Network Security: The Principles of Threats, Attacks and Intrusions (Part 1)

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gibbleguts.com
HACKERS
INFORMATION HIGHWAY

Contents

- Background to security risks and the Internet
- TCP/IP vulnerabilities
- Attack Trends
- Classification of attacks
  - Social Engineering
  - Hacking or Cracking
  - Viruses and Worms
  - Trojan Horses

  } *Blended Attacks*

  - Network Layer Attacks - spoofing, hijacking
  - (Distributed) Denial of Service Attacks

Live tests reported in “Cryptogram” (B. Schneier) www.counterpane.com

- A random computer on the Internet is scanned dozens of times a day
- The life expectancy of a default installation of Red Hat 6.2 server, or the time before someone successfully hacks it, is less than 72 hours
- A Windows home user with file sharing enabled, was hacked five times in four days
- Systems are subjected to NetBIOS scans an average of 17 times a day
- The fastest time for a server being hacked: 15 minutes after plugging it into the network

Quote from Kevin Mitnick ….

- “It's naive to assume that just installing a firewall is going to protect you from all potential security threats. That assumption creates a false sense of security which can be worse than having no security at all.”

Security and the Internet ……

- Between February 2000 and December 2001 we have seen….
- The biggest Denial of Service Attack in the history of computing (7-11 February 2000)
- The biggest Virus Attack in the history of computing (“I Love You”, 4 May 2000)
- The biggest Worm Attack in the history of computing (Nimda, 18 Sept 2001)

Security and the Internet ……

- Lion Worm Ver 0.11 released March 29, 2001
- Release of the Code-Red Worm July 19, 2001
  - Infected 359,000 computers in 14 hours
  - At peak 2000 computers were being infected per minute
- Release of Nimda Worm on 18 September 2001
  - Infected 160,000 at peak
  - within one day 450,000 unique IP addresses were attempting to spread the worm
- …. Leading to some of the most dangerous web server attacks ever known (18 September 2001)

Significant Vulnerabilities in 2002

- Gigger Worm - JavaScript virus attacks Microsoft Outlook, Microsoft Express and IRC
- Buffer overflow problems with Internet Explorer 5.01, 5.5 and 6.0 and IIS 4.5 and 5.1
- DOS problems in Microsoft's IIS 4.0, 5.0, 5.1, Cisco's ADSL routers, SNMPv1, and DNS Bind v9

Providing you are not using Microsoft Outlook, Microsoft Express, Internet Explorer, IRC, SNMP Network Management, DNS Bind or any of Microsoft's web servers since IIS 4.0 - you should be OK!!

Significant Vulnerabilities in 2003

- 25 January, 2003 - SQL Server (Slammer) Worm
  - Small MS SQL Worm (376 bytes) replicates itself using a buffer overflow technique.
  - When worm gains control it generates random IP Address and send itself by connecting to remote UDP port 1434
  - Large number of attempts leads to Denial of Service attack
  - www.ravantivirus.com/virus/showvirus.php?v=164
  - www.cert.org/advisories/CA-2003-04.html

Significant Vulnerabilities in 2003

- 16 July, 2003 - Buffer Overflow in Windows RPC and XP Shell - Severity Rating: *High*
  - RPC Buffer overflow in RPC allows attacker to gain absolute control of a Windows machine!!
  - XP Buffer overflow allows attacker to execute code with logged-in user's privlidges!!
  - Both of these are severe and a rating of "high" has not been seen for over a year
  - www.watchguard.com/archive/images/lsglossary.htm#rpc

Significant Vulnerabilities in 2003

- 17 July, 2003 - Denial of Service in *all* Cisco IOS Routers - Severity Rating: *Critical*
  - Critical DOS vulnerability which affects all Cisco IOS software running on all Cisco routers
  - By sending a specifically designed IPv4 packet to a router, all data can be blocked.
  - Although this attack is specific to IPv4 and not IPv6 most people are still running IPv4
  - This is a very significant and dangerous attack and a rating of “critical” has not been seen for over two years
  - www.watchguard.com/archive/images/lsglossary.htm#dos

Significant Vulnerabilities in 2003

- 11 August, 2003 - Blaster - Severity Rating: *Critical*
  - W32.Blaster.worm - simple worm that exploits one of the worst Windows vulnerabiities in recent history
  - Utilised critical flaw reported on July 16 to create new blended attack
  - Does not even have to use e-mail to spread
  - Exploits DCOM (Microsoft's distributed object management tool) buffer overflow with TCP port 135 (Microsoft's RPC Location Service) to gain full control of machine
  - Uses TFTP to download msblast.exe and alters regisry settings to ensure it runs every time machine is rebooted

Case Examples of Buffer Overflow in recent months

Examples from both Windows and Unix/Linux

- MS Blaster.Worm — Buffer overflow in RPC / DCOM process
- CDialog — Linux script interpreter
- XV — Unix image program
- Microsoft SQL — LPC service

Case Study - Blaster

- 8 August, 2003 Major Corporate Network Disabled with Blaster (name withheld)
  - All access to off-site web servers stopped 8 August. No apparent reason
  - Numerous tests carried out over 4 hour period by disconnecting various parts of the corpotate intranet
  - The Blaster worm was discovered but the patches had autodownloaded a few minutes too late
  - Port 135 (as used by Microsoft Web Servers was disabled on all machines). Hence no services like windows updates
  - Outage -10 hours
  - Cost to repair - $30,000 (*excluing* time spent patching servers in user departments an lost productivity)

Significant Vulnerabilities in 2003

- 23 August, 2003 - SoBig.F - Severity Rating: *Critical*
  - One of the most widespread viruses known
  - Crippled e-mail services. 57% of all e-mails infected on 21 August (21.6 of 38 million scanned by AOL that day)
  - Many large corpoates in Asia hit as well as international organisations such as Air Canada, CXS Corp. etc
  - Designed to turn computers into spam relay machines
  - Contained an encrypted file which has 20 key IP addresses to be used for large DDOS attack

Case Study - SoBig.F

- 23 August, 2003 Major Corporate Network Disabled with SoBig.F (name withheld)
  - Microsoft patches applied to all servers but it was not clear why the patch only worked in some cases and no indication of the reason it did not stick
  - Subsequently discovered that patch would only install correctly if cetain service packs were in place and backtracking on service packs often left a corrupted system file which stopped the blaster patch from working (see note)
  - Microsoft released a patch for the patch!!
  - EVERY machine in network had to be patched
  - In mean time 20-40K e-mails per day had to be filtered
  - Estimated cost to organisation $25,000

Significant Vulnerabilities in 2004

- 26 January 2004 - MyDoom email virus - Severity Rating: *High*
  - 100 million infected e-mails in 36 hours
  - Mass mailing and peer-to-peer file sharing worm that drops copies of itself into windows system directory
  - Contains its own SMTP engine to construct outgoing messages
  - Contains a Denial of Service payload
  - Can generate random e-mail subjects, message bodies and attachment file names
  - contains executable attachments (22K zip file)

Watch this space - its not over yet!!

TCP/IP and the Internet ……

- TCP/IP was designed early in the 1980s when security was hardly an issue
- TCP/IP (version 4) therefore has virtually no security facilities, yet …..
- TCP/IP is today used in virtually every:
  - local area, metropolitan, wide area, global network, and..
  - application (conventional, voice, multimedia, etc …)
- Scale of access (address, time) is unprecedented

Attack Incident Trends*

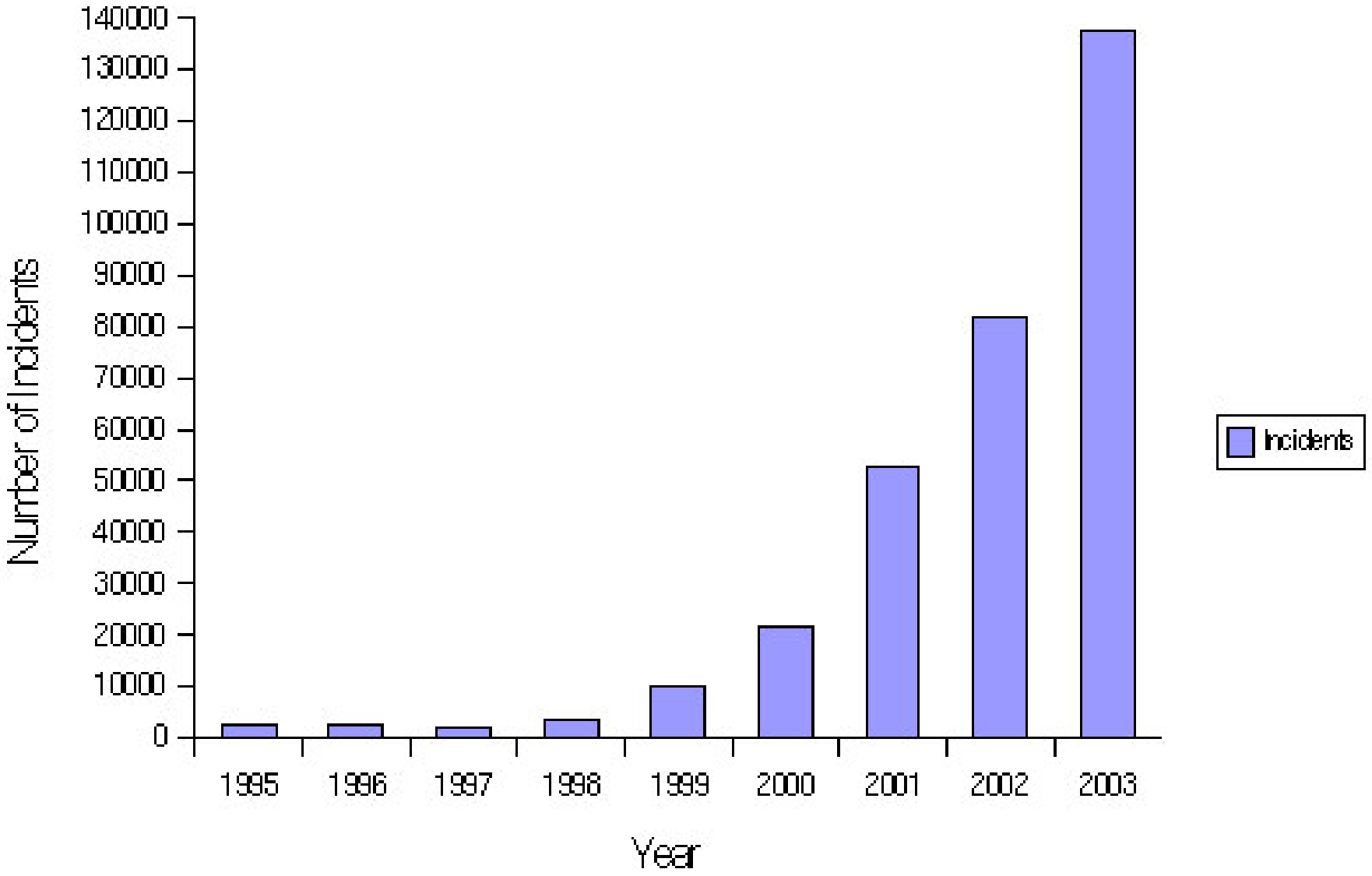
- Organisations Reporting Incidents
  - 1997 37%
  - 1999 33%
  - 2002 67%
- Where they attack
  - Internal Systems - 28%
  - Internet Access - 60%
  - Remote Dial In - 18%
  - Other - 7%

* Source: 2002 Australian Computer Crime and Security Survey

Factors Affecting Attack Trend

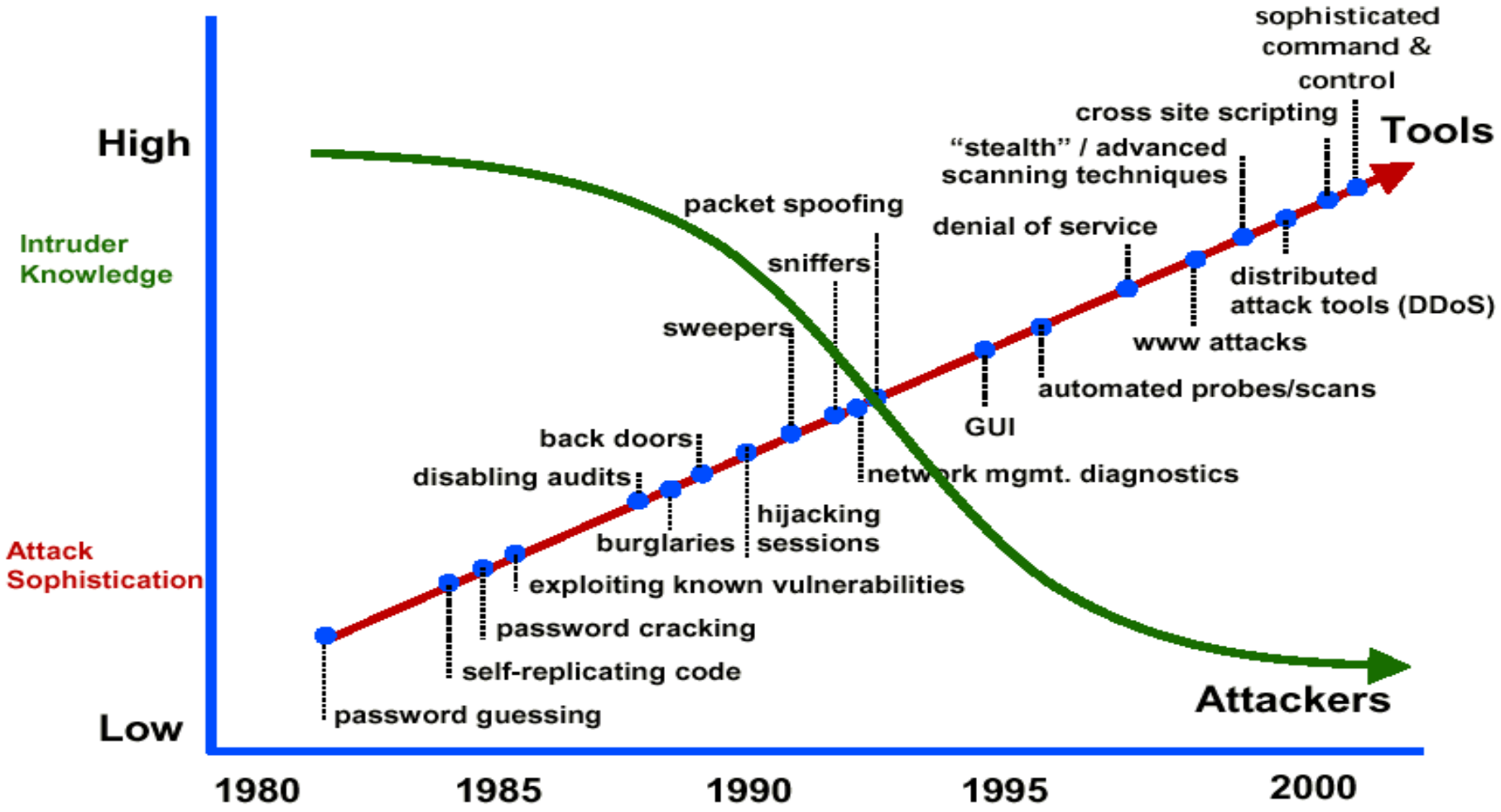
- Increased use of the Internet
- Increasing software complexity
- Abundance of attack tools
- Increased use of broadband home access
- Slow adoption of good security practices

Rise of Attack Incidents



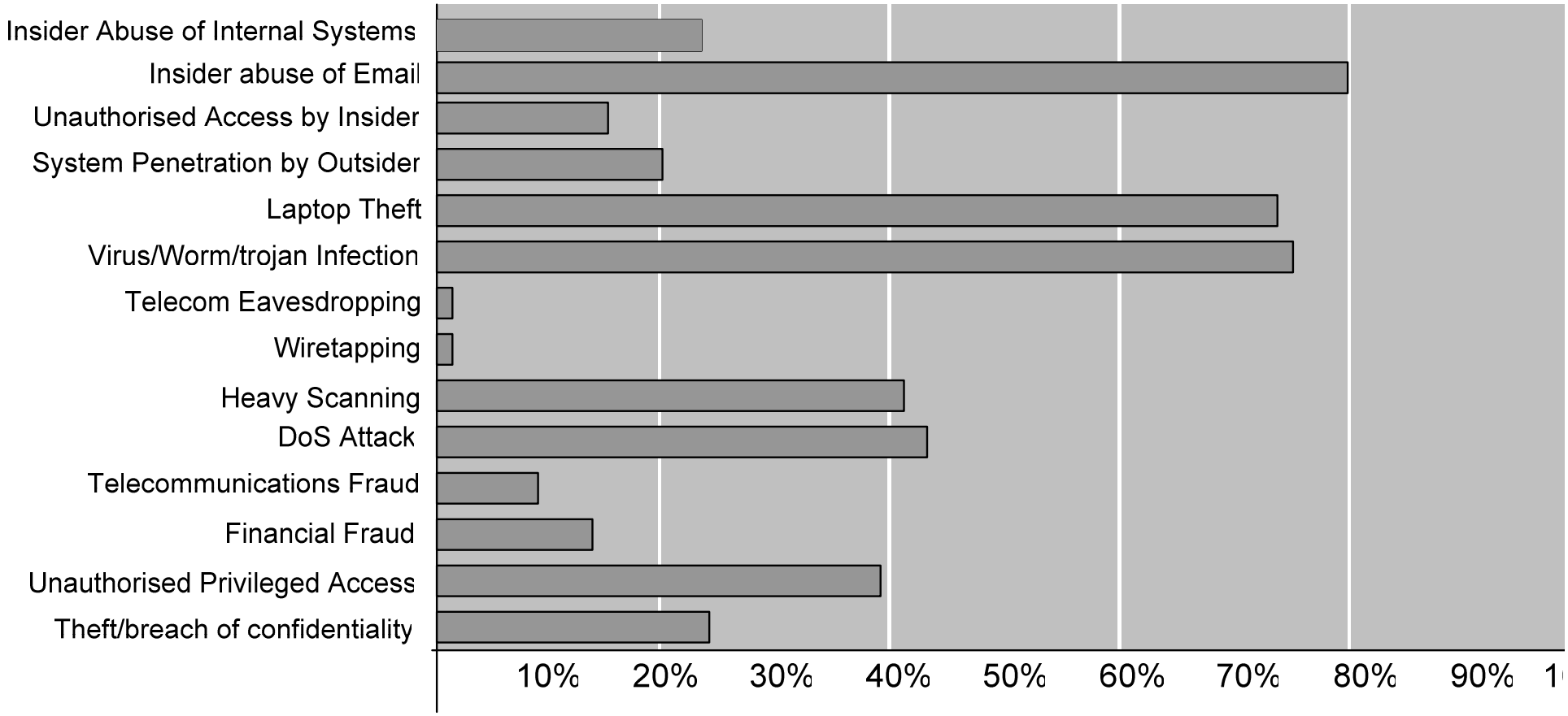
Rise in Incidents Reported to the CERT/CC - www.cert.org/stats (2004)

Rise of Attacks -
Attack Sophistication vs Intruder Tech Knowledge

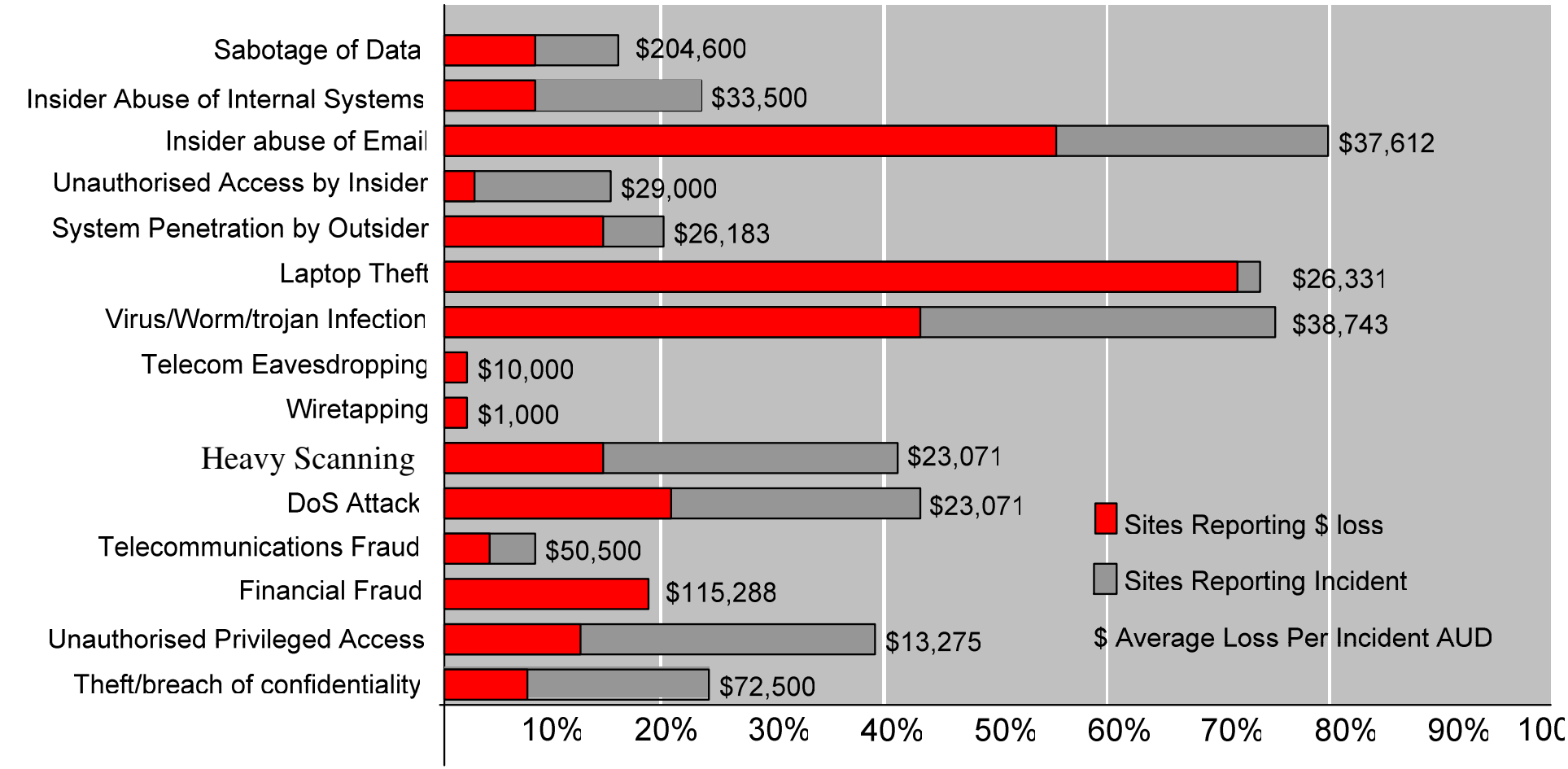


Howard Lipson. Tracking and Tracing Cyber-Attacks: Technical Challenges and Global Policy Issues. CERT Coordination Center. Nov. 2002

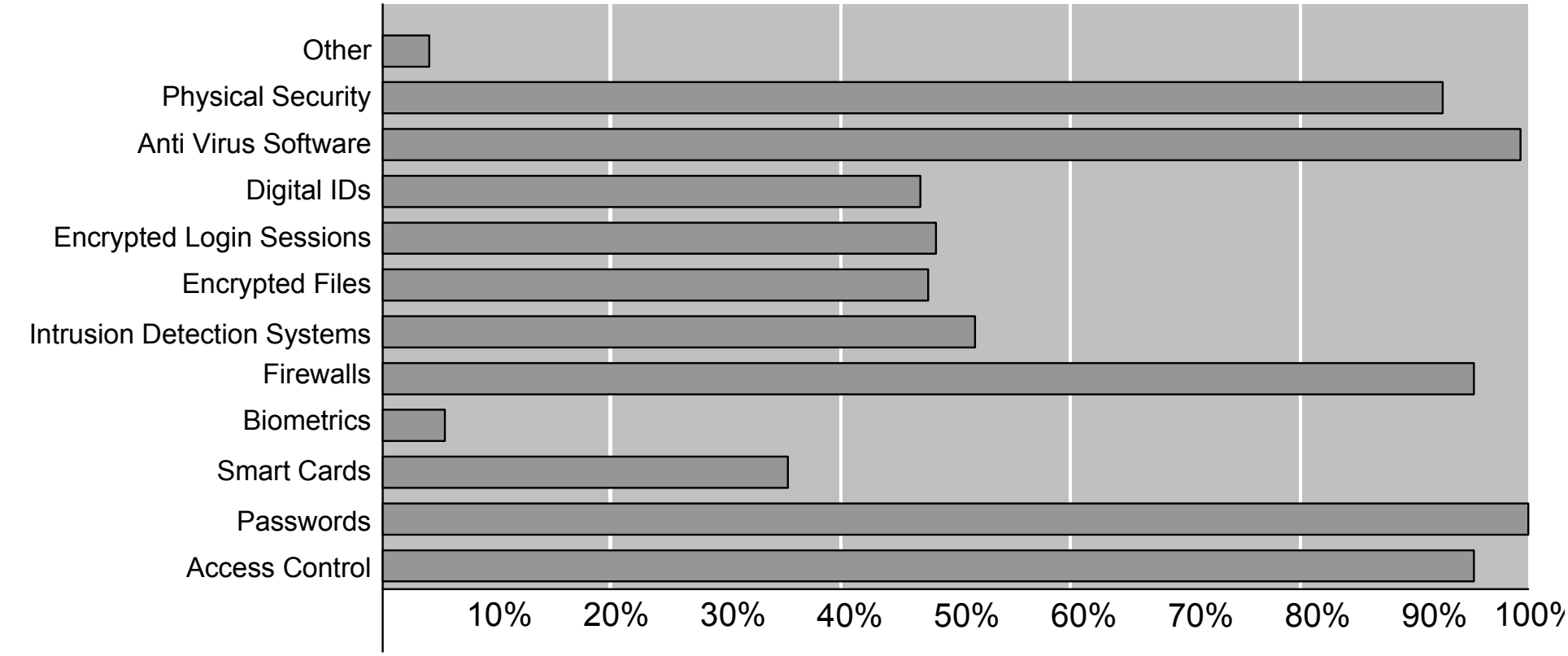
Types of Attack



Cost of Attack

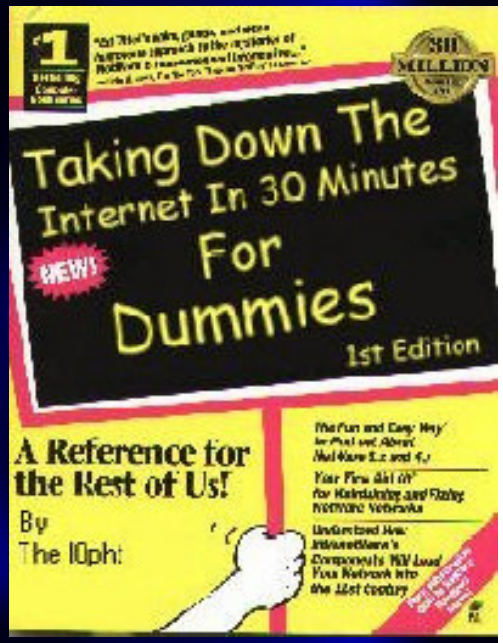


Attack Protection Systems



Classification of Attack Methods

- Social Engineering
  - Persuading somebody to ….
- Hacking or Cracking
  - Guess, corrupt or steal information
- Viruses and Worms
  - Viruses - Melissa, AnnaKournikova, SoBig
  - Worms - Lion, Ramen, Code-Red, Nimda, Blaster, MyDoom (2004)
- Trojan Horses
  - Back Orifice, PKZIP3, SubSeven etc

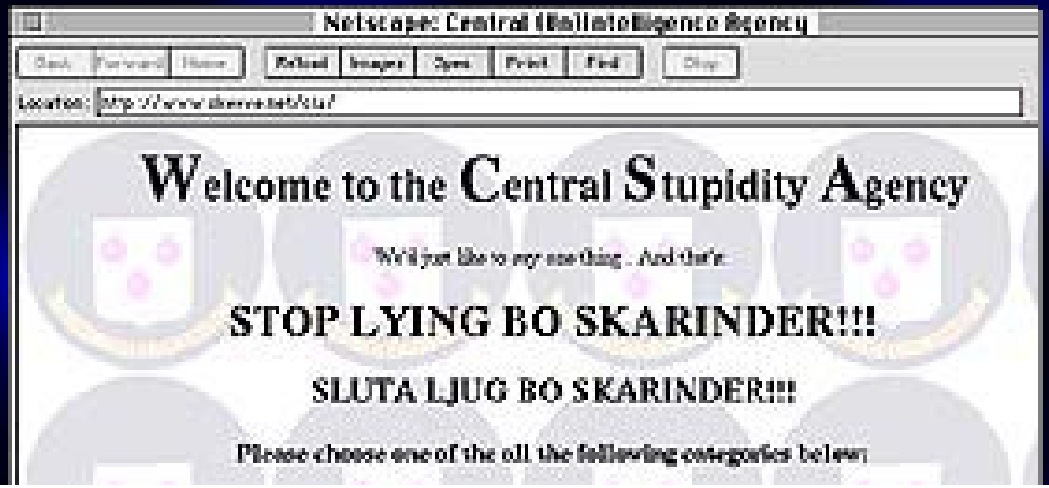


Classification of Attack Methods

- Network Layer Attacks
  - IP spoofing (masquerading)
  - Sequence number prediction
  - TCP hijacking

Classification of Attack Methods

- (Distributed) Denial of Service Attacks
  - Operating system attacks
    - Ping of Death, Tear Drop, Land, Snork, Bonk …
  - Network attacks
    - SYN flood, TCP fin/rst, Smurf, Coke ….
  - Preventing DOS attacks
  - Distributed DOS (DDOS) attacks



Threats to TCP/IP Services

- Simple Mail Transport Protocol (SMTP)
- Telnet
- Network Time Protocol (NTP)
- Finger/Whois
- Network File System (NFS)
- File Transfer Protocol (FTP)
- Hypertext Transfer Protocol (HTTP)
- ActiveX
- Secure Shell (SSH)
- Domain Name Service (DNS)
- NetBIOS
- Server Message Block (SMB)

Social Engineering

- Persuade someone to disclose sensitive information (eg Nigerian Letter Scam)
- Persuade someone to run/install malicious or subverted software
- Impersonating new employee who has forgotten userid/password
- Impersonating a technical support staff member and requesting a user login to ‘check’ accounts

Hacking and Cracking

- Password guessing or written down
- Default passwords (guest, manager ….)
- Password Cracking Tools, readily available from the Internet for a wide range of password protected systems: UNIX password files, Word documents, ZIP files, Windows password files, etc
- Complete set of attack tools at: “Church of the Swimming Elephant”. www.cotse.com

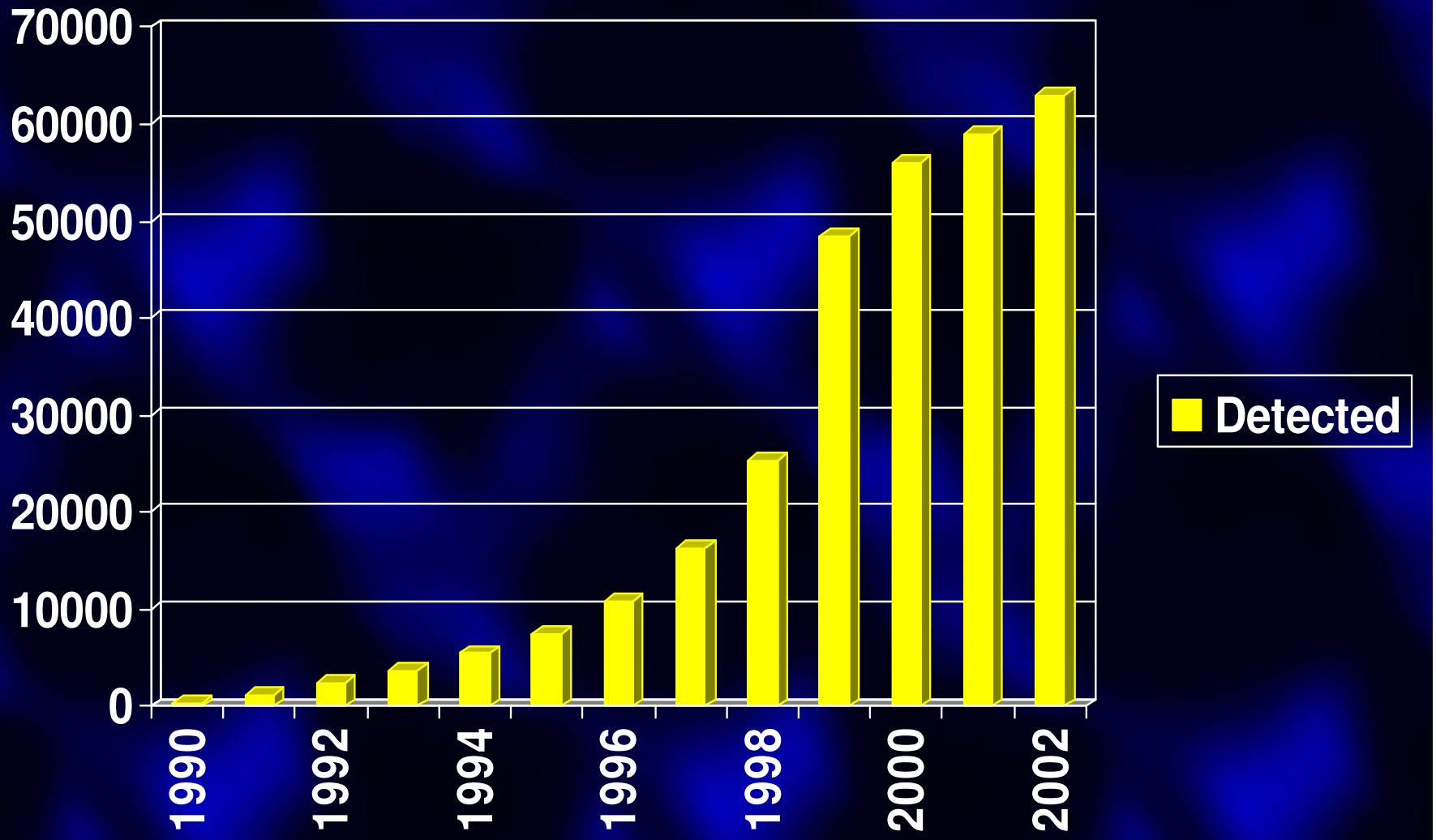
Hacking and Cracking

- Password Attacks
  - Brute Force (for few characters) and Dictionary (for real-word password) attacks
  - CRACK is available at: ftp://ftp.cert.org/pub/tools/crack
  - Can often find 10% of passwords
  - Demonstrates value of OTPs (One Time Passwords)

Hacking and Cracking

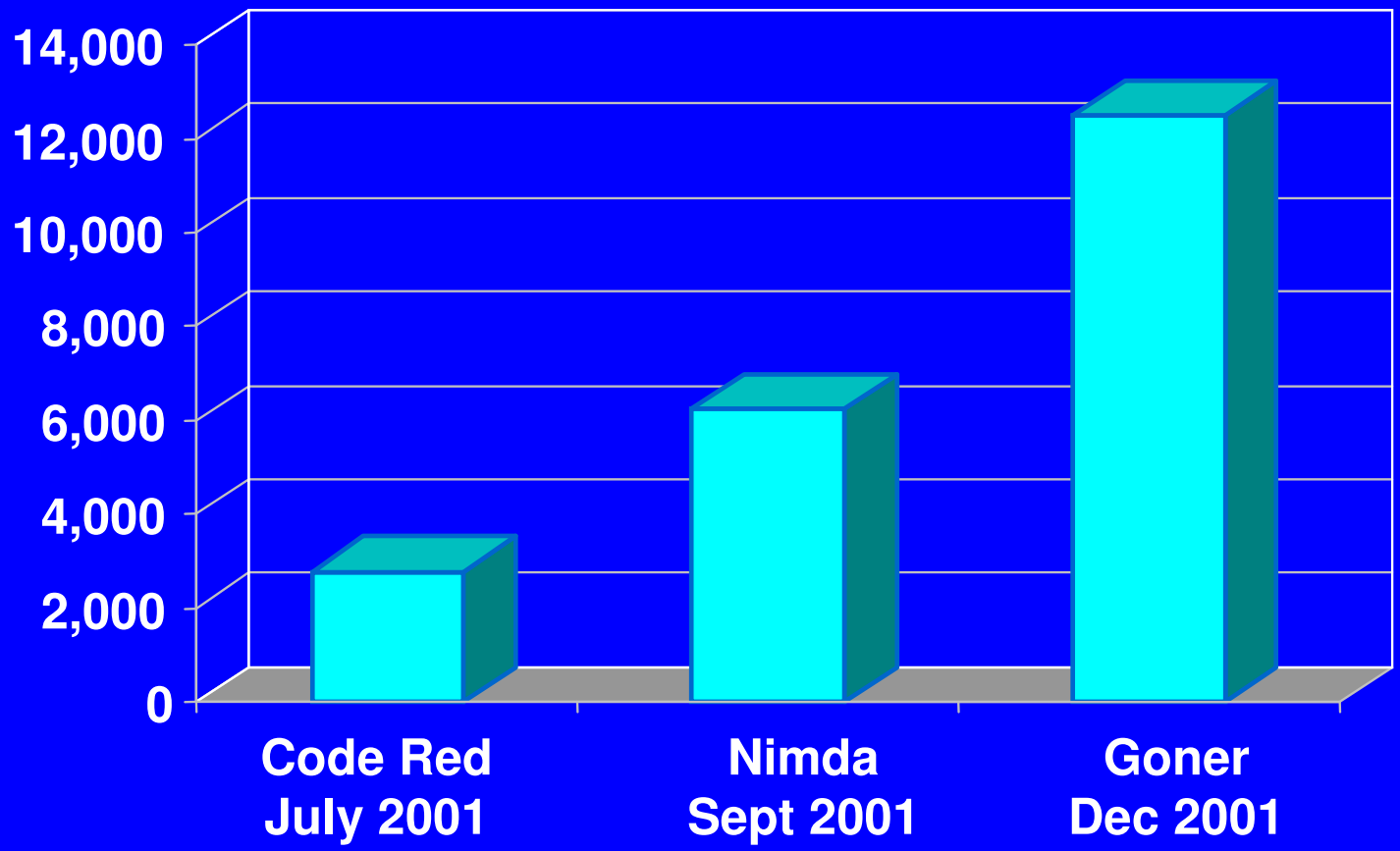
- Packet Sniffers
  - Sniffers can be legitimate tools - eg Microsoft's Protocol Analyser, Ethereal
  - Difficult to distinguish between legitimate and illegitimate use
  - Usually monitor all IP traffic
  - Demonstrates value of OTPs

Virus, Worm ... Count Increasing



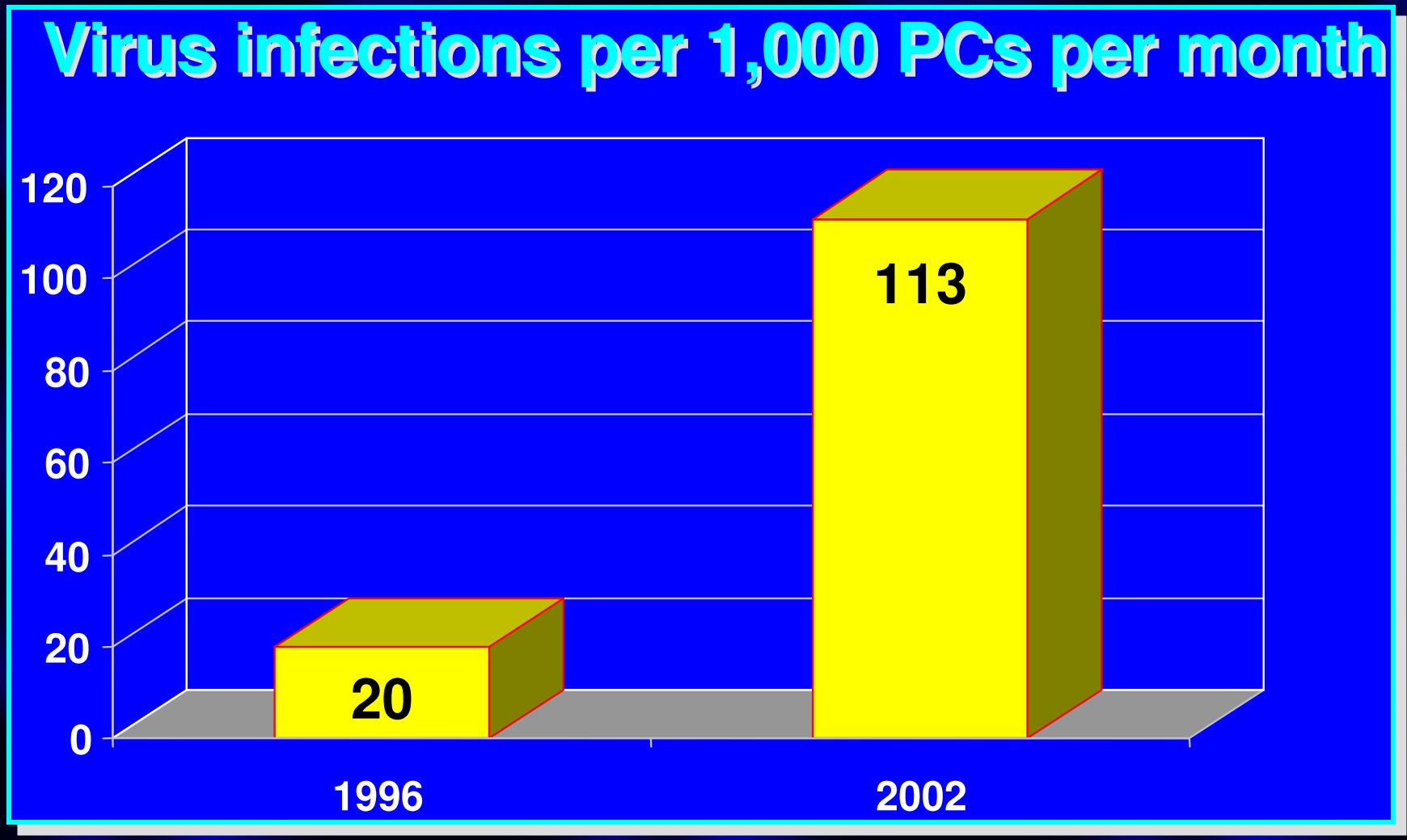
NOTE These figures include viruses, worms and other malicious code

Machines infected per hour at peak of outbreak



Source: McAfee AVERT 2001-2002

PC Infection Rate Increasing



Source: ICSA 2002

Viruses, Worms and Network Propagation Systems

- Viruses (Definition in “notes”)
  - Malicious program that spreads by infecting various files
  - When infected file is opened, virus runs its program first and then opens the (now infected) file
  - Most viruses spread by transferring infected file from one computer to another via e-mail attachments

Viruses Categories

- File infection viruses
  - attach themselves to .exe, .com, etc. (Many are DOS hangovers)
  - Polymorphic viruses change their appearance each time an infected program is run
- System or boot sector viruses
  - infects executable code, eg DOS boot sector
- Macro viruses
  - infects Microsoft Word, eg Melissa (www.melissavirus.com)
- E-mail viruses usually carried by attachments

Virus Protection

- Effective protection is anti-virus S/W which:
  - scans e-mail attachments
  - checks for virus signatures
- Examples:
  - Norton (www.norton.com)
  - McAfee (www.mcafee.com)
  - Sophos (www.sophos.com)

  Most of these have versions which provide "push" technology and update a customer's site automatically

Viruses, Worms and Network Propagation Systems

- Worms (Definition in “notes”)
  - Mass-Mailing Worms
    - do not infect files but propagate via file transfer (eg e-mail attachments) which then release a virus upon opening (eg MyDoom, 2004)
  - Network-Aware Worms
    - exploits security vulnerabilities such as unprotected shared drives, vulnerabilities in FTP etc usually by forcing a buffer overflow
    - examples - Ramen, Lion and Code-Red worms

Worm Protection

- Mass mailing worms
  - filter attachments and apply anti-virus software
- Network-aware worms
  - application of patches to fix security holes
  - Use of personal firewalls can assist
    - Zone alarm, (www.zonelabs.com)
    - Tiny firewall, (www.tinysoftware.com)
    - SyGate (wwww.sygate.com)
    - IPCop (Linux) (www.ipcop.com)
    - Smoothwall (Linux) (www.smoothwall.org)
  - Intrusion Detection System software

Lion Worm (29/3/2001)

- Infects Redhat LINUX machines
- Attacks port 53 (DNS) and installs a trojan which e-mails the /etc/passwd and /etc/shadow files to huckit@china.com
- Then deletes /etc/hosts.deny lowering the security
- Protection: See
  - www.sans.org/y2k/lion_protection.htm, March 2001

Ramen Worm (17/1/2001)

- Infects Redhat LINUX 6.2 and 7 machines
- Attacks an RPC or ftpd service
- Patches available for current versions of LINUX
- Protection: See
  - www.securityfocus.com/archive/78/157627 (bugtraq)
  - www.symantec.com/avcentre/vinfodb.html (general)
  - http://service1.symantec.com/sarc/sarc.nsf/html/Linux.Ramen.Worm.html (specific)

Code-Red Worm (19/7/2001)

- Infects all unprotected versions of Microsoft's IIS web server
- 359,000 machines attached in first 14 hours (peak infection rate was 2000/minute)
- Protection: See
  - www.securityfocus.com (bugtraq)
  - www.symantec.com/avcentre/vinfodb.html
  - www.caida.org/analysis/security/code-red

Nimda -The Mother of all Worms

('Admin' spelt backwards!)

- 18 September 2001
- Within 24 hrs -100,000's computers, 10,000's companies, 15 countries
- Generates own list of IPs then probes for IIS servers
- Utilised Code Red II worm affected machines
- Utilised 16 known vulnerabilities in Microsoft IIS
- Generates 16 HTML requests to non-patched IIS servers up to 13 times from each infected computer
- Modifies system files and registry keys
- Travels though shared drives and computers
- Creates administrator account on infected machine
- Attached to URL's infecting unsuspecting browsers

Case Study - Nimda Worm

- Attacks IIS servers that were not patched up to SPK6a (NT4) and SPK2 (Windows 2000)
- On our firewall we had 24,000 attempted connections at 2am and firewall failed (Automatic download of SophoS worm patch blocked)
- Once the worm reached the trusted network it infected IIS servers *behind* the firewall
- Attacks by issueing multiple “get” requests for files such as root.exe, cmd.exe, admin.dll
- Protection: See
  - www.securityfocus.com (bugtraq)
  - www.symantec.com/avcentre/vinfodb.html
  - www.caida.org/dynamic/analysis/security/nimda

Keeping Up-to-Date with Attacks ..

- www.cert.org/advisories (main index by year)
- www.wildlist.org (virus spread data)
- www.securityfocus.com/news (bugtraq)
- www.symantec.com/avcentre/vinfodb.html
- www.caida.org/dynamic/analysis/security (analysis of propagation etc)
- www.microsoft.com/technet/treeview/default.asp?url=/technet/security/bulletin/
- www.cotse.com “Church of the Swimming Elephant”, (source of attack tools for testing)

.. estimated that only 34% of organisations admit to having been attacked (eg Nimda)

Computer Emergency Response Teams (certs)

- www.apcert.org (Asia-Pacific)
- www.singcert.org.sg (Singapore)
- www.auscert.org.au (Australia)
- www.gcsb.govt.nz/ccip (New Zealand)
- www.hongkong.cert.org (Hong Kong)
- www.mycert.org.my (Malaysia)
- www.certcc.or.kr (Korea)
- www.cncert.org.cn (China)
- www.jpcert.or.jp/english (Japan)
- www.cert.org/advisories (US)

Viruses, Worms and Network Propagation Systems

- Trojan Horses
  - Installing a trojan horse program allows attacker to access user's machine remotely (via Internet)
  - Often received as e-mail attachments
  - Two components: client application, (runs on attacker's computer), and server application, (runs on victim's computer)

Trojan Horse contd …..

- Trojan Horses are distinct from viruses/worms. Do not infect files and have no means of propagation
- A Trojan Horse is program which pretends to be benign, but contains malicious code
- Normally waits to be downloaded or installed by a user - then its attack payload executes

Trojan Horse - Back Orifice 2000 (BO2K)

- Also call Netbus 1.2, 1.53, 1.60, 1.70, 2.0 ….
- Operates on all Windows machines
- Remote attacker can login, send, receive files
- Can re-route and defeat firewall configurations as it can operate on any port
- Very difficult to detect, filename can be made invisible
- Mobile version (Mobile BackOrifice) available
- Other examples include:
  - PKZIP 3, FTP, SubSeven
  - Attack FTP Installer, BackDoor, DeepBO, Executor, FTP99, Happy99

Back Orifice 2000 (BO2K)

- Client machine can monitor and control a server:
  - Execute any application on target machine
  - Log keystrokes from target machine
  - Restart target machine
  - Lockup target machine
  - View contents of any file on target machine
  - Transfer files to and from target machine
  - Display screen saver password of user on target
- Very vulnerable to attack without a firewall!

Other Trojan Horse Programs

- PKZIP 3 Trojan
  - No real v3 PKZIP. This rogue version attempts to reformat the hard drive
  - Works by stealing reputation of another and making download freely available on the Internet
  - It was never available from www.pkware.com
- Wuarchive FTPD Trojan
  - Nasty replacement for the widely used FTP daemon
  - Allows Trojan back door root access and privileged mode access

Other Trojan Horse Programs

- SubSeven Server Trojan
  - Similar to BO2K
  - Machines can be infected by e-mail attachments containing the virus
  - This Trojan was distributed under pretence of being an anti-virus program for detection of non-existent virus
  - Modern versions of this Trojan have ability to command infected SubSeven servers from Internet Relay Chat channels, including initiating Ping flood DOS attacks
  - Anti SubSeven Server is a protection and counter-attack tool

Defence Against Trojan Horses

- Best defence is safe computing practices
- Use signature/checksum programs such as Tripwire (see under Intrusion Detection)
- Trojan Horses can come from unsolicited executable e-mail attachments from recognised senders, (resulting from a virus poaching that person's e-mail address book)

Defence Against Trojan Horses

- Virus-friendly applications, eg Outlook Express will often hide extensions of certain file types
- Famous example AnnaKournikova.jpg.vbs attachment (13/2/01) appearing in Outlook Express to be the much more benign AnnaKournikova.jpg
- Some e-mail programs will even automatically run received attachments to be helpful!!

Evolution of the Threat

Stage III
Mass-Mailers
and Worms

Viruses Gain Complexity. Start to Take Over Machines and Steal Data. No Longer Needs Human Element to Spread

Stage II
"Macro Era"

95 - 98 Virus Numbers Grow Rapidly. Viruses Spread Rapidly e.g. Macro Viruses via E-Mail

Stage I
"Floppy Era"

80's -94 Localised Impact e.g. Michelangelo

The New Trend - Blended Threats

Code Red for example:

- Hacking technique, with propulsion of a worm!
  - No user interaction required
  - No disk infection
  - Code Red sits in memory and sneaks across the Internet on the back of HTTP communications between MS web-servers
- Watch for ‘copy-cat’ variants eg Blaster (August 2003) was a variation on a Windows RPC Buffer Overflow released a month earlier (July 2003)

The New Trend - Blended Threats

- Worms that drop parasitic viruses
- Destructive Trojans
- Password stealers
- RATs (Remote Access Trojans)
- Trojanised applications which replace legitimate system tools
- Multiplatform attacks (payloads affecting multiple platforms), eg Linux worms that drop.exe Trojans

….further blending of worms + viruses + Trojans

Blended Threats - Recent Example

- Bugbear (W32/Bugbear@MM) - Sept 30, 2002
  - Blended threat worm - very nasty!
  - Uses multiple infection paths, disables anti-virus and firewall software, and exploits IE vulnerabilities
  - Can also install backdoor Trojan and key-logger

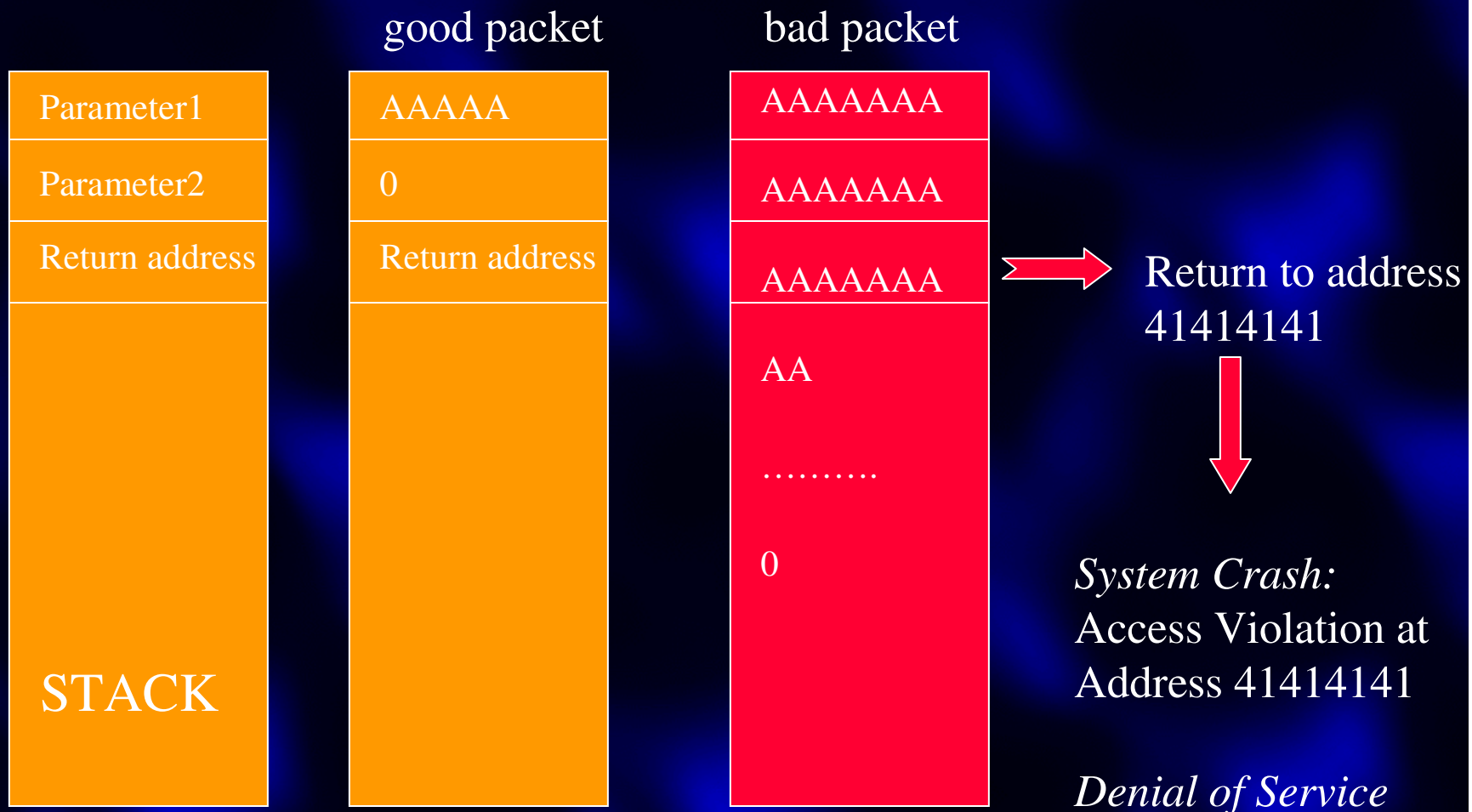
Buffer Overflow - Common Attack Method

- Technique used to gain remote execution on host
- Takes advantage of inadequate vetting of integrity of incoming TCP/IP packets
- Often involves overwriting return addresses on the stack
- Involves sending executable code as binary data within an attack packet, usually carefully crafted to be located at specific position within packet
- May be complicated by the need to encode the packet, eg Base64, uuencode

Buffer Overflow - contd

- Question - Why does an operating system not check for buffer overflows?
- Answer - In many cases it does. For example when a user logs in various checks are made
- The problem occurs when rogue (attack) packets arrive after all checking has been carried out
- Question - why not check every field of every packet everywhere in the system?
- Answer - !!!!!!

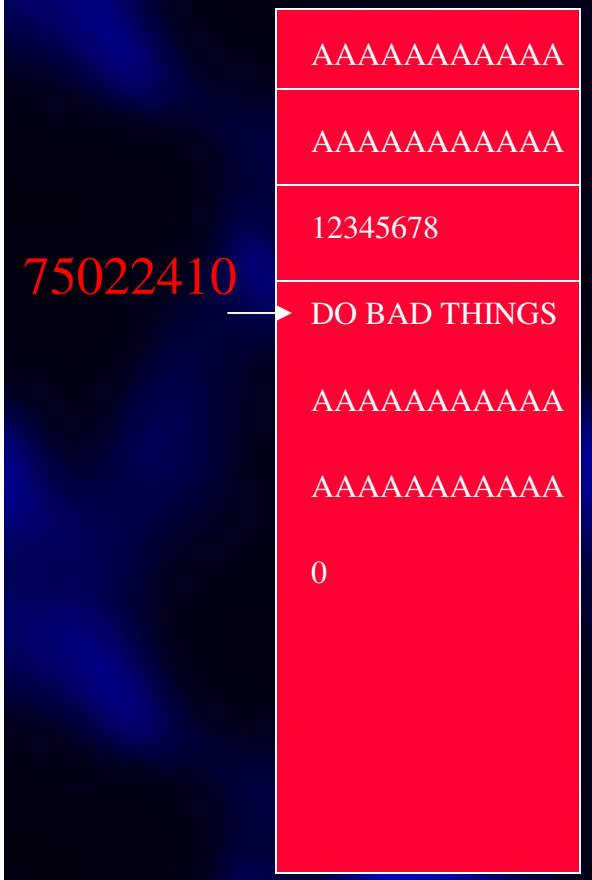
Buffer Overflow - contd



Buffer Overflow - contd

- In previous slide Parameter1 and Parameter2 are fields obtained from (rogue) packet and placed in stack. Parameter1 overflows fields & return address
- The return address becomes X”41414141” which causes a crash = DOS attack
- In following slide an alternative attack causes the return address (12345678) to Call the ECX register which points to some nasty code in the rogue packet
- Either way DOS is achieved
- Common problem with RPC ports where both ends are already trusted and authenticated but rogue packets enter network (eg with spoofed IP addresses - to follow)

Buffer Overflow - contd



Return to address
12345678

EAX	0	
EBX	12345660	
ECX	75022410	

……...		
12345677	NOP	
12345678	CALL	ECX
1234567A	AND	EAX,EAX
……...		

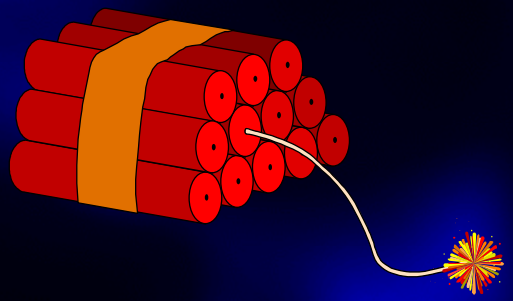
Voila!

Buffer Overflow - contd

- How can this happen if client is authenticated and where both ends are already trusted?
- Rogue packets enter network (eg with spoofed IP address)
- Common problem with RPC ports (for example)

Network Layer Attacks

- IP Spoofing (Masquerading)
- TCP Session Hijacking
- TCP Sequence Number Attack



Threats to TCP/IP

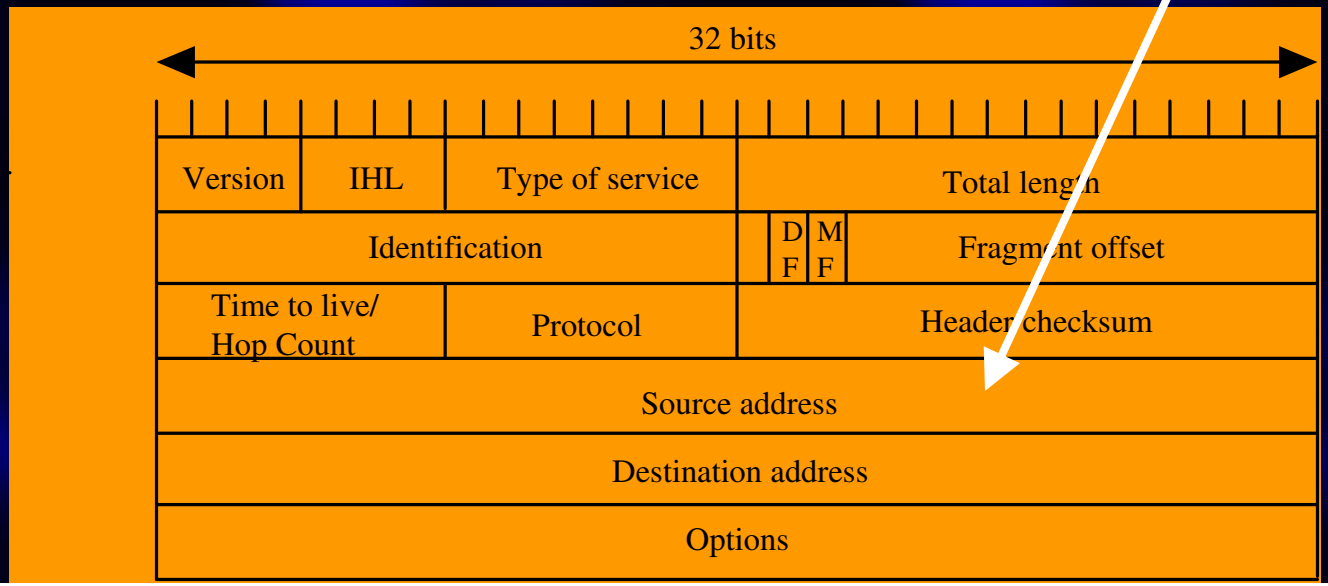
- IP Spoofing
- TCP Sequence Number Attack
- TCP Session Hijacking

Often combined

All exploit weaknesses in TCP/IP and source code freely available on the Internet

IP Spoofing

- IP packet header (Version 4) vulnerable to attack
- Christmas Day attack - source IP address forged
- Source routed packets vulnerable to IP header tampering
- Easy for *internal* attackers

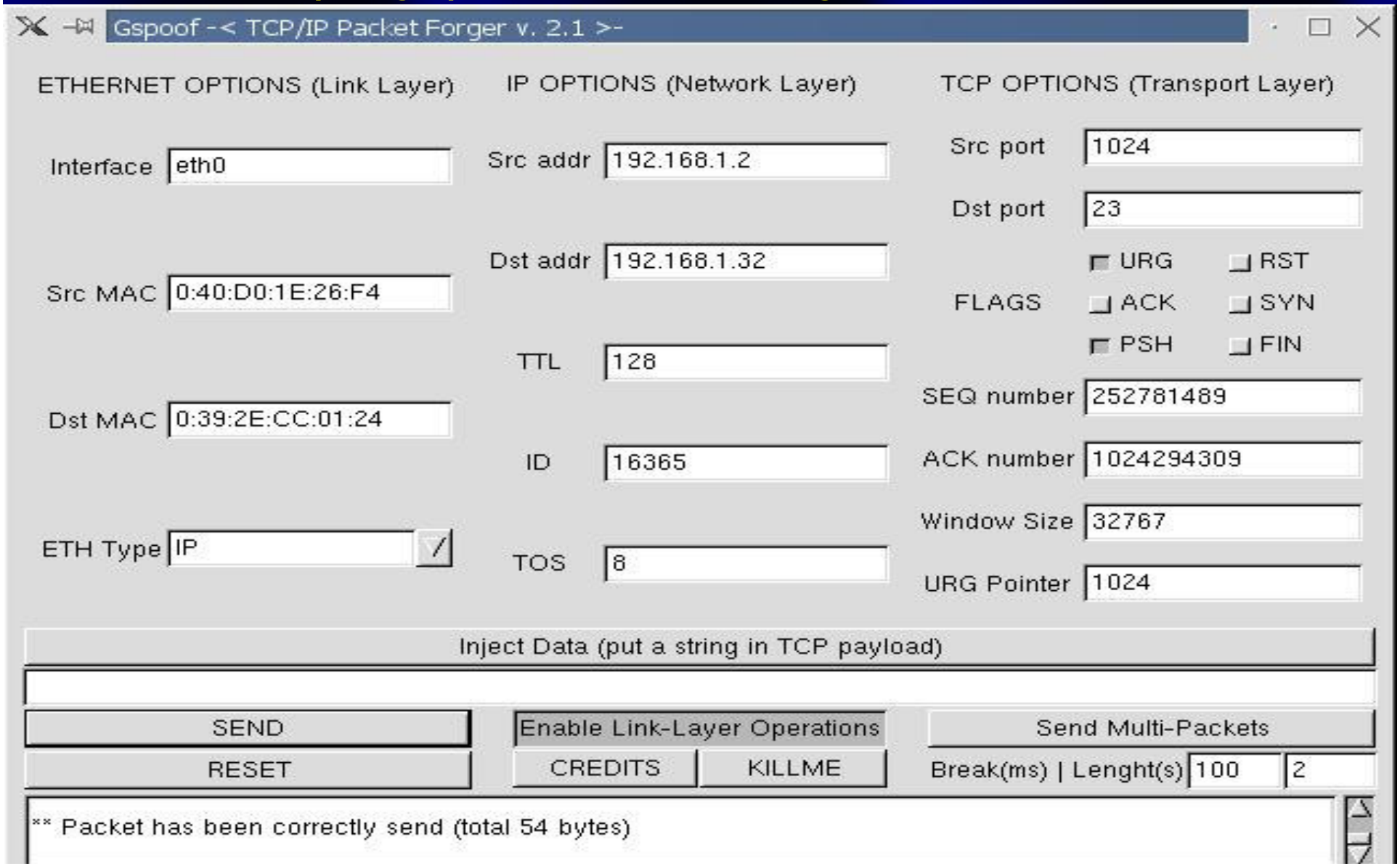


IP Spoofing

- Attacker impersonates host at IP layer by forging source address using RAW-socket. This feature now available in Windows XP!
- Commonly used to launch SYN flood attacks, ICMP redirects, and ping flooding
- Target host has no way of knowing IP address has been spoofed
- DNS spoofing works by returning incorrect address
- IP spoofing combines with TCP seq. number attack …

Spoofing an IP Packet

Ref: http://gsproof.sourceforge.net/screenshots



Threats to TCP/IP

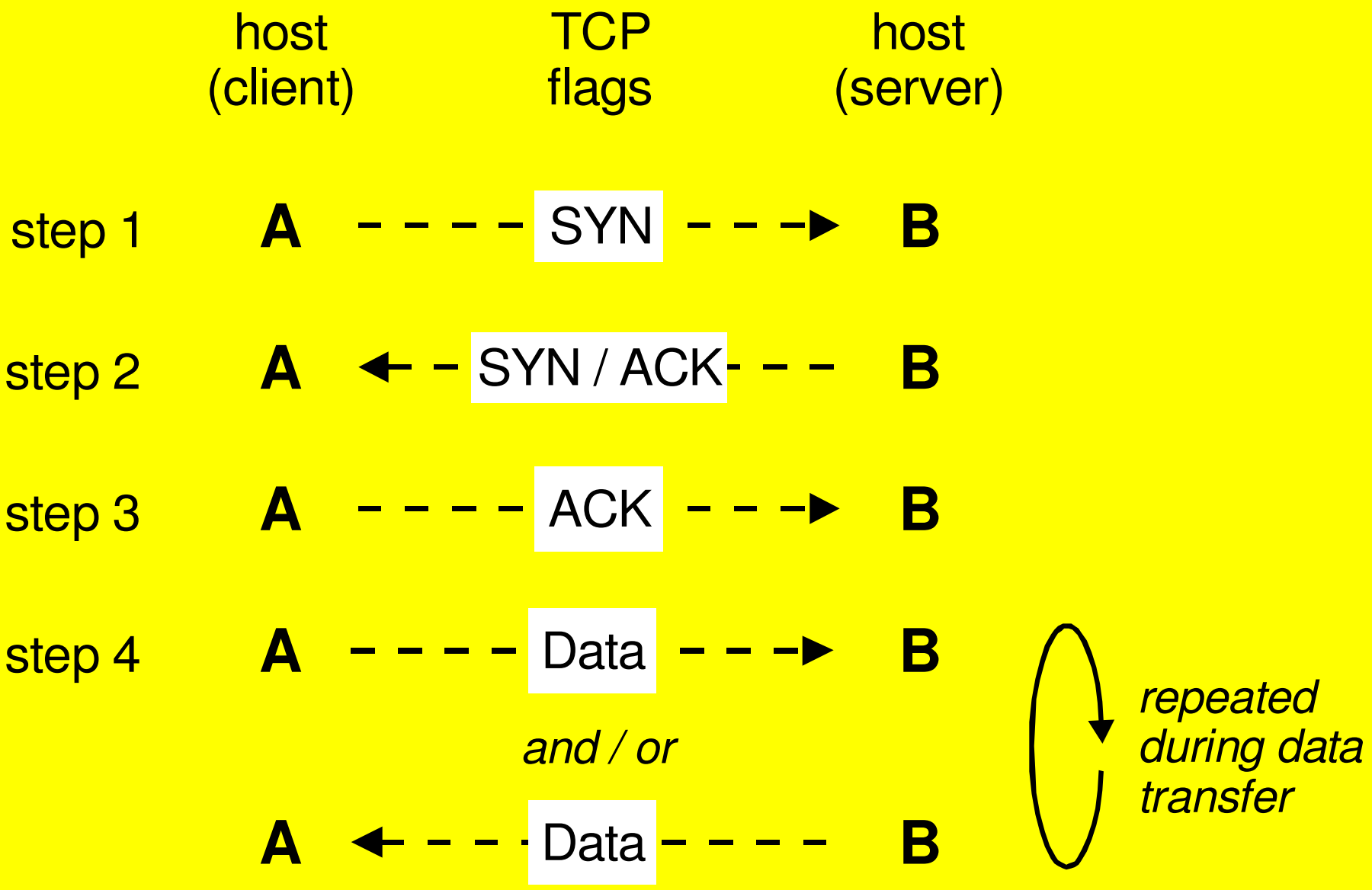
- IP Spoofing
- TCP Sequence Number Attack
- TCP Session Hijacking

Often combined

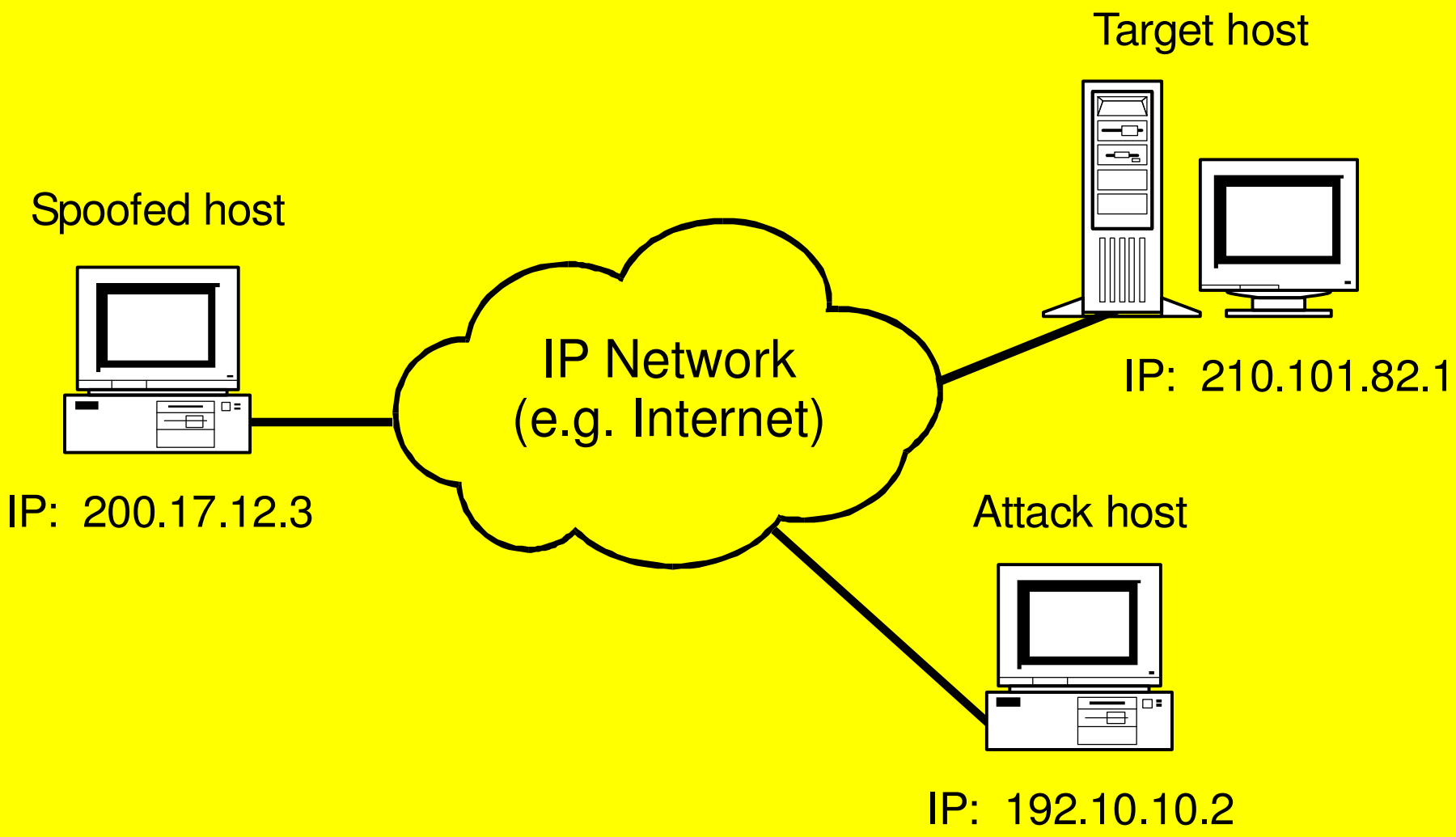
All exploit weaknesses in TCP/IP and source code freely available on the Internet

TCP Sequence Number Attack

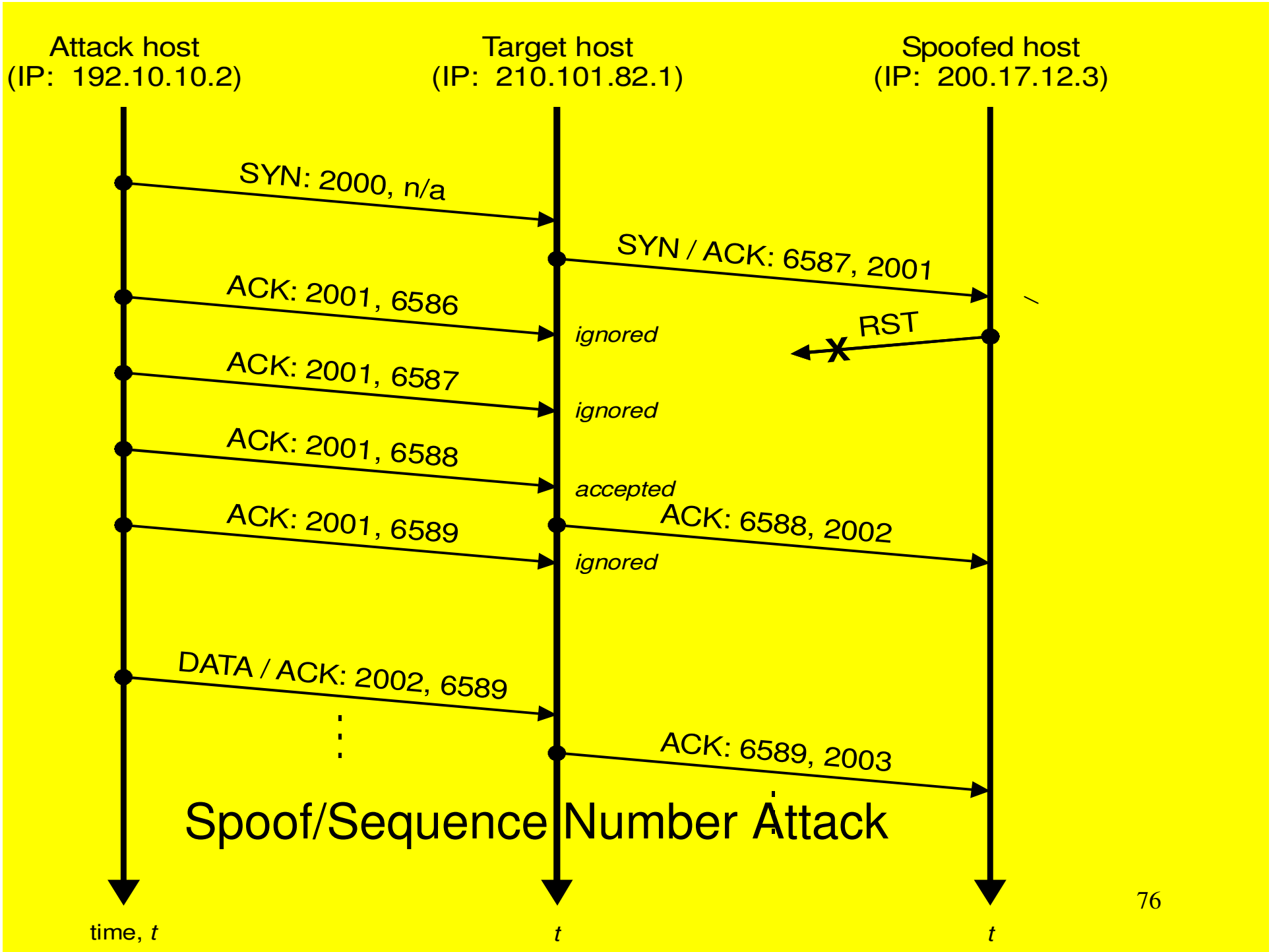
- TCP sequence number prediction takes advantage of TCP's sequenced data delivery
- If attacker determines correct sequence number then they can generate own TCP segments
- Two methods:
  - attack TCP handshake (TCP (IP) spoofing)
  - take over legitimate session (TCP hijacking)



Can Attack TCP Handshake or Data Transfer



Spoof/Sequence Number Attack


Attack host
(IP: 192.10.10.2)
Target host
(IP: 210.101.82.1)
Spoofed host
(IP: 200.17.12.3)
SYN: 2000, n/a
SYN / ACK: 6587, 2001
ACK: 2001, 6586
ignored
RST
ACK: 2001, 6587
ignored
ACK: 2001, 6588
accepted
ACK: 2001, 6589
ACK: 6588, 2002
ignored
DATA / ACK: 2002, 6589
ACK: 6589, 2003
Spoof/Sequence Number Attack
time, t
t
t

TCP Sequence Number Attack

- Attacker must ensure spoofed host is unreachable, otherwise it will receive SYN/ACK and issue RST to defeat attack
- Attacker must therefore
  1. wait until spoofed host off-line or
  2. take it offline with denial of service attack (eg SYN flood)
- Non-Blind Spoofing
  - easy - attacker on same LAN segment as target host
  - can use protocol analyser for direct access to IP packets and TCP sequence numbers

TCP Sequence Number Attack

- Blind Spoofing
  - attacker on different LAN segment from target host
  - must guess initial TCP sequence number based upon operating system. Three ways -

  1. 64K rule - used in older OSs (eg OSF, SunOS)
  2. time related generation of sequence numbers
  3. pseudo-random generation of sequence numbers

  - prediction almost impossible with 2 and 3

TCP Sequence Number Attack

- Blind Spoof can be turned into Non-blind Spoof by using source routed IP packets or affecting routing tables en route
- Source routed packets allow return route to be specified in IP packet header which can be spoofed by attacker
- Therefore very important to drop source routed IP packets - especially if they originate from an untrusted network

Threats to TCP/IP

- IP Spoofing
- TCP Sequence Number Attack
- TCP Session Hijacking

Often combined

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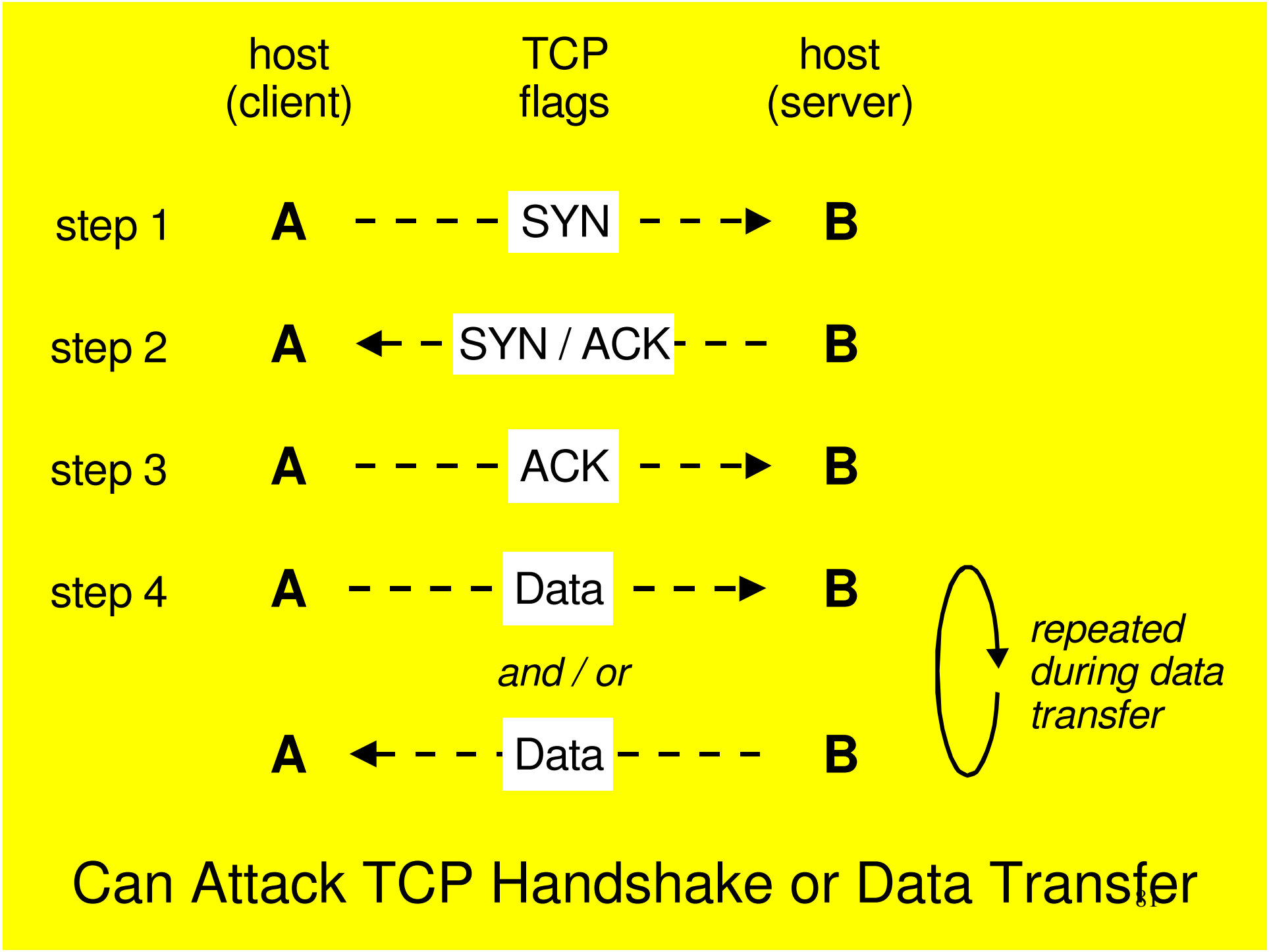
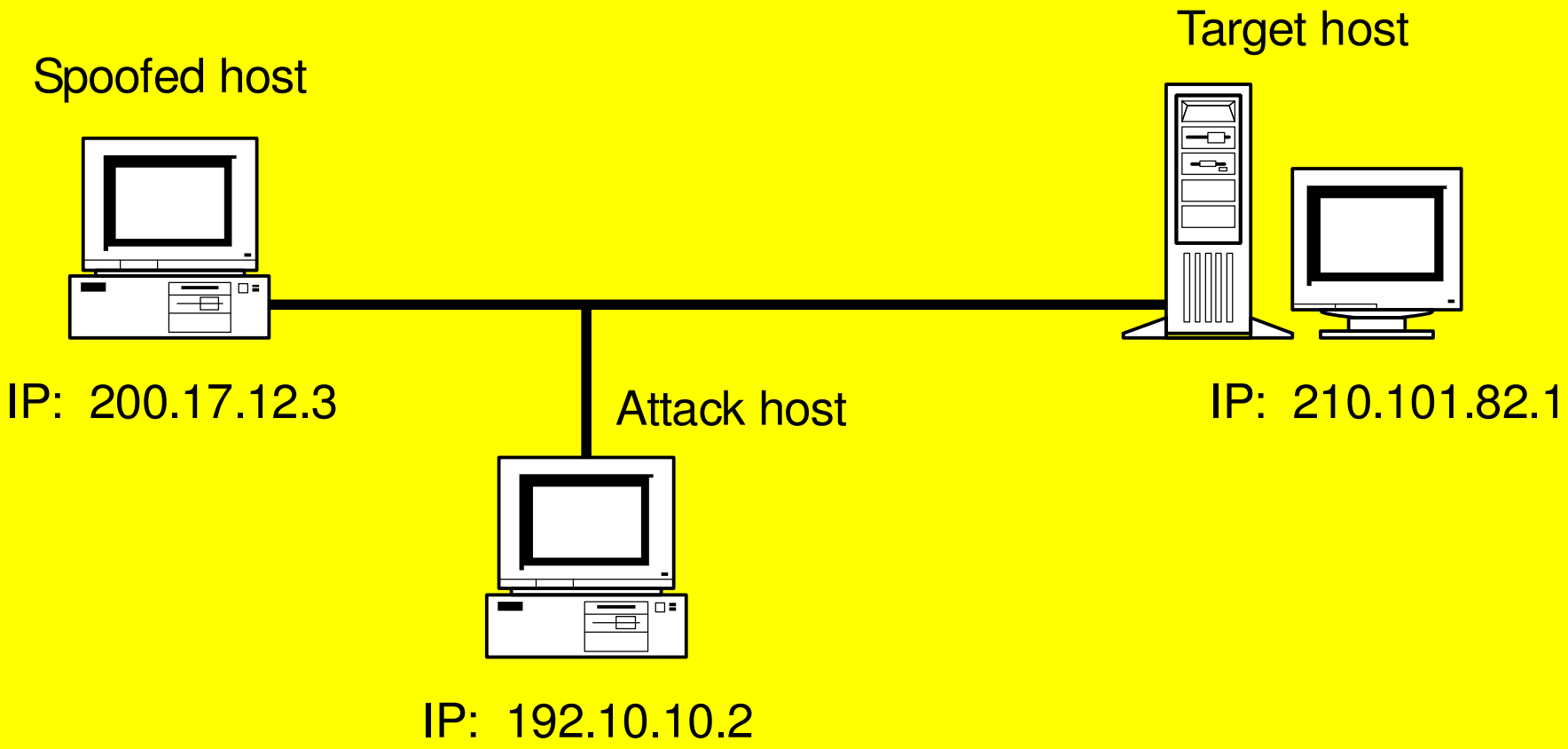


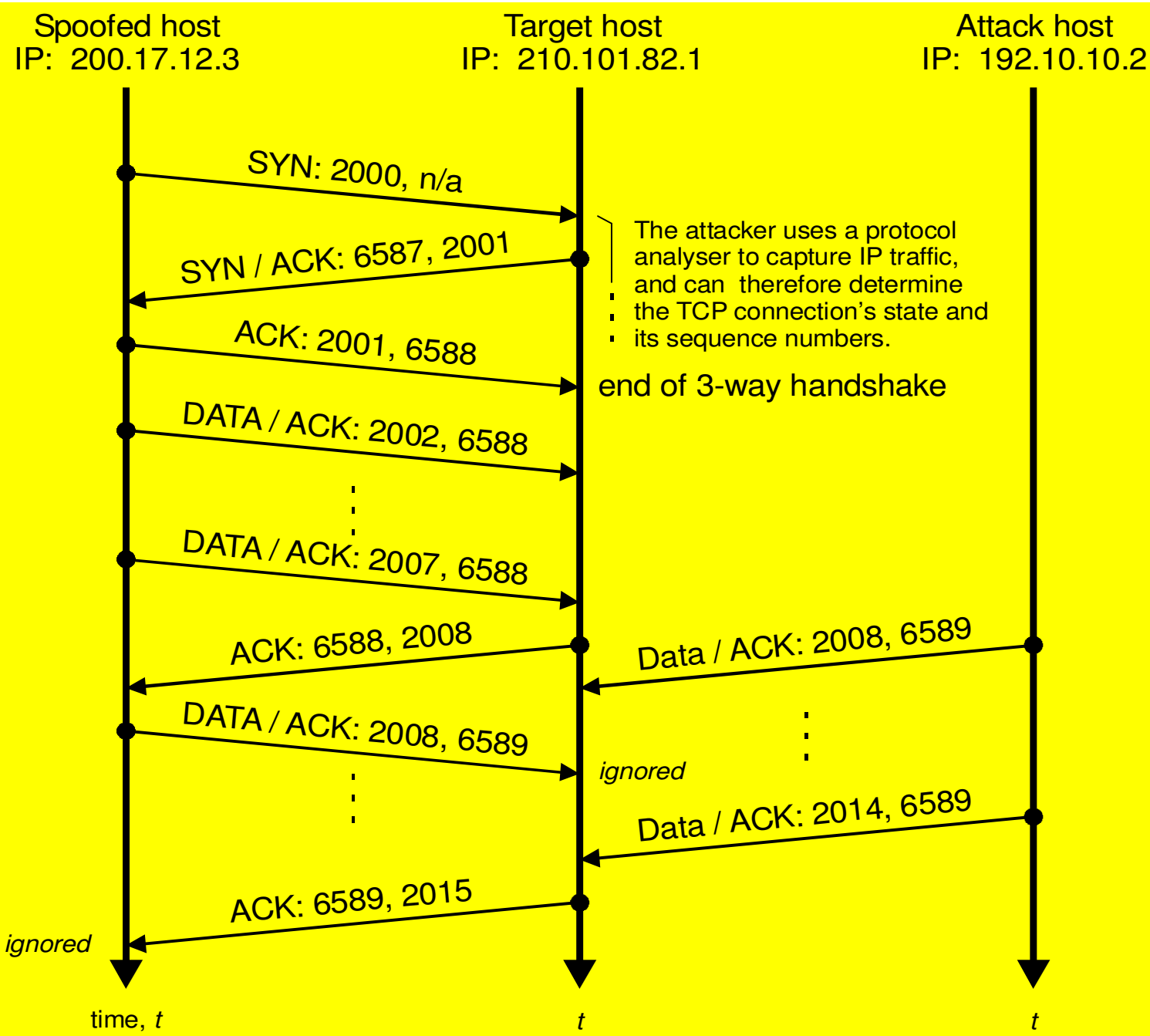
Can Attack TCP Handshake or Data Transfer

TCP Session Hijacking

- TCP session hijacking used in conjunction with IP spoofing and TCP sequence number attack
- Can be used to take over TCP applications like Telnet, FTP, rlogin
- Once attacker has TCP segment sequence they can take over connection
- All packets then sent by hijacked (spoofed) host will be ignored by target host as sequence numbers will be incorrect



TCP Session Hijacking



TCP Session Hijacking

TCP Session Hijacking – counter-measures

- TCP session hijacking can circumvent one-time passwords and is smarter than simple sniffing
- ISPs can help by blocking all IP packets with source addresses which originate from outside the domain (spoofed addresses)
- Trusted hosts (eg .rhosts) should only be used with authentication and encryption
- Correctly configure firewall

Denial of Service Attacks

- Intention is not to gain illegal access but to make network services unavailable to users
- Sometimes called *nuke* attack
- Flooding attacks overload server
- Examples include: - Ping o' Death, SYN Flood, ICMP redirect messages
- No real solution but sharing services across different servers and using a properly configured firewall can assist