WaveSEC for Windows

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Overview presentation

- Part one: Current '*secure*' Wireless networking
  - Deployments,
  - Protocols
  - other problems.

- Part two: Our WaveSEC solution explained

  - Building your own secure Access Point on a mini-PC
  - Putting it all in a €100 consumer AP, the Linksys WRT54g
  - Demonstrate how you can use the BlackHat WaveSEC AccessPoint.

Why do we need an (Opensource) secure AP?

- April 7th 2004: http://www.cisco.com/warp/public/707/cisco-sa-20040407-username.shtml

"A default username/password pair is present in all releases of the Wireless LAN Solution Engine (WLSE) and Hosting Solution Engine (HSE) software. A user who logs in using this username has complete control of the device. This username cannot be disabled."

Why do we need an (Opensource) secure AP?

- October 17th 2003:
  http://www.computerworld.com/securitytopics/security/story/0,10801,86187,00.html

  Joshua Wright, the systems engineer who created a tool that targets wireless LANs protected by Cisco Systems Inc.'s Lightweight Extensible Authentication Protocol (LEAP), said he did so to demonstrate the ease with which dictionary attacks against the protocol can crack user passwords.

  Wright said Cisco users should "be aware of the risks that exist by using the LEAP protocol." He said he plans to release the attack tool, which he has dubbed ASLEAP, in February, although he declined to say how he would make it available.

  The tool uses a challenge-and-response methodology built into LEAP to obtain the information needed to mount a dictionary attack, according to Wright. He then uses a 100GB electronic dictionary that includes various languages to discover passwords, a process that Wright said can be done in a matter of seconds.

- Cisco released advisory on april 12th 2004 (5 months later!)
  http://www.cisco.com/warp/public/707/cisco-sn-20030802-leap.shtml

Why do we need an (Opensource) secure AP?

- May 13th 2004: http://www.auscert.org.au/render.html?it=4091

  Denial of Service Vulnerability in IEEE 802.11 Wireless Devices

  "An attacker using a low-powered, portable device such as an electronic PDA and a commonly available wireless networking card may cause significant disruption to all WLAN traffic within range, in a manner that makes identification and localisation of the attacker difficult."

  "At this time a comprehensive solution, in the form of software or firmware upgrade, is not available for retrofit to existing devices. Fundamentally, the issue is inherent in the protocol implementation of IEEE 802.11 DSSS."

Why do we need an (Opensource) secure AP?

- May 4ᵗʰ 2004: http://www.uniras.gov.uk/vuls/2004/236929/

  Vulnerability Issues in TCP

  The issue described in this advisory is the practicability of resetting an established TCP connection by sending suitable TCP packets with the RST (Reset) or SYN (Synchronise) flags set.

  "The Border Gateway Protocol (BGP) is judged to be potentially most affected by this vulnerability."

Why do we need an (Opensource) secure AP?

- April 20th 2004: http://www.uniras.gov.uk/vuls/2004/236929/

  The following mitigation steps are still being evaluated and may be incomplete. Customers should work with vendors for the workaround most appropriate for the product in question [...]

- Implement IP Security (IPSEC) which will encrypt traffic at the network layer, so TCP information will not be visible.

- Reduce the TCP window size (although this could increase traffic loss and subsequent retransmission).

- Do not publish TCP source port information.

New problems

- Various new wireless communication protocols (Bluetooth, GPRS, GSM, WDCMA, WiFi)

- New billing models for hotspot access (scratch cards, subscriptions, roaming)

- Wireless is much easier to eavesdrop then ethernet cables or phonelines

- Connecting to a rogue Access Point; Or accidently connecting to a private Access Point

- You have to be able to connect to the network before you can authenticate, pay and then somehow go into a secure mode to use the Access Point.

- Most standard way of securing Access Points is WEP, which is useless for hotspots, since you are telling everyone all the secrets (The WEP key)

- You can't rely on preloaded software by a sysadmin, since this might be a roaming user.

New Markets: Lots of money to be made NOW

- Bind users through AccessPoint capabilities
- Bind users through Wireless card capabilities
- Bind users through Certification Systems
- Grabbing new customers is more important then security
- Binary only firmware to protect Intellectual Property
- Binary only firmware to restrict radio access (FCA requirement)

Security vs Marketing
New solutions often based on hype:

- Focus on desirable billing method (Get rich quick)

- Focus on customer 'relationship' (Get rich quick)

- Focus on pushing users through portals (Advertisement income), sometimes preventing users from full access.

- Cheap uplink, almost always behind NAT

- Often heard excuse: New protocols need to work on old AP hardware.

- Strange desire to "protect the link layer"

Security vs Marketing
Classic solutions often based on perfect security

- Not lightweight solutions (problem for PDAs and APs)

- Require complex software and cryptography

- Require extensive CS knowledge to configure for use

- Require pre-arrangement or trusted third party to prevent "man in the middle" attacks, which goes against commercial desire to quickly take customers

- Too much is in Microsoft's hands (no Windows,no go)

WiFi Standards slowly emerging

- WEP: old 128bit, weak IV broke most WEP implementations: http://wepcrack.sourceforge.net/

- WEP+: fixed weak Ivs, 256bit, but it is still WEP

- WPA: worse then WEP for passphrase of less then 20 characters: http://wifinetnews.com/archives/002453.html Supported by Microsoft, more difficult with other OS.

- EAP: Extended Authentication Protocol. Many new layers to protect, layers "carry over" from previous crypto processing. Complex. Not unlikely to get broken. Projects to connect EAP with SIM and Radius, see http://www.wlansmartcard.org/

WiFi Standards slowly emerging

- LEAP: cracked 9 months ago, withheld by Cisco http://asleap.sourceforge.net/

- PEAP: Son of LEAP, less patents then LEAP, more secure. For now...

- 802.1x (don't confuse with 802.11x): EAP-Radius based. See http://www.open1x.org/

- Dynamic WEP: often combined with 802.1x

  Problems: Most of them operate in the card, so binary firmware only. Makes it more difficult to fix or upgrade too.
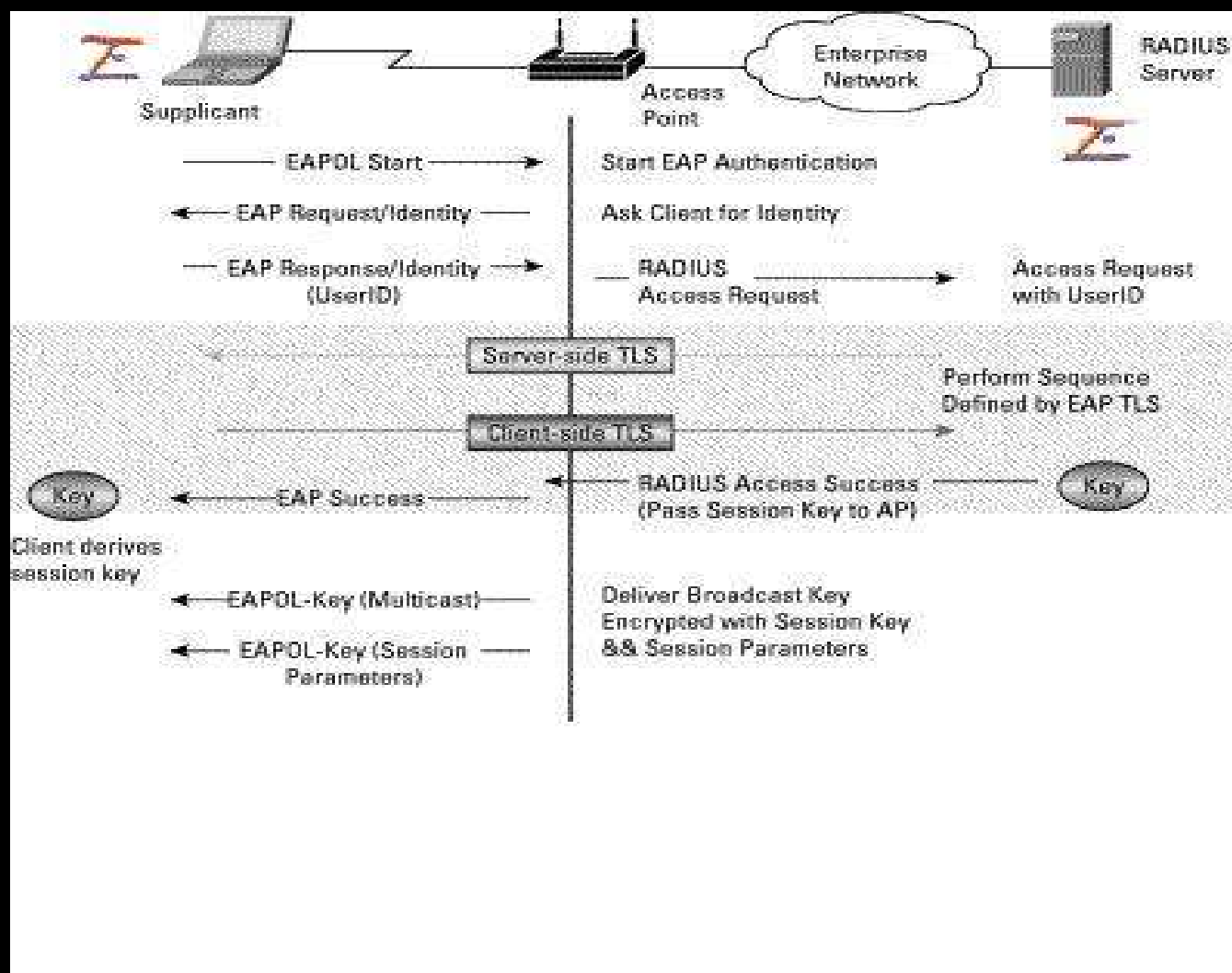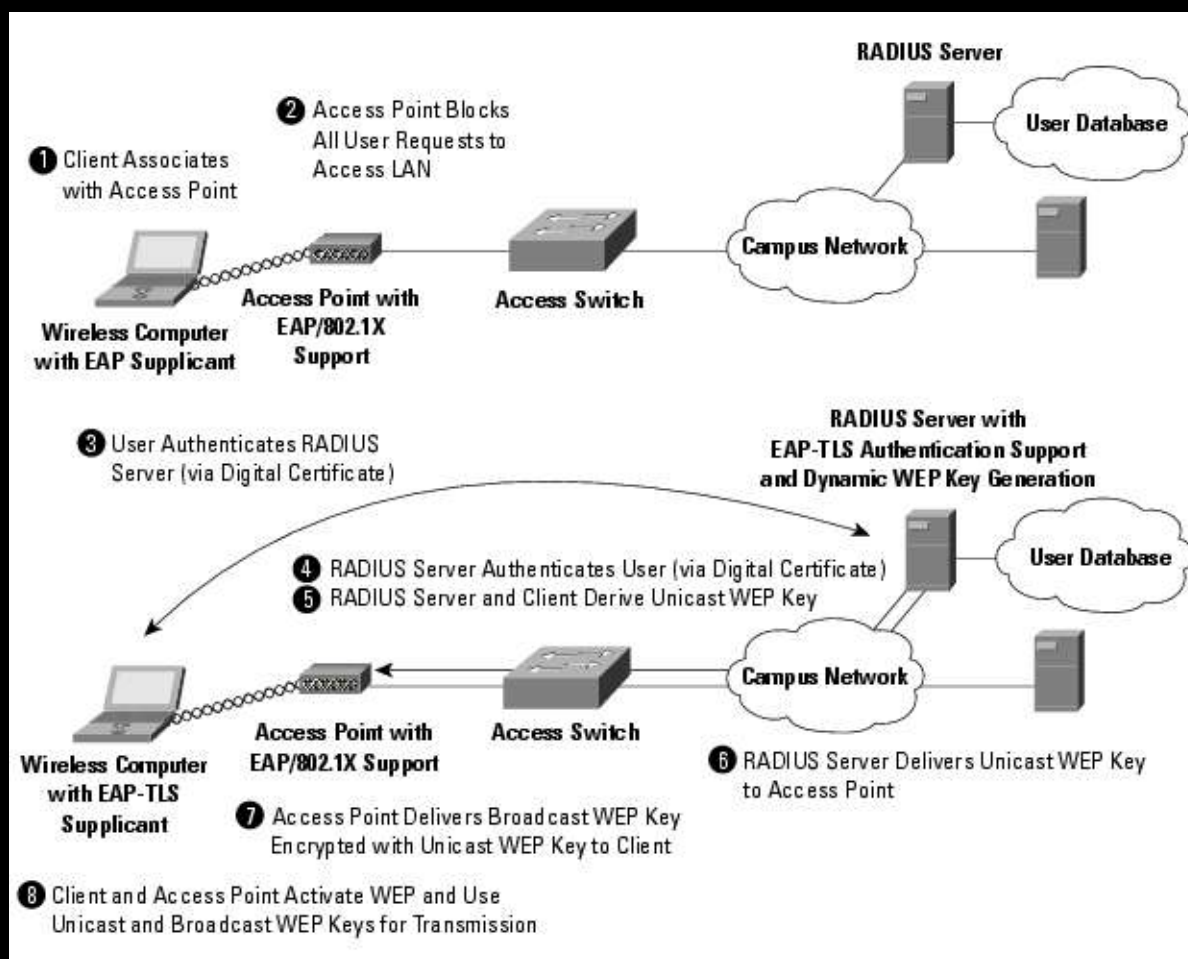
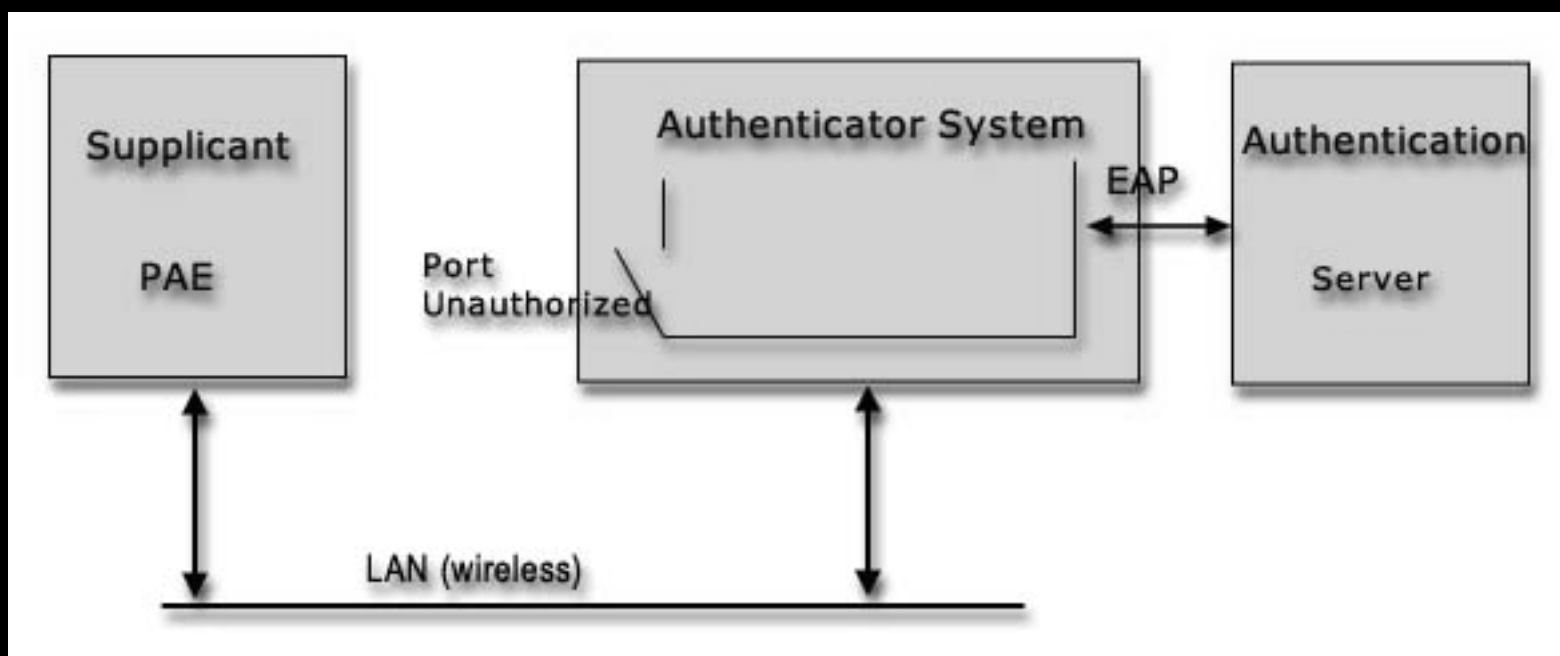# Complexity of EAP

Complexity of EAP

Complexity of EAP
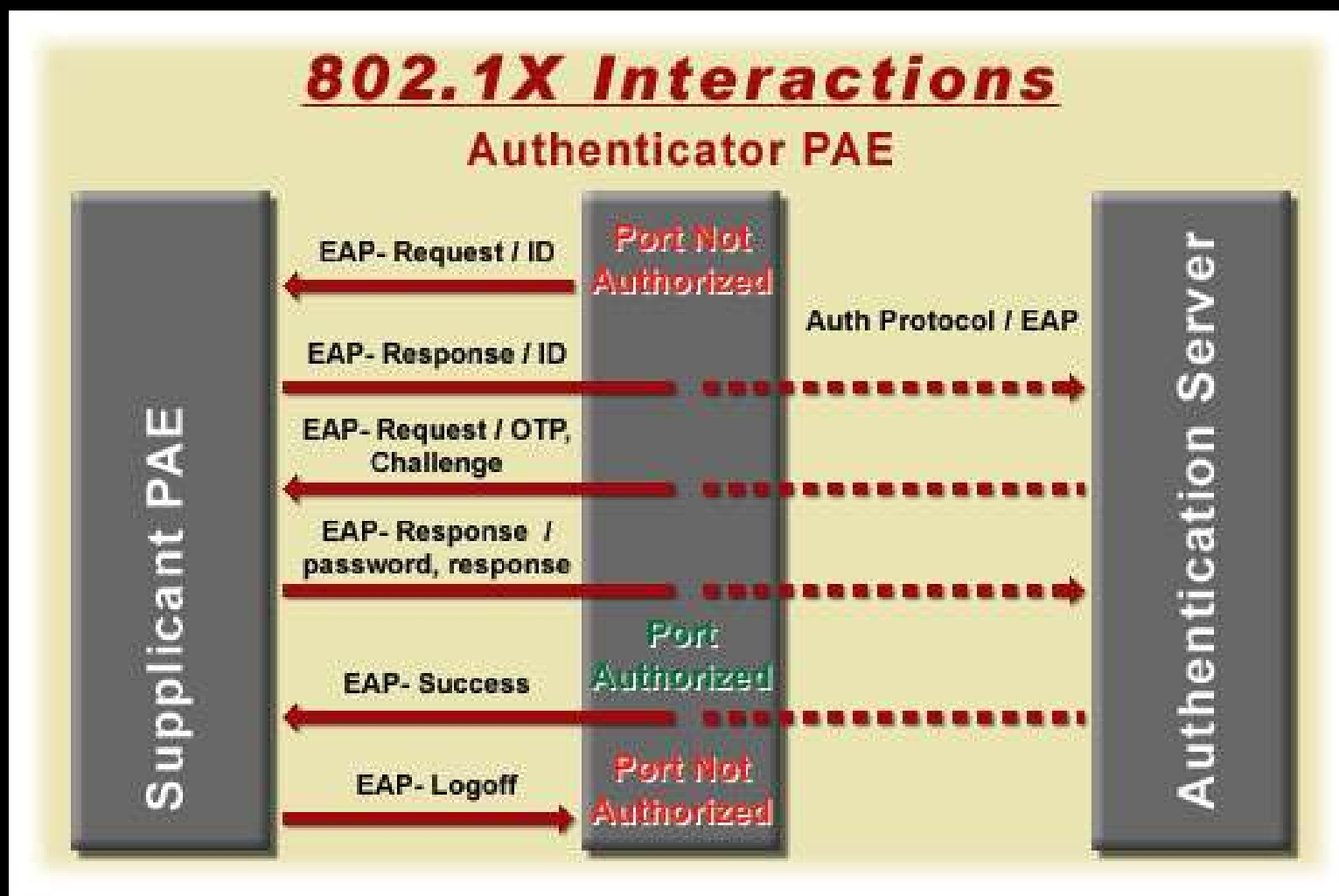
802.1x

- Windows has driver support.
- Linux support is poor; Missing Cisco and Centrino
- Hacks using Win32 binary: DriverLoader and ndiswrapper.

VPN standards emerging

- SSL based VPNs: Low Latency, Vulnerable to RST attacks)

- Custom VPN clients: Nortel, Cisco, Windows (hardly interop, Usuall broken behind NAT)

- Unix hacks: stunnel (see abobe), CIPE (cracked)

- Microsoft hack: LT2P (IPsec with glue to use RAS)

- IPsec with RFC extensions
  X.509: Certificates
  XAUTH: user/password
  IKEv2 (Advanced options negotiations)

What is a "hotspot"

- Redirect all traffic to authentication site (usually AP)
- Authenticate user, do billing
- (optionally?) encrypt all traffic
- Stop redirecting user (redir over proxy instead)
- De-authenticate when EO$

- Redirection to authentication server is vulnerable to MITM
- AP can be spoofed by malicious user

What not to protect

- We cannot protect against users associating with a rogue Access Point as long as we do not have cryptographically secured beacons.

- We cannot protect the link layer.

- Protect against DoS as much as we can (limit use of TCP 3way handshake, try to use Ipsec)

- EAP/802.11 alone cannot fix this. IPsec with authentication can. It could even use EAP/802.11, but why? There are other ways.

Our proposal: WaveSEC

- Use proven technology: IPsec with either X.509 or DNSSEC/DHCP

- Don't care about the link layer. Enforce crypto, do authentication in IP layer ("There is no OSI model")

- IPsec supoprted by most network devices

- IPsec has been deployed widely, and has not been broken in many years.

- No patents, licences, royalties or binary-only software or firmware

- Possibility to seperate WiFI and Crypto operations, so that the radio, or even AP, doesn't need to do the crypto operations that are CPU expensive

IPsec in a nutshell

- Part 1: Diffie-Hellman Key Exchange
  - Ensures privacy
  - Vulnerable to Man in the middle attack
- Part 2: Identity exchange and verification
  - Exchange ID's
  - Both parties independantly check ID with trusted third party (dnssec or CA).
  - Both parties agree on encryption method, eg RSA key based. RSA key of other party needs to be signed with a known and trusted CA.
  - Both parties agree on a stream cipher for the encryption, eg AES
  - Both parties agree to pass along certain packets, eg 10.0.1.0/24
  - Extra's: NAT Traversal, Dead Peer Detection, XAUTH/RADIUS,

Unresolved problem by all technologies

- Rogue Aps. Users cannot control which AP they associate with.

- Trusted third party. Users have to make some leap of faith at some point, unless they pre-arrange something (DNSSEC is not deployed yet, CAs are too trivial to inject or falsify)

- With IPsec, at least if you do switch later on, you only send the rogue AP crypted garbadge.

Coffee Break

WaveSEC for full IPsec clients (UNIX)
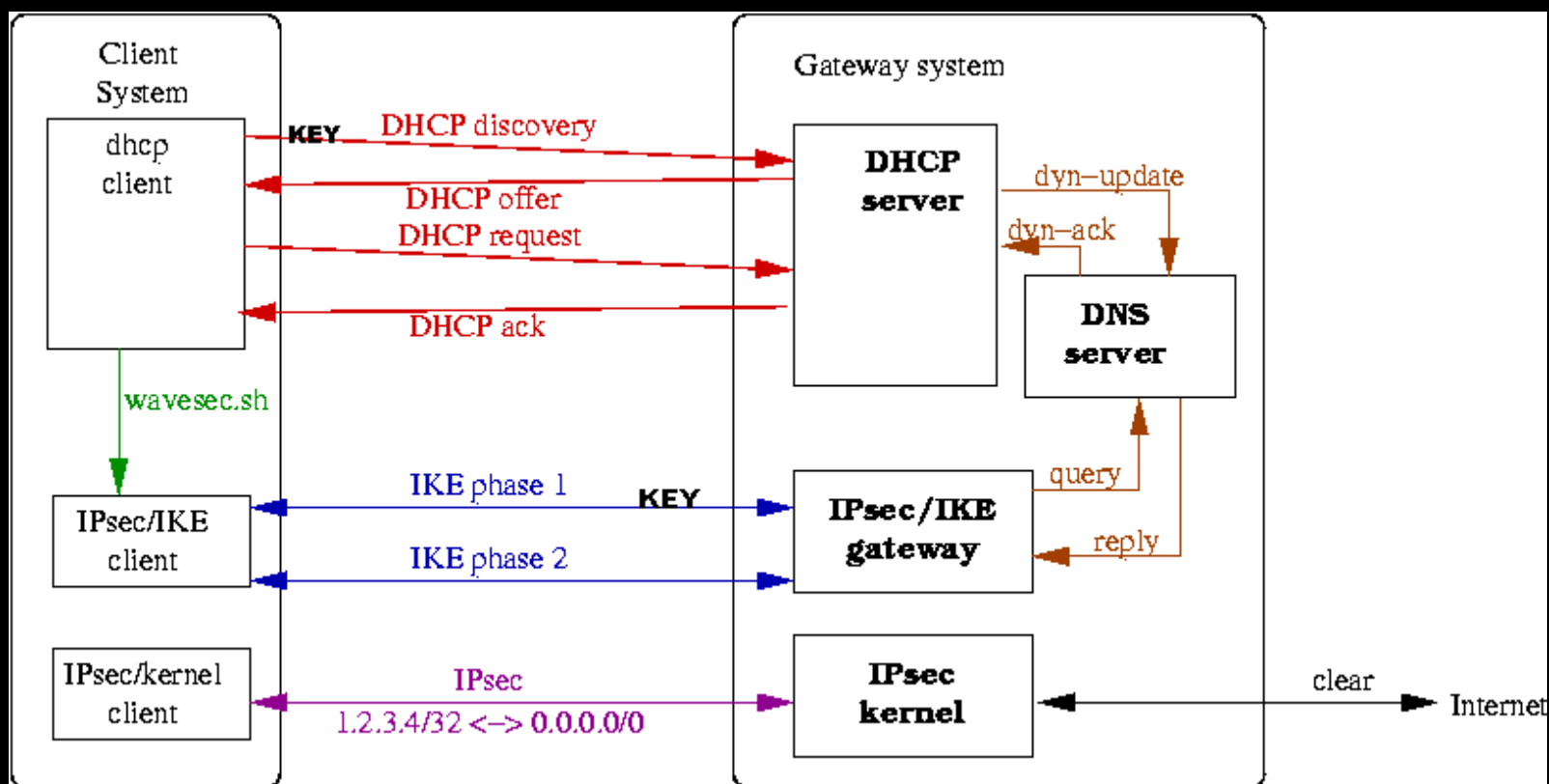
WaveSEC for Windows clients
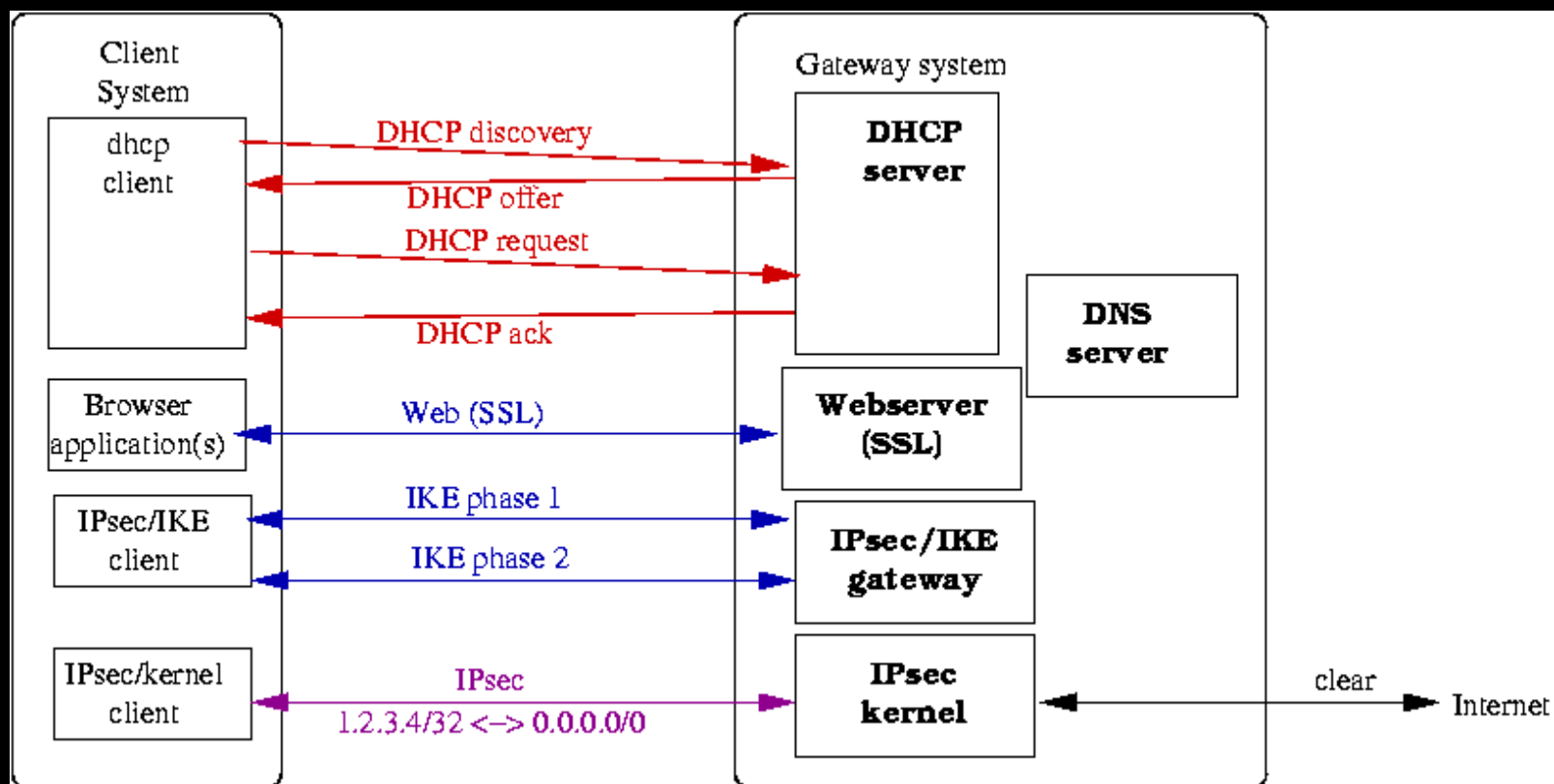
Building your own Access Point with WaveSEC

- Provide a DHCP server (ISC dhcpd)

- Provide a DNS server (ISC bind9)
  Good idea to ratelimit dns packets to prevent people using IP-over-DNS tunneling, eg
  http://nstx.dereference.de/
  (don't tell StarBucks or Krasnapolsky)

- Provide an IPsec server (Openswan)
  - X.509 certificate generation on the fly after CreditCard processing?
  - XAUTH/Radius based scratch cards?

Building your own Access Point with WaveSEC

- Provide SSL capable webserver (Apache)
  - For downloading custom software, and explain the user what to do.

- Provide X.509 functionality (OpenSSL)
  - for generating CA, certs and signatures.

- Provide Transparent Proxy server (Squid w. IPtables)
  - makes AP seem faster

WaveSEC prototype
Symtrax Cyrix MediaGX 300mhz, 64MB RAM, 20GB disk, 3x ether.

WaveSEC prototype software based on Fedora

- Full RedHat Fedora Core 1 install
- Used RPMS for apache,openssl, dhcpd,php
- Used Openswan-2 (ftp.openswan.org)

  We glued everything together using PHP and Expect

WaveSEC prototype: Generate CA

- "Initialise Certificate Agency" button

- mkdir /etc/sslca ; cd /etc/sslca

- edit /usr/share/ssl/openssl.cnf to taste (eg name, default_bits, change default path from demoCA to /etc/sslca, change validity (3650 days)

- /usr/bin/openssl req -x509 -days 1460 -newkey rsa:1024 -keyout caKey.pem.locked -out caCert.pem -passin pass:foobar -passout pass:foobar

WaveSEC prototype: Generate AP key

- /usr/bin/openssl req -newkey rsa:1024 -keyout filename.Key.pem.locked -out filename.Req.pem -passin pass:foobar -passout pass:foobar
- Optionally remove passphrase for software
- openssl rsa -passin pass:foobar -passout pass:foobar -in filename_lock -out filename_unlock

WaveSEC prototype: Sign & Install AP key

- /usr/bin/openssl ca -in filename.Req.pem -days 730 -out filename.Cert.pem -passin pass:foobar -notext -cert caCert.pem -keyfile caKey.pem.locked

- cp gatewayCert.pem /etc/ipsec.d/certs/   # AP host pubkey

- cp gatewayKey.pem* /etc/ipsec.d/private/ # AP host privkey

- cp caCert.pem /etc/ipsec.d/cacerts/   # AP host cert CA

- # following needs entry in /etc/ipsec.secrets
  cp gatewayKey.pem.locked /etc/ipsec.d/private/

- # Certificate Revocation List (optional)
  openssl ca -gencrl -out /etc/ipsec.d/crls/crl.pem

- Service httpd restart ; service ipsec restart

WaveSEC prototype: Configure Openswan

- Configure /etc/ipsec.secrets
  : RSA blackhat.xelerance.com.key "your_password"

- Configure /etc/ipsec.conf wavesec connection
  conn wavesec-for-windows
      right=%any
      left=%defaultroute
      leftsubnet=0.0.0.0/0
      leftcert=blackhat.xelerance.com.pem
      leftid="C=NL,L=Amsterdam,O=Xelerance,OU=Wireless
        Security Department,CN=CA wireless,
        E=postmaster@xelerance.com"
      auto=add

WaveSEC prototype: Configure Openswan

- Leftid option can be seen with:
  openssl x509 -in cacert.pem -noout -subject

- Check and see if connection loaded correctly with:
  ipsec auto --listall
  (double check that "has private key" appears with gateway key)

WaveSEC prototype: Configure PHP

- Optional: Install "nocat" for port redirection to AP
- Interpret browser OS and redirect to client page:

```
include("wavesec.inc");
check_and_go_secure();
$browser = $GLOBALS["HTTP_USER_AGENT"];
if (stristr($browser,"Linux")!= FALSE)
    Header("Location: /linux/");
else if (stristr($browser,"Windows NT 5.1")!=FALSE)
    Header("Location: /winxp/");
else if (stristr($browser,"Windows NT 5.0")!=FALSE)
    Header("Location: /win2k/");
else if (stristr($browser,"Mac OS X")!=FALSE)
    Header("Location: /macosx/");
else Header("Location:/other/");
```

WaveSEC prototype: Configure PHP

- Generate a new hostkey for the client on the AP (Identical to generating the gateway key earlier)

- Optionally remove passphrase:
  openssl rsa -passin pass:foobar -passout pass:foobar -in filename_lock -out filename_unlock

- For windows client, an extra step, make PKCS12 file (includes root CA)
  /usr/bin/openssl pkcs12 -export -inkey filename_lock -in filenameCert.pem -name wavesec -certfile caCert.pem -caname \"WaveSEC CA\" -out filenameCert.p12 -passin pass:foobar -passout pass:foobar

WaveSEC prototype: Making wavesec.exe

- "Our" client is made with NullSoft Installer Software (NSIS), consists of:

  - IPsec supportive tools for either XP or 2K

  - WinXP: ipseccmd.exe from WinXP CD:\SUPPORT\TOOLS

  - Win2k: ipsecpol.exe http://agent.microsoft.com/windows2000/techinfo

  - Ebootis VPN tool http://vpn.ebootis.de/package.zip (ipsec.exe)

  - certificate loader: certimport.exe (certimport -f foobar clientXXCert.p12) http://www.xelerance.com/

WaveSEC prototype: Making wavesec.exe

- ipsecmon.exe for debugging (Win2k only)
- wget.exe with ssl to fetch p12 file. (For possible future use) (ftp://ftp.sunsite.dk/projects/wget/windows/wget-1.9.1b-complete.zip)
- ipseccmd and the MMC ipsec snap-ins for debugging (ipseccmd \\yourmachinename show all)
- We packages these files into our wavesec client files:

  WaveSEC-0.99-xp.exe (BlackHat CD)
  WaveSEC-0.99-2k.exe (BlackHat CD)

WaveSEC prototype: Limited experience so far

- currently, our exe files are static. We have to seperately download, or let the user download the configuration file and the certificate file.
  (We are working on hacking self-extracting zip files on linux)

- Prevent leaching certificate files by Evil Users. Eg: delete upon download.
  (not yet implemented ni prototype)

- Extend NSIS package to 'figure out' where the certificate file and Windows' ipsec.conf file were downloaded (fetch with wget? dynamicly overwrite self extracting .exe files?)

WaveSEC prototype: Limited experience so far

- Windows does send Notify/Delete, but Openswan ignores them. Bug?

- If Openswan ignores them (or windwos box crashes and wont send them), we can have two identical conns open on different IP's. Use uniqueids=no should mitigates this (kills older client connection)

- Use rekey=no (server kills idle clients, clients have to rekey actively)

- I am also not sure "ipsec -off" properly works on Windows. Intermittent issues.

WaveSEC prototype: Limited experience so far

- Windows seems to accept plain text communication for policies that should only do crypto. Windows bug or ipsec.exe policy agent bug. Need to be traced down.

- People removing WaveSEC software while policies are loaded. Yes they are loaded again after reboot, without the need for the supporting tools!!

- Windows can only tunnel "everything" to the default gateway. If fails to send packets for "everything" to another host. Though that is a fairly bad setup anyway, requiring NAT. (think "limited hotel IPs")

WaveSEC prototype: TODO

- ipsec -off at shutdown/suspend

- get rid of dos box (make real win32 binary)

- tray icon for on/off

- splashscreen :)

- better certificate installer with file selector menu.

- Or modify self-extracting zip file so we can add certificate and configuration file at a known place within the .exe file, so know exactly where to find them to process them (eg to insert the certificat into the Registry)

Try out WaveSEC at the conference!

- Grab me during the conferene if you need help
  Double check the Root CA that you get so no hacker
  can be a MITM here:

Certificate Properties

General | Details

This certificate has been verified for the following uses:
- SSL Client Certificate
- SSL Server Certificate

Issued To

Common Name (CN):	wavesec.xelerance.com
Organization (O):	Xelerance
Organizational Unit (OU):	*<Not part of certificate>*
Serial Number:	01

Issued By

Common Name (CN):	WaveSEC CA
Organization (O):	Xelerance
Organizational Unit (OU):	*<Not part of certificate>*

Validity

Issued On:	04/14/2004
Expires On:	04/14/2006

Fingerprints

SHA1 Fingerprint:	F3:6D:A6:60:C1:30:37:71:03:32:CF:E7:0E:9D:9E:78:FE:61:A9:84
MD5 Fingerprint:	C6:9B:DB:FB:05:A9:E1:5F:9D:85:C5:3A:F0:41:23:D7

✖ Close

Next step: WaveSEC on consumer AP

- Linksys WRT54g (100Mhz MIPS, 16MB RAM, 4MB FLASH)

Next step: WaveSEC on Linksys

- It runs Linux, and we can install/recompile the kernel and rest of the system.

- Should run openswan-2 (probably not openswan-1)

- based on OpenWRT (http://openwrt.ksilebo.net/)

- haven't squished it all in 16MB yet, so using nfs mount for storage

- Get AES working, which works in Openswan-1 but hasn't fully merged in a released Openswan-2

- Use "fsstarter" instead of all the sed/awk/perl scripst to start IPsec

- Perhaps pre-calculate certificates, since the MIPS CPU isn't that good?

- Look for mini SSL capable webserver

Next step: WaveSEC on Linksys

- We ported Openswan-2 to the MIPS/openwrt platform. Patches are included in Openswan-2.1.2 (released may 19 2004)
  To install, add the following to /etc/ipkg.conf:

  src openswan ftp://ftp.openswan.org/openswan/binaries/openwrt/buildroot-20040509/ipkg/

  and run:
  - Ipkg update
  - Ipkg install gmp mawk openswan-module openswan

- Speed: 1000 Kbyte/sec AES encryption and decryption.
- Verfied RSAkey based automatic keying works.
- Memory left over after establishing tunnel: 1200 kbytes.
- Memory left over 12 hours later: 400kbyte (oops?)
- X.509 code has not yet been tested on the MIPS.