Rogue Squadron: Evil Twins, 802.11intel, Radical RADIUS, and Wireless Weaponry for Windows

Beetle, beetle@shmoo.com
Bruce Potter, gdead@shmoo.com

The Shmoo Group
www.shmoo.com

Oh boy, an Overview!

- Wi-Fi threats from old to... old?
- Rogue APs: basics to badass
  - EAP Peeking, Two-factor Terrorism
- Wireless Weaponry for Windows
  - Airsnarf for Windows, Rogue Squadron
- Rogue AP defense
  - HotspotDK, sage advice from the Shmoo
- Q & A

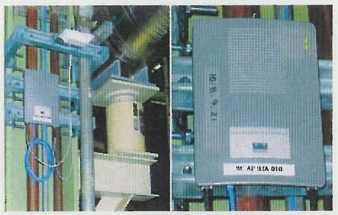
Why oh why do we Wi-Fi?

- Who here has an open wireless network at home?
- Who here has an open wireless network at work?
- Crap! My Tivo can't do WPA. Neither can my PSP. Ummm... does it matter?
- When and where should we Wi-Fi?
  - Coffee Shops? Airports? Hospitals? Banks? Ummm... Nuclear Power Plants?

standards. The same infrastructure also will provide wired LAN connectivity throughout the plant for both voice and data applications as well as for remote video monitoring and control.

According to Carter, TXU plans to use the wireless solution—provided by Azima—to help Comanche Peak integrate its work order management and scheduling processes, electronic procedures, clearance and safety tagging, operator logs, equipment monitoring, electronic messaging, plant drawings, phone books, equipment references and locations, and selected Internet/intranet access. Video applications will include radiation protection monitoring, remote equipment monitoring, and video conferencing.

So far, Azima has installed monitoring devices on more than 50 pieces of critical equipment within Unit 2 of Comanche Peak. Besides vibration, the devices also monitor current, partial discharge, motor speed, and other key variables. Other wireless applications already installed throughout the plant include mobile computing, video monitoring, and VoIP telephones (Figure 4).

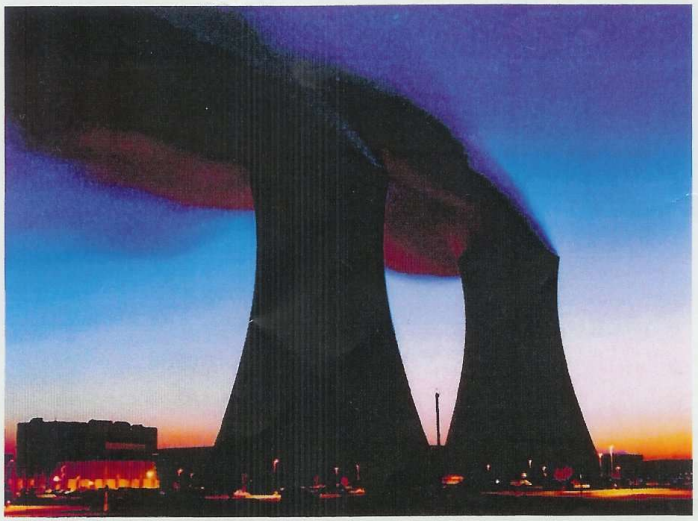


4. Collecting the data. A typical wireless access point at Comanche Peak. So far, Azima has installed monitoring devices on more than 50 pieces of critical equipment within Unit 2. *Courtesy: TXU*

More wireless implementation stories

Two other projects underscore the growing popularity of wireless machinery monitoring. One is at Exelon Nuclear's Limerick Generating Station (Figure 5) in Montgomery County, Pa. The Limerick plant has had maintenance problems with the fans used to exhaust turbine enclosures. Nicknamed "fans-in-a-can" because they are typically mounted inside cylindrical ducts, these fans are inaccessible to technicians while the plant is on-line. But since the installation of transmitter-equipped vibration and temperature sensors on the fans' motors, Limerick has seen reductions in the time and costs of document control and tracking, data conversion/transcription, and error checking/reduction.

The other wireless monitoring project worth mentioning was at the San Onofre Nuclear Generating Station in California. Engineers at the plant had long wanted to remotely monitor the temperature of several 2,500-hp secondary plant motors as an indicator of their health. According to Lloyd Pentecost, a maintenance engineer at the plant, "If a motor were to fail unexpectedly, the plant would have to operate at only 80% capacity for a number of days, and the losses could exceed $400,000." Pentecost is pleased with the network of wireless temperature sensor/transmitters that has been installed at San Onofre because "Collecting and analyzing motor temperature data in real time allows action to be taken before a catastrophic failure occurs."



5. Watching those "fans in a can." At Exelon Nuclear's Limerick Generating Station, wireless technology is being used to monitor inaccessible fans and motors. *Courtesy: Exelon Nuclear*

EPRI promotes wireless

The Comanche Peak de-wiring project was executed in partnership with EPRI, which set up the performance benchmarks and monitored the project. EPRI plans to issue a comprehensive report on it this summer.

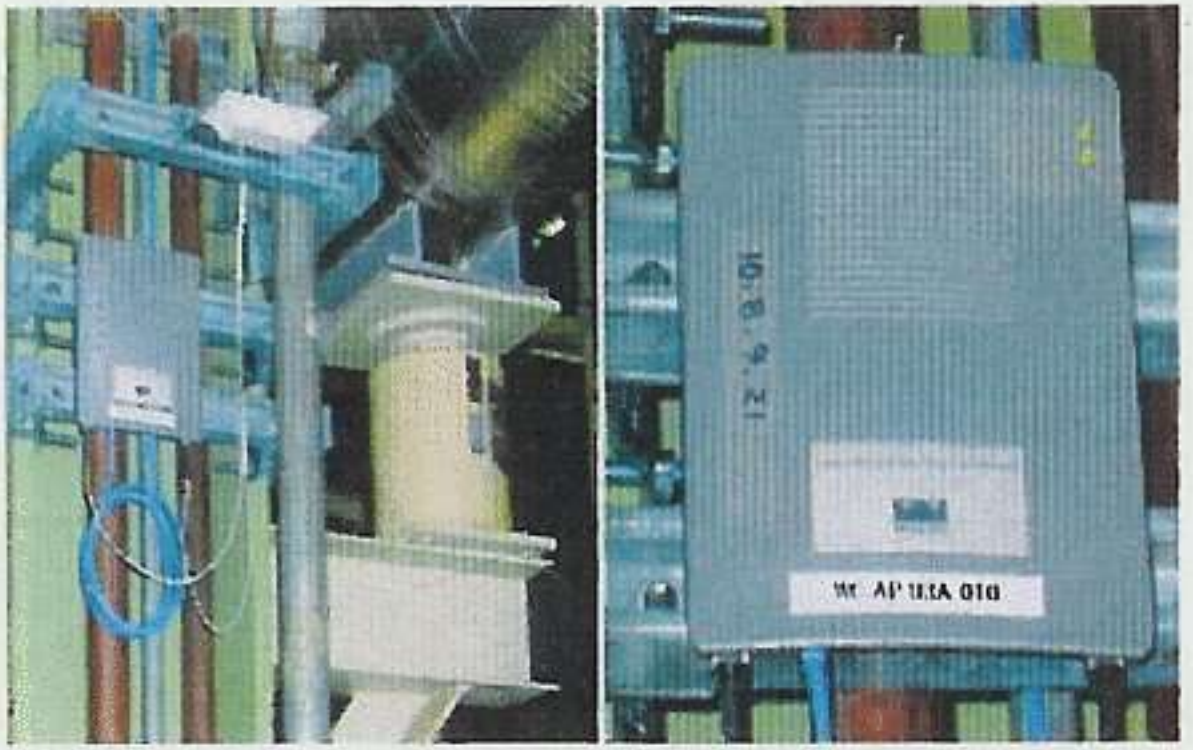
Ramesh Shankar, who is spearheading an EPRI program to evaluate the feasibility of installing more remote monitoring systems at U.S. utility generating stations, believes that wireless is a technology whose time has come. He says a major focus of the effort is to determine the extent to which wholesale deployment of wireless devices might improve plant safety and reliability.

Shankar adds that his program already has two "products." One lays out the business case for applying wireless technologies; the other offers advice to plant managers on implementation and regulatory issues. To support the effort, EPRI has formed a Wireless Technology Working Group to develop guidelines and to help member companies achieve reliable, economical, and safe use of wireless devices. EPRI also has helped the DOE's Oak Ridge National Laboratory form the Wireless Industrial Networking Alliance (WINA). The mission of WINA is to promote a dialogue among suppliers, end users, and government about wireless technologies in the nation's power plants.

To accelerate the adoption of wireless technologies for machinery monitoring and data/voice/video communications, WINA is focusing on four different activities:

- Explaining wireless technologies to end users.
- Promoting effective standards, regulations, and practices.
- Quantifying and communicating the benefits of going wireless.
- Benchmarking against customer requirements.

Each year, WINA sponsors two wireless workshops that are focused solely on the power generation industry. The next one is scheduled for October 3–5 in Jersey City, N.J. ■



4. Collecting the data. A typical wireless access point at Comanche Peak. So far, Azima has installed monitoring devices on more than 50 pieces of critical equipment within Unit 2. *Courtesy: TXU*


Six easy ways to secure your wireless network - ZDNet UK Insight - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://insight.zdnet.co.uk/communications/wireless/0,39020430,39170748,00.htm
Go Links
Insight > Communications
Tuesday 26th October 2004
Six easy ways to secure your wireless network
Scott Lowe
TechRepublic
October 20, 2004, 13:00 BST
TALK BACK!
Tell us your opinion
TechRepublic
Real World. Real Time. Real IT.
Securing wireless networks is an important as it is simple - here are six simple tips for you to make sure you're safe
Implementing a wireless networking system can result in serious security problems if the system is not properly secured. This is true of a wireless network deployed at home or one deployed in the office. In fact, some residential Internet service providers have clauses in their agreements that indicate that service is not to be shared with people outside of those covered by the agreement. If you deploy an insecure wireless network, it could result in a loss of service, or in the use of your network as a launching pad for attacks against other networks.
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The point of properly securing a wireless access point is to close off the network from outsiders who do not have authorisation to use your services. A properly secured
Must Read Comms
First Wi-Fi phones get in approval
Subcutaneous RFID tag privacy advocates
Mobile Java hit with secu scare
Home PCs put cybersec risk
More...
Comms News
Intel deal provides WiMa boost
Cisco upgrades IP telepl security
Wireless porn set to be $ market
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Software
Monitors
More...
Also in Insight
Internet


Google Search: evil twin wireless - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://news.google.com/news?hl=en&lr=&tab=wn&ie=UTF-8&q=evil+twin+wireless&btn
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Web Images Groups News Froogle Local more »
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Search News
Search the Web
Advanced News Search
Preferences
News
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Sorted by relevance Sort by date
Top Stories
World
U.S.
Business
Sci/Tech
Sports
Entertainment
Health
News Alerts
About Google News
Jim Karpen's Web Guide
Pocket PC Magazine, IA - Jun 21, 2005
... of connecting to the legitimate hotspot, you connect to the evil twin, which is ... The guide covers topics such as wireless syncing, remote syncing, printing from ...
Protect your Mobile Workers from Wireless Hotspot Phishing
eBCVG - Jun 8, 2005
... In this scenario a hotspot user connects to the "Evil Twin" wireless access point, believing it to be a legitimate commercial hotspot. ...
Avoiding 'evil twin' scams
New York Daily News, NY - Jun 6, 2005
... "Evil-twin" computer invaders set up a wireless network, usually overlapping with a public one, which provides what looks like real Wi-Fi access. ...
Hackers use twin sites, networks for ID thefts
Charlotte Observer, NC - May 22, 2005
... Now, evil-twin wireless networks can thwart some of those precautions. During a tech conference in London last month, fraudsters ...
Beware of 'evil twin' while using Wi-Fi
San Antonio Express (subscription), TX - May 24, 2005
Be careful when logging on to the wireless network at your local coffee shop — you may run into an evil twin. No, we're not talking ...
Gartner lambasts security FUDmongers
Register, UK - Jun 9, 2005
... past Gartner has been vocal about corporate wireless security issues in particular but like us they've probably had their fill of talk of Evil Twin threats and ...
Wireless Security Leader Signs 12 Leading Resellers and Opens Six ...
eBCVG - Jun 20, 2005
... 3.0 delivers a broad range of unique capabilities for wireless intrusion protection ... counter the most serious attacks -- MAC spoofing APs, Evil Twin/Honey Pot ...
Evil Twins a Menace to Wireless Security
TechNewsWorld, CA - Jun 4, 2005
... However, wireless attacks such as Evil Twin and other wireless phishing scams cannot be seen by personal firewalls," Richard Rushing, chief security officer of ...
Done

Where did we go wrong? Where are we going?

- Technology of convenience versus the inconvenience of securing it.
- The poor, poor users were left out in the authentication cold.
- Half-ass security standards pass the buck and / or provide defacto insecure options.
- Security acronyms have taken precedence over proper implementation.


"Choose a Mobile Network with Care."
For a low-priced mobile network, choose FI2G/FINNET.
Club World. More beds, more places, more often.
Hello Switch to Radiolinja for Elisa, the Vodafone network in Finland.
Hello We've changed our name!
Radiolinja is now called Elisa, the Vodafone network in Finland.
elisa


"CHOOSE A MOBILE NETWORK AT RANDOM!"
Club World. More beds, more places, more often.
'Hello Switch to Radiolinja for Elisa, the Vodafone network in Finland.

How the FUCK does the user know?!

Rogue AP 101

- Traditional thought = corporate network backdoor
  - Unauthorized AP plugged into Intranet
- A la Airsnarf, usernames & passwords for websites (or worse) can be stolen
  - Attacker runs enticing / duplicate AP
  - User associates to AP that has duplicate SSID, websites “appear” to be legitimate
  - User gives up username, password, DOB, SSN, Mom's maiden name, and MORE!

Access Point

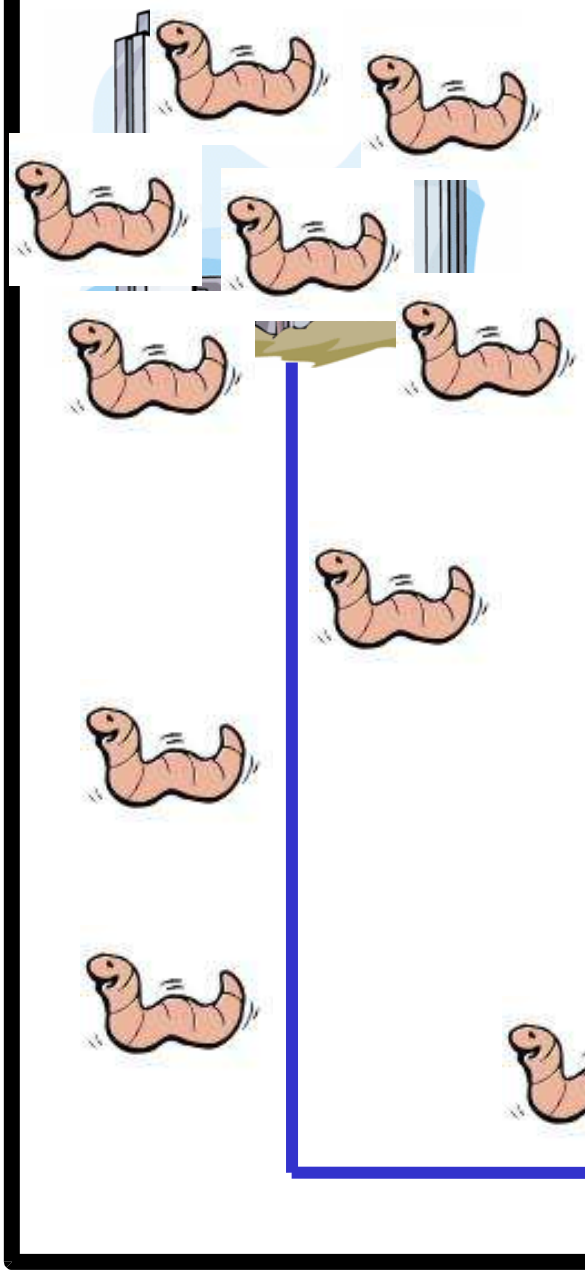
SSID: “goodguy”

Stronger or Closer Access Point

SSID: “badguy”

Wi-Fi Card

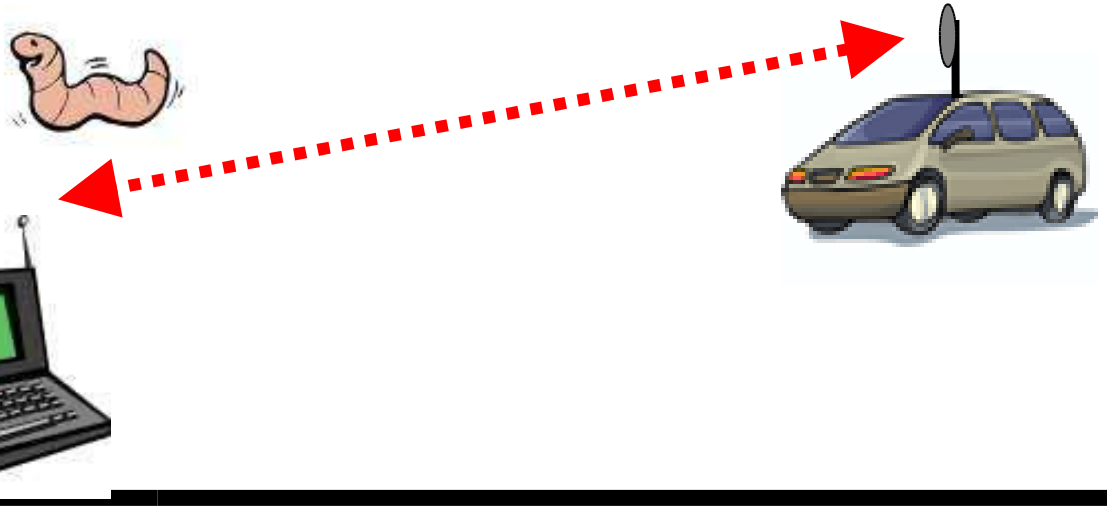
SSID: “badguy”

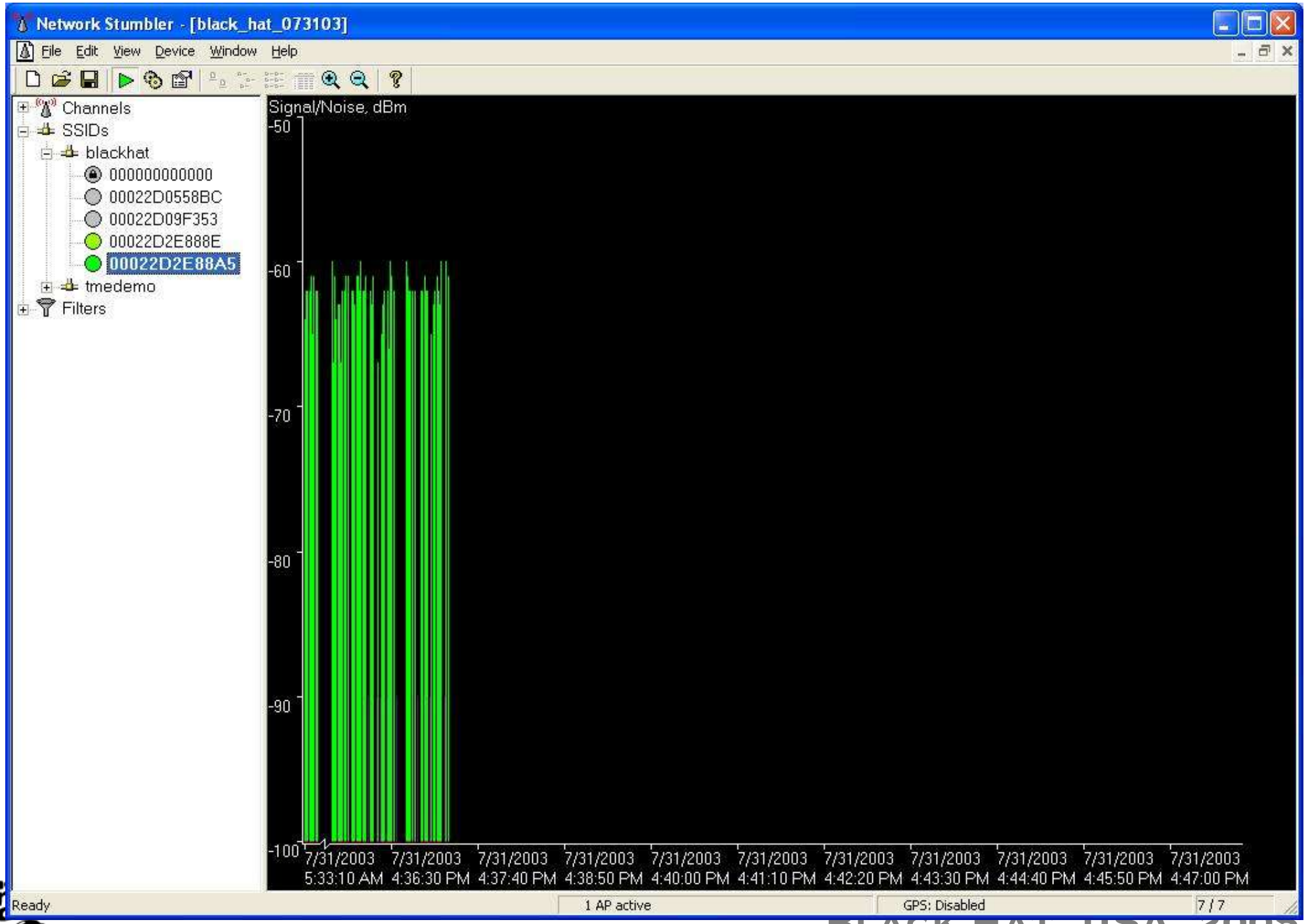


Inverse Wardriving v.
(gnivirdraw)

1. A rogue AP looking for “WiFi suckers”.

2. And you thought a user dual-homed with a **modem** was bad… ?




Network Stumbler - [black_hat_073103]
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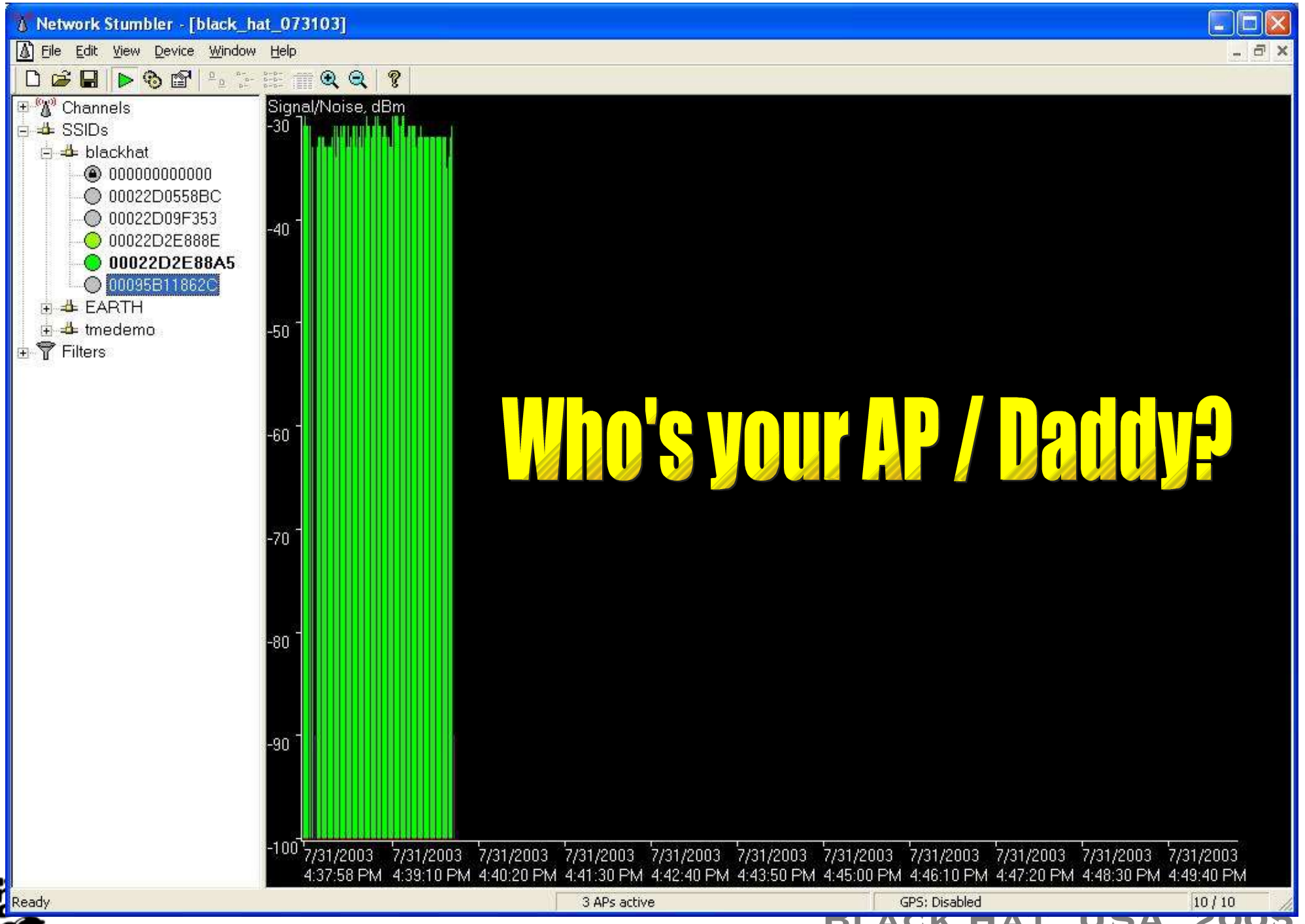
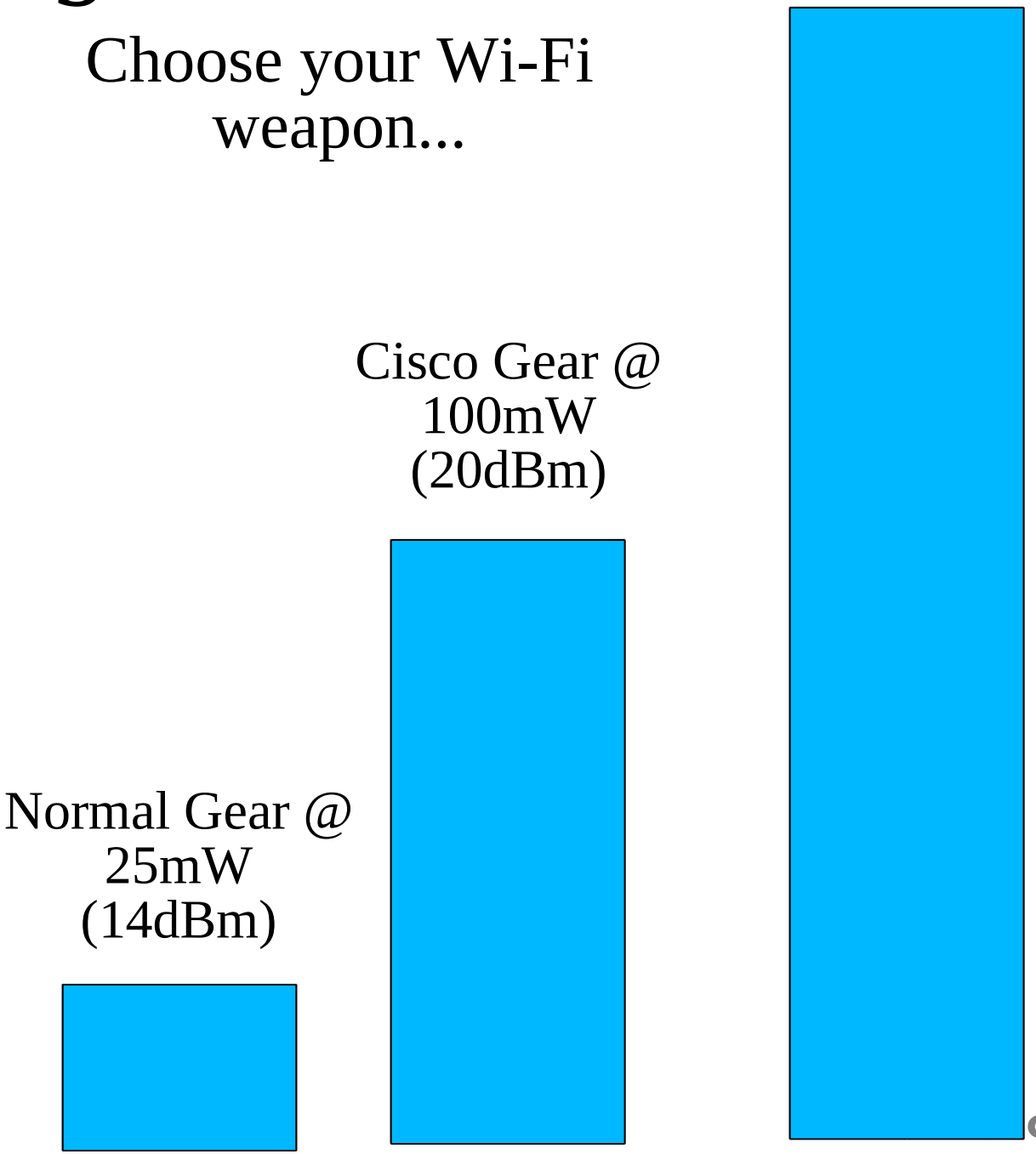
00022D0558BC
00022D09F353
00022D2E888E
00022D2E88A5
tmedemo
Filters
Signal/Noise, dBm
-50
-60
-70
-80
-90
-100
7/31/2003 5:33:10 AM
7/31/2003 4:36:30 PM
7/31/2003 4:37:40 PM
7/31/2003 4:38:50 PM
7/31/2003 4:40:00 PM
7/31/2003 4:41:10 PM
7/31/2003 4:42:20 PM
7/31/2003 4:43:30 PM
7/31/2003 4:44:40 PM
7/31/2003 4:45:50 PM
7/31/2003 4:47:00 PM
Ready
1 AP active
GPS: Disabled
7 / 7



Who's your AP / Daddy?

Rogue AP Attacks

Choose your Wi-Fi weapon...



Use a 15dBd antenna with a Senao for 38dBd total...

6 WATTS!

VS 25mW?

BAD GUY WINS! NO CONTEST!

Rogue AP How-To

- Use a hostap compatible wireless card to create a competing access point
- Provide IP, gateway, DNS
- Resolve all websites to your address, or NAT and selectively provide fake DNS replies
- Dynamically display fake websites for popular URLs via virtual hosting
- Lather, rinse, repeat.

Badass Backends and Two-Factor Terrorism

- Web-based authentication via wireless is an unholy marriage of two technologies—provides new attack vectors.
- Two-factor authentication can not even save you. Yes, this means 0wning SecureID via rogue AP is possible.
- Username, PIN, and token can be snarfed and used in REAL TIME!
- Thanks GPRS and EVDO!

Badass Rogue AP Attack Demo

Own3D!

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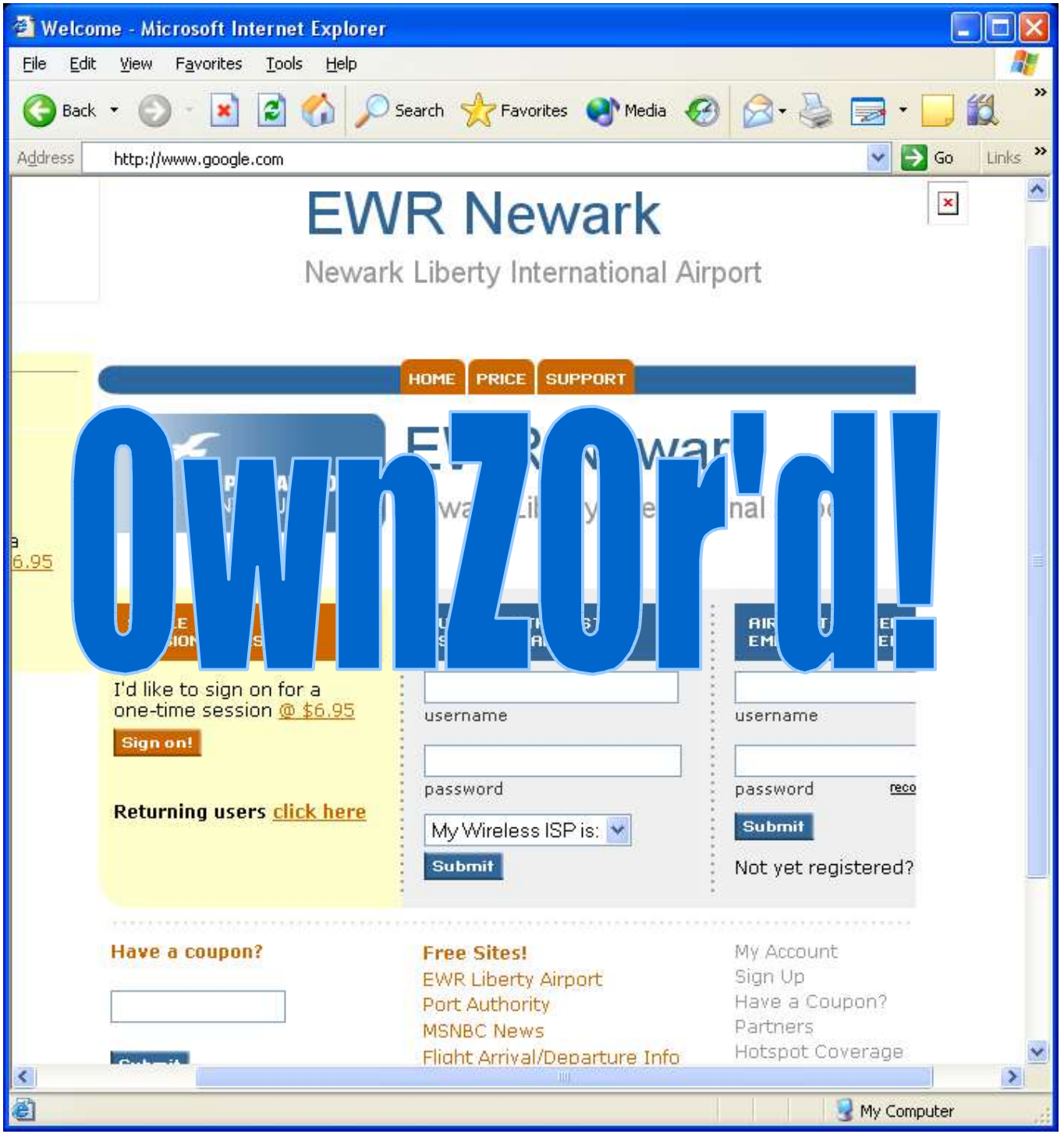

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USA, 2005

Rogue APs won't go away...

- Users will be users, and they WILL fall for access point “impersonators”.
- If you didn't notice, phishing and identity theft are on the rise... and so is hotspot usage.
- “Extra” wireless client profiles provide extra avenues of attack.
- EAP is an acronym, not a catch-all.
- Gartner can blow us.

802.11intelligence

- What other bits of info are users giving away via wireless?
  - Domains
  - Shares
  - Proxies
  - Installed software
  - Other preferred wireless networks
  - More?

What about EAP-secured wireless networks?

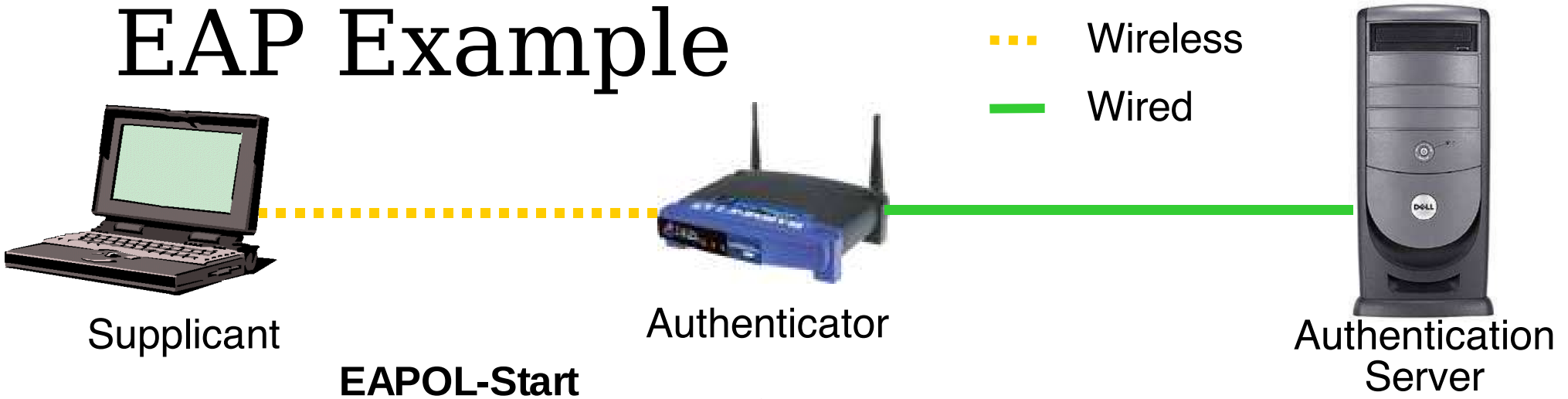
All Your EAP

- Oh crap. The EAP acronym bonanza:
  - EAP-MD5-Challenge, EAP-MSCHAPv2, EAP-GTC
  - EAP-SIM
  - EAP-TLS
  - EAP-TTLS (w/ MD5-Challenge, GTC, MSCHAPv2, PAP, CHAP, et al. variants) by Funk
  - LEAP, EAP-FAST by Cisco
  - PEAP (w/ MSCHAPv2, MD5-Challenge, GTC variants) by Microsoft et al.
- Lots of ways to screw this up. But first...

EAP for Dummies

- Three major components:
  - Supplicant = User / Client
  - Authentication Server = Duh. RADIUS fits here.
  - Authenticator = Device in between the two.
- Authentication goes something like this:
  - EAP-Request / Identity to Supplicant from Authenticator
  - EAP-Response / Identity to Authenticator from Supplicant which gets passed to Authentication Server
  - Challenge / Response brokered, and if successful authentication, then Authenticator allows Supplicant access to network based on what Authentication Server say is appropriate.

EAP Example



EAPOL-Start

EAP-Request / Identity

EAP-Response / Identity

EAP-Response / Identity

EAP-Request

EAP-Request

EAP-Response

EAP-Request

EAP-Success

EAP-Success & Key

EAP-Key

Rogue APs vs EAP Security?

- EAP security really only comes in to play with its tunneled variants that use TLS.
- Two basic goals in mind with the “secure”, credential-tunneled variants of EAP:
  - Give the supplicant a way to authenticate the authentication server so they don't go spilling their guts to the wrong guy.
  - Create a secure tunnel so that the supplicant and authenticator can have a secure challenge / response exchange mechanism, which can also be used to pass dynamic keying material.

Rogue RADIUS

- Who says rogue APs can't be used against corporate wireless networks that employ EAP?
- As we said, there are plenty of ways to screw up EAP. Thanks vendors!
- FreeRADIUS provides a simple & easy way to accept EAP credentials
  - Integrates nicely with hostapd.
- Can allow for “EAP Peeking”...

EAP-TLS Example

802.11 Authentication & Association

802.1x EAP Protocol Exchange

802.1x EAP-TLS Protocol Exchange

EAP-Success

EAP-Success & Key

EAP-Key

EAP-TTLS Example

802.11 Authentication & Association

802.1x EAP Protocol Exchange

802.1x EAP-TTLS Protocol Exchange

Secure Tunnel Established

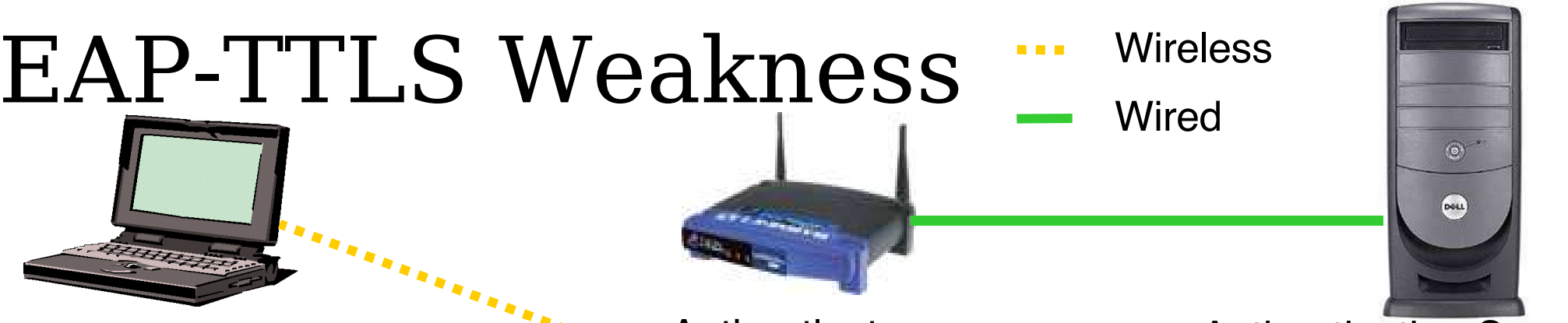
User Credentials Exchanged

EAP-Success

EAP-Success & Key

EAP-Key

EAP-TTLS Weakness



Previous EAP-TTLS Authentication Established

DISASSOCIATED!

802.11 Authentication & Association

802.1x EAP Protocol Exchange

802.1x EAP-TTLS Protocol Exchange

Secure Tunnel Established w/o Remote Certificate Check?

User Credentials Given Up?

All Your PAP... Google for targets, if you like. ;)

EAP-TTLS w/ PAP Attack?

Windows XP SP2

EAP-TTLS w/ PAP over TLS

RADIUS Server

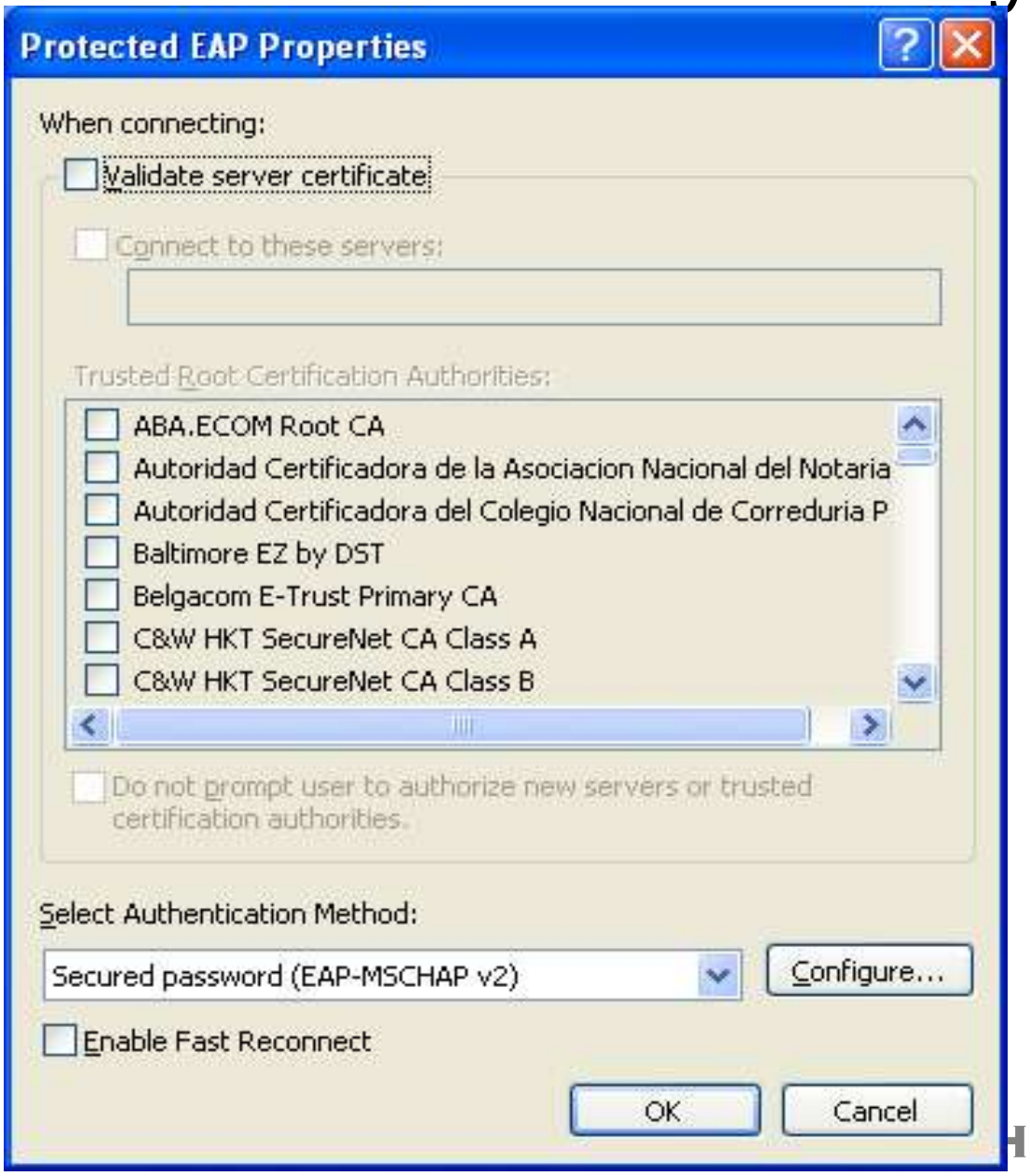
Rogue AP w/ Rogue RADIUS Server

Wireless

Wired

1. Disassociate users.
2. Learn username & password.
3. Disassociate, copy creds to local EAP config.
4. Impersonate victim with legit username & password whenever.

All Your CAs… The "All or None" Vulnerability

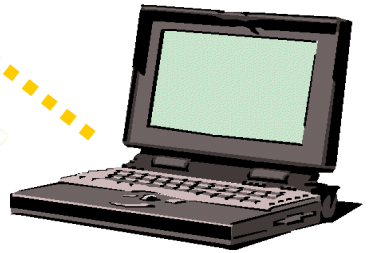


PEAP Attack?

Windows XP SP2

PEAP w/ MSCHAPv2 over TLS

RADIUS Server



Rogue AP w/ Rogue RADIUS Server

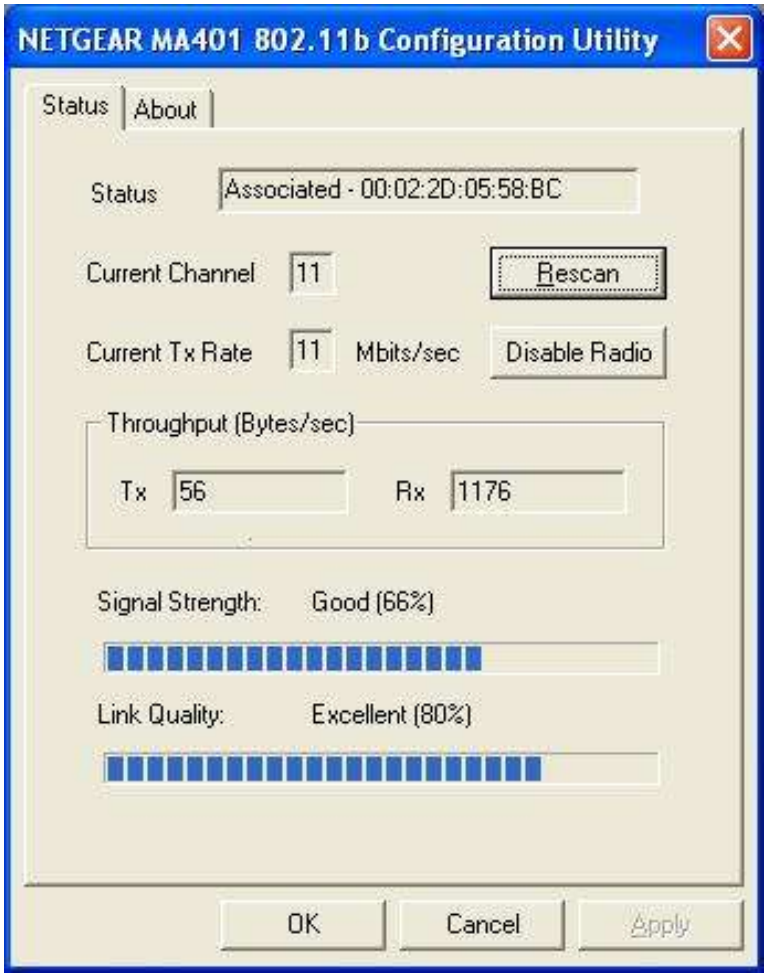
1. Disassociate users.
2. Learn DOMAIN and username w/ rogue AP.
3. Disassociate, seed local password file.
4. User continuously attempts to re-authenticate.
5. Repeat #3. Authentication success = correct password guessed!

Wireless Weaponry for Windows

- But rogue AP attacks require a "sophisticated hacker", right? Wrong.
- SoftAP + TreeWalk + Apache + ActivePerl = Airsnarf for Windows
  - http://airsnarf.shmoo.com/airsnarf4win.html
  - "Evil Twin Access Points for Dummies"
- But why only run one rogue AP, when you can run two... or three?
- Rogue Squadron?

Rogue Squadron Demo

Is there no defense?


NETGEAR MA401 802.11b Configuration Utility
Status
About
Status
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Current Channel
11
Rescan
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11
Mbits/sec
Disable Radio
Throughput (Bytes/sec)
Tx
56
Rx
1176
Signal Strength:
Good (66%)
Link Quality:
Excellent (80%)
OK
Cancel
Apply

:(

Defending Wireless Networks

- We seemed to have covered a lot of ground on the Offensive.. What about Defense *boom boom* Defense!
- Multiple issues afoot… need a solid grasp of network engineering, security, and user needs/will
  - Architecture and Configuration
  - Protecting the enterprise and Protecting the Client
  - Secure and Security Operations

Wireless Architecture

- Many options… maybe too many
- First, need to understand how network and system architecture impacts wireless security
- Layered defenses are a good way to start…
  - Some folks just secure layer 2
  - Some folks just secure layer 3
  - Some folks do both
- What's the right solution?

Protecting Just Layer 3 is a Bad Idea ™

- The goal is not to JUST protect the traffic
  - But that's all Layer 3 protection really buys you
- Does NOT protect a client from layer 2 tricks such as Rogues
  - The impact of Rogues may be mitigated, but depending on how good/bad the VPN software is, they may still be tricked
- Does NOT protect the infrastructure
  - Bad network architecture (leaking STP, CDP, routing info, shared LAN segment, etc) can still lead to compromise.

Protecting Just Layer 2 is a bit Better

- Using Layer 2 authentication and encryption (if done right) prevents most attacks on the client AND infrastructure
  - For instance, if you're leaking STP, at least it's encrypted
- But, note the previous 40 slides.. Layer 2 security is hard work

Protecting Both is a lot of work

- But, it's really your best defense
  - So, play the risk/reward game
- Given my option, I'd put my money on Layer 2 and get that RIGHT before spending money on layer 3

Configuration

- Don’t screw up your wireless configuration
  - Cost of failure is high
- Don’t screw up your client configuration
  - Cost of failure is high
- Even proper configuration does not ensure a secure network or client
  - Bad code in VPN or ESP software, for instance, could sink the whole thing anyway

Securing the Client or the Infrastructure?

- Just in case you missed it, your Enterprise 1x solution does not protect your client machines on the road
- Need Client software that can detect and defend against rogue AP attacks
- TSG released the Hot Spot Defense Kit at DC BH 03

Defending Wireless Networks

- At the time of HSDK, there was NO capability for rogue detection in commercially avail software
- Today, we're still not much better
  - AirDefense Mobile, some other small stuff
  - Rogues are THE BIGGEST threat against enterprise networks
- So, while the industry is still finding their whatnot with both hands, we're making…

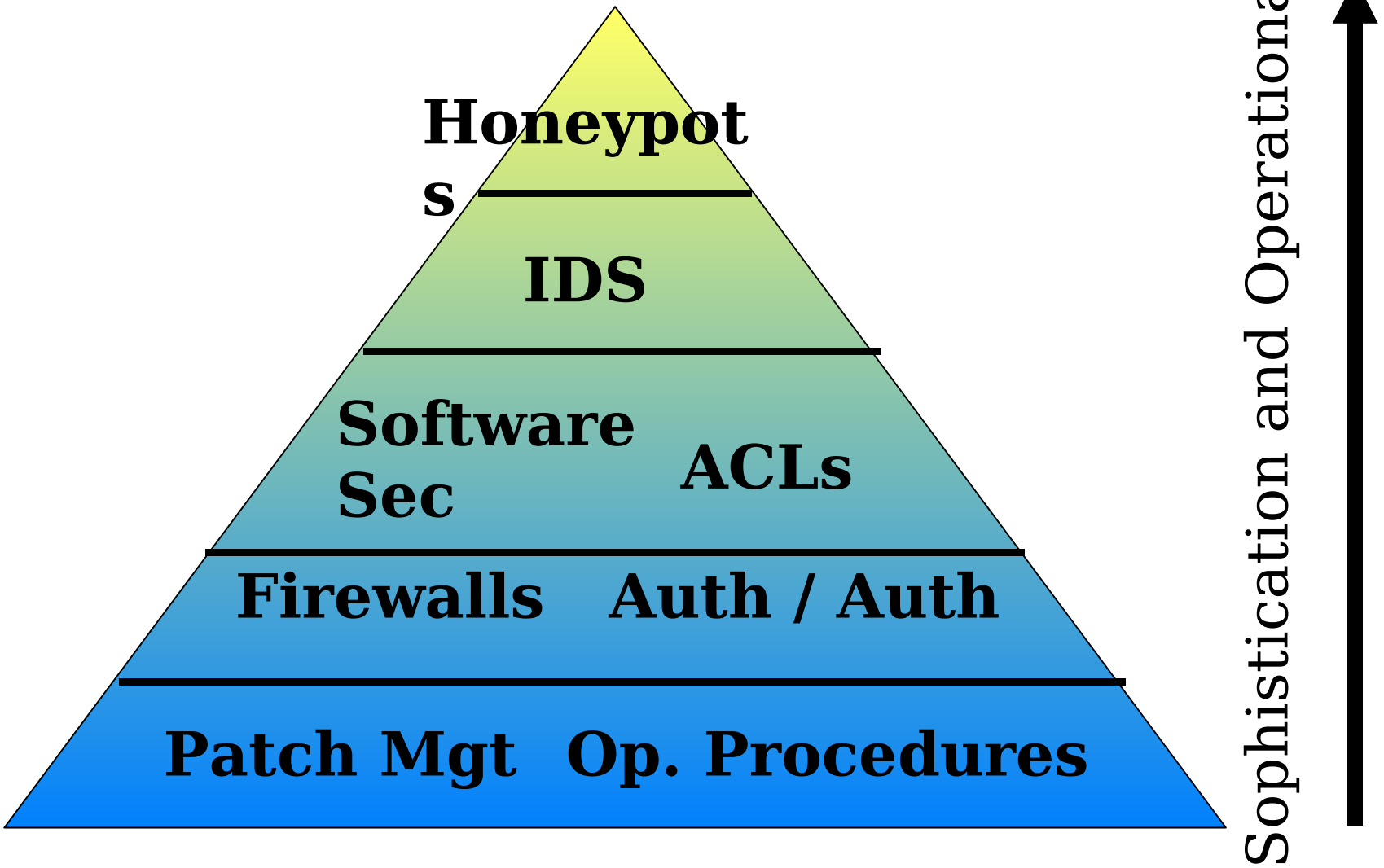
Hot Spot Defense Kit v2

- Enterprise wireless IDS systems look for any attack, not just one directed at a particular client
- When you are on the road (or don't have the "luxury" of an enterprise WIDS) you need the same kind of protection
- HSDK v 2 aims to be an environmental monitor of sorts
  - Looks for any zip in the wire, not just ones directly effecting the client
  - If you're in downtown Baltimore, and someone starts shooting, you tend to freak out even if they're not shooting at you… wireless shouldn't be any different

HSDK v2

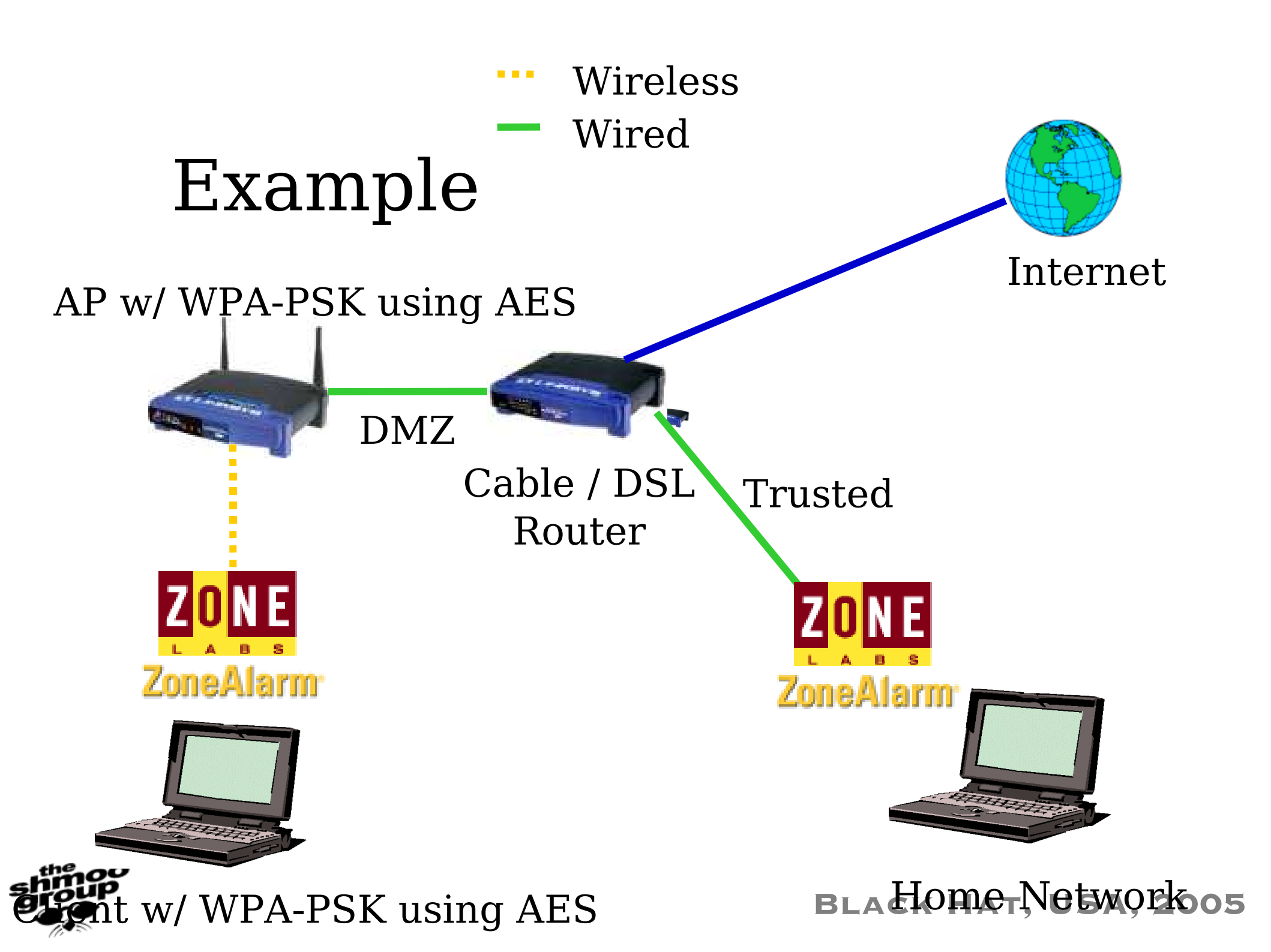
- Still under development
- Looking for:
  - Mass auth/deauth/assoc attacks
  - Fake AP signatures
  - Reinjection attacks (hard)
  - Bluetooth attacks (wireless isn't just .11, ya know)
  - The standard rogue detection stuff from v1
- If something is detected, the green ball turns red (step away from the computer)
  - If security software isn't usable, it's useless
- http://airsnarf.shmoo.com
- http://hsdk.shmoo.com

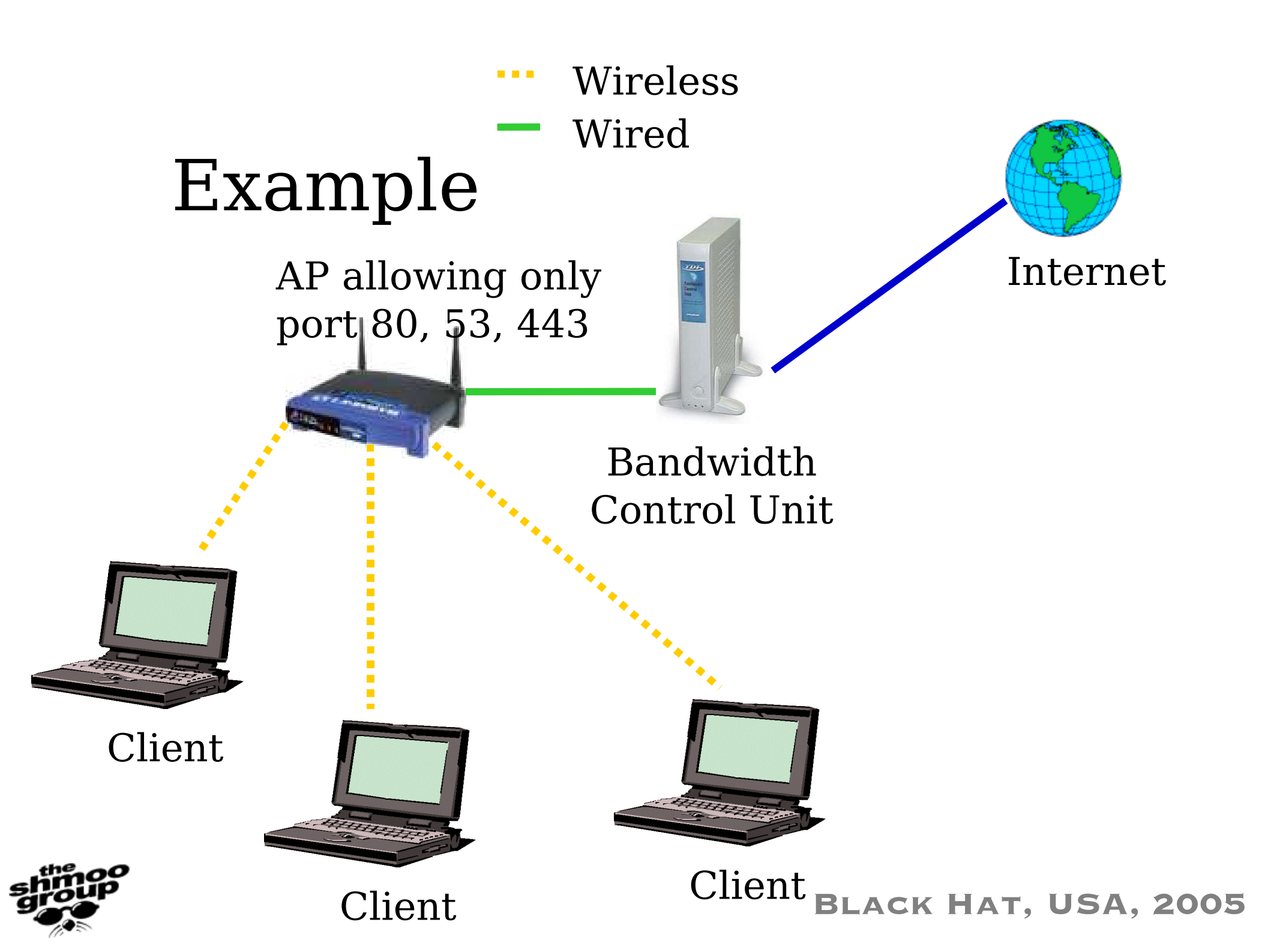
Secure vs Security Operations

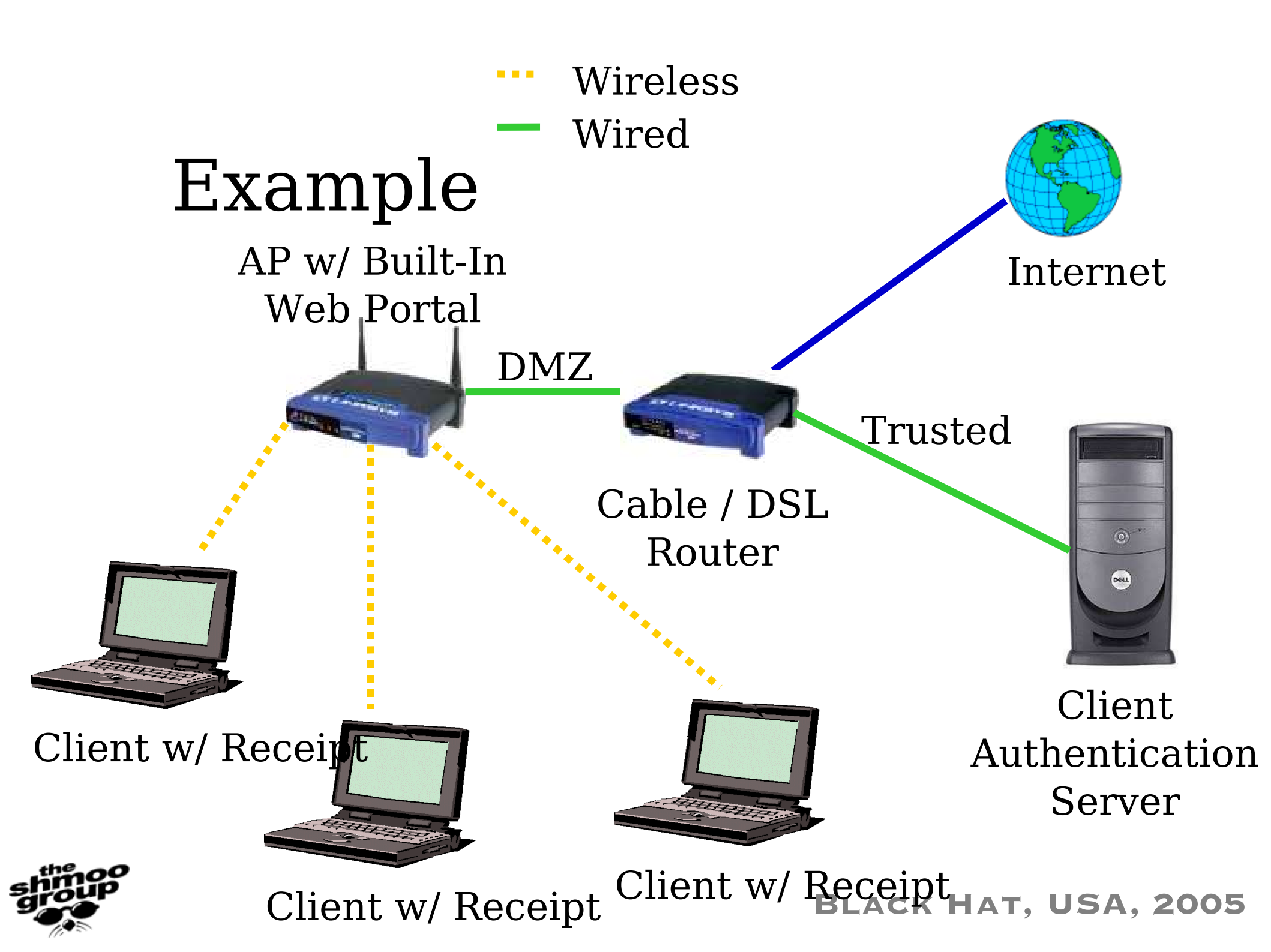


What's in YOUR wireless network?

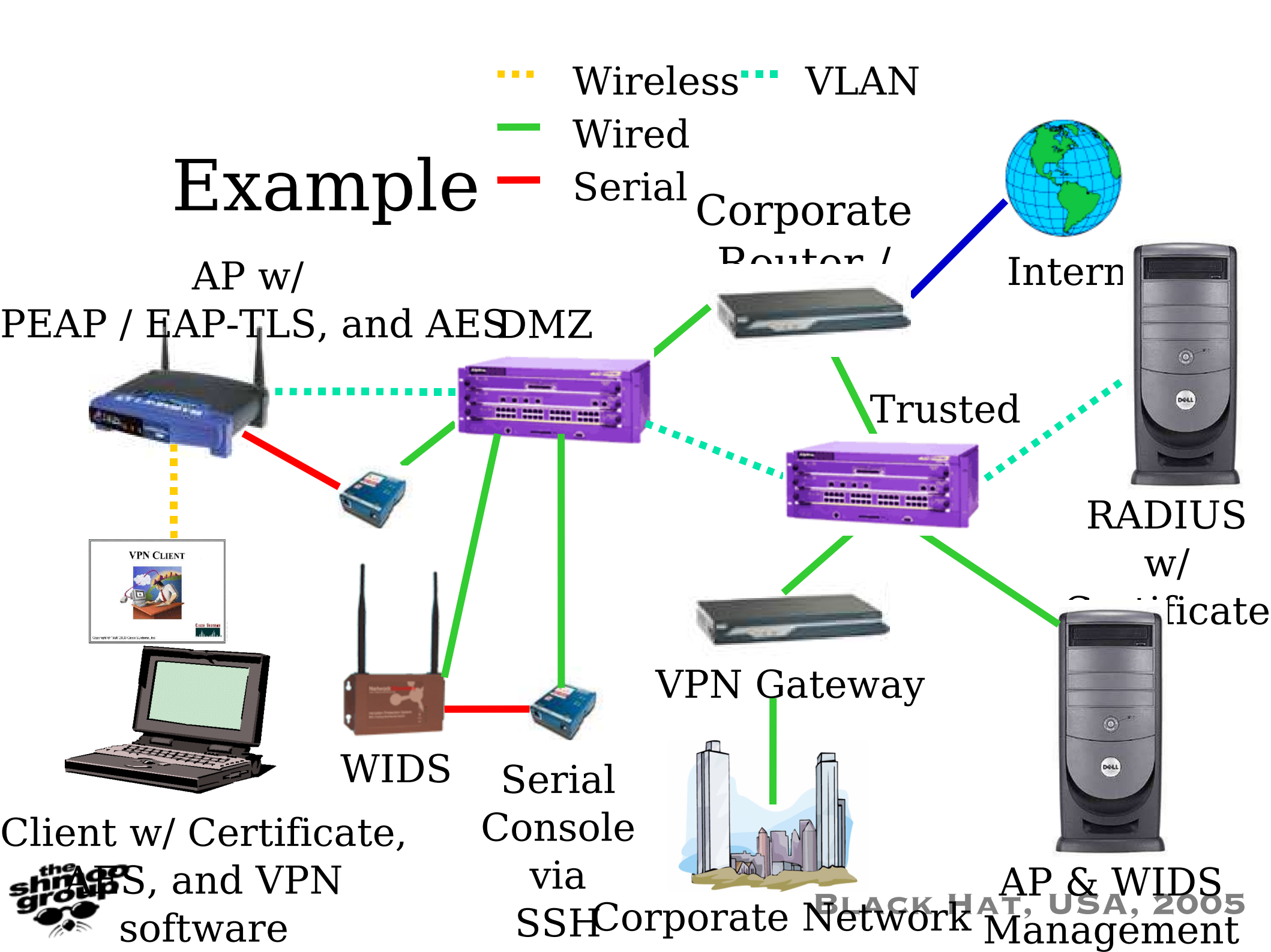
Example


Wireless
Wired
Internet
AP w/ WPA-PSK using AES
DMZ
Cable / DSL
Router
Trusted
ZONE LABS
ZoneAlarm
ZONE LABS
ZoneAlarm
Client w/ WPA-PSK using AES
Home Network


Wireless
Wired
Example
AP allowing only
port 80, 53, 443
Internet
Bandwidth
Control Unit
Client
Client
Client


Wireless
Wired
Example
AP w/ Built-In
Web Portal
DMZ
Internet
Trusted
Cable / DSL
Router
Client
Authentication
Server
Client w/ Receipt
Client w/ Receipt
Client w/ Receipt

Example


Wireless
VLAN
Wired
Serial
Corporate
Router /
Intern
AP w/
PEAP / EAP-TLS, and AES
DMZ
Trusted
RADIUS
w/
VPN Client
VPN Gateway
WIDS
Serial
Console
via
SSH
Client w/ Certificate,
AES, and VPN
software
Corporate Network
AP & WIDS
Management

More WMI 4 U

- Trying to get a handle on wireless, but all you are is a Windows network administrator? Perfect.
- WMI allows you to do some nifty things.
  - Scan for SSIDs
  - Check for dual-homed wireless users
  - Find rogue APs?
- See Beetle's ToorCon 2004 presentation.

17 line SSID Scanner for Windows in VBScript

```
on error resume next
set objSWbemServices = GetObject("winmgmts:\\.\root\wmi")
set colInstances = objSwbemServices.ExecQuery("SELECT * FROM
MSNDis_80211_BSSIList")
for each obj in colInstances
    if left(obj.InstanceName, 4) <> "WAN " and right
(obj.InstanceName, 8) <> "Miniport" then
        for each rawssid in obj.Ndis80211BSSIList
            ssid = ""
            for i=0 to ubound(rawssid.Ndis80211SSid)
                decval = rawssid.Ndis80211Ssid(i)
                if (decval > 31 AND decval < 127) then
                    ssid = ssid & Chr(decval)
                end if
            next
            wscript.echo ssid
        next
    end if
next
```

Summary

- Implementations vs Acronyms
  - “EAP” and “VPN” sound great—did you get them RIGHT, though?
- Configuration management of user wireless profiles
  - Rule with an iron fist or DIE!
- Why do you Wi-Fi?
  - It's OK to say “NO” if it's not a “good fit”.
- Wireless threats vs $$$?

Links

- http://airsnarf.shmoo.com/
- http://airsnarf.shmoo.com/rogue_squadron/
- http://hsdk.shmoo.com/
- http://www.shmoo.com/
- And the next con you should be planning on attending is ToorCon!
  - http://www.toorcon.org/

Questions?