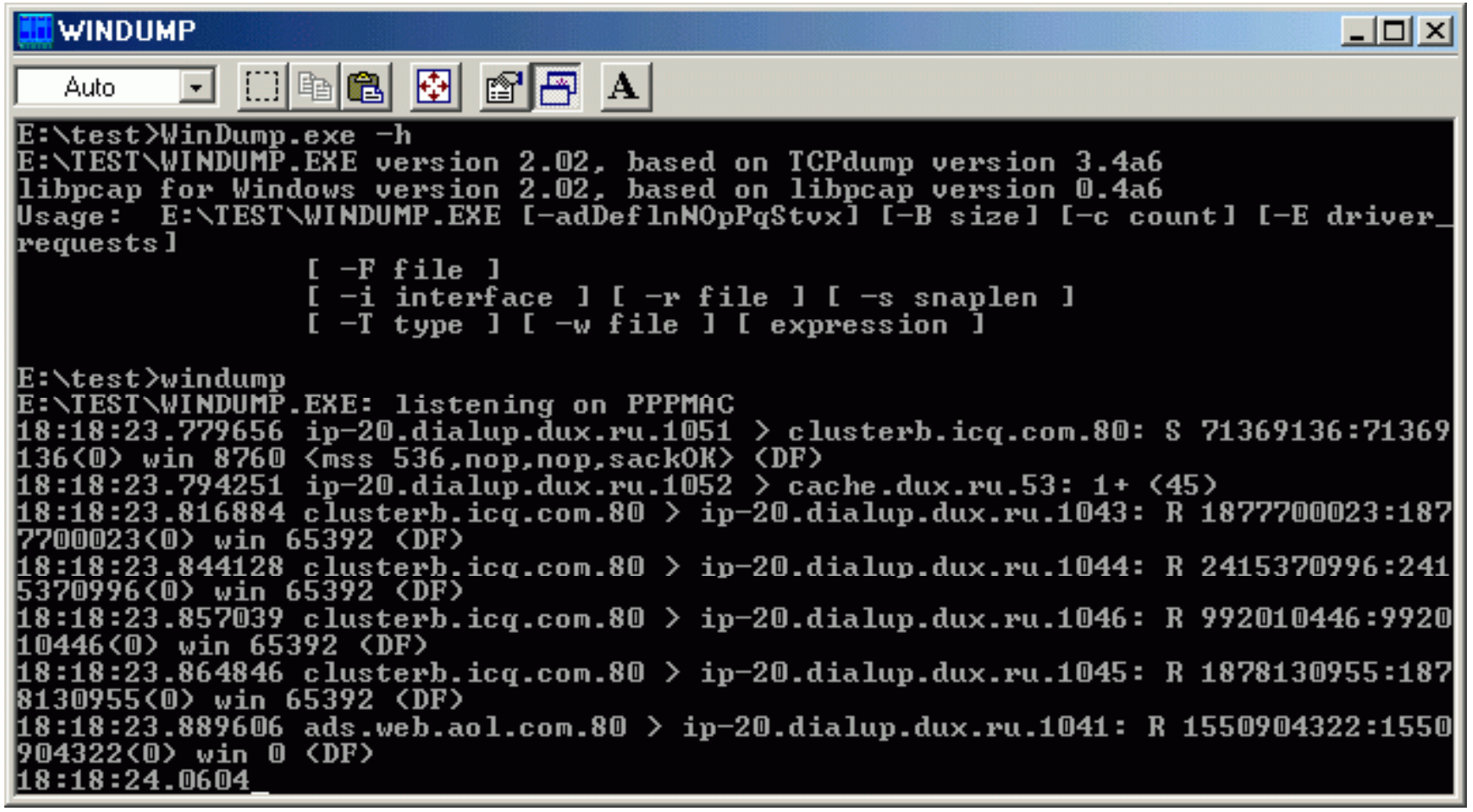
Sniffing Tool: WinDump

WinDump is the porting to the Windows platform of tcpdump; the most used network sniffer/analyzer for UNIX

It is fully compatible with tcpdump and can be used to watch and diagnose network traffic according to various complex rules

```
C:\scan>windump -i 1 -qnt dst host 192.168.4.3 and not port 8080 and proto UDP
windump: listening on \Device\NPF_{DEB64C05-DEE8-4B4B-8783-2C3FE6BA847F}
IP 192.168.4.15.2770 > 192.168.4.3.514: udp 118
IP 192.168.4.15.2775 > 192.168.4.3.514: udp 114
IP 192.168.4.15.2776 > 192.168.4.3.514: udp 161
IP 192.168.4.15.2784 > 192.168.4.3.514: udp 114
IP 192.168.4.15.2785 > 192.168.4.3.514: udp 162
IP 192.168.4.15.2786 > 192.168.4.3.514: udp 160
IP 192.168.4.15.2788 > 192.168.4.3.514: udp 116
IP 192.168.4.15.2798 > 192.168.4.3.514: udp 114
```

WinDump: Screenshot

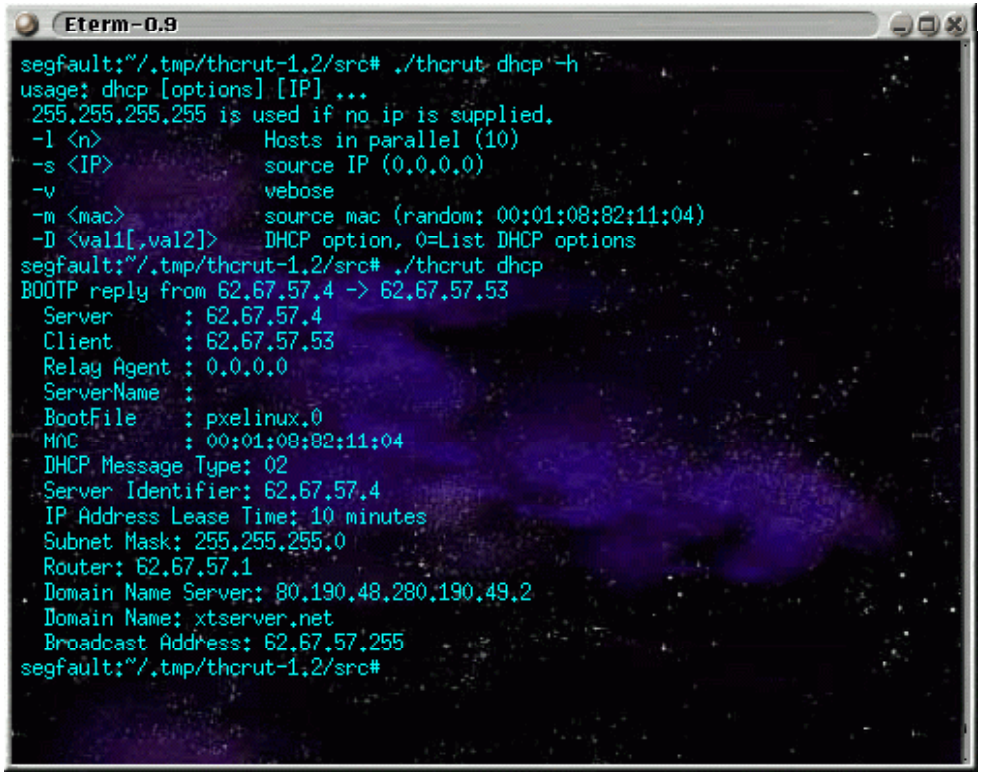


Multiuse Tool: THC-RUT

THC-RU gathers information from local and remote networks

It offers a wide range of network discovery tools: arp lookup on an IP range, spoofed DHCP request, RARP, BOOTP, ICMP-ping, ICMP address mask request, OS fingerprintings, and high-speed host discovery

THC-RUT comes with a new OS fingerprint implementation



Source: *http://www.thc.org/thc-rut/*

Tool: WinPcap

WinPcap is a free public system for direct network access under Windows

Most networking applications access the network through widely used system primitives, such as sockets

This approach allows easy transfer of data on a network, because the OS copes with low-level details (protocol handling, flow reassembly, and so on) and provides an interface similar to the one used to read and write on a file

WinPcap can be used by different kind of tools for network analysis, troubleshooting, security, and monitoring

Source: *http://winpcap.mirror.WireShark.com/*

Tool: AirPcap

AirPcap enables troubleshooting tools like Wireshark (formerly WireShark) and WinDump to provide information about the wireless protocols and radio signals

It is the first open, affordable, and easy to deploy WLAN (802.11b/g) packet capture solution for the Windows platform

It comes as a USB 2.0 adapter, and it has been fully integrated with WinPcap and Wireshark

It enables you to capture and analyze:

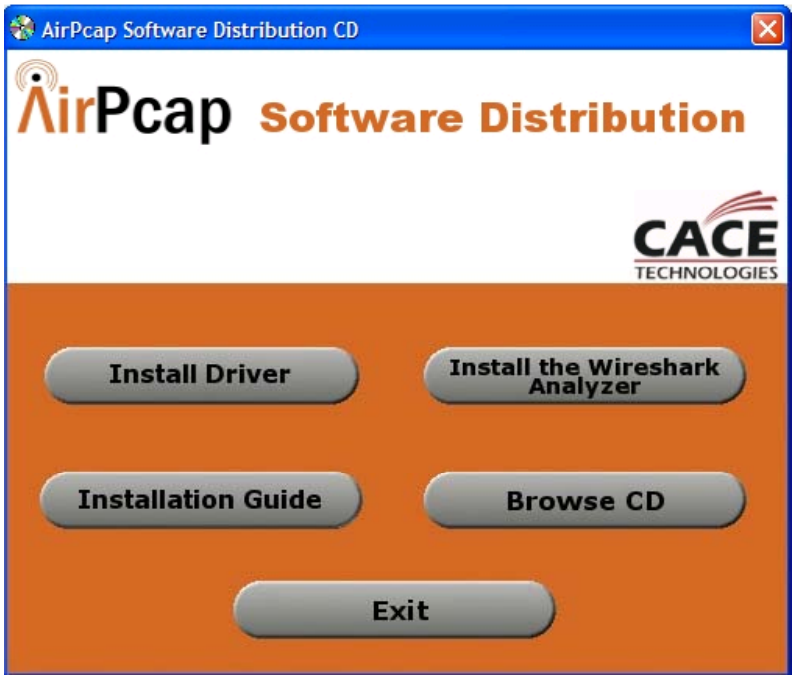
- 802.11b/g wireless traffic
- Control frames
- Management frames
- Power information

Source: *http://www.cacetech.com/*

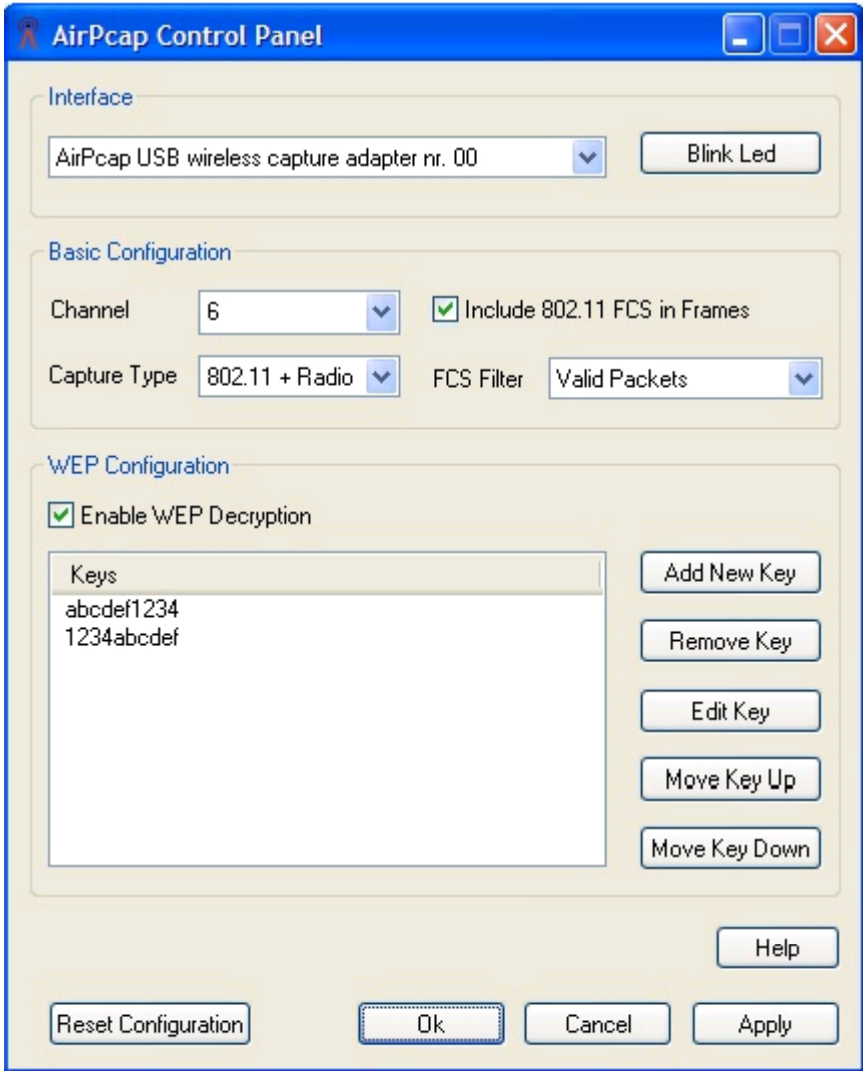
Tool: AirPcap

Features:

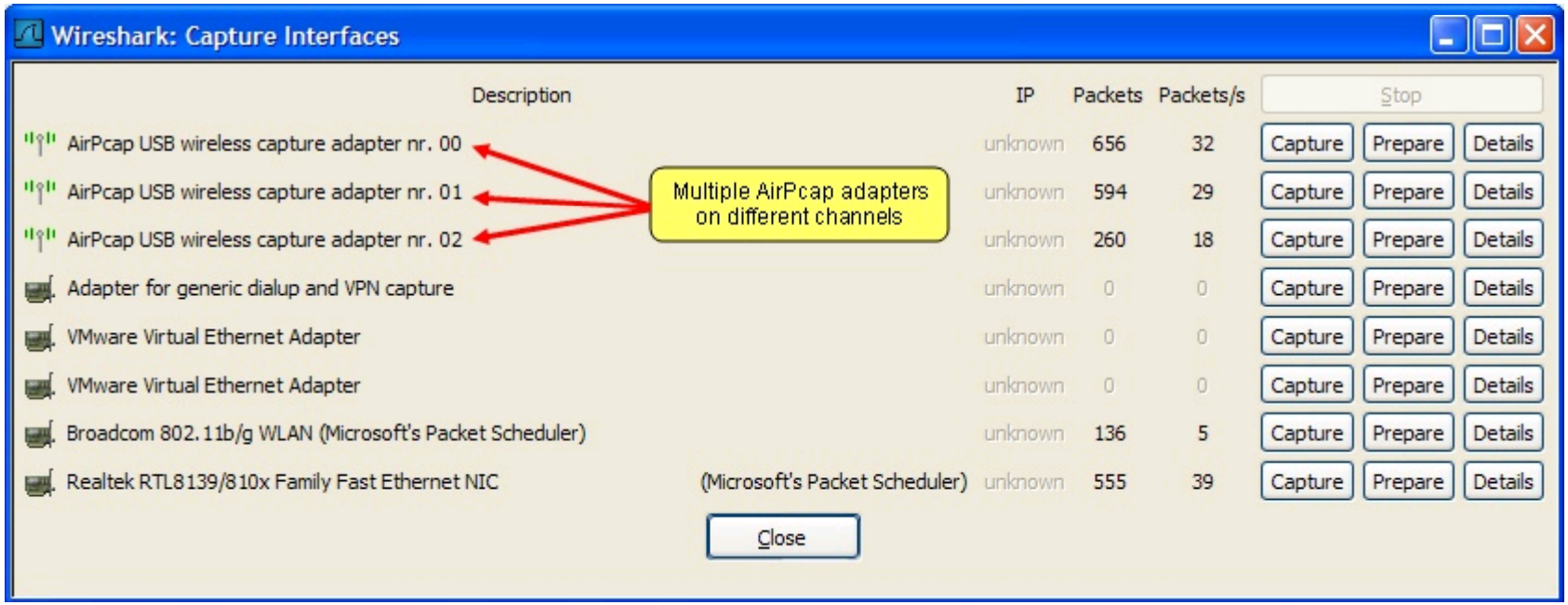
- Complete visibility on your wireless networks
- Portable and versatile
- Easy to set up
- Easy to use
- The performance you need
- Ready to power your application



AirPcap: Screenshot 1

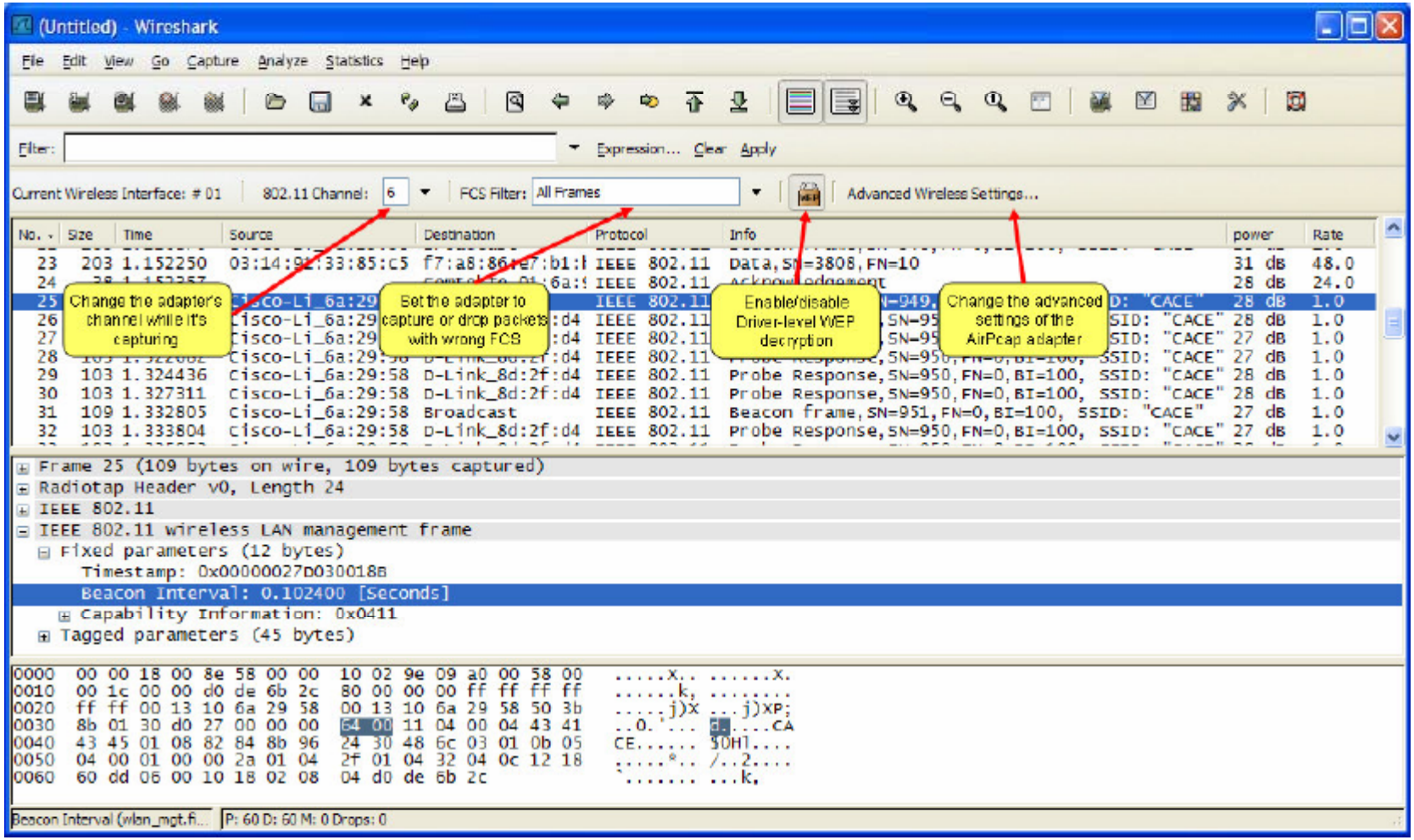


AirPcap: Screenshot 2

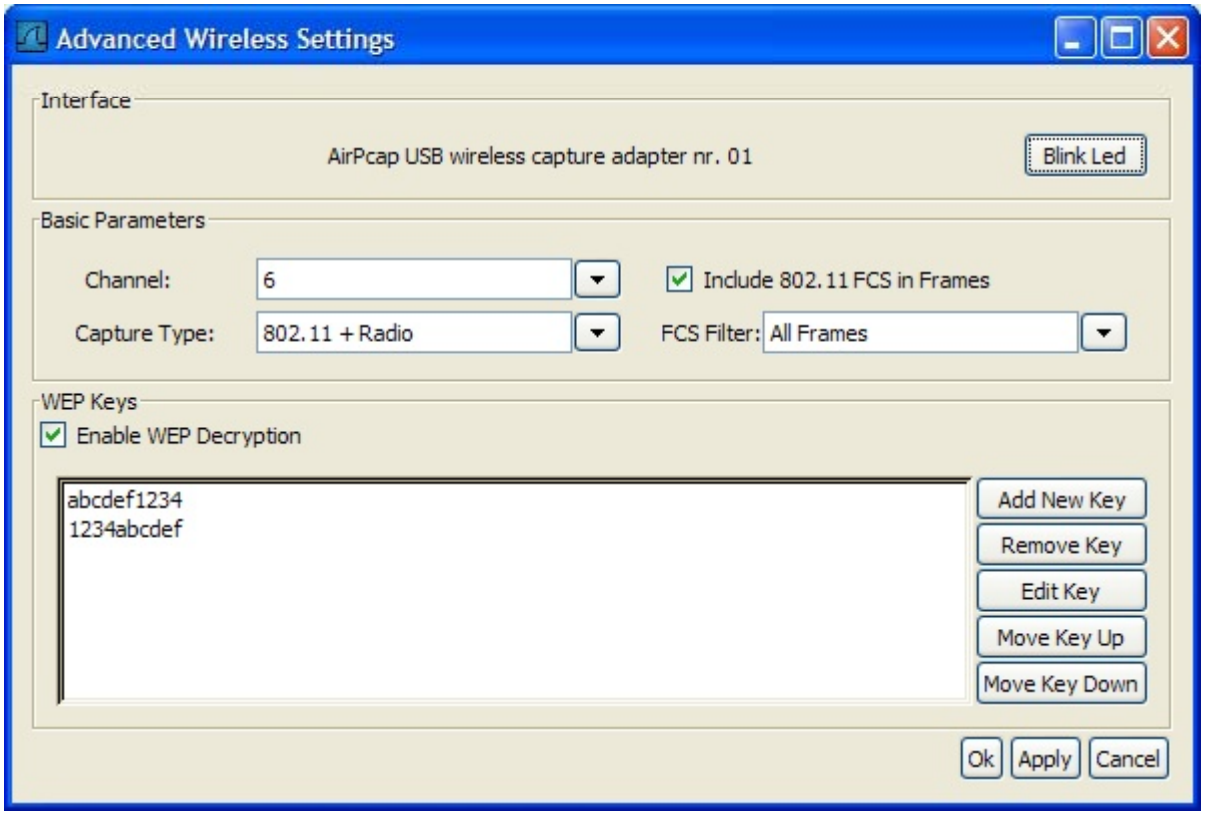


Multiple AirPcap Adapters in Wireshark

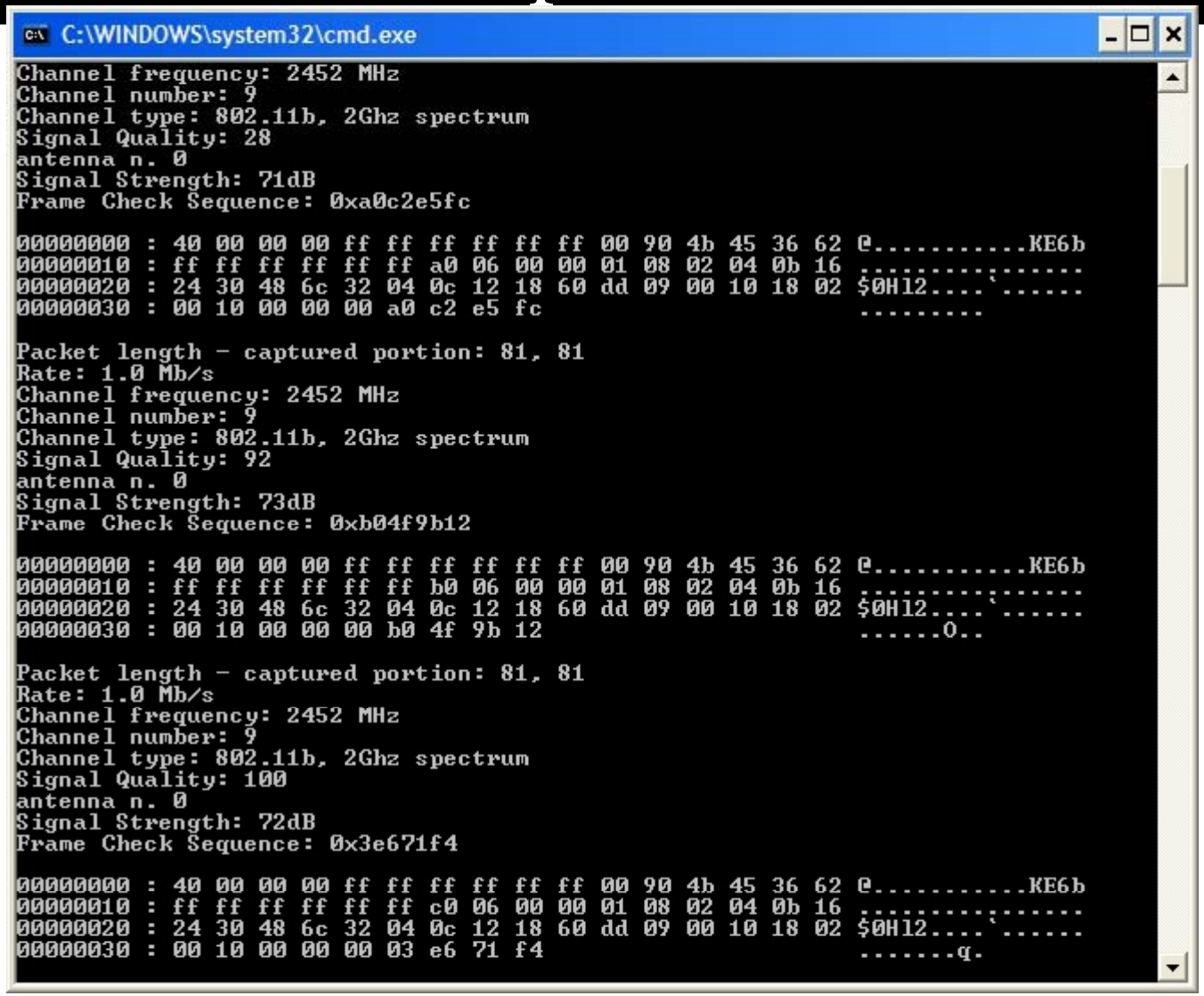
AirPcap: Screenshot 3



AirPcap: Screenshot 4



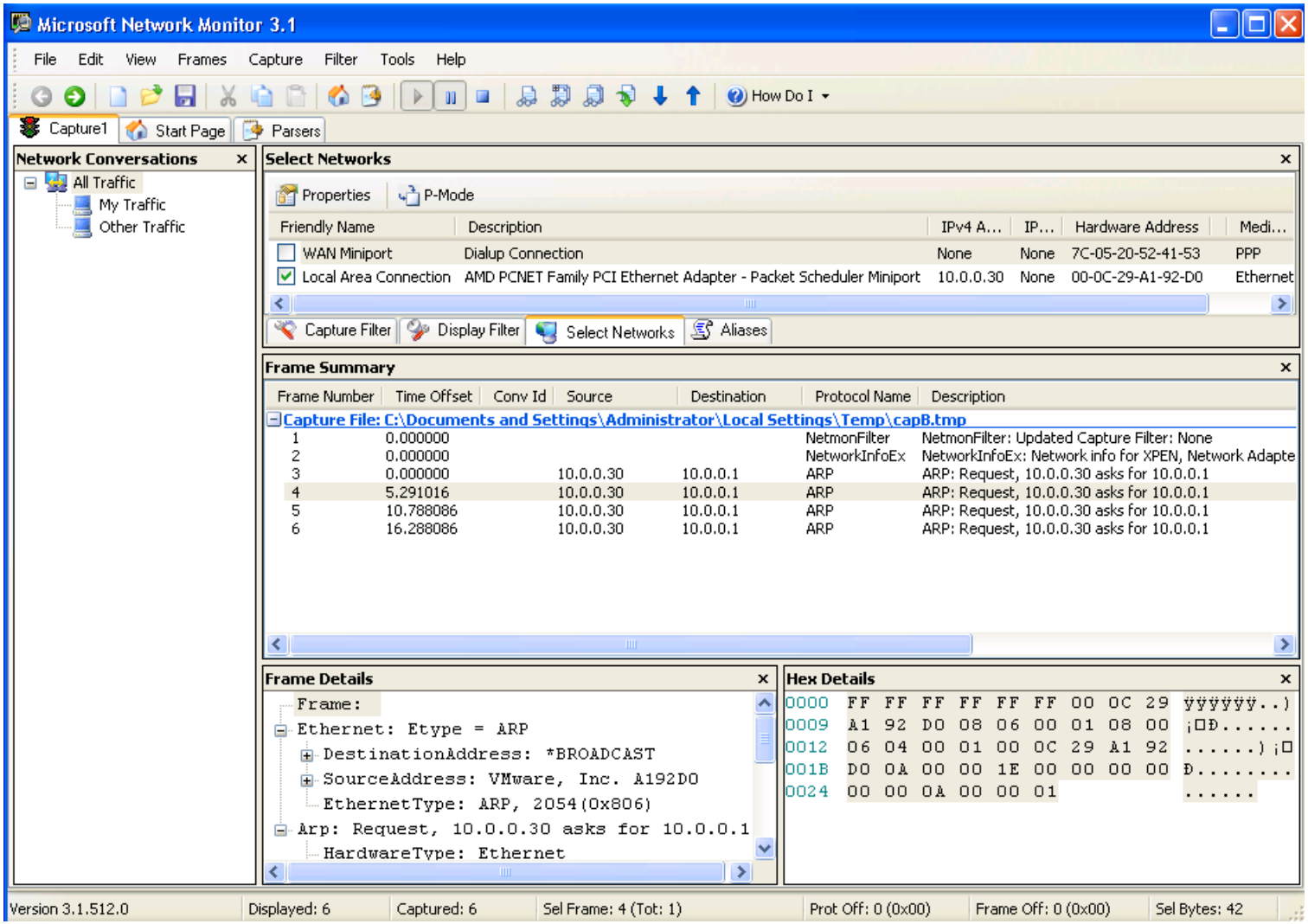
AirPcap: Example Program from the Developer's Pack

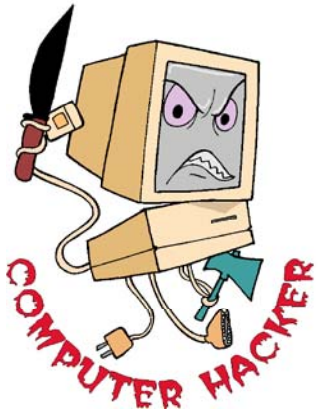


Microsoft Network Monitor

- Wireless (802.11) capturing and monitor mode on Vista – with supported hardware, (Native WIFI)
- It troubleshoots wireless connections
- It can trace wireless management packets
- It scans all channels or a subset of the ones your wireless NIC supports
- RAS tracing support on Vista

Microsoft Network Monitor: Screenshot





Hacking Wireless Networks

Steps for Hacking Wireless Networks

Step 1: Find networks to attack

Step 2: Choose the network to attack

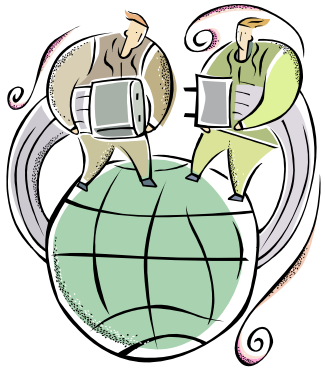
Step 3: Analyze the network

Step 4: Crack the WEP key

Step 5: Sniff the network

Step 1: Find Networks to Attack

An attacker would first use NetStumbler to drive around and map out active wireless networks



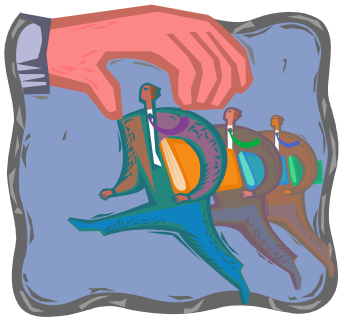
Using Netstumbler, the attacker locates a strong signal on the target WLAN

Netstumbler not only has the ability to monitor all active networks in the area, but it also integrates with a GPS to map APs

Step 2: Choose the Network to Attack

At this point, the attacker has chosen his target

NetStumbler or Kismet can tell him whether or not the network is encrypted



Step 3: Analyzing the Network

Example:

- WLAN has no broadcasted SSID
- NetStubmler tells you that SSID is ZXECCOUNCIL
- Multiple access points are present
- Open authentication method
- WLAN is encrypted with 40bit WEP
- WLAN is not using 802.1X

Step 4: Cracking the WEP Key

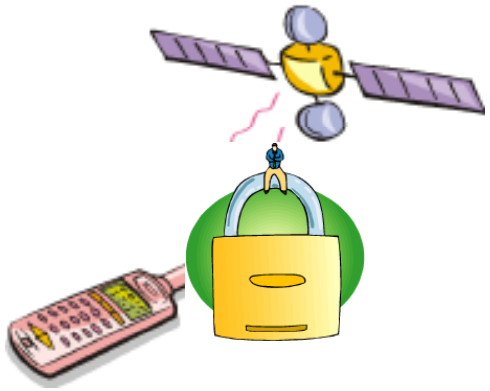
- Attacker sets NIC drivers to monitor mode
- It begins by capturing packets with Airodump
- Airodump quickly lists the available network with SSID and starts capturing packets
- After a few hours of Airodump session, launch Aircrack to start cracking!
- WEP key for ZXECCOUNCIL is now revealed!

Step 5: Sniffing the Network

Once the WEP key is cracked and the NIC is configured appropriately, the attacker is assigned an IP and can access the WLAN

Attacker begins listening to traffic with WireShark

Look for plaintext protocols (in this case, FTP, POP, and Telnet)

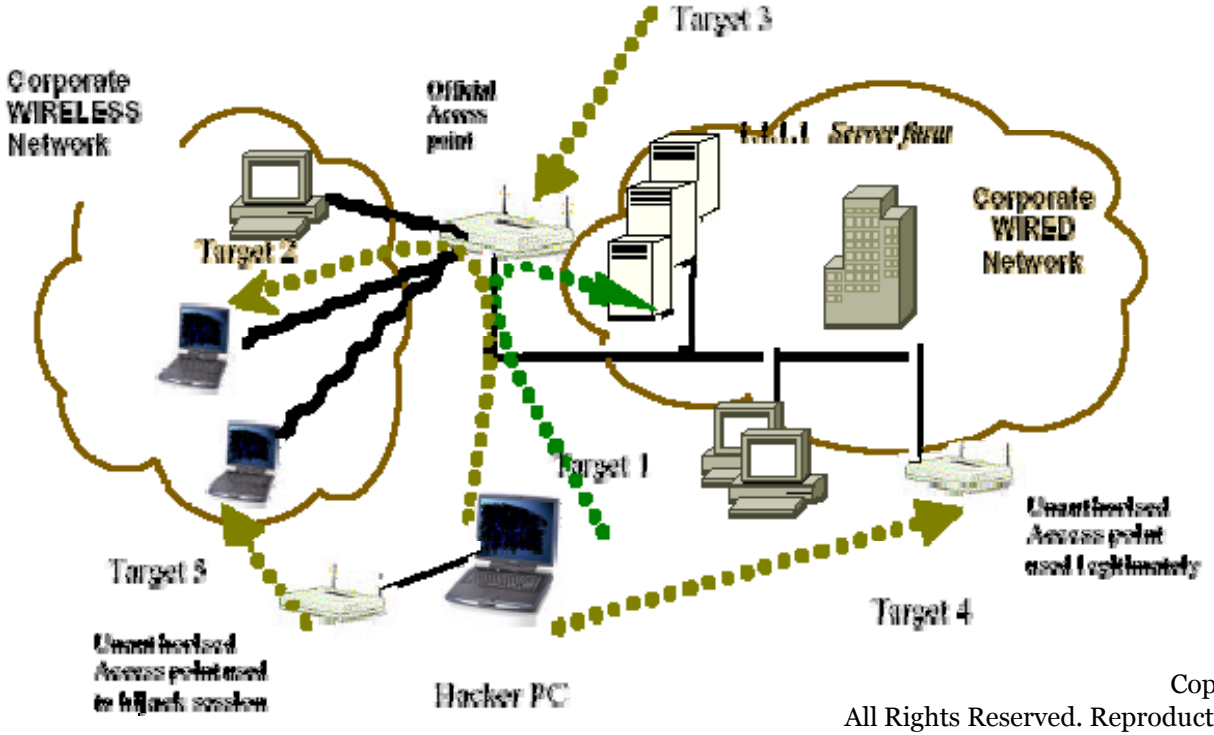


Wireless Security

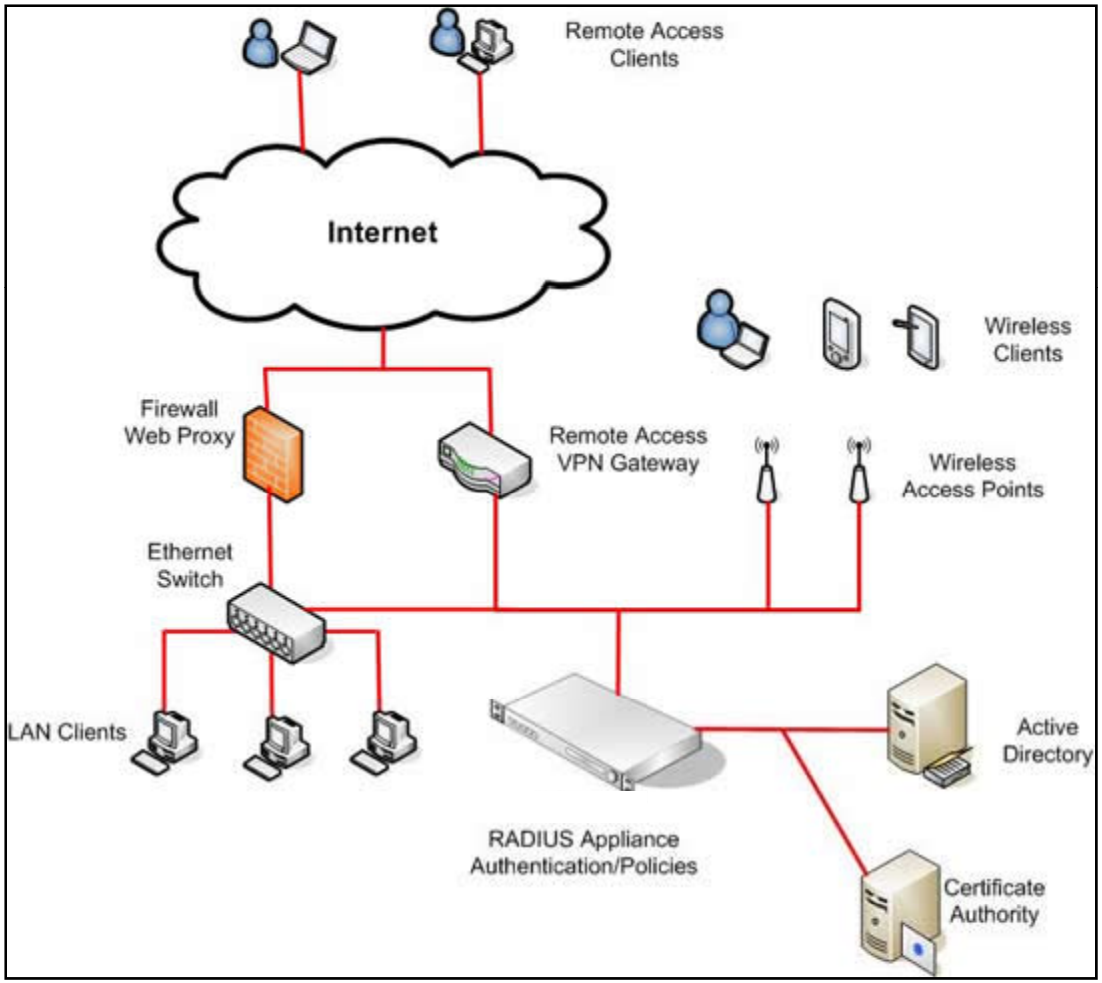
WIDZ: Wireless Intrusion Detection System

WIDZ is a proof of concept IDS system for 802.11 that guards APs and monitors locally for potentially malevolent activity

It detects scans, association floods, and bogus/rogue APs. It can easily be integrated with SNORT or RealSecure



Radius: Used as Additional Layer in Security



Securing Wireless Networks

MAC Address Filtering

- MAC Address Filtering method uses a list of MAC addresses of client wireless network interface cards that are allowed to associate with the access point

SSID (NetworkID)

- The first attempt to secure a wireless network was the use of Network ID (SSID)
- When a wireless client wants to associate with an access point, the SSID is transmitted during the process
- The SSID is a seven-digit alphanumeric ID that is hard coded into the access point and the client device

Firewalls

- Using a firewall to secure a wireless network is probably the only way to prevent unauthorized access

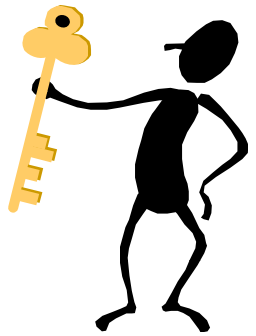
Wireless networks that use infrared beams to transport data from one point to another are secure

Securing Wireless Networks (cont'd)

- Change the default SSID names, such as NETGEAR
- Add passwords to all devices on the wireless network
- Disable broadcasting on network access points
- Do not give the network a name that identifies your company, like EC-Council-NYC
- Move wireless access points away from windows
- Disable DHCP and use manual IP addresses
- Do not allow remote management of access points

Securing Wireless Networks (cont'd)

- Use the built-in encryption at the access point
- Disable the features you do not use such as printing and music support in the AP
- Upgrade your firmware regularly
- Put a firewall between the wireless network and other company computers on the network
- Encrypt data at the application protocol, for example, SSL
- Change all default settings for access points:
  - Such as the IP address
- Regularly test wireless network security
- Include VPN in your wireless security solutions



Wireless Network Security Checklist

- ✓ Ensure that all unused ports are closed
  - ✓ Any open ports must be justified
  - ✓ "Pessimistic" network view
- ✓ Enforce the rule of least access
- ✓ Ensure SSIDs are changed regularly
- ✓ Ensure insurance and authentication standards are created and enforced
- ✓ Use strong encryption
  - ✓ SHA-1 (Secure Hashing Algorithm)
- ✓ Initiate encryption at user and end at server that is behind the firewall, outside the DMZ
- ✓ Treat WLANs as untrusted networks that must operate inside the DMZ

Wireless Network Security Checklist (cont'd)

- ✓ Access trusted network via VPN and two-factor authentication
- ✓ Increase application security:
  - ✓ Possibly through use of an enterprise application system
  - ✓ Minimally through increased encryption
- ✓ Do not allow ad hoc WLANS
- ✓ Embrace and employ the 802.11i IEEE security standard
  - ✓ Native per user access control
  - ✓ Native strong authentication (tokens, smartcards, and certificates)
  - ✓ Native strong encryption

WLAN Security: Passphrase

A passphrase is a sequence of words or other text used to control access to a computer system, program, or data

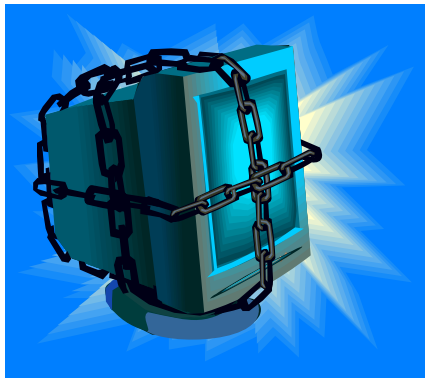
It is similar to a password in usage, but is generally longer for added security

Passphrases are often used to control both access to, and operation of, cryptographic programs and systems

Passphrases are particularly applicable to systems that use the passphrase as an encryption key

Don’ts in Wireless Security

- Do not breach your own firewall
- Do not reject Media Access Control
- Do not reject WEP
- Do not permit unauthorized access point
- Do not permit Ad-hoc Laptop communication



Wireless Security Tools

WLAN Diagnostic Tool: CommView for WiFi PPC

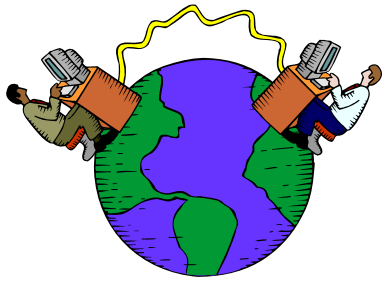
CommView for WiFi PPC is a special lightweight edition of CommView for WiFi that runs on Pocket PC handheld computers

It is a WLAN diagnostic solution designed for express wireless site surveys, as well as capturing and analyzing network packets on wireless 802.11b/g networks

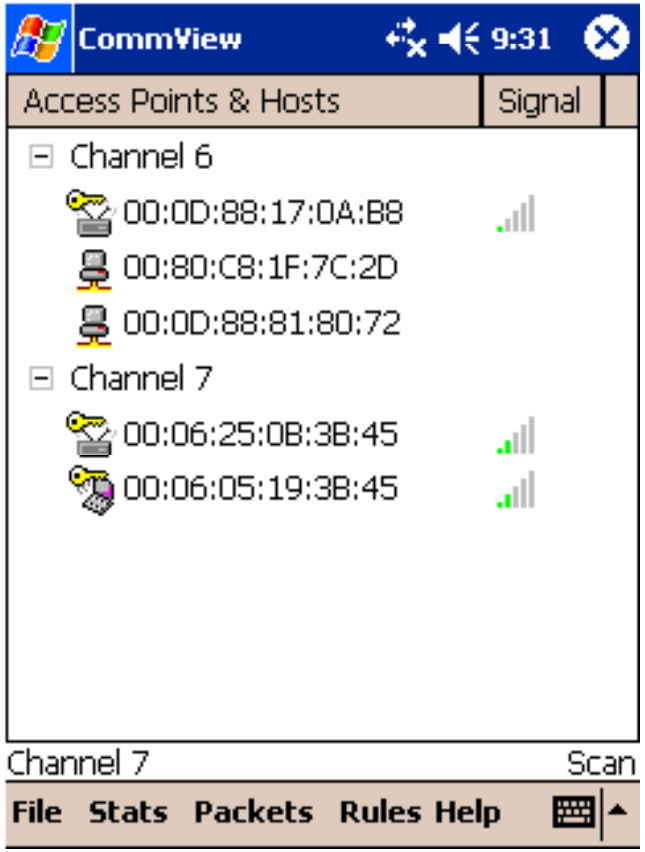
It gathers information from the wireless adapter and decodes the analyzed data

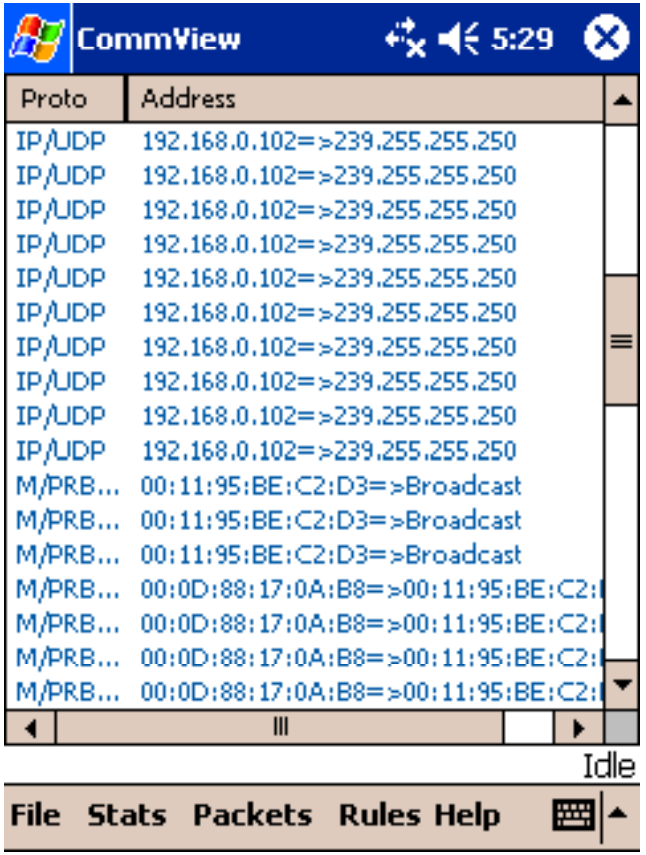
With CommView for WiFi PPC, you can:

- Scan the air for WiFi signals
- Select channels for monitoring
- Detect access points and wireless stations
- Capture packets
- Measure signal strength
- View the list of network connections
- Examine and filter individual packets

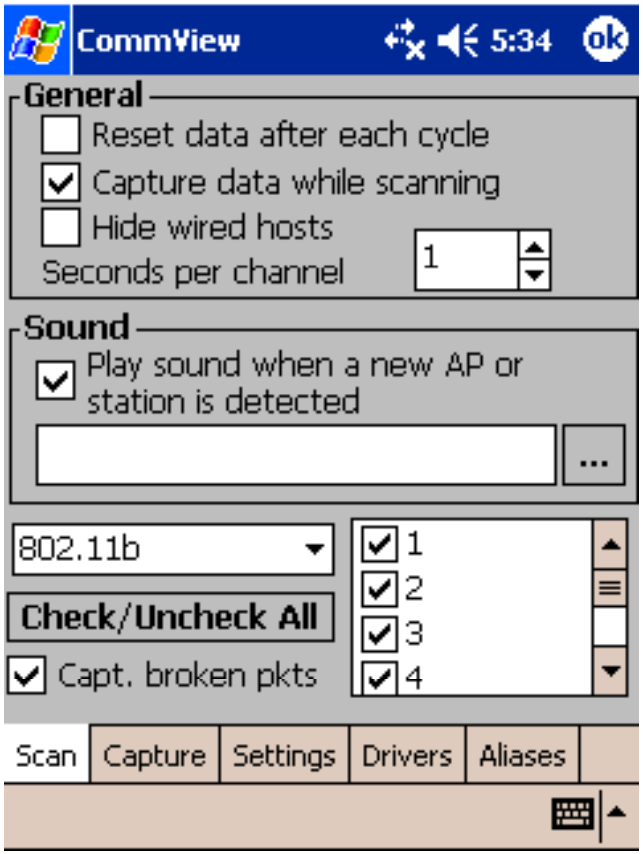


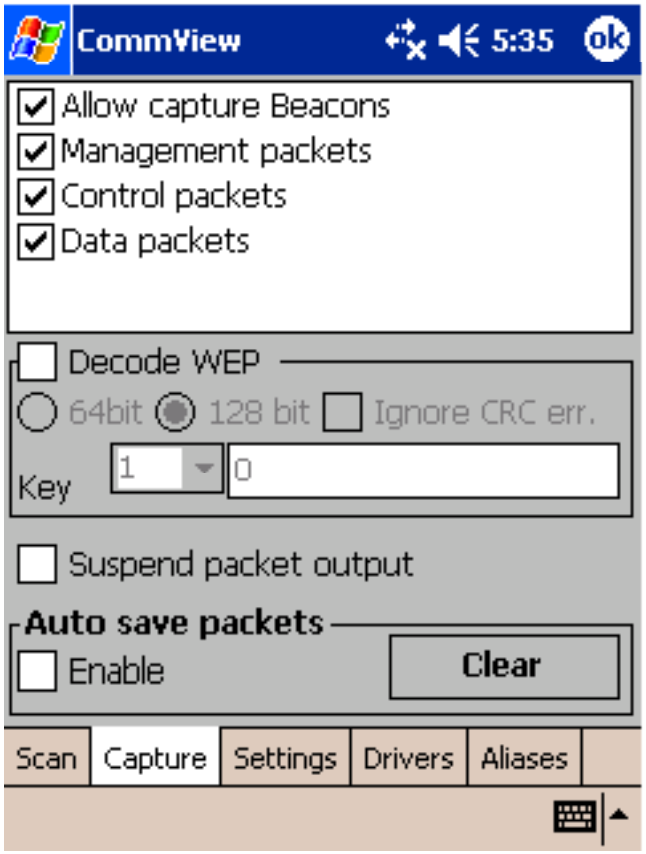
CommView for WiFi PPC: Screenshots





CommView for WiFi PPC: Screenshots





WLAN Diagnostic Tool: AirMagnet Handheld Analyzer

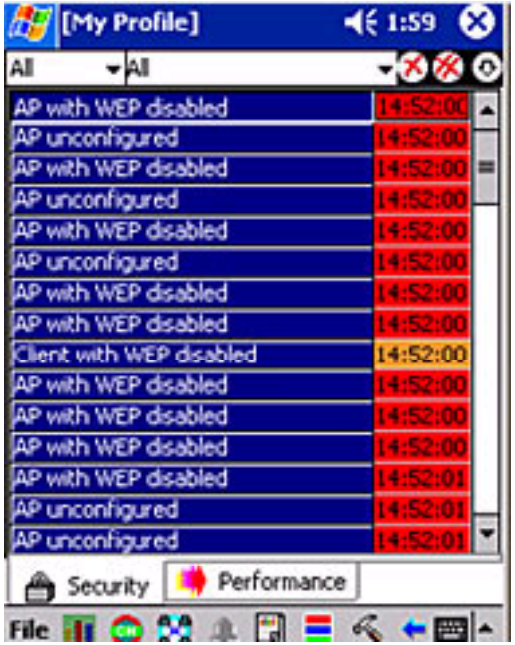
Handheld Analyzer is a convenient and inexpensive way to solve serious problems in the enterprise wireless LAN

It is used for troubleshooting of 802.11 b LANs

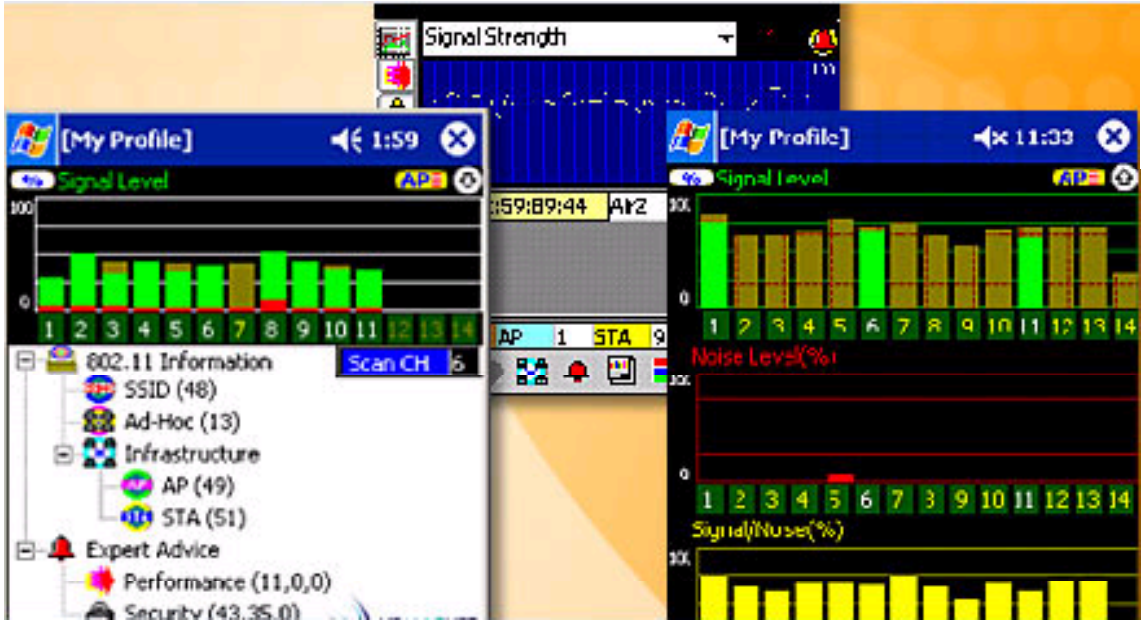
Features:

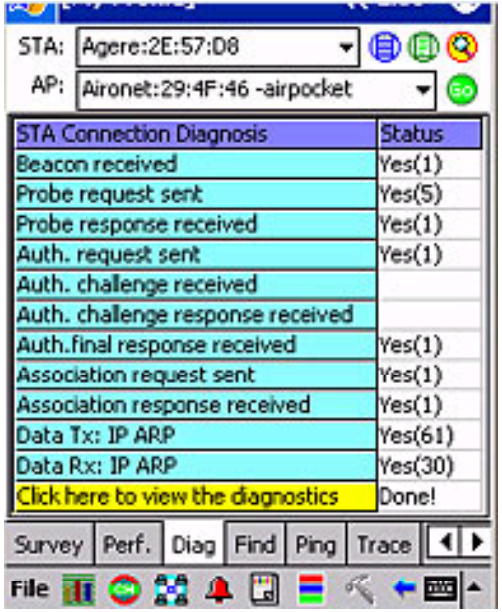
- Automatically detects vulnerabilities
- Locks down security policies
- Performs live, interactive network tests
- Tracks down rogues and devices
- Detailed packet and frame analysis
- Accesses the AirWISE® expert
- GPS support
- Flexible mobile form factor

AirMagnet Handheld Analyzer: Screenshot 1

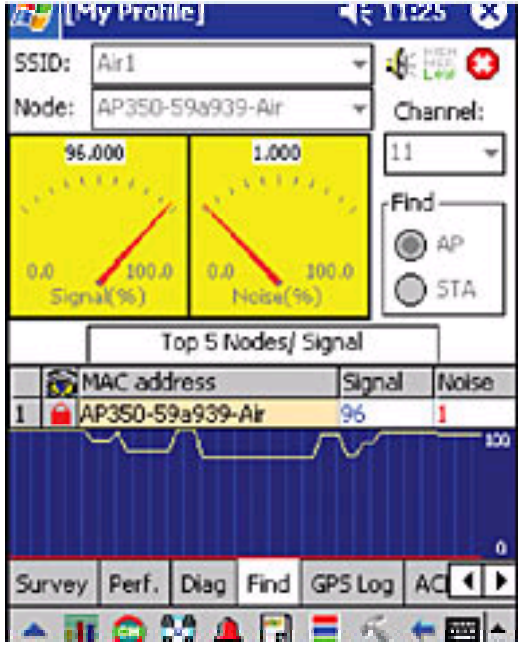


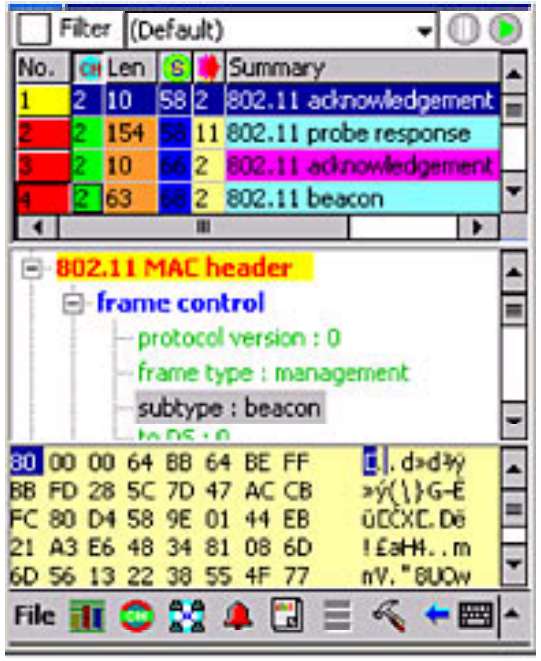
AirMagnet Handheld Analyzer: Screenshot 2

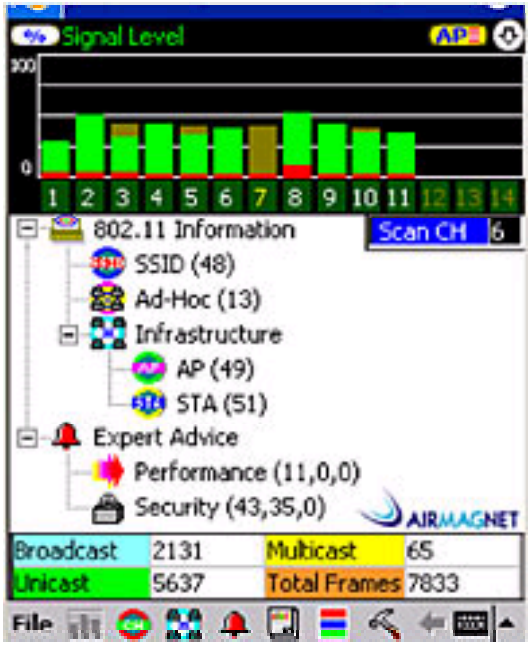




AirMagnet Handheld Analyzer: Screenshot 3







Auditing Tool: BSD-Airtools

BSD-Airtools is a package that provides a complete toolset for wireless 802.11b auditing

It contains a bsd-based WEPCracking application, called dweputils, as well as kernel patches for NetBSD, OpenBSD, and FreeBSD

It also contains a curses-based AP detection application similar to NetStumbler (dstumbler) that can be used to detect wireless access points and connected nodes, view signal to noise graphs, and interactively scroll through scanned APs and view statistics for each

It also includes other tools to provide a complete toolset for making use of all 14 of the prism2 debug modes as well as do basic analysis of the hardware-based link-layer protocols provided by prism2's monitor debug mode

Source: *http://www.dachb0den.com/*

AirDefense Guard

AirDefense Guard is an 802.11a/b/g wireless LAN intrusion detection and security solution that identifies security risks and attacks, provides real-time network audits, and monitors the health of the wireless LAN

It detects all rogue WLANs

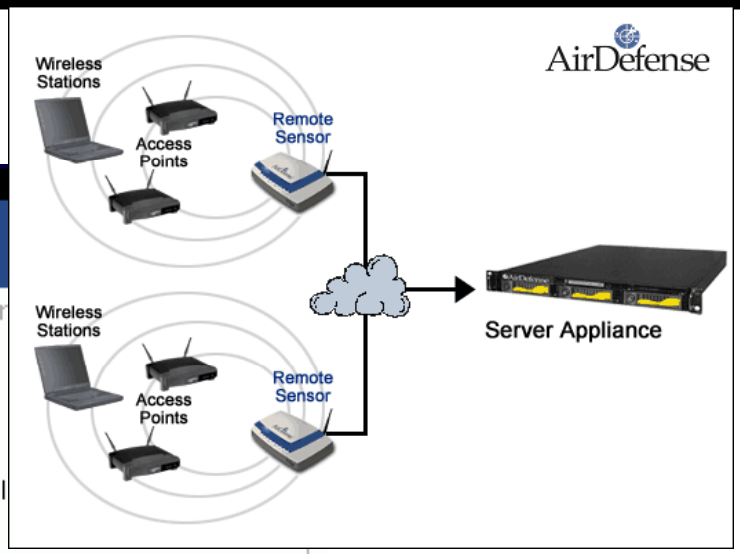
It secures a wireless LAN by recognizing and responding to intruders and attacks as they happen

It performs real-time network audits to inventory all hardware, tracks all wireless LAN activity, and enforces WLAN policies for security and management

It monitors the health of the network to identify and respond to hardware failures, network interferences, and performance degradation

Source: *www.AirDefense.com*

AirDefense Guard: Screenshot



AirDefense™

Home

Wireless Status

Enforce Policy

Alert History

Preferences

Help

You are currently protected by AirDefense Personal.

AirDefense will alert you to impending dangers in your wireless network environment or security risks in your system

Last Scan Performed: 09:36 30.03.2006
Total Number of scans: 1

Your Wireless Threat Ir

Current threat level:

What this means:

Your computer is well configured. It has minimal wireless security risks. It will be very hard for intruders to hack it.

Guarded

Low

Wireless Threats Status

	Critical	Major	Minor	Ignore	Total
Today	0	0	0	0	0
Yesterday	0	0	0	0	0
All	0	0	0	0	0

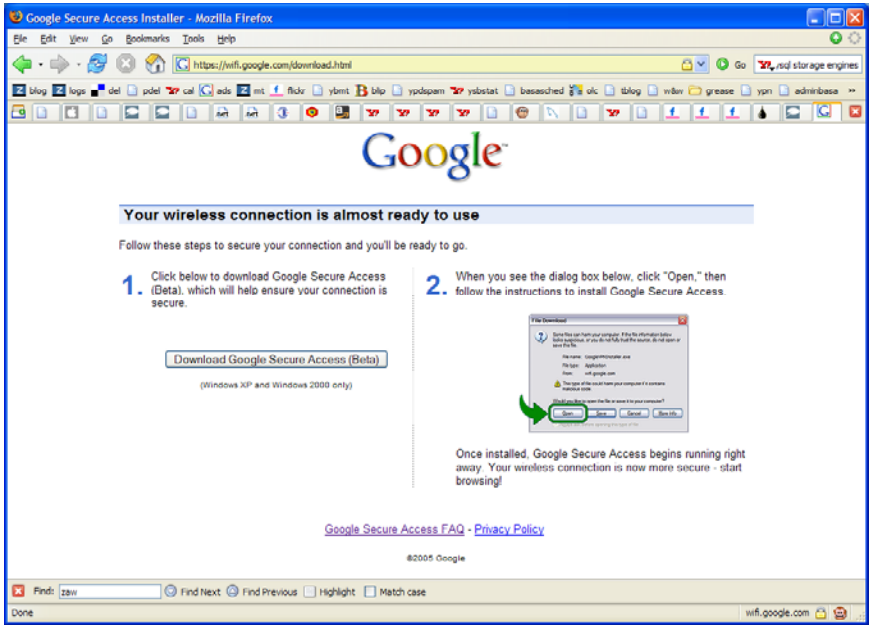
PERSONAL

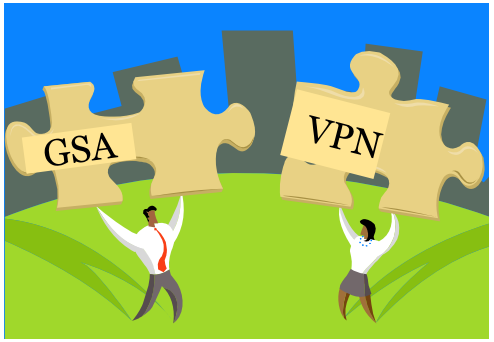
Google Secure Access

Google Secure Access is a downloadable client application that allows users to establish a more secure WiFi connection

It connects to Google's VPN ("Virtual Private Network")

It encrypts your Internet traffic and sends it through Google's servers to the Internet. The data that is received will then be encrypted and sent back through Google's servers to your computer



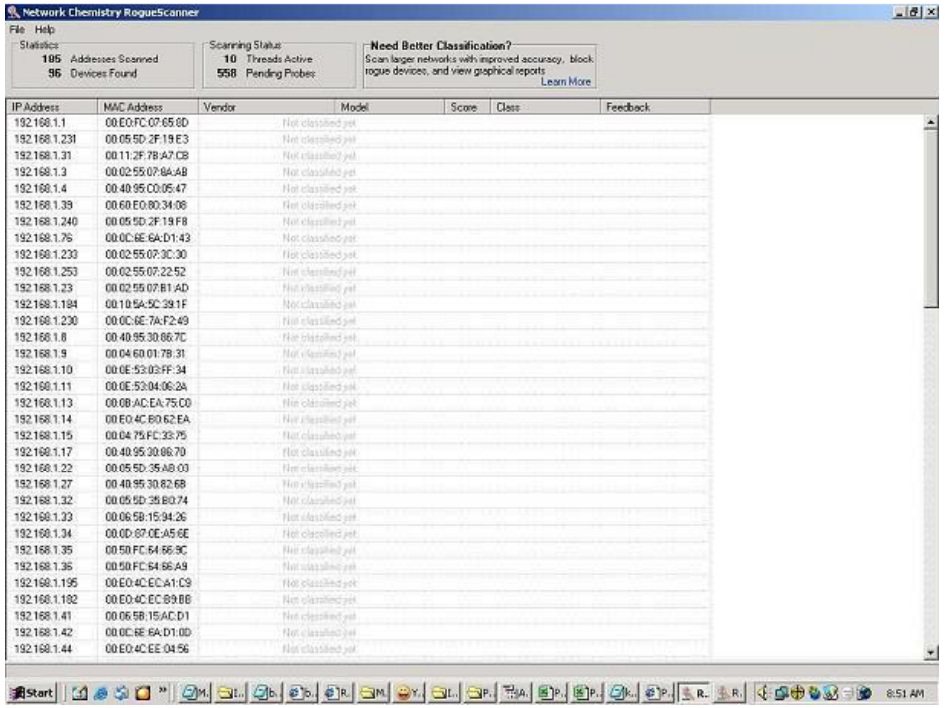


Tool: RogueScanner

RogueScanner is a network security tool for automatically discovering rogue wireless access points by scanning a wired network

It can also be used for network asset discovery

It can find all network connected devices like printers, routers, web cameras, and PCs



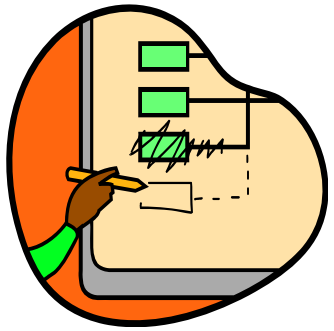
What Happened Next?

Jason Springfield, an ethical hacker, was called in to investigate the incident. Jason performed the following tests:

- He scanned the network and traced it
- He checked for SSID broadcasted and secured it by assigning unique alpha numeric values
- He traced rogue access points by using tools, such as, NetStumbler and MiniStumbler
- He deployed WEP to provide confidentiality of data on WLAN
- He employed WSA for auditing the network and traced the vulnerabilities

Jason suggested them to take following precautions:

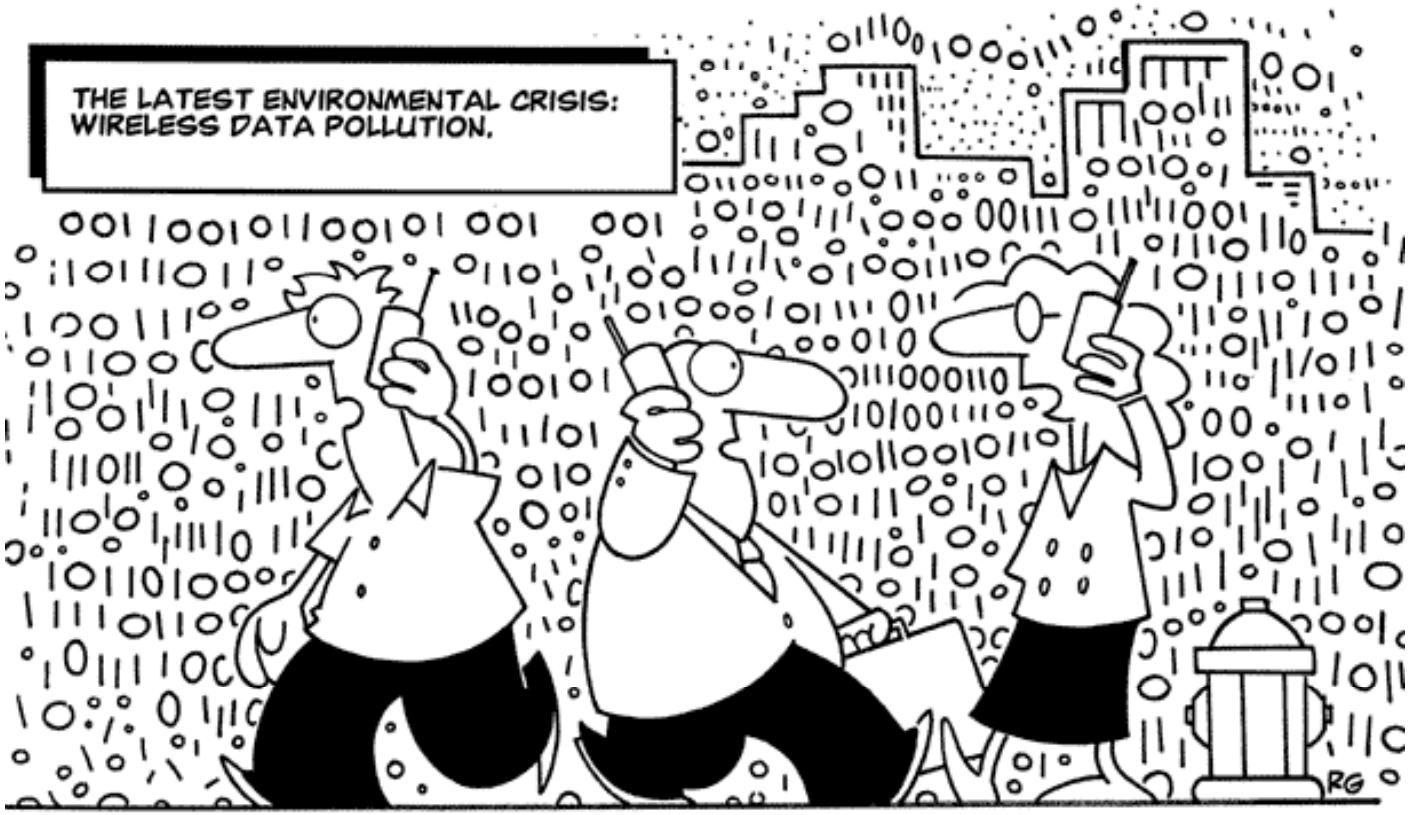
- Use MAC address filtering, SSID, and firewalls for wireless networks
- Use infrared beams to transport data



Summary

- A wireless network enables a mobile user to connect to a LAN through a wireless (radio) connection
- Wired Equivalent Privacy (WEP) is designed to provide a WLAN with a level of security and privacy comparable to what is usually expected of a wired LAN
- It is vulnerable because of relatively short IVs and keys that remain static
- Even if WEP is enabled, an attacker can easily sniff MAC addresses as they appear in the clear format. Spoofing MAC addresses is also easy
- Wireless networks are vulnerable to DoS attacks
- Wireless network security can adopt a suitable strategy of MAC address filtering, firewalling, or a combination of protocol-based measures

"This phone won't disturb anyone at the movies.
It has a ringer that sounds like people eating popcorn!"



"It's an internet-ready, tri-mode, LCD color, MP3 compatible, digital wireless communicator. We make them extra big so people will notice how cool you are."

"Watch where you're going, Larry — you walked right through my wireless data stream!"