Security Incident Investigation

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Agenda

- Background
- Legal
- Criminal profiling
- Investigation
- Forensics

What is Computer-Related Crime?

- Crimes directed against a computer
- Crimes where the computer contains evidence
- Crimes where the computer is used to commit the crime
- Average loss from an incident around $1 million

The Modern Computer Criminal

- Motivated by:
  - financial gain
  - political gain
  - revenge
- Accomplished code writers
- Create their own tool kits
- Will either steal from you or damage you
- 71% chance he/she is insider

Examples

- Credit card theft ring in Lithuania with multiple sites around the world attacks e-tailer
  - Downloads 900 cards per day and offers security assistance to plug holes for a fee
  - Sells and trades cards
- Script kiddie in Netherlands attempts to penetrate fortune 100 company and steal passwords - the victim had no firewall
- Internal employee crashes SCADA system in large metropolitan power company

How Criminals Get Their Info

- Observing equipment and events
- Using public information
- Dumpster diving
- Compromising systems
- Compromising people (social engineering)

Top Ten Vulnerabilities

- Denial of service exploits
- Weak accounts
- Microsoft Internet Information Server
- Open databases
- eBusiness web applications
- Open email
- File Sharing
- RPC
- BIND
- Linux buffer overflows

There Are Only 4 Kinds of Attacks

- Denial of service
- Social engineering
- Technical
- Sniffing

Techniques

- Masquerading as legitimate users
- Social engineering
- Any method of harvesting passwords
- System masquerades

Cleaning Up After an Attack

- Delete tools and work files
- Modify Unix logs
  - Syslog
  - messages files (especially the mail log)
  - su log
  - lastlog (including wtmp and utmp)
  - daemon logs
  - transfer logs
- Modify NT logs

Treat every incident as if it will end up in a criminal prosecution.

Standards for Investigations

- Criminal
  - establish case beyond a reasonable doubt
  - rules of evidence apply - proceedings formal
  - jury is finder of fact
- Civil
  - establish case on preponderance of evidence
  - rules of evidence apply - proceedings formal
  - judge or jury may be finder of fact
- Administrative
  - establish case on preponderance of evidence
  - proceedings may be informal
  - arbitrator(s), mediator(s), other finders of fact

Electronic Communications Privacy Act - Your Enabling Law

- Owner may intercept communications between an *intruder and that owner's computer system*

Electronic Communications Privacy Act - Your Enabling Law

- Owner providing others with the ability to use that computer to communicate with other computer systems may:
  - make routine backups and perform other routine monitoring
  - intercept with prior consent of the user
  - intercept portions of communications necessary to determine origin and destination
  - intercept where necessary to protect owners rights or property

Privacy Protection Act

- Part of 18 USC
- Jurisdiction
  - Federal
- Elements
  - covers materials intended for publication

Fourth Amendment

- Protection against unreasonable search and seizure
- Generally applies to law enforcement only
- Exception: When acting as an “agent” of law enforcement

Agent of the Government

- The private party performs a search which the government would need a search warrant to conduct;
- The private party performs that search to assist the government, as opposed to furthering its own interests (e.g., protecting its rights or property); and
- The government is aware of that party's conduct and does not object to it.

Rules of Evidence

- Hearsay rule
- Best evidence rule
- Must be probative
- Produced in the normal course of business
- Must be authentic
- Chain of custody

Tainted Fruit

- Evidence that results from improperly collected evidence
  - privacy violations
  - protective order violations
  - violations of law
- Everything in the chain from the improperly collected evidence on is tainted and may not be used at trial

Chain of Custody

- Accounts for access to evidence from collection to presentation in court
- Evidence should be sealed, physically and/or electronically
- Custodian signs, dates and seals
  - must be able to attest to custody
- Evidence is locked in evidence locker
- Data may be cryptographically signed

Criminal Profiling

- Criminal profiling
  - Using available information about a crime and crime scene to compose a psychological portrait of the unknown perpetrator of the crime
- Classical profiling goals
  - Provide a social and psychological assessment of the offender
  - Create a psychological evaluation of possessions found at the crime scene

Developing a Profile of an Intruder

- Crime scene analysis
  - how was access obtained? What skills were required?
  - how did the intruder behave on the system? Damage? Clean-up? Theft?
- Investigative psychology
  - motivation
  - personality type

Goals of an Investigation

- To ensure that all applicable logs and evidence are preserved
- To understand how the intruder is entering the system
- To obtain the information you need to justify a trap and trace of the phone line the intruder is using or to obtain a subpoena to obtain information from an ISP

Goals of an Investigation

- To discover why the intruder has chosen the computer
- To gather as much evidence of the intrusion as possible
- To obtain information that may narrow your list of suspects
- To document the damage caused by the intruder
- Gather enough information to decide if law enforcement should be involved.

Immediate Objective: *PRESERVE THE EVIDENCE* !!!

- Begin a traceback to identify possible log locations
- Contact system administrators on intermediate sites to request log preservation
- Contain damage
- Collect local logs
- Image disks on victim computers

Crime Scene Management

- Clear everyone away from the computer under investigation
- Examine for communications connections (modem and network)
- Examine for other connections and observe the screen display - photograph or sketch the display for future reference
- Unplug communications connections from the computer - turn nothing off at this point

Crime Scene Management

- Disconnect the modem from the telephone - do not use the phone
- Document and label all connections to the computer
- Pull the plug(s)
- Reboot from an external source (bootable floppy or CD-ROM) and make physical images of hard drives
- Shut down and collect any potential evidence - bag and tag individually.

Building an Incident Hypothesis

- Start with witness accounts
- Consider how the intruder could have gained access
  - eliminate the obvious
  - use logs and other physical evidence
    - consider the skill level or inside knowledge required
- Create images of affected computers

Building an Incident Hypothesis

- Develop a profile of the intruder
- Consider the path into the victim computer
- Recreate the incident in the lab if necessary
  - use real images whenever possible
- Consider alternative explanations
  - test alternatives

Back Tracing

- Elements of a back trace
  - end points
  - intermediate systems
  - e-mail and packet headers
  - logs
- Objective: to get to a POP
- The only messages that can't be back traced are those using a true anonymizer and those where no logs are present

Obtaining Subpoenas

- Notify involved organization that you are going to subpoena and request that they preserve evidence - find out who to deliver the subpoena to
- File John/Jane Doe lawsuit with an emergency order to subpoena appropriate records
- Subpoena the logs you need
  - Get everything you can on the first pass
  - May need depositions

Log Info - Unix

- Times of login and logout - LASTLOG
- Anomalies in the LASTLOG - use a log analysis tool such as CHKLASTLOG
- Source IP address - use SYSLOG or any other logs you have that record IP addresses
- Reboots - CRON LOG
- Other logs may be from TCP wrappers installed on critical services

Log Info - NT

- Times of login and logout - SECURITY EVENT LOG
- Source IP address - SECURITY EVENT LOG (not reliable)
- Other useful information may be in SYSTEM EVENT LOG

Log Info - Web Servers

- Http access logs
- Http referrer logs
- Http error logs
- Make sure logging is configured for source IP address, times and dates
- Make sure logs cover all pages on the site

Using Logs as Evidence

- Must not be modifiable
  - Spool off to protected loghost
  - Optical media
  - Backups
- Must be complete
  - All superuser access
  - Login and logout
  - Attempts to use any controlled services
  - Attempts to access critical resources
  - E-mail details
- Appropriate retention

Analyzing Logs

- If there are no logs
  - May be able to use forensic analysis
  - Check other involved computers
- Multiple log analysis
  - Corroboration
  - Fill in gaps
  - Step by step tracing between attacker, victim and intermediate computers

What Do We Mean by "Forensics"?

- Forensic Computer Science
  - Discovery and analysis of ambient data on a computer disk
  - Using some form of science or technology to develop evidence in a legal setting
- Operational Forensics
  - Using ambient data, logs and forensic tools to restore a computer system to pre-damage condition
- Network Forensics
  - Network backtracing

The Role of Forensic Examination in an Investigation

- Computer forensics deals with the recovery of evidence from "hidden" areas of disks, data and systems
- Three major applications
  - developing leads
  - verifying hypotheses
  - recovering damaged systems
- Computer forensic evidence plays the role of physical evidence in a computer incident

When Forensic Evidence is Useful

- Developing leads
  - is there evidence of the incident connecting the suspect and the victim?
  - has the suspect accessed systems involved in the incident?
  - With whom has the suspect communicated?
- Verifying hypotheses

What to Expect From Forensic Evidence

- “Smoking guns” very rare
- Excellent lead generation
  - requires good “seeds” - starting points
- Corroboration of facts collected in other ways
- May require lots of patience - needle in the haystack

Evidence Collection

- All records of the unauthorized access.
- Make sure that your victim keeps those records in a secure area of a computer, preferably encrypted, or on a secured disk. Also caution the victim not to use e-mail to discuss the intrusion.
- All records of system activity on the day (or within a few hours) of the access.

Evidence Collection

- Backup tapes of the above.
- Make an exact copy of that data in the form in which it existed in the computer (i.e., onto a backup disk or tape - use SafeBack). Make more than one copy if possible.
- Disks, printouts, CDs, etc

Evidence Preservation

- ***NEVER*** work directly on the computer under test!!!!!
- Preserve the “crime scene” from alteration
- Document everything
  - photos, drawings, notes, etc.
- If you seize the PC, protect it from booting

Evidence Analysis

- Backups
  - Logical
    - files as reported by the FAT or other file system
  - Physical
    - bit stream data transferred from disk sectors directly
- Images
  - physical duplicate of the original disk

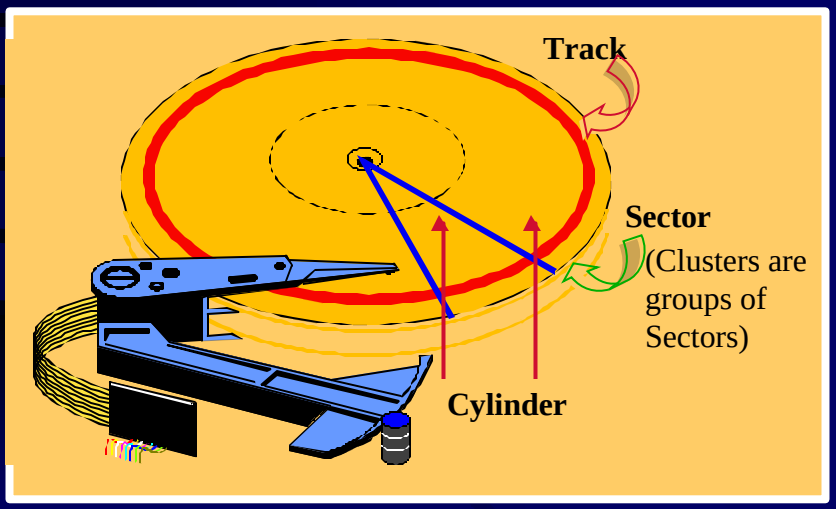
Selecting Forensic Tools

- The forensic examiner's kit
  - Tools and techniques you use to collect the data
  - Tools and techniques you use to analyze the data
- Criteria
  - Must not alter data as a side effect of the collection process
  - Must collect all the data we want and only what we want
  - Must be able to establish that they worked as advertised
  - Must be accepted by the computer forensic community
  - Results they produce must be repeatable

Where Evidence Hides

- Slack space
- Unallocated space
  - true unallocated space
  - deleted file space
- Swap files
- Cache files

Disk Geometry



Slack Space

Last Cluster in a File

Making & Using Backups

- Only physical backups are useful
  - use Safeback from NTI or enCase from Guidance Software
- The backup itself may be scanned for keywords and URLs
- The backup may be restored to a test disk for analysis of a true physical mirror of the original
  - better access to slack and unallocated space

The Backup Process

- Boot from a floppy
  - DOS operating system
  - copy of Safeback on the disk
  - enCase boot disk with drivers
- Use digital tape, Jaz or similar drive or CD-ROM for the backup medium
  - audit trail on the boot floppy
- Direct copy to another disk
  - set up a second hard disk as slave - original as master
  - boot from floppy with Safeback or enCase on it

Developing Leads - Tools

- URLs and e-mail addresses
  - IPFilter (NTI)
  - enCase Grep feature
- Text strings
  - Text Search (NTI)
  - enCase search
  - searches files, slack and unallocated space
  - know what you're looking for first

Evidence Collection Step by Step

- Shut down computer - reboot with floppy - SafeBack or enCase bit stream or image
- Run FileList or use enCase
- Secure the computer - copy the backup
- Cryptographically sign evidence with CRCMD5 or use enCase
- Encrypt evidence & put into chain of custody

Extracting Evidence

- Run IPFilter against bitstream or enCase grep against evidence file
  - E-mail and URL addresses & image file names
- Run Text Search with keyword list against physical disk on mirror
  - boot from DOS floppy
  - for NT use NTFSDOS on DOS bootable floppy
- Boot from and analyze the image

Preserving Evidence

- Evidence must be able to be shown to be pristine
  - data - encrypt and sign with cryptographic signature
  - physical - bag, seal and tag
- Never perform forensics on evidence
  - always use images
- Never operate a computer containing possible evidence

Computer-Related Crime Investigation = Job Security