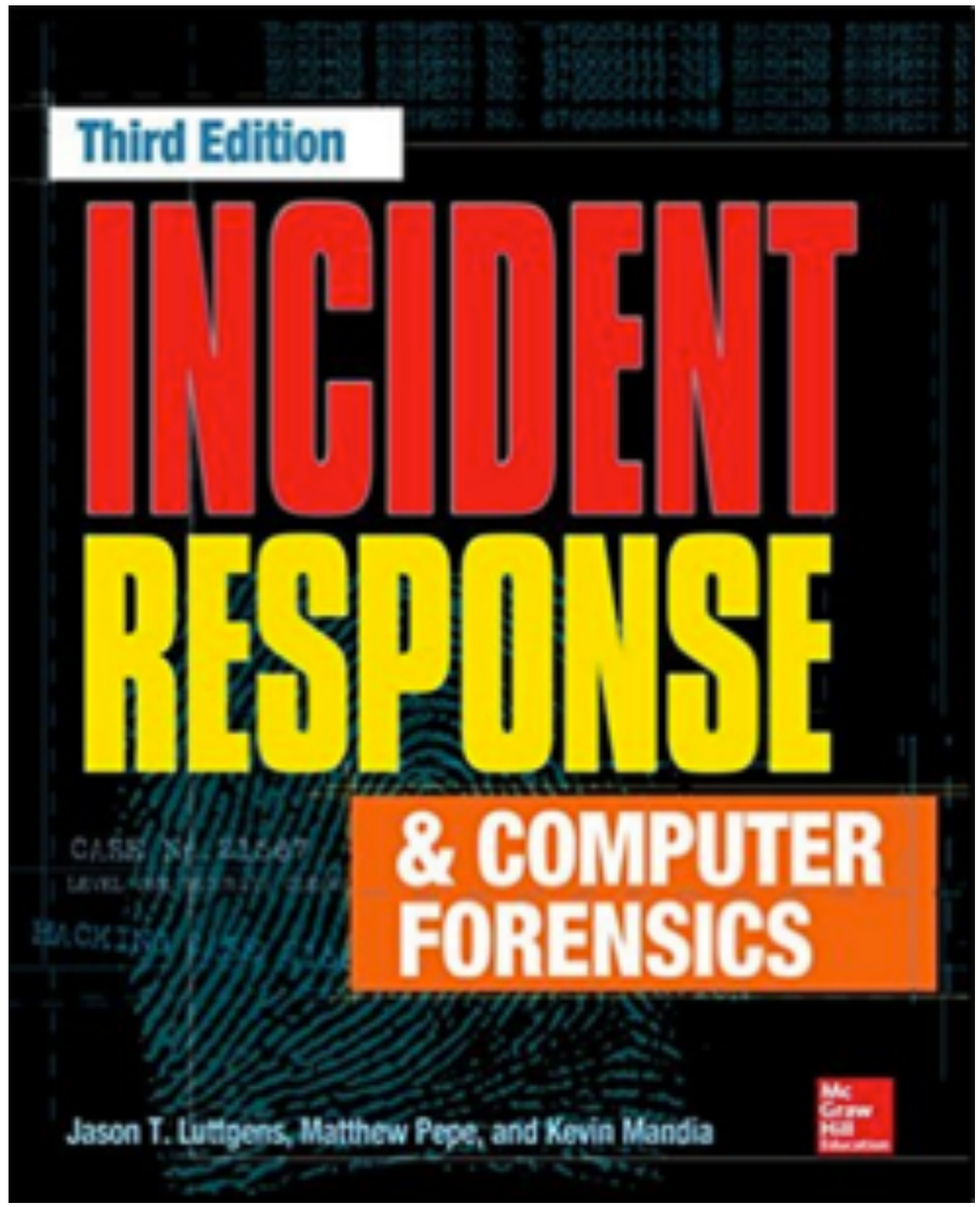
CNIT 121: Computer Forensics



1 Real-World Incidents

Events and Incidents

- **Event**
  - ***Any observable occurrence in a system or network***
- **Incident**
  - ***Violation or threat of violation of security policies, acceptable use policies, or standard security practices***

Incident Response

- **Confirm whether an incident occurred**
- **Rapid detection and containment**
- **Determine scope**
- **Prevent a disjointed, noncohesive response**
- **Determine and promote facts and actual information**
- **Minimize disruption to business and network operations**

Incident Response

- **Minimuze damage to the compromised organization**
- **Restore normal operations**
- **Manage public perception**
- **Allow for legal action against perpetrators**
- **Educate senior management**
- **Enhance security posture against future incidents**

IR Teams

- **Investigation team**
  - **Determines what has happened and performs a damage assessment**
- **Remediation team**
  - **Removes the attacker and enhances security posture**
- **Public relations**

Live Response

- **Classical forensics was done post-mortem**
  - **On a hard disk image**
- **Now much analysis is performed on systems that are powered on (live)**
  - **Including memory analysis to see running processes, network connections, etc.**

Case 1

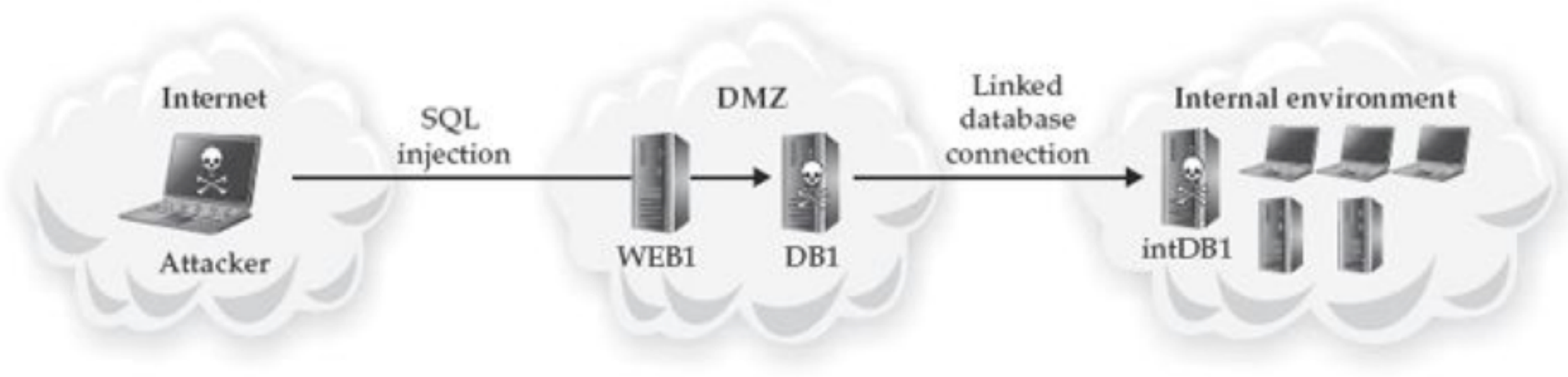
Show Me the Money

Initial Compromise

- **Early January: SQL injection vulnerability exploited on server WEB1**
  - **In a DMZ belonging to a small business unit purchased by the parent organization four years prior**
- **Command execution on database server DB1, with privileges of the SQL Server service (local administrator)**
  - **Using xp_cmdshell**
  - **Download malware and execute it on DB1**

Escape DMZ

- **Misconfiguration in DMZ firewall allowed malware to execute SQL commands on a database server intDB1**
- **Located within the corporate environment**



Recon

- **Attacker spent weeks performing reconnaissance of corporate environment**
- **For first week, attacker used SQL injection**
- **Then the attacker implanted a backdoor**
- **Extracted and cracked password hash for local administrator account on intDB1**
- **Now the attacker has local admin on most systems**

Exploit Domain Controller

- **Installed keylogger malware**
- **Obtained password hashes from multiple systems for administrator accounts**
  - **Including hashes from the Domain Controller**

Mid-February

- **More than 20 backdoors, spanning three distinct malware families**
- **We'll call the primary backdoor family BKDOOR**
  - **Custom malware creation kit**
  - **Allowed attacker to modify binaries to avoid antivirus detection**

BKDOOR

- **Full control of victim system**
- **File upload and download**
- **Tunnel Remote Desktop Protocol trafic into the environment**
- **Proxy network traffic between backdoors**
- **Encrypts command-and-control (C2) traffic with RC4 "C2 data"**
- **Persistence through "DLL search-order hijacking"**

PROXY Malware Family

- **Redirected connections to destination address specified in its configuration file**

- **Can also accept original destination address from the BKDOOR malware**

BKDNS Malware Family

- **Tunneled C2 traffic through DNS queries and responses**
- **A backup system, not used during this investigation**
- **Used on both Windows and Linux systems**

Late March

- **Attacker stole data multiple times**
- **Took usernames and passwords**
- **Network architecture and IT information**
- **Information about financial systems and how financial data was handles**

Stealing Financial Data

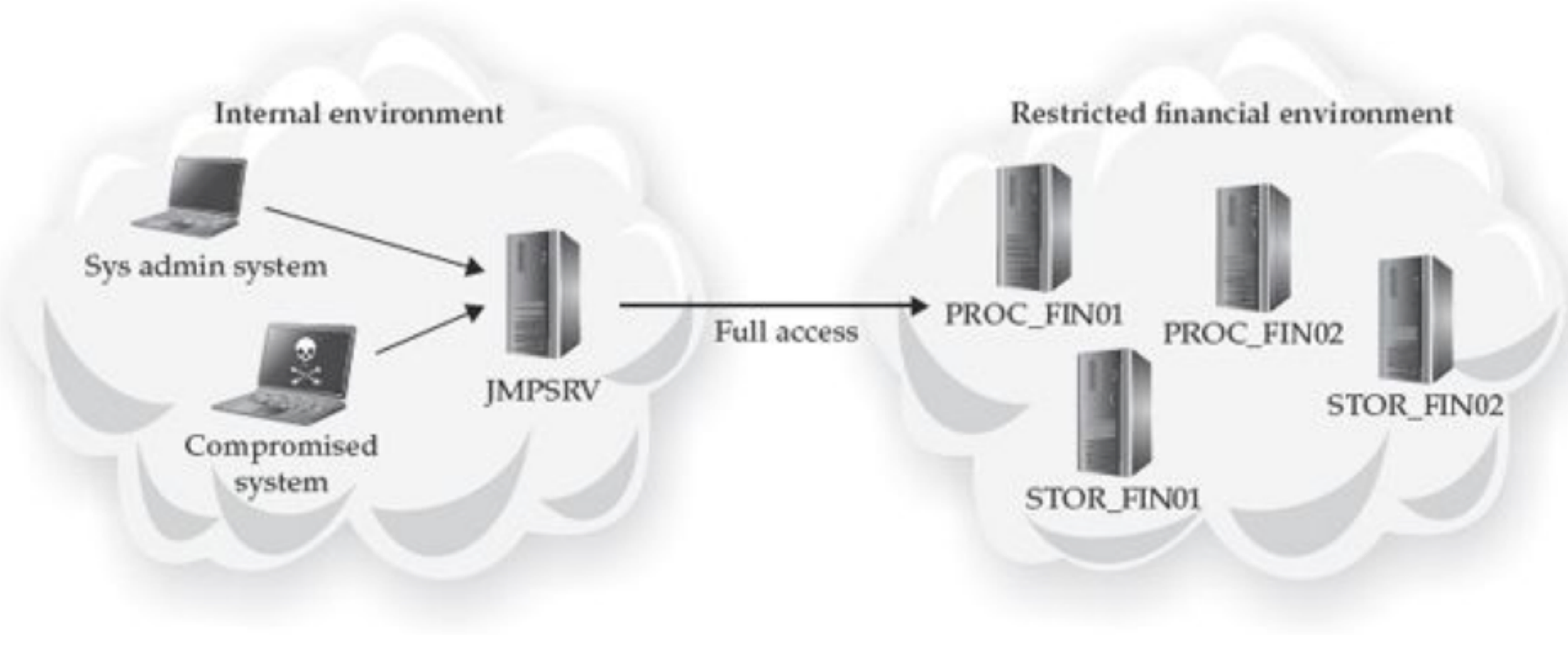
- **Outbound FTP connection to an attacker-controlled FTP server**

- **Also used a backdoor to send financial data to C2 server**

- **Compressed the data as ZIP, RAR or CAB files**

Jump Server

- **Gateway into restricted financial environment**



PCI Data

- **Payment Card Industry data**
- **Magnetic stripe has two tracks**
  - **Track 1 & Track 2 (similar data)**
- **CVV/CVV2 number used to verify physical possession of the card**
- **Not all merchants collect the CVV/CVV2 number**

Compromise JMPSRV

- **Gained access with stolen domain administrator password (two-factor authentication not used)**
- **Transferred reconnaissance tools to JMPSRV**
- **Begin reconnaissance of restricted financial environment**
- **Took password hashes from RAM on JMPSRV**

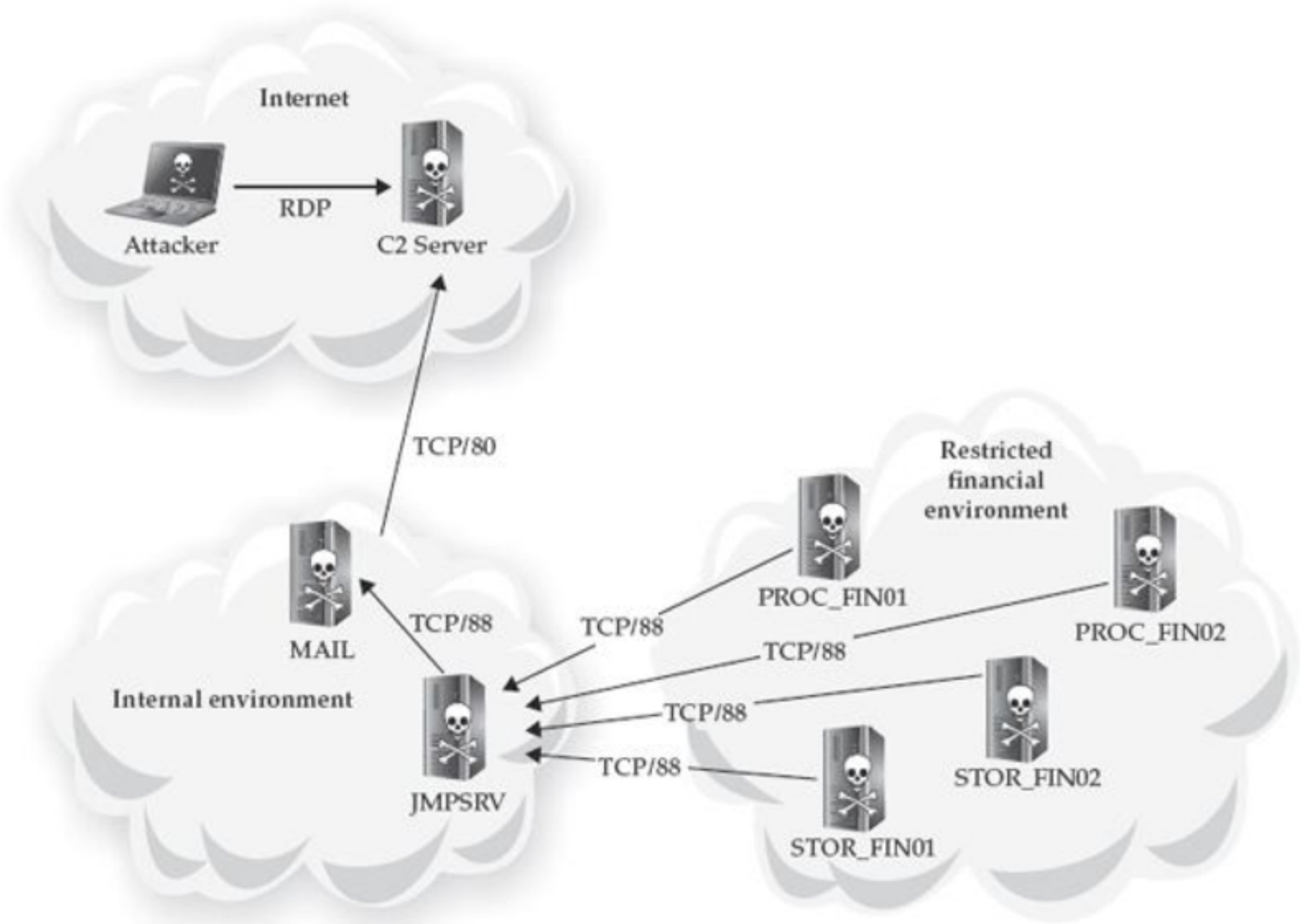
Recon

- **Next two months finding**
  - **Systems that processed or stored cardholder information**
  - **Systems with direct Internet connections**
- **Stole documents that described the infrastructure**

Naming Convention

- **90 systems processed or stored financial information**
- **PROC_FIN01, PROC_FIN02, STOR_FIN01, STOR_FIN02, etc.**
- **None connected directly to the Internet**
- **Attacker sent data through JMPSRV and MAIL to get out**

Proxy Connections



Testing Methods

- **Put Sysinternals "PsSuite" on PROC_FIN01**
  - **Used pslist to see running processes**
  - **Dumped RAM from multiple processes**
  - **Created a RAR archive and transferred it out**
- **Trying to find processes that contained cardholder data**

Cardharvest

- **Two days later, attacker installed a custom binary named "cardharvest.exe" onto PROC_FIN01**
  - **Searched process RAM for Track 2 data every 15 seconds**
  - **Hashed the data to prevent duplicate collection**
  - **Encrypted it using RC4 and a hard-coded static key**
  - **Saved it to a local file**

Three Months

- **Over the next three months**
- **Attacker stole millions of cardholder data records**
- **From all 90 financial systems**

Detection

- **After ten months of exploitation**
- **A system administrator noticed that MAIL was communicating with a server in a foreign country over port 80**
- **Triage showed that there was a compromise**
- **Initiated incident response**

Incident Response

- **Team travelled to client location**
- **Immediate containment plan**
- **Comprehensive incident investigation**
- **Eradication event to remove all traces of the attacker**
- **Less than two months for complete IR**

Investigation Team

- Search for indicators of compromise on all systems in the environment
- Analyze Windows, Linux, and Apple OS X systems
- Analyze network traffic from more than 10 Internet points of presence
- Analyze both Windows (PE) and Linux (ELF) malware
- Understand complex financial systems and a complex environment in order to fully understand the incident

Remediation Team

- Implement an immediate containment plan for the restricted financial environment
- Work with the investigation team to develop a more comprehensive approach to the overall remediation effort
- Implement a sweeping eradication event across the organization within a two-day period
- Work around the real-world impact of affecting financial systems for any length of time

Case 2

Certificate of Authenticity

Initial Compromise

- **In mid-May, attacker sent 100 spear-phishing emails**
  - **Targets chosen because of business relationship to speakers at an industry conference**
  - **Most had local administrator privileges**
  - **None had domain administrator privileges**

Malicious PDF

- **One recipient, Bob, opened the attachment with a vulnerable version of Adobe Acrobat**
- **Exploit installed GHoST RAT (Remote Access Trojan)**
- **Attacker gained control of BOBSYS01 from the C2 server**

VPN Compromise

- **Two days later, attacker performed reconnaissance on BOBSYS01**
- **Bob was an engineer**
- **Had VPN software that used a machine certificate, username, and password**
- **Obtained and cracked local administrator password hash**
- **Used mimikatz.exe to extract Bob's password and VPN machine certificate**

The Attacker Obtained

- Bob’s username
- Bob’s password
- Bob’s machine certificate
- Local administrator password (the same for most systems in the environment)

- **No longer needs Bob's system**
- **Attacker can now VPN in from any system**

HOME3

- **Less than one week later**
- **Attacker connected via VPN from a system named HOME3**
- **Used RDP but ended the session by closing the window instead of logging out**
- **Caused an event to be logged in the Security event log**
  - **Capturing attacker's host name and IP address (from Texas)**

Recon

- **Attacker spent the next 2 weeks performing reconnaissance**
- **Mapped network shares and directory listings**
- **Installed keyloggers**
- **Accessed email through Outlook Web Access (OWA) with stolen credentials**

SENS1

- **Two weeks later, attacker started accessing business-critical data from a share on file server SENS1**
- **Sensitive engineering data for a new product**
- **Access Control Lists (ACLs) restricted this data to engineers working on the project**
  - **But the attacker had local administrator access and modified the ACLs to gain access**

Next Four Weeks

- **Attacker sporadically stole data**
- **Created encrypted RAR files**
- **Renamed them to CAB files**
- **Uploaded to an attacker-controlled FTP server**
- **Then deleted RAR file and ran Windows defragmentation utility**
  - **In an attempt to cover tracks**

SIEM

- **Two weeks after the attacker began stealing data**
- **Company started evaluating a new Security Information and Event Management (SIEM) utility**
- **Included VPN logs in the data sets**
- **SIEM showed Bob logging in from multiple systems and IP addresses simultaneously on multiple days**

Chasing Attacker

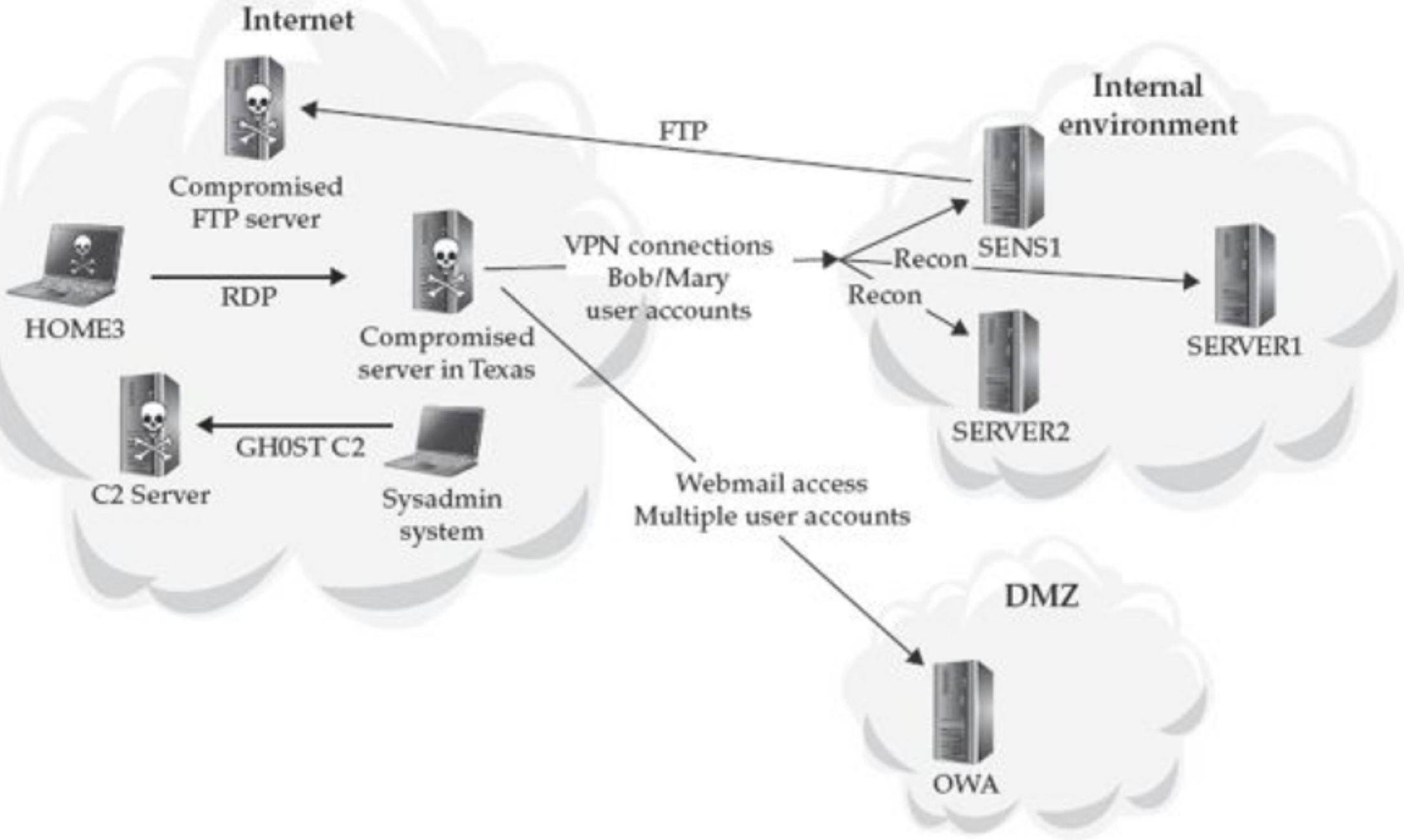
- **Security staff disabled Bob's account**
- **Attacker started using another account, Mary's**
- **SIEM quickly discovered malicious use of Mary's account**
- **Initiated incident response and called IR specialists in**

Real IR

- **Identify IP addresses attacker used to VPN from**
- **GHoST RAT was sending beacons to one of those same IPs**
- **This led to discovery of compromise on BOBSYS01**
- **Comprehensive eradication event performed two weeks after IR initiated**

OWA Access

- **Two days after the eradication event**
- **SIEM detected one of attacker's IP addresses attempting access to OWA, with multiple user accounts**
- **Even though company had changed all passwords during the eradication event, not all users had actually changed their passwords**
- **A second enterprise-level password change disabled all accounts that failed to change passwords within 24 hours**


Internet
Compromised
FTP server
FTP
Internal
environment
HOME3
RDP
Compromised
server in Texas
VPN connections
Bob/Mary
user accounts
Recon
Recon
SENS1
SERVER1
SERVER2
GH0ST C2
C2 Server
Sysadmin
system
Webmail access
Multiple user accounts
DMZ
OWA

Attack Lifecycle