

# Auditability and Accountability

SecAppDev 2008

# Quiz

## Here's the scenario

- Your software has just suffered a major security breach
- The CEO has called in law enforcement and a Computer Security Incident Response Team (CSIRT) to help clean up the mess

# Now what?

What are the CSIRT's top priorities?

How will your software help the CSIRT do its job?

Who will write the company's *next* software?

# Here's my answer to #1

- Highest priority is to determine the business impact
- Second highest is situational awareness throughout the incident
- Third is to recommend a course of action to take, and then to coordinate execution of that plan

# In reality

In my 20+ years of incident response experience:

- The CSIRT is called up after the fact
- Often, the attackers have come and gone
- CSIRT has to assemble the puzzle from available data
  - There's never enough—or the right—available data

# CSIRT needs to...

Determine the who, what, when, where, and how (WWWWH)

- Using existing records of the events
- Disk and network forensics often not terribly useful
  - After the fact may be too late
- Auditability vs. accountability

# Event logging

In a production data processing environment, there can be many sources of log data

- With luck, they're sent to a central log concentrator
- Consider the per-source perspective
  - What did the (router, firewall, web server, Java container, database) see?
  - Now, what did they *report*?
  - How do they speak to WWWWH?

# Synthesizing the data

From our event data, what can we tell?

- How is it all used to figure out what happened?
- How do our encrypted network protocols affect what we see?
- Examples



# Examples –1

Does this mean anything (useful) to you?

```
Jan 24 12:00:21 example-host ipop3d[40900]: pop3s SSL service init from 10.1.2.3
Jan 24 12:00:22 example-host ipop3d[40901]: pop3s SSL service init from 10.1.2.3
Jan 24 12:00:43 example-host imapd[40914]: imap service init from 127.0.0.1
Jan 24 12:00:47 example-host imapd[40929]: imap service init from 127.0.0.1
Jan 24 12:00:47 example-host imapd[40936]: imap service init from 127.0.0.1
Jan 24 12:00:48 example-host imapd[40949]: imap service init from 127.0.0.1
Jan 24 12:00:49 example-host imapd[40952]: imap service init from 127.0.0.1
Jan 24 12:00:49 example-host imapd[40953]: imap service init from 127.0.0.1
Jan 24 12:01:21 example-host ipop3d[40967]: pop3s SSL service init from 10.1.2.3
Jan 24 12:01:22 example-host ipop3d[40968]: pop3s SSL service init from 10.1.2.3
Jan 24 12:02:21 example-host ipop3d[40993]: pop3s SSL service init from 10.1.2.3
```

# Examples –2

## How about this one?

```
Jan 20 10:48:25 example-host sshd[64110]: Accepted publickey for krvw from  
10.1.2.3 port 33494 ssh2  
Jan 20 11:10:39 example-host sshd[64761]: Invalid user patrick from  
216.144.225.211  
Jan 20 11:10:40 example-host sshd[64763]: Invalid user patrick from  
216.144.225.211  
Jan 20 11:10:49 example-host sshd[64775]: Invalid user rolo from 216.144.225.211  
Jan 20 11:10:50 example-host sshd[64777]: Invalid user iceuser from  
216.144.225.211  
Jan 20 11:10:51 example-host sshd[64779]: Invalid user horde from  
216.144.225.211  
Jan 20 11:10:54 example-host sshd[64785]: Invalid user wwwrun from  
216.144.225.211  
Jan 20 11:10:55 example-host sshd[64787]: Invalid user matt from 216.144.225.211  
Jan 20 11:10:59 example-host sshd[64795]: Invalid user test from 216.144.225.211
```

# Examples –3 (last one...)

And what does this one tell you?

```
64.4.8.137 - - [24/Jan/2007:06:15:09 -0500] "GET /robots.txt HTTP/1.0" 200 0 "-" "msnbot/1.0
(+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:06:15:09 -0500] "GET /rss.xml HTTP/1.0" 200 8613 "-" "msnbot/1.0
(+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:06:38:41 -0500] "GET /robots.txt HTTP/1.0" 200 0 "-" "msnbot/1.0
(+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:06:38:41 -0500] "GET /about.php HTTP/1.0" 200 9770 "-" "msnbot/1.0
(+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:06:42:21 -0500] "GET /index.php HTTP/1.0" 200 5080 "-" "msnbot/1.0
(+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:06:42:38 -0500] "GET /courses.php HTTP/1.0" 200 7509 "-" "msnbot/1.0
(+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:06:50:07 -0500] "GET /whats_new.php HTTP/1.0" 200 12404 "-"
"msnbot/1.0 (+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:10:09:30 -0500] "GET /contact.php HTTP/1.0" 200 3526 "-" "msnbot/1.0
(+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:10:09:34 -0500] "GET /consulting.php HTTP/1.0" 200 4936 "-"
"msnbot/1.0 (+http://search.msn.com/msnbot.htm) "
64.4.8.137 - - [24/Jan/2007:10:09:34 -0500] "GET /sclist.php HTTP/1.0" 200 3139 "-" "msnbot/1.0
(+http://search.msn.com/msnbot.htm) "
```

# Wow, those were ugly

## So, what is missing from our logging?

- Meaningful data about the software
- Pretty much all of WWWW

*Wouldn't it be neat if they looked more like...*

# What if...

Isn't this a little more meaningful?

```
Jan 24 12:00:20 example-host apache[32767]: 10.1.2.3 "GET /webmail.php HTTP/1.0"  
Jan 24 12:00:47 example-host imapd[40929]: imap service init from localhost:apache  
Jan 24 12:00:47 example-host imapd[40929]: user wvrk authenticated  
Jan 24 12:00:48 example-host imapd[40929]: user wvrk downloaded 3 new messages  
Jan 24 12:00:49 example-host imapd[40929]: user wvrk messageids: 1234, 2345, 3456  
Jan 24 12:00:49 example-host imapd[40929]: user wvrk  
Jan 24 12:01:21 example-host apache[32767]: webmail.php: user wvrk session terminated
```

*What can dev do to improve the status quo?*

# Dev's role in infosec

How do you contribute to infosec today?

- Protect
- Detect
- React

*Now, let's consider some alternatives*

# Protect –1

## Designing the software

- Think about the application-to-OS interface
- Compartmentalization of function
  - Make full use of OS security features
    - E.g., separate identities/credentials for different functions
  - Virtual machines for some functions
- Case study: Postfix MTA

# Protect –2

## Deploying the software

- File and directory access controls
- Apply the principle of least privilege

*“Every program and every user of the system should operate using the least set of privileges necessary to complete the job.”*

*– Saltzer and Shroeder, 1975*



# Protect –3

## Security states

- Many infosec organizations use a tiered priority scale for security incidents
  - E.g., “Infocon”, priority 1-5, green through red scale
- Consider how your software might be aware and interact
  - E.g., heightened logging, defensive posture

# Protect –4

## App-level intrusion detection

- Consider viability of a “mini IDS” in your software
  - E.g., statistical profiling of normative behavior
  - Possibly in conjunction with extant IDS
- Case study: hotel credit card processing “velocity checker”

# Detect –1

Your app has just detected a XSS attempt

- What does it do in response?
- Lock out user account?
- Call the CSIRT?

User forgot his password and had it reset

- Do anything different?
- How about zeroing sensitive data from customer account?

# Detect –2

## Event logging and monitoring

- Client and server considerations
  - Reporting agent and log concentrator
- Highest risk components of software
  - Your architectural risk analysis should guide you here
- Consider how your application works with your Ops team's monitoring
  - What would you need to know if you had to analyze an intrusion?
  - Do they use any standardized data fields, nomenclature, or other practices?

# Detect –3

## More thoughts on logging...

- Integrate with existing event logging systems
  - E.g., Windows, syslog, syslog-ng
    - Also consider SNMP, CMIP or other management protocols
  - Watch out for free-form data
  - Cross-site scripting opportunity?
- Be careful about what is logged
  - Privacy laws
  - Coordinate this thoroughly with legal counsel
  - Case study: US retailer

# Detect –4

## Support for “Infocon” tiers

- Is state read-only or can your app affect elevated levels?
- Log additional data for high tiers?
- Random security questioning of users?

Example: NTFS event logging options

# React –1

Ok, the alarm has been pulled—now what?

- Evidence handling support
  - Log query and search tools
  - Tamper-evident seal for log extracts
  - Digital signatures of log data to enhance non-repudiation capabilities
- Quarantine of suspect data
  - Data uploaded to app stored away in a safe place

# React –2

## Support for honeypots

- Shunting attacker to alternate system
- Stateful export to honeypot
  - Sanitized system data
  - Account credentials
  - Realistic



# Infrastructure

Be sure your logging architecture is solid

- Centralized log server
  - Monitored by security team
- Secure protocols
- Non-repudiation of logged data
- Mutual authentication
  - How do you know you're talking to the logger
- What's the performance impact?
  - Separate admin data from production

# Legacy apps

How do you improve the auditability of your legacy apps?

- Application firewalls can help to a degree
  - Most are exclusively for web apps
- Must have intimate knowledge of how the app works in order to be useful
- Event logging is a trivial and natural add-on this way

# Getting started

Don't wait for "them" to come to you

- Seek out the CSIRT at earliest stage of the dev process
  - Coordinate features, logging, etc.
  - Inventory of what gets logged is vital
  - Interface with IDS data/team to ensure compatibility with app logging data
- Seek out General Counsel or privacy officer
  - Ensure logging is in compliance
  - May need to be different by region

# The difference

*You're thinking that a lot of these things seem pretty extreme. Some are.*

*However, all of them are borne from experience in the trenches.*

*A well auditable app will make an enormous difference when the alarms go off.*

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