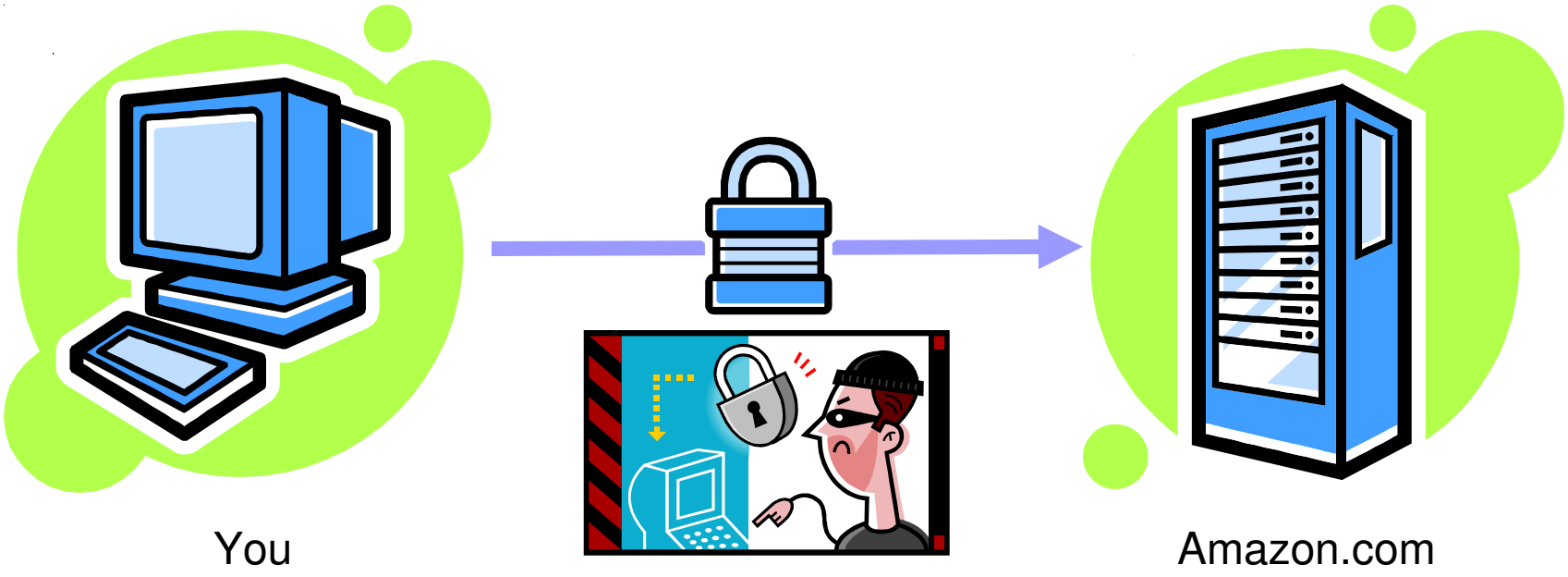
Viruses, Worms, Zombies, and other Beasties

COS 116: 4/10/2008

Sanjeev Arora

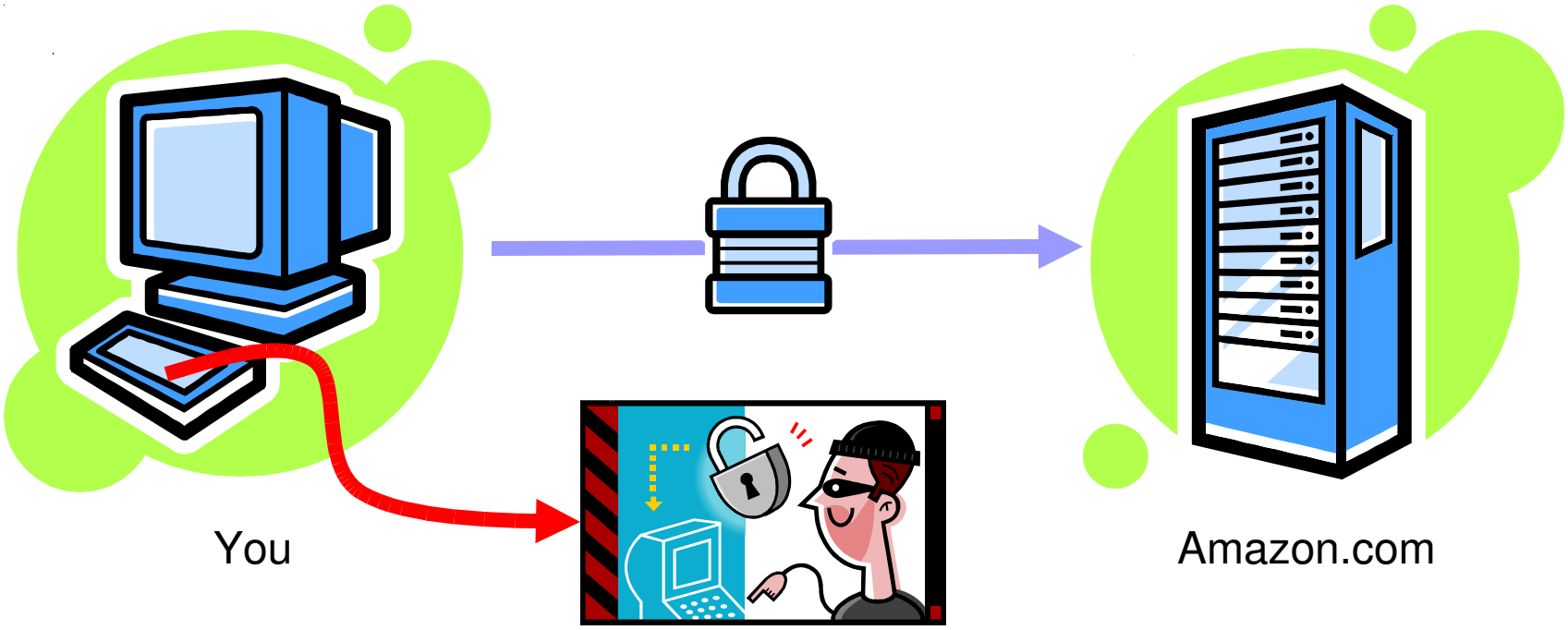
Encryption (topic next week)



Encryption strongly protects data en route

Today's story: Attackers don't need to break encryption to compromise your system.

Encrypted ≠ Secure



Break into your computer and “sniff” keystrokes as you type

Breaking into a Computer

What does it mean?

How is it done?

Can we prevent it?

What's at Stake?

Kinds of damage caused by insecurity

- Data erased, corrupted, or held hostage
- Valuable information stolen
  (credit card numbers, trade secrets, etc.)
- Services made unavailable
  (email and web site outages, lost business)

Other fears: cybercrime, terrorism, etc.

Main themes of today's lecture

Self-reproducing programs and their uses in viruses, worms, zombies

Other threats to computer security

Internet = Today's Wild West
(weak or nonexistent policing means citizens have to protect themselves)

There is no magic bullet against cyber crime, but following good security practices can help you stay safe

Breaking into a Computer

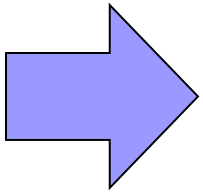
What?

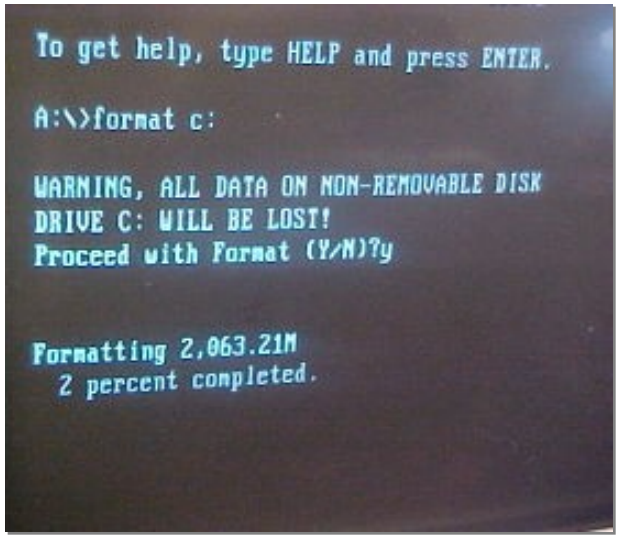
- Run unauthorized software

How?

- Trick the user into running bad software (“social engineering”)
- Exploit software bugs to run bad software without the user’s help

Example of attacks via social engineering: Trojan Horse





CoolScreenSaver.exe

Viruses and Worms

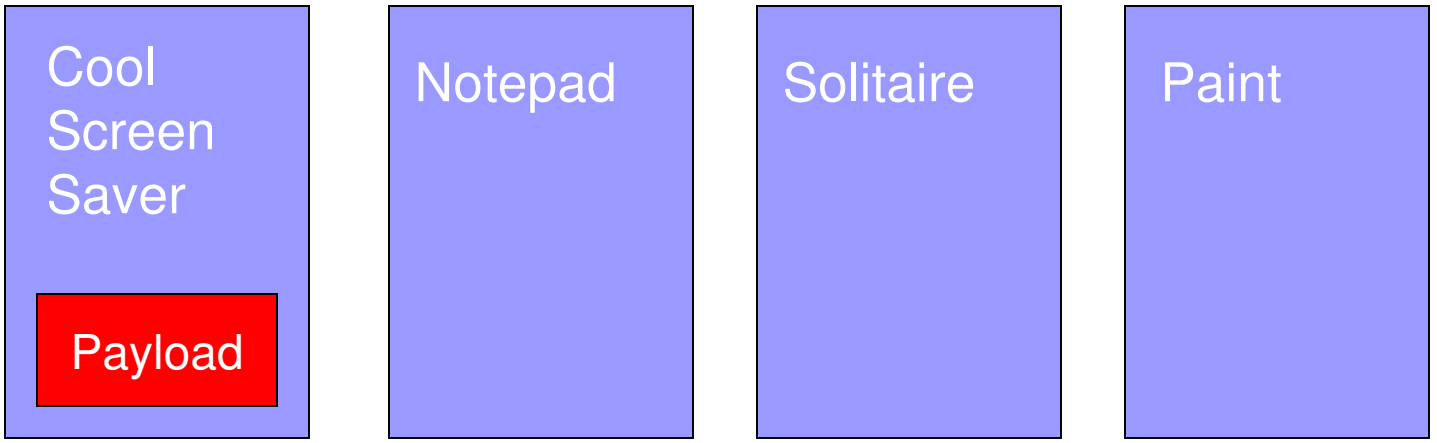
Automated ways of breaking in;

Use self-replicating programs

(Recall self-replicating programs:
Print the following line twice, the second time in quotes. "Print the following line twice, the second time in quotes.")

Computer Viruses

Self-replicating programs that spread by infecting other programs or data files



Must fool users into opening the infected file

Email Viruses

- Infected program, screen saver, or Word document launches virus when opened
- Use **social engineering** to entice you to open the virus attachment
- **Self-spreading:** after you open it, automatically emails copies to everyone in your address book

The Melissa Virus (1999)

- Social engineering: Email says attachment contains porn site passwords
- Self-spreading: Random 50 people from address book
- Traffic forced shutdown of many email servers
- $80 million damage
- 20 months and $5000 fine

David L. Smith
Aberdeen, NJ

Combating Viruses

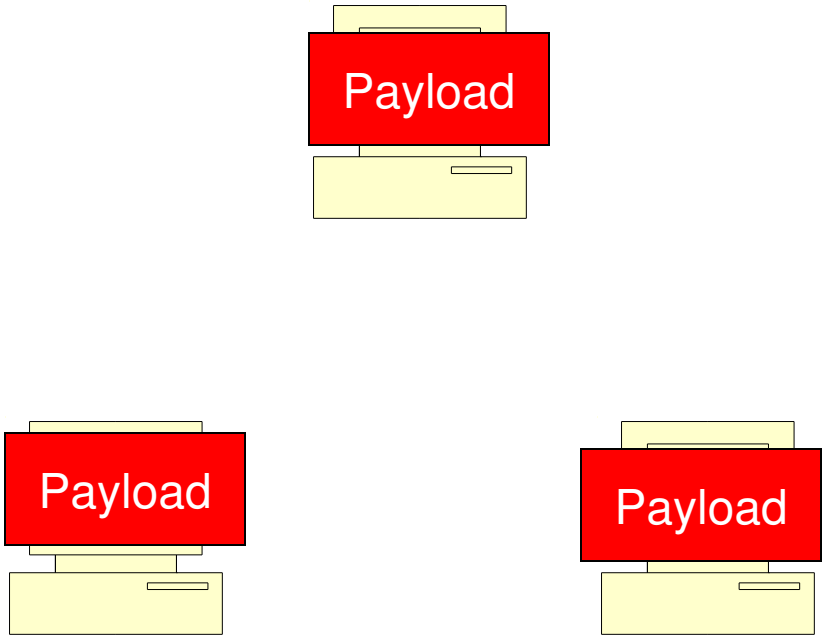
Constant battle between attackers and defenders

Example:

- Anti-virus software looks for “signatures” of known viruses
- Attacker response: *Polymorphic viruses* – change their code when they reproduce to make detection harder
- Anti-virus software adapts to find some kinds of polymorphism
- But an infinite number of ways to permute viruses are available to attackers

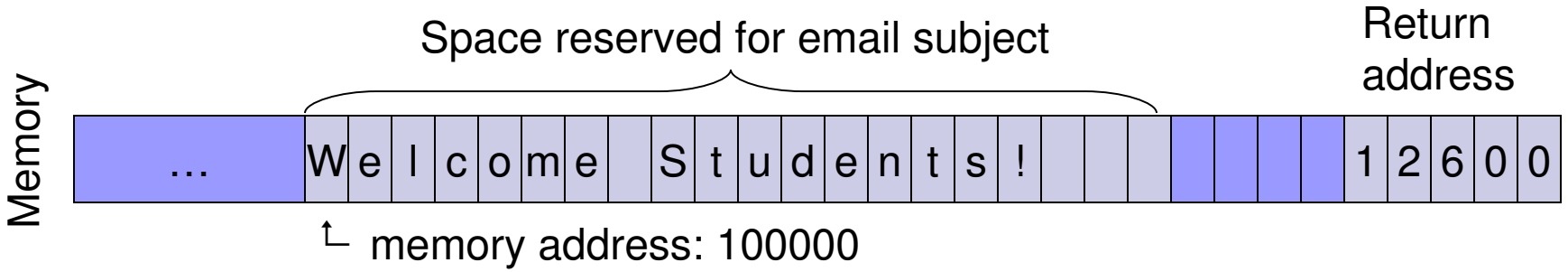
Computer Worms

Self-replicating programs like viruses, except exploit security holes to spread on their own without human intervention



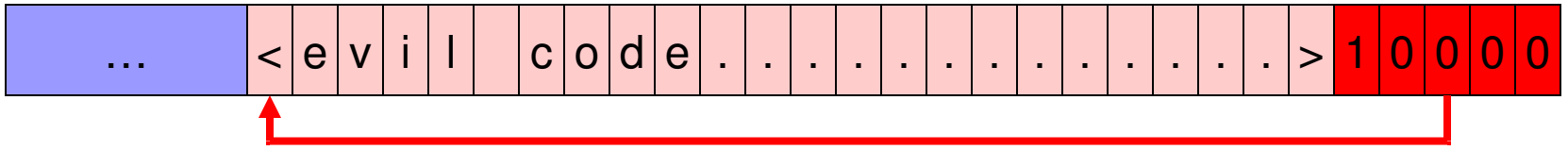
Frequent source of vulnerability: Buffer Overflow bug

From: COS 116 Staff
Subject: Welcome Students!



Buffer overflow bug: Programmer forgot to insert check for whether email subject is too big to fit in memory "buffer"

From: Bad Guy
Subject: <evil code . . . . . >100000



The Morris Worm (1988)

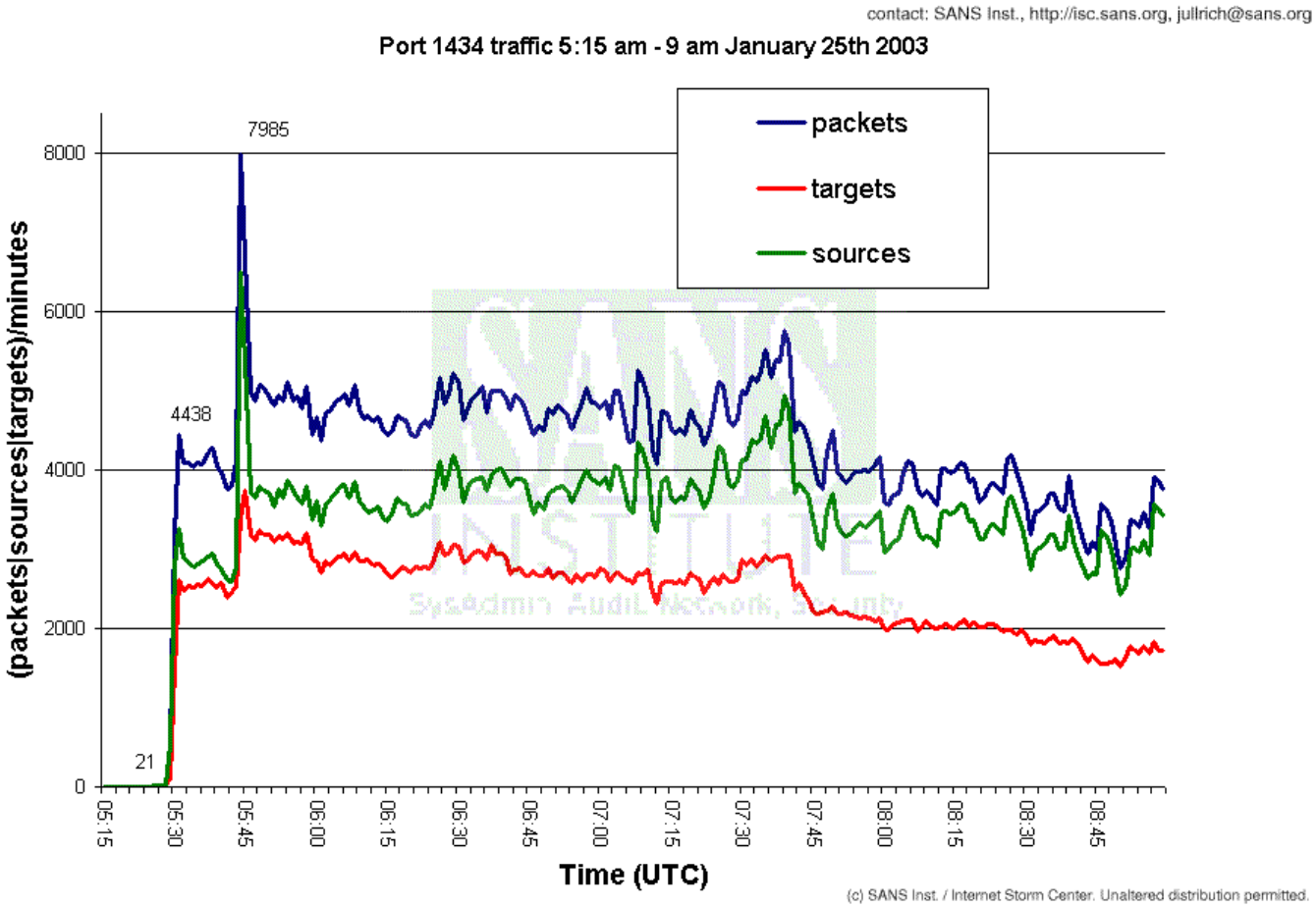
- First Internet worm
- Created by student at Cornell
- Exploited holes in email servers, other programs
- Infected ~10% of the net
- Spawned multiple copies, crippling infected servers
- Sentenced to 3 years probation, $10,000 fine, 400 hours community service

Robert Tappan Morris

The Slammer Worm (2003)

- Fastest spreading worm to date
- Only 376 bytes—Exploited buffer overflow in Microsoft database server products
- Spread by sending infection packets to random servers as fast as possible, hundreds per second
- Infected 90% of vulnerable systems within 10 minutes**!** 200,000 servers
- No destructive payload, but packet volume shut down large portions of the Internet for hours
- 911 systems, airlines, ATMs — $1 billion damage!
- Patch already available months previously, but not widely installed

Why is it so hard to stop Worms?



Spread of the Slammer worm

“Can we just develop a software to detect a virus/worm?”

[Adleman’88] This task is undecidable.
(so no software can work with 100% guarantee)

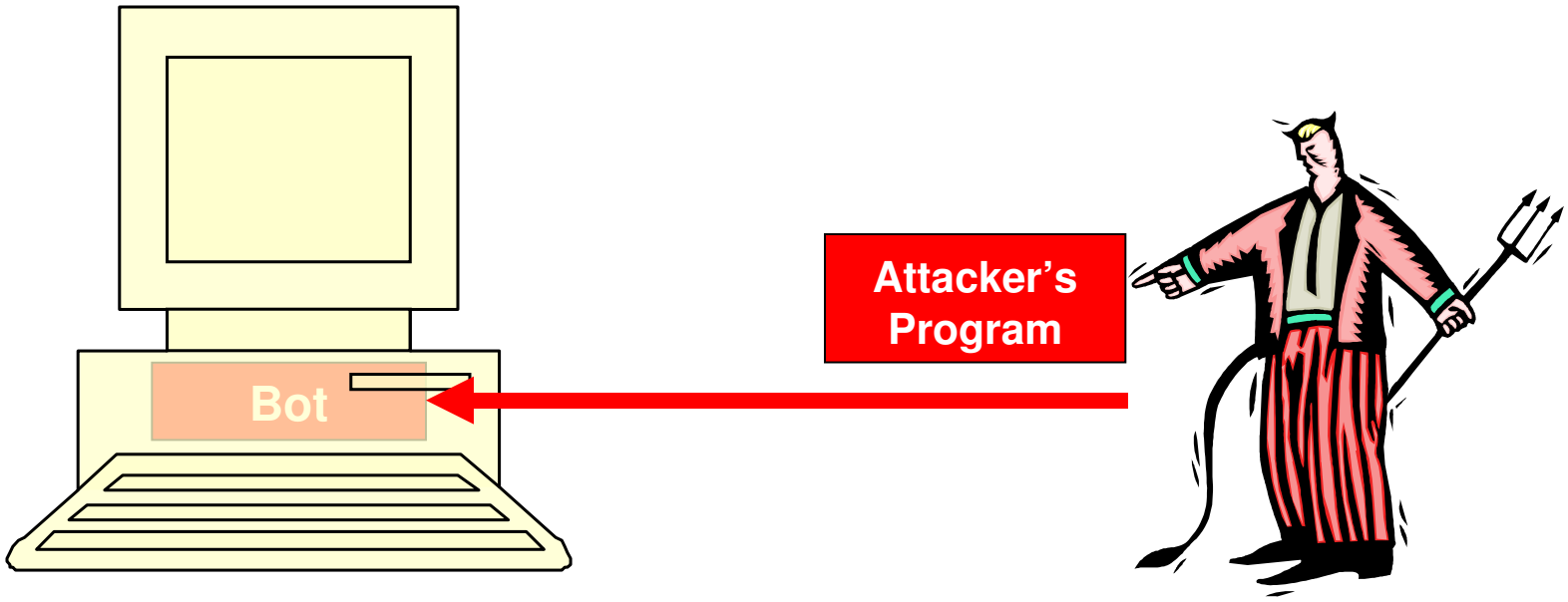
Why do people write worms and viruses?

Sometimes because they are misfits/anarchists/bored

Main reason: Botnets

- Virus/worm payload:
  Install *bot* program on target computer
- Bot makes target a *zombie*,
  remotely controlled by attacker
- Many zombies harnessed into armies
  called *botnets* – often 100,000s of PCs

Zombies

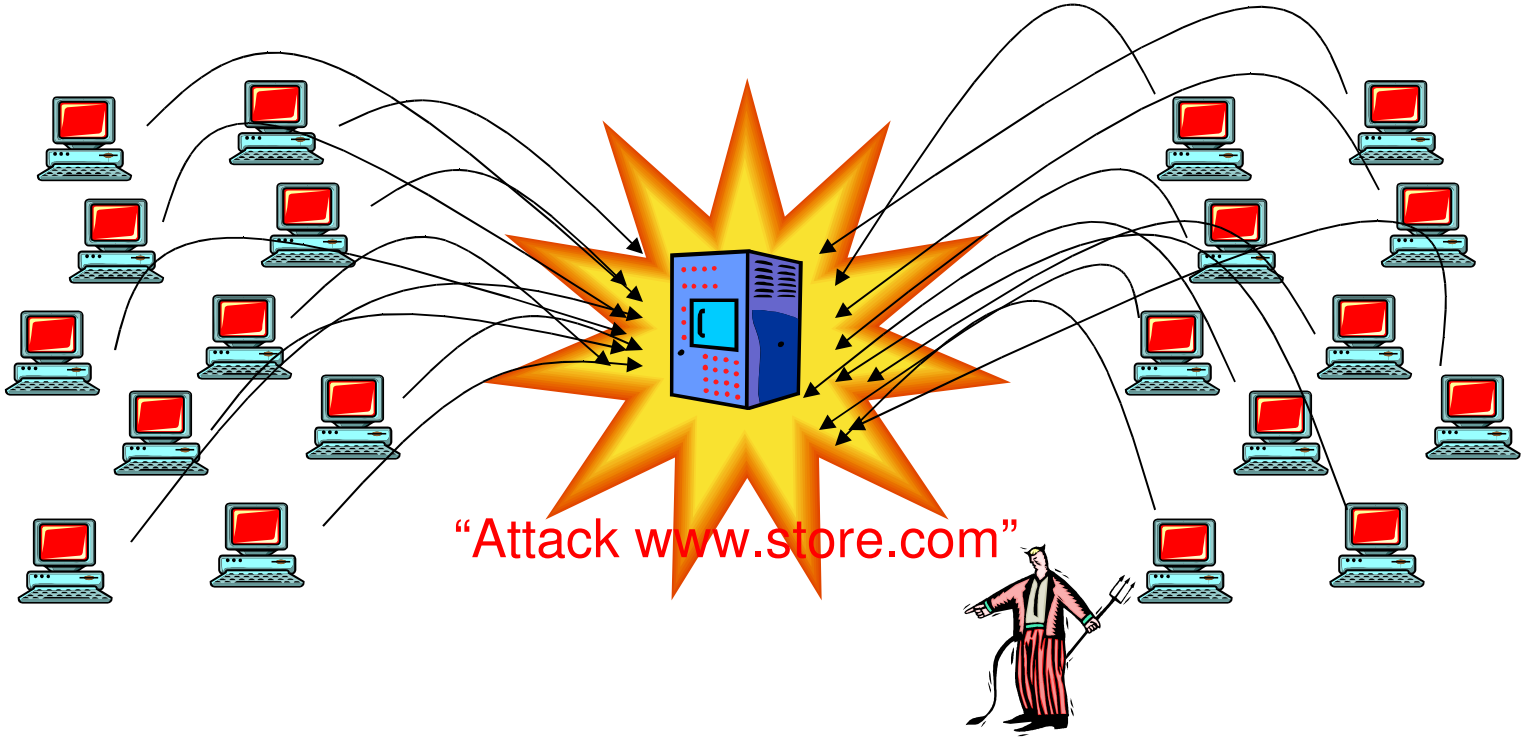


Bot program runs silently in the background, awaiting instructions from the attacker

Why go to the trouble of creating a botnet?

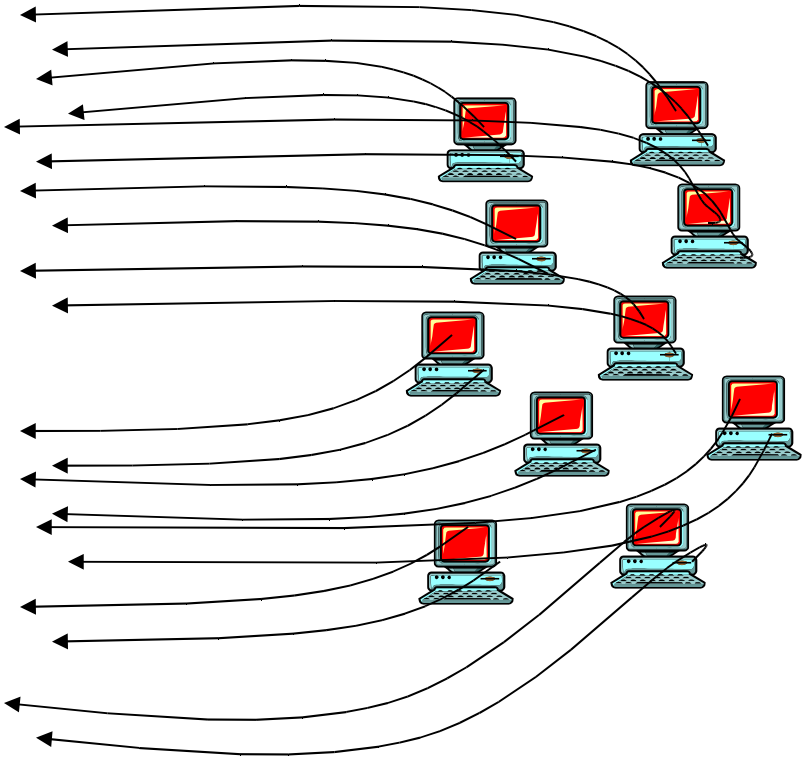
Reason 1: DDOS Attacks

"Distributed Denial of Service"



Objective: Overwhelm target site with traffic

Reason 2: Sending Spam



"Forward this message:
Subject: Viagra!
…"

Messages are hard to filter because there are thousands of senders

Other reasons

- Click fraud.
- Commit other cybercrime that is hard to trace

Storm Botnet

- Created via email scam in 2007; spread to a million computers
- Owners unknown; said to be Russian
- Used for DoS and Email spams; its services believed to be for rent/sale
- Fiendishly clever design (a) distributed control, similar to Kazaa, Gnutella (b) rapidly morphing code; morphs every hour or so. (c) seems to detect attempts to track/contain it, and “punishes” its pursuers

If you weren’t scared enough already…

Princeton prof hacks e-vote machine

Students uploaded viruses able to spread to other machi

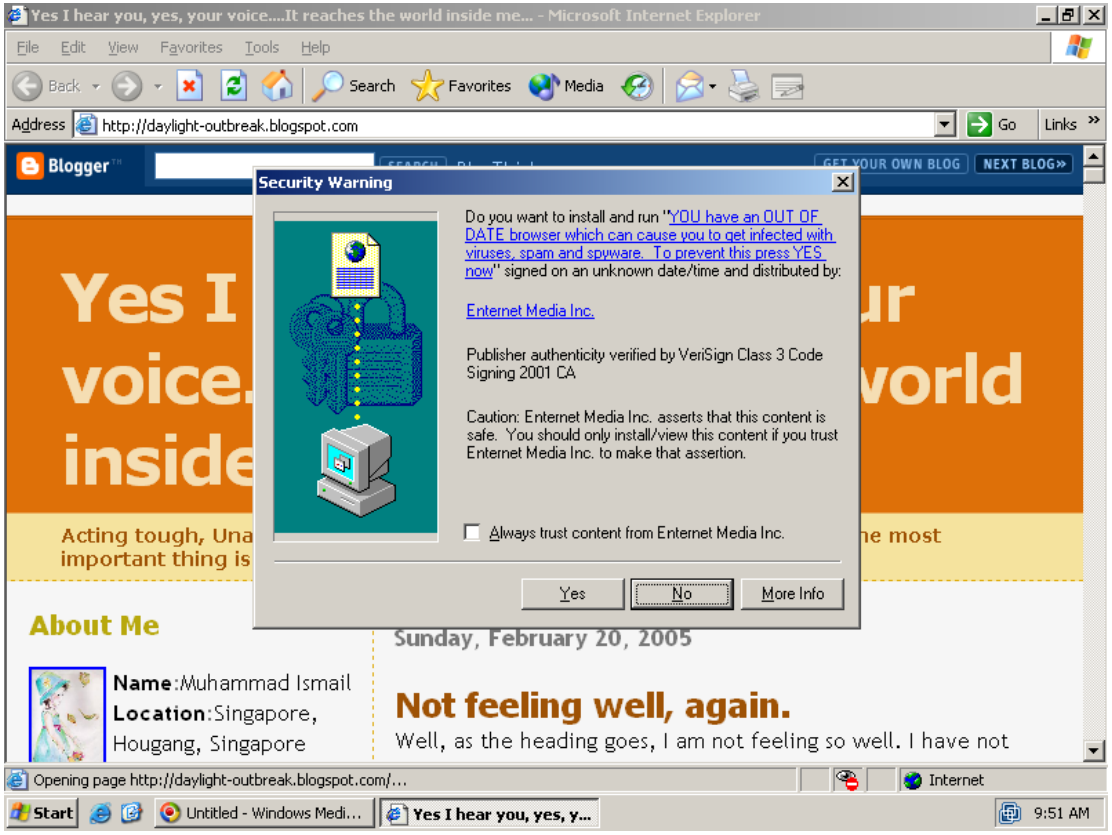
Associated Press
updated 9:48 p.m. ET, Wed., Sept. 13, 2006

TRENTON, N.J. - A Princeton University computer science professor added new fuel Wednesday to claims that electronic voting machines used across much of the country are vulnerable to hacking that could alter vote totals or disable machines.

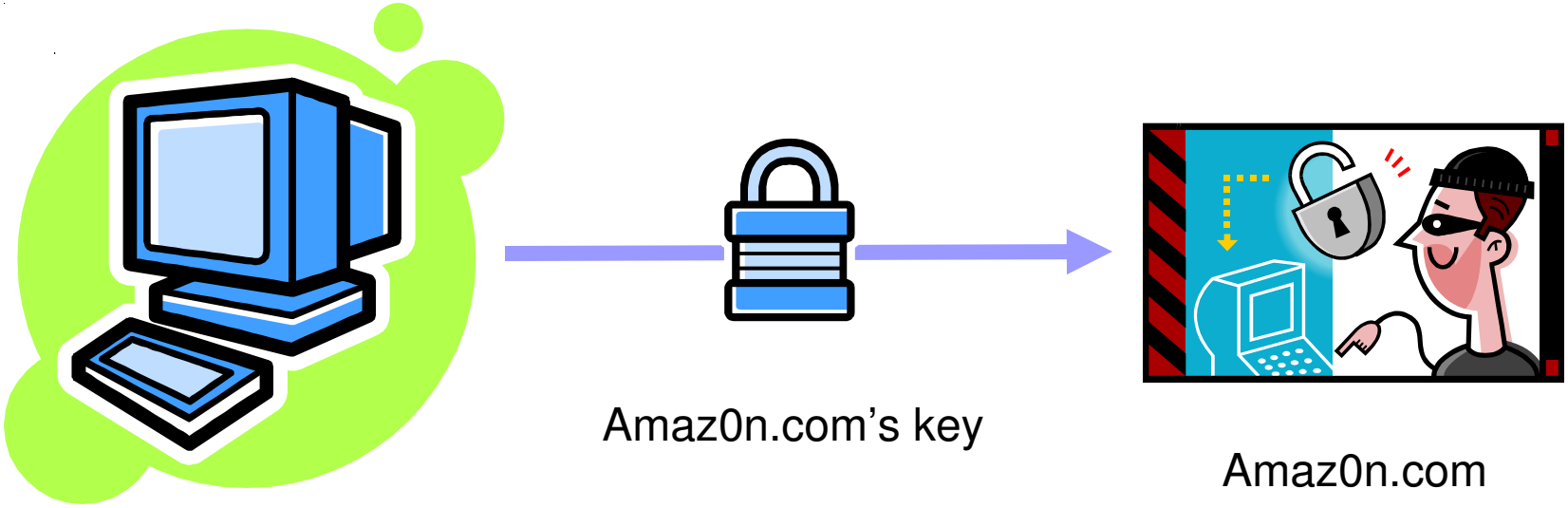
In a paper posted on the university's Web site, Edward Felten and two graduate students described how they had tested a Diebold AccuVote-TS machine they obtained, found ways to quickly upload malicious programs and even developed a computer virus able to spread such programs between machines.

Spyware/Adware

- Hidden but not self-replicating
- Tracks web activity for marketing, shows popup ads, etc.
- Usually written by businesses: Legal gray area



Spoofing Attacks



You

Amaz0n.com's key

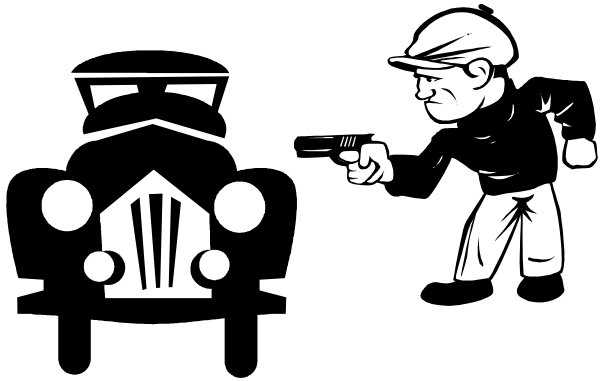
Amaz0n.com

Attacker impersonates the merchant ("spoofing")

Your data is encrypted…

…all the way to the bad guy!

Attackers are Adaptive



Defenders must continually adapt to keep up

Can we stop computer crime?

Probably not!

- Wild West nature of the Internet
- Software will always have bugs
- Rapid exponential spread of attacks

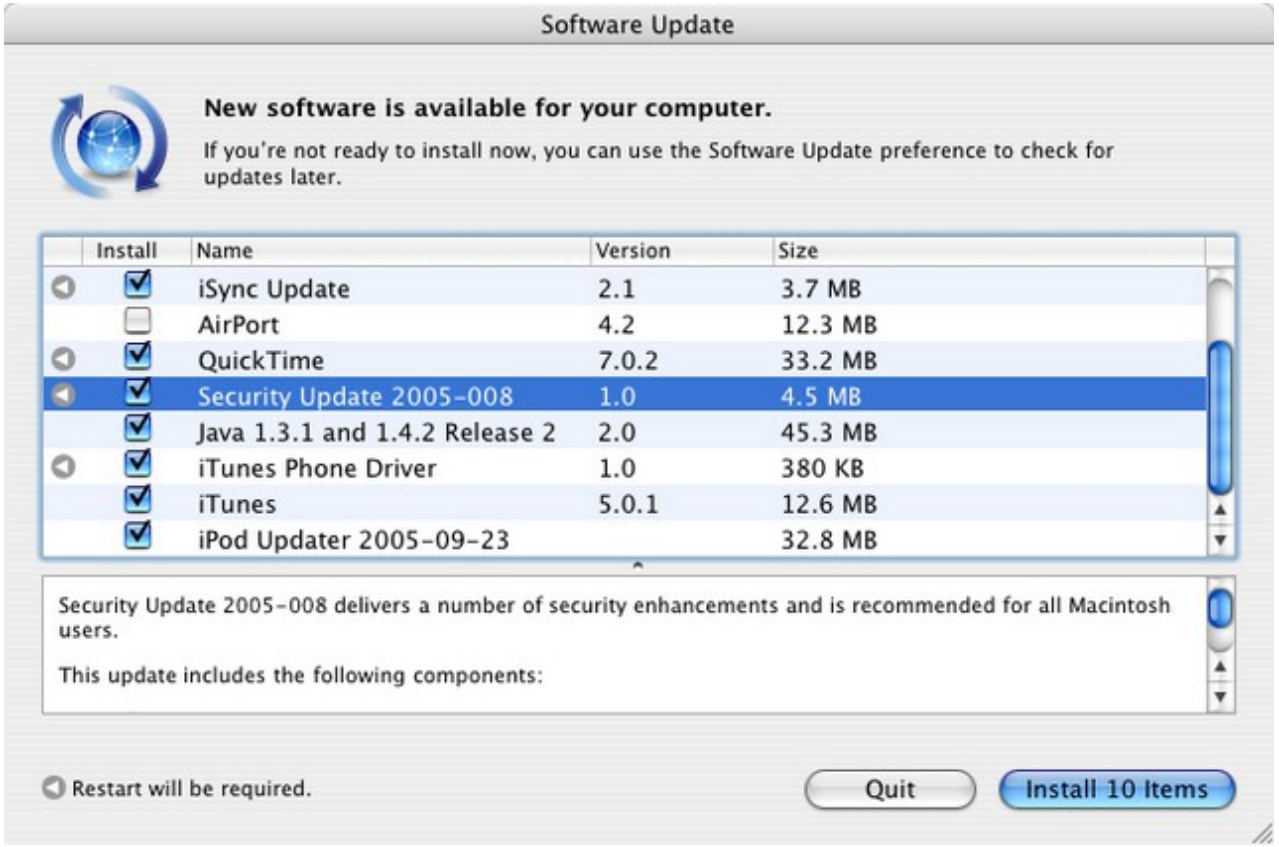
But we can take steps to reduce risks…

Protecting Your Computer

Six easy things you can do…

- Keep your software up-to-date
- Use safe programs to surf the ‘net
- Run anti-virus and anti-spyware regularly
- Add an external firewall
- Back up your data
- Learn to be “street smart” online

Keep Software Up-to-Date

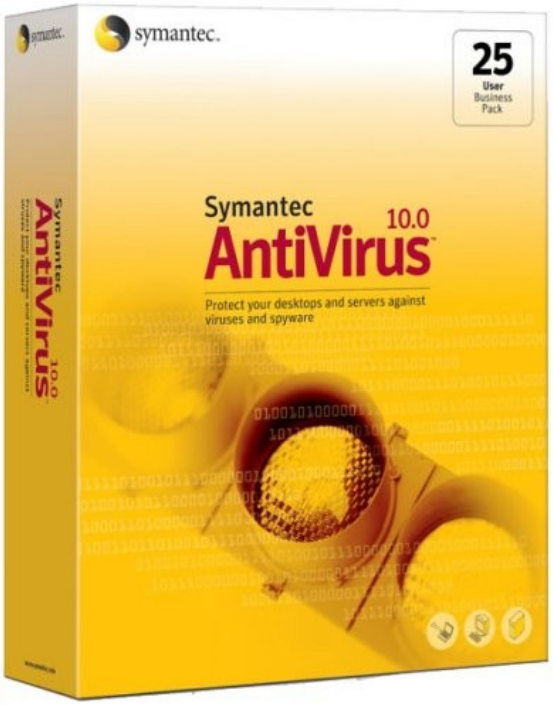


Use Safe Software to Go Online

Firefox
(web browser)

Thunderbird
(email)

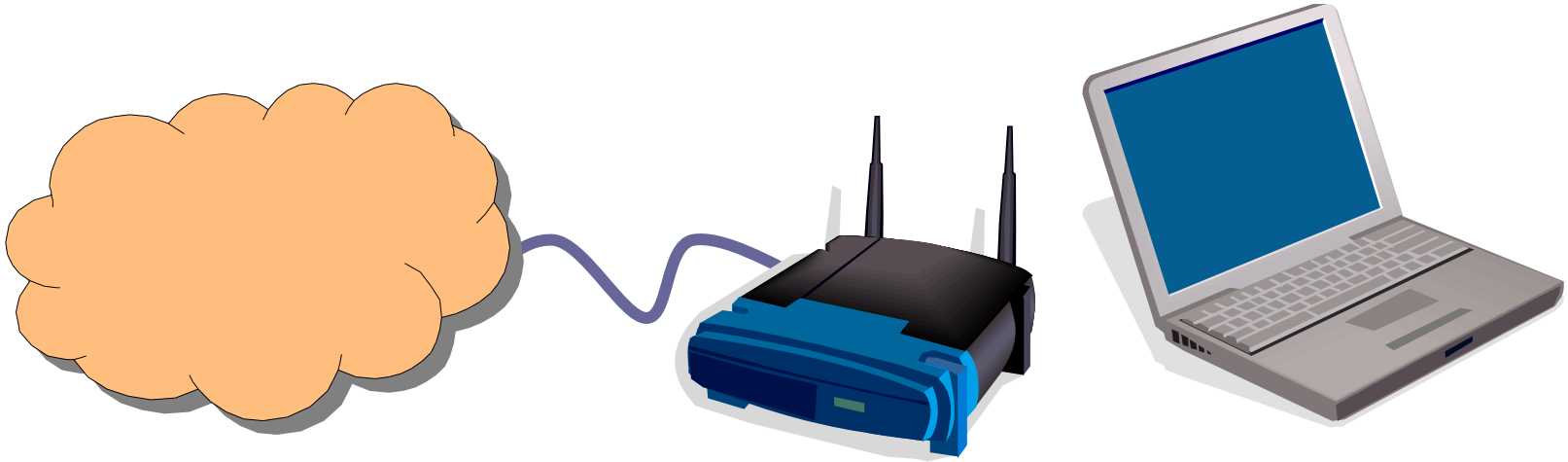
Anti-virus / Anti-spyware Scans



Symantec Antivirus
(Free from OIT)

Spybot Search & Destroy
(Free download)

Add an External Firewall



Provides layered security
(think: castle walls, moat)

(Recent operating systems have built-in firewall features)

Back Up Your Data

Tivoli Storage Manager
(Free from OIT)

Learn Online “Street Smarts”

- Be aware of your surroundings
  - Is the web site being spoofed?
- Don’t accept candy from strangers
  - How do you know an attachment or download isn’t a virus, Trojan, or spyware
- Don’t believe everything you read
  - Email may contain viruses or leads to a phishing attack – remember, bad guys can forge email from your friends