Security

CSE 454

Outline

- **Spam**
- **Viruses**
- **Worms**
- **Spyware**

- **[Worms in depth]**

SPAM

- **Problem**
  - Zero marginal cost of sending an email
- **Solutions**
  - Machine learning client to detect spam
  - Brightmail
    - Dummy accounts
    - Correlate SPAM messages
    - Supply fingerprint to enterprise customers
  - Client refuses messages from unknown senders, until
    - They respond to a Turing test query
    - They execute a computationally expensive applet
    - Micropayment

Link Spam

- **Keyword / Meta tag stuffing**
  - Linguistic spoofing
- **Multiple titles**
- **Tiny fonts**
- **Invisible text**
  - <body bgcolor="FFFFFF">
  - Your text here
  - Problem: takes up space. Size=1? Bottom?
- **Doorway / jump pages**
  - Fast meta refresh
- **Cloaking ~ Code swapping**
- **Pagerank spoofing (Link newtworks)**

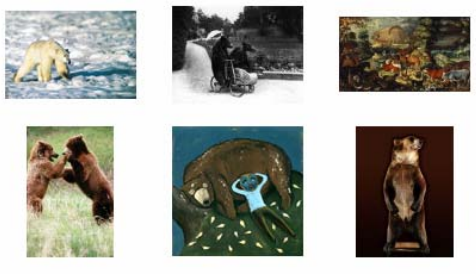
Robots

- **Threat: automatic creation of accounts**
  - Paypal
  - Storage associated: Hotmail, Yahoo communities…
  - Adbots in chat rooms
  - Online polls
- **Solutions**
  - Turing tests
    - Distorted speech recognition
    - Overlayed distorted text recognition
    - CAPTCHA
      - Automated public Turing test to tell computers and humans apart
      - http://www.captcha.net/

Gimpy: Type 3 words

Mori & Malik (UCB) program solving ez-gimpy with accuracy 83%

Semantic Tests



ESP Game

http://www.espgame.org/

Viruses

- **Defn**
  - Requires human action to spread
  - Infects most files on local computer
  - Doesn't automatically spread across network
  - Carries payload (destructive or annoying messages)
- **Common Modus Operandi**
  - Macro attached to office document
- **Solutions**
  - Fingerprint based (to detect viruses)
  - Application checksums (to detect tampering)

Worms

- **Defn**
  - Automatically spreads to other systems
- **Modus Operandi**
  - Protocol worms
  - Hybrid virus / worms
- **Solutions**

Spyware: analysis and mitigation

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kingsofchaos.com

- **A benign web site for an online game**
  - earns revenue from ad networks by showing banners
  - but, it relinquishes control of the ad content

banner ad from adworldnetwork.com (a legitimate ad network)

inline javascript loads HTML from ad provider

Incident: January 2004

- **kingsofchaos.com was given this "ad content"**

```
<script type="text/javascript">document.write('
\u003c\u0062\u006f\u0064\u0079\u0020\u006f\u006e\u0055\u
006f\u0077\u0050\u006f\u0070\u0075\u0070\u0028\u0029\u0
03b\u0073\u0068\u006f\u0077\u0048\u0069 ...etc.
```

- **This "ad" initiated a cascade of redirections through many sites, and ultimately:**
  - bombarded the user with pop-up ads
  - hijacked the user's homepage
  - exploited an IE vulnerability to install spyware

What's going on?

- **The advertiser was really an ad-spammer**
  - his goal: **force** users to see ads from his servers
    - revenue from ad "affiliate programs"
    - paid to show ads for bogus anti-spyware software
- **Why install spyware?**
  - to show ads whether or not the victim is on the Web
  - to make escape hard
    - his spyware shows his ads
    - the hijacked home page shows his ads
    - some of his ads re-install spyware and re-hijack

Take-away lessons

- **Your PC has value to third parties**
  - spyware tries to steal this value from you
    - adware: eyeballs and demographic information
    - spyware: sensitive data, PC resources
- **Web content should never be trusted**
  - even if its direct provider is
- **Consumer software and OSs are weak**
  - browsers are bug-ridden
  - OSs cannot deal with malicious software

What is Spyware?

- **Incredibly difficult to define precisely**
  - no clean line between good and bad behavior
  - hard to define 'informed consent'
- **Spyware is a *software parasite* that:**
  - collects info of value and relays it to a third party
  - hijacks functions or resources of PC
  - installs without consent of user, resists de-installation
- **Spyware provides value to others, but not to you**

Types of spyware

Class	# signatures
Cookies and web bugs	47
Browser hijackers	272
Adware	210
Keyloggers	75
Dialers	201
Backdoors / monitors	279

From the "Spybot S&D" database, Feb. 2005

Infection methods

- **Piggybacking on legitimate software**
  - provides revenue stream for free software vendors
- **Drive-by downloads**
  - malicious Web content exploits browser vulnerability
  - software is installed and run silently
- **Installed during remote attack**
  - some worms now carry spyware payload
- **Snowball effect from existing spyware**
  - trojan downloaders

Spyware trends

- **Most Internet PCs have it**
  - June '03: 80% of Internet-connected PCs are infected
  - *[AOL/NCSA online safety study]*
- **It's getting more vicious**
  - December '04: 14% of enterprise PCs have backdoor or monitor spyware
  - doubled between October '04 and December '04
  - *[Webroot reported scan statistics]*
- **Convergence of threats**
  - worms, viruses, spyware, botnets are fusing

Two research studies

- **November 2003 study of adware within UW**
  - passive network measurement of entire campus
  - measured spread of four adware programs
- **Sneak preview of crawler-based study**
  - active retrieval of content from the Web
  - how much is "out there," and who is spreading it

UW adware study

- **Examined four programs**
  - Gator, Cydoor, SaveNow, and eZula
  - piggyback installation, adware and HTML rewriting
- **Derived network signatures**
  - look for the spyware "phoning home"
    e.g., Gator traffic contains Gator/x.xx UserAgent and is sent to a *.gator.com host
  - signatures permit passive network monitoring

Method

- **Network monitor deployed at UW**
  - sniffs packets sent between UW hosts and Internet
  - gathered a 7 day Web trace
    - Aug. 26th – Sept. 2nd, 2003
  - looked for packets that match signatures
    - traffic matches signature ⇒ sender has spyware

The major result

	WWW	Gator	Cydoor	SaveNow	eZula
# clients (% clients)	**31,303** (100%)	**1,077** (3.4%)	**399** (1.3%)	**406** (1.3%)	**63** (0.2%)

- **5.1% of UW hosts have ≥ 1 of these programs**
- **This may appear small, but:**
  - Only considers 4 spyware programs out of thousands
  - University may be non-representative
    - modem pool has 2.5x higher infection rate
  - a Gator vulnerability => 1000+ UW hosts at risk

Security flaws

- **Gator & eZula "auto-update" their code, data**
  - periodically download ZIP file, unzip into filesystem
- **No integrity / authenticity checks on updates**
  - Could attack with DNS spoofing or TCP hijacking
  - We could install an executable in "Startup" directory
  - Tens of millions of hosts susceptible
- **They communicated flaws to both companies**
  - Gator flaw was quickly repaired

Is there "at-risk" behavior?

- **# of web objects downloaded**
  - fewer than 1000 requests per week: 1.8% have Gator
  - more than 12,000 requests per week: 8.9% have Gator
- **# of executables downloaded**
  - none downloaded over week: 0.9% have Gator
  - one or more over week: 8.4% have Gator
- **using the Kazaa P2P client**
  - issued one or more Kazaa request: 38% have Gator

  but…62% of spyware infections are in hosts that didn't issue a Kazaa request

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Two studies

- **November 2003 study of adware within UW**
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- **Sneak preview of crawler-based study**
  - active retrieval and analysis of Web content
  - how much is "out there," and where is it coming from?

Method

- **Crawl subsets of Internet to find spyware**
  - used "heritrix" public domain crawler
  - downloaded .zip, .exe, .cab, etc. (programs)
- **Cluster of virtual machines to analyze programs**
  - "forked" a clean Windows VM per program
    - installed program, ran anti-spyware tool to analyze
  - O(1 min) per program
    - on 10-node cluster, O(15,000) programs per day
    - many performance optimizations possible

Major result

- **Web sites crawled: 12,000**
  - URLs retrieved: 23,714,927
- **# of executable files downloaded: 9,330**
  - # infected with spyware: 766 (8.21%)
  - unique spyware programs found: 137

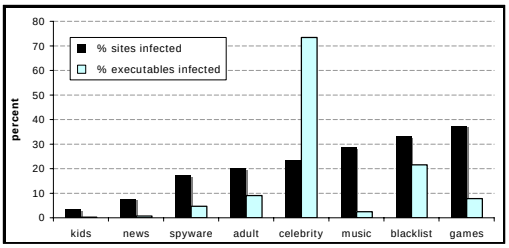
1 in 12 **executables on the Internet have spyware!**

What kind of spyware is out there?

Behavior	% spyware
Adware	57%
Browser hijackers	56%
Keyloggers	0.06%
Dialers	0.1%
Backdoors / monitors	15%

- **Other stats:**
  - 58% try to evade discovery or removal
  - 32% monitor Web browsing behavior
  - most popular: eZula, 180 solutions, SaveNow

Where does it come from?



- **spyware purveyors "troll" popular destinations**
- **blacklists aren't terribly useful**

Spyware Wrap-up

- **Spyware affects many people**
  - 5% of UW computers have adware
    - substantially underestimates all spyware
  - 1 in 12 executables on the Internet have spyware
- **Most spyware appears benign**
  - adware is the most rampant
  - but, trojans and monitors are on the rise
- **Even "benign" spyware can harm you**
  - hidden risk of security flaws, instability
  - no opportunity to mitigate or isolate