Preparing for Mainframe Security Vulnerabilities

SDS MAINFRAME SECURITY

Finding Awareness, Virtuality, Boundaries, and Humanity in Mainframe Security

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Approach

- Pre-Computing Security Awareness
- Security Virtualization and Virtuality
- Passive versus Active Approaches
- Mandates
- Dissolving the Boundary Between History and Real-Time
- Reaction, Alerting, Automation, and Platform Choice
- Pervasive Humanity

Pre-Computing Security Awareness

- Trust, Group Identities, Shibboleths, Rumpelstiltskin
- Armor, Walled Cities, Keeps
- Locks, Doors, Guards, Passwords
- Rules, Laws, Sanctions, Enforcers, Legal Systems
- Records: Individuals, Chronicles, Logs

"Those who cannot remember the past are condemned to repeat it."

– George Santayana

Security Virtualization and Virtuality

- Locked doors and server rooms
- Passwords and resource-attached access
- "I was just kidding" vs Military-grade security
- Rings of security?
- Separation of duties; externalization of security
- Secrets, integrity, but not trust
- SMF, SYSLOGs, other LOGs
- Three types…

Passive versus Active Approaches

- Know the past, but it's not enough
- Know patterns, but it's not enough
- Build protection, but it won't stay enough
- Look for what isn't the case, not just "eureka"
- Stay informed on issues and fixes

Mandates!

- Accounting principles
- Professional standards
- Business and stock market laws, rules
- SOX!
- PCI, HIPAA,GLBA, PIPEDA, GDPR, etc.
- Limitations: Moore's Law and Murphy's Law

Dissolving the Boundary Between History and Real-Time

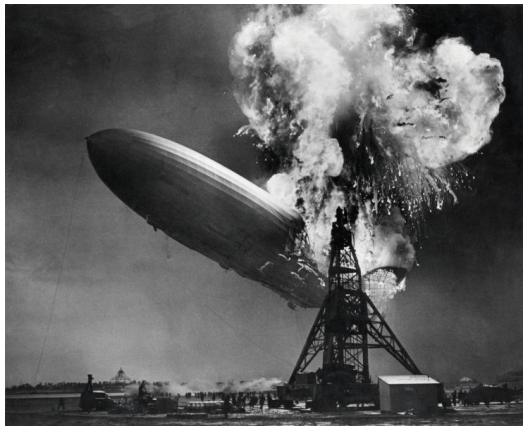
- Real-time notification of alerts
- Intelligence, pattern matching, emergent patterns: AI
- Consolidation of sources
- Selection of sources
- Dynamic adjustment, refinement, curation

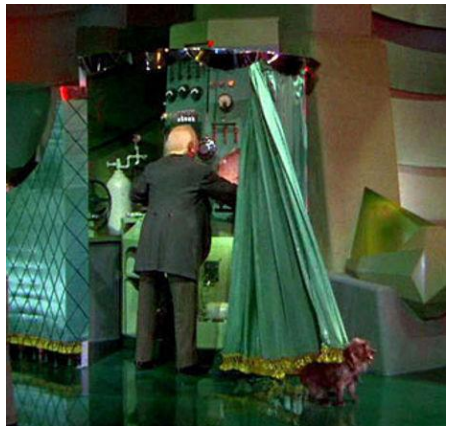
Reaction, Alerting, Automation, and Platform Choice

- "Automate as close as possible to the source" refers to keeping events, reactions, and targets close
- But with multiple platforms, the locus is the business and its people
- Synchronous, on-platform, vs asynchronous, multi-platform
- Flooding of automated actions can become DoS; likewise with alerts
- Build and respond to a four-dimensional picture
- …because it's all about…

Pervasive Humanity

Oh, the humanity!





"Technology out of control" and "The man behind the curtain"

- Humanity: the standard, the target, the meaning, the future
- The shape of things to come orbits the shape of humanity
- The choice of what matters, how to react and proact, always comes home

SDS MAINFRAME SECURITY

Improving Mainframe Security by Addressing Vulnerabilities through SIEM

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Agenda

- 2022 Cost of a Data Breach Report - Ponemon
- What is SIEM and why should you integrate the mainframe into your SIEM strategy?
- z/OS security events you should consider sending to your SIEM

2022 Cost of a Data Breach Report: IBM & Ponemon Institute

- Average total cost of a data beach in the US is $9.44 million.
- It took an average of 277 days to identify and contain a data breach.
- Leveraging AI and automation tools saved $3.05 million per breach.
- Implementing a zero trust architecture saved $1 million per breach.
- Extended detection and response (XDR) technologies helped save an average of 29 days in breach response time.

Why integrate z/OS events into SIEM?

- Compliance requirement
  - PCI, SOX, HIPAA, GLBA, etc.
- Mainframes contain sensitive data
  - Target for hackers
  - Large corporations have 70% of data on mainframes
- z/OS is not invulnerable
- If you have a SIEM, include the mainframe!

What is SIEM? – Security Information & Event Management

- Security Management provides a holistic view of an organization's information technology security
- SIEM combines SIM (Security Information Management) and SEM (Security Event Management) functions into ONE Security Management System

Why SIEM?

- SIEM is the core of a defense in-depth strategy
- Attackers leave behind a trace – Logs
- Security events provide insight into…
  - When the event occurred?
  - Why it happened?
  - What happened?

- This portion of the presentation is about security events you may want to consider monitoring using a z/OS SIEM data collection agent.
- The suggestions are by no means exhaustive, my goal is to provide general recommendations as a foundation for a thorough security evaluation and configuration of a z/OS SIEM agent.

Mainframe Vulnerabilities

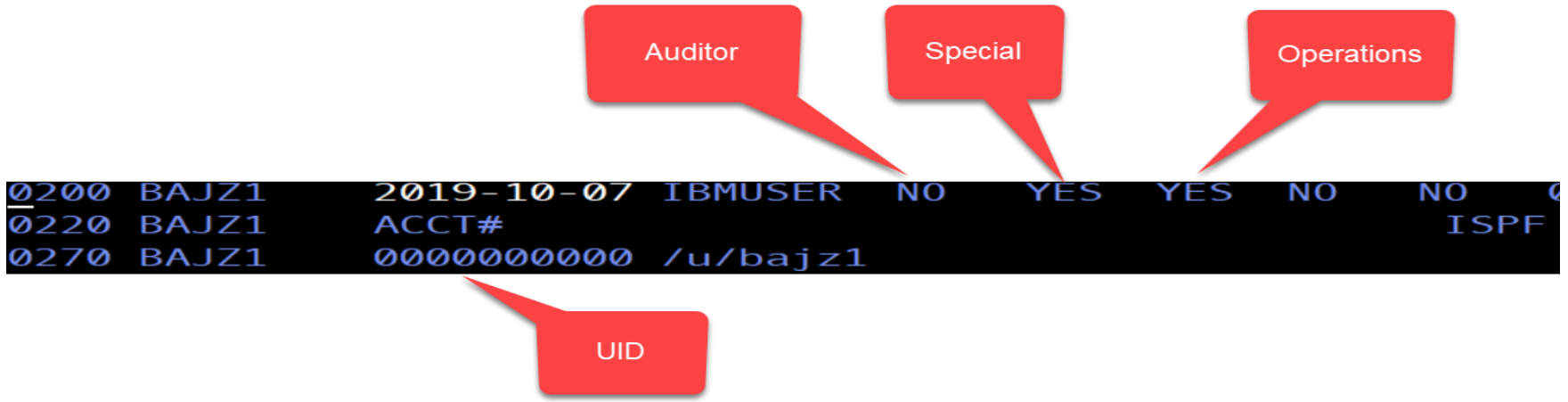
- Sharing credentials with others
- Unauthorized access to APF libraries
- RACF database improperly protected
- Excessive number of super users
- Data set profiles with UACC(READ) or higher
- Data set and resource profiles in WARN mode

Vulnerability: RACF Database Inadequately Protected

- Nefarious user, looking for a way to elevate their security level, issues RVARY command
  - Video 1

Vulnerability: RACF Database Inadequately Protected

- The command works, and the user knows the name of the primary and backup RACF databases
- Knowledge of the RACF database name allows our user to attempt to offload the database using IRRDBU00.
- The output is a flat file image of the RACF database. Using this file, the users with the SPECIAL attribute can be identified
- The passwords are not viewable but, using this information, attempts can be made to guess or crack the passwords of the users with increased authority



Vulnerability: RACF Database Inadequately Protected

- Without the SIEM agent the "unauthorized user" could go on for months unnoticed
- Even if there was no malicious intent, corrective action could be taken immediately to eliminate the vulnerability

Vulnerability: User Increasing Their Own Authority

- User with Special Authority gives themselves Operations Authority
- Perhaps there's some legitimate reason for this but Special and Operations authority on the same user ID is a "dangerous" combination
- The SIEM captures the Security Event

```
<113>Oct 03 14:10:43 SDS1 CEF:0|SDS|VSA|4.2.1|SMF80:13-00 RACF|ALTUSER|9|cat=SMF dvchost=SDS1 cs4Label=CpuSerial cs4=0003BEF72965 dst=172.22.157.10 rt=Oct 03 2022 14:1
0:43 duid=BAJZ1 dproc=BAJZ1 externalId=0187793.0 rawEvent=SMF80:13-00 RACF dpriv=CUSTOMER cs1Label=Rule cs1=BYP:Bypass Rule Checks  reason=Success EvtCd-EvtQual=13-00 s
priv=SPECIAL cs5Label=Reason1 cs5=Chg-to-class-of-prof,SETROPTS-AUDIT(cl)/Profile-chg,AUDITOR-did-SAUDIT,SPECIAL requestClientApplication=TCPS0056 DT006=RACF-Command:Kw
d=SPECIAL%%User=BCVR0   DT038=User/Group-Owner-of-Profile:CUSTOMER DT049=User-on-ACEE:ART ZEIGLER DT053=User-security-Tokens:PORTofEntry:TCPS0056,OwningUser:BAJZ1   ,O
wningGroupId:CUSTOMER
```

Recommendations

- Enable and monitor SMF type 80 security records (written every time a RACF command is executed successfully or not)
- All RACF commands should be monitored, especially those that:
  - Add new user profiles (ADDUSER)
  - Alter user profiles particularly to increase authority (ALTUSER
  - Changes to the password associated with a user profile (PASSWORD)
  - Add new data set profiles or alter existing profiles (ADDSD, ALTDSD)
  - Alter resource access lists (PERMIT)
  - Define or alter general resource profiles (RDEFINE, RALTER)
  - Change or display the status of the RACF database (RVARY)
  - Set RACF options (SETROPTS)

Vulnerability: Password Guessing

- An "unauthorized user" has learned (by offloading the RACF database, guessing, or intuiting) the IDs of privileged accounts
- User attempts to logon by guessing passwords, stopping short of the site-defined limit on invalid passwords
- Legitimate users enter invalid passwords all the time
  - But having multiple invalid attempts on 2 different user IDs from the same terminal within minutes of each other is suspicious

<113>Nov 22 11:34:51 SDS1 CEF:0|SDS|VSA|4.2.1|WTO|ICH408I|9|cat=WTO dvchost=SDS1 cs4Label=CpuSerial cs4=0003BEF72965 dst=172.22.157.10 rt=Nov 22 2022 11:34:51 duid=BCVR1 dproc=SDS1 externalId=0075380.0 reason=ICH408I cs1Label=Rule cs1=MES:ICH408I* cs2Label=message cs2=ICH408I USER(BCVR1) GROUP(CUSTOMER) NAME(COLIN VAN DER ROSS) LOGON/JOB INITIATION - INVALID PASSWORD ENTERED AT TERMINAL O31TCP18

<113>Nov 22 11:34:51 SDS1 CEF:0|SDS|VSA|4.2.1|SMF80:01-01 RACF|JOB-INITIATION/TSO-LOGON/TSO-LOGOFF|9|cat=SMF dvchost=SDS1 cs4Label=CpuSerial cs4=0003BEF72965 dst=172.22.157.10 rt=Nov 22 2022 11:34:51 duid=BCVR1 dproc=BCVR1 externalId=0075379.0 rawEvent=SMF80:01-01 RACF dpriv=CUSTOMER cs1Label=Rule cs1=BYP:Bypass Rule Checks reason=INVALID-PASSWORD EvtCd-EvtQual=01-01 cs2Label=descriptor cs2=VIOLATION cs5Label=Reason1 cs5=RACROUTE-REQ-VERIFY,or-initACEE-failed fileType=VIOLATIO requestClientApplication=O31TCP18 DT049=User-on-ACEE:COLIN VAN DER ROSS DT053=User-security-Tokens:PORTofEntry:O31TCP18,OwningUser:BCVR1 ,OwningGroupId:CUSTOMER

Vulnerability: Password Guessing

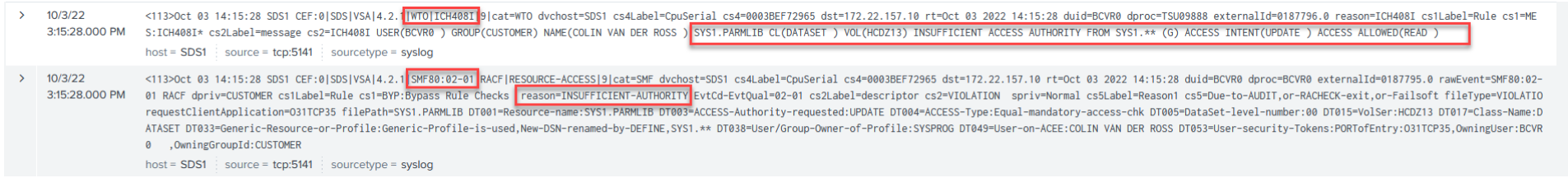
- If you not using Secure TN3270 access to your mainframe, Passwords can be sniffed using an IP Packet Trace
- Here is an example of an IP Packet Trace capturing a TSO LOGON
  - Video 2

Recommendations

- Enable and monitor SMF type 80 records that log invalid passwords
- Alternatively monitor console messages (ICH*, ACF*, TSS*) that log invalid password attempts to the system log
- Pay particular attention to attempts to access privileged user IDs and attempts to access different user IDs from the same terminal or IP address
- Implement secure TN3270 access to the mainframe

Vulnerability: Unauthorized Access to PARMLIB

- In the Security event below the user attempts to update PARMLIB



- Although update is denied, the user has read authority which allows access to a wealth of information including a list of APF authorized libraries and the program properties table that includes programs that can bypass RACF

```
 /*                    OMVS
PPT PGMNAME(BPXVCLNY)                  /* PROGRAM NAME
    CANCEL                             /* CAN BE CANCELLED (DEFAULT)
    KEY(8)                             /* PROTECTION KEY   (DEFAULT)
    NOSWAP                             /* NON-SWAPPABLE
    PRIV                               /* PRIVILEDGED
    SYST                               /* SYSTEM TASK , NOT TIMED
    NOPASS
```

Vulnerability: Unauthorized Access to APF Libraries

- User attempts to edit an APF authorized library and is denied by RACF

```
ICH408I USER(BCVR0    ) GROUP(CUSTOMER) NAME(COLIN VAN DER ROSS   ) 362
  SDSQ.VSA.LOADLIB CL(DATASET ) VOL(SDSSY1)
  INSUFFICIENT ACCESS AUTHORITY
  ACCESS INTENT(READ    )  ACCESS ALLOWED(NONE    )
```

- The SIEM Agent captures the event and forwards it to the SIEM in real-time

<113>Oct 03 14:00:45 SDS1 CEF:0|SDS|VSA|4.2.1|WTO|ICH408I|9|cat=WTO dvchost=SDS1 cs4Label=CpuSerial cs4=0003BEF72965 dst=172.22.157.10 rt=Oct 03 2022 14:00:45 duid=BCVR0 dproc=TSU09888 externalId=0187772.0 reason=ICH408I cs1Label=Rule cs1=MES:ICH408I* cs2Label=message cs2=ICH408I USER(BCVR0) GROUP(CUSTOMER) NAME(COLIN VAN DER ROSS) SDSQ.VSA.LOADLIB CL(DATASET) VOL(SDSSY1) INSUFFICIENT ACCESS AUTHORITY ACCESS INTENT(READ) ACCESS ALLOWED(NONE)

<113>Oct 03 14:00:45 SDS1 CEF:0|SDS|VSA|4.2.1 SMF80:02-01 RACF|RESOURCE-ACCESS|9|cat=SMF dvchost=SDS1 cs4Label=CpuSerial cs4=0003BEF72965 dst=172.22.157.10 rt=Oct 03 2022 14:00:45 duid=BCVR0 dproc=BCVR0 externalId=0187771.0 rawEvent=SMF80:02-01 RACF dpriv=CUSTOMER cs1Label=Rule cs1=APF:SDSQ.VSA.LOADLIB reason=INSUFFICIENT-AUTHORITY EvtCd-EvtQual=02-01 cs2Label=descriptor cs2=VIOLATION spriv=Normal cs5Label=Reason1 cs5=Due-to-AUDIT,or-RACHECK-exit,or-Failsoft fileType=VIOLATIO requestClientApplication=O31TCP35 filePath=SDSQ.VSA.LOADLIB DT001=Resource-name:SDSQ.VSA.LOADLIB DT003=ACCESS-Authority-requested:READ DT004=ACCESS-Type DT005=DataSet-level-number:00 DT015=VolSer:SDSSY1 DT017=Class-Name:DATASET DT038=User/Group-Owner-of-Profile:IBMUSER DT049=User-on-ACEE:COLIN VAN DER ROSS DT053=User-security-Tokens:PORTofEntry:O31TCP35,OwningUser:BCVR0 ,OwningGroupId:CUSTOMER

Vulnerability: Unauthorized Access to APF Libraries

- Our unauthorized user attempts to add a dataset to APF via JCL. This time he is successful

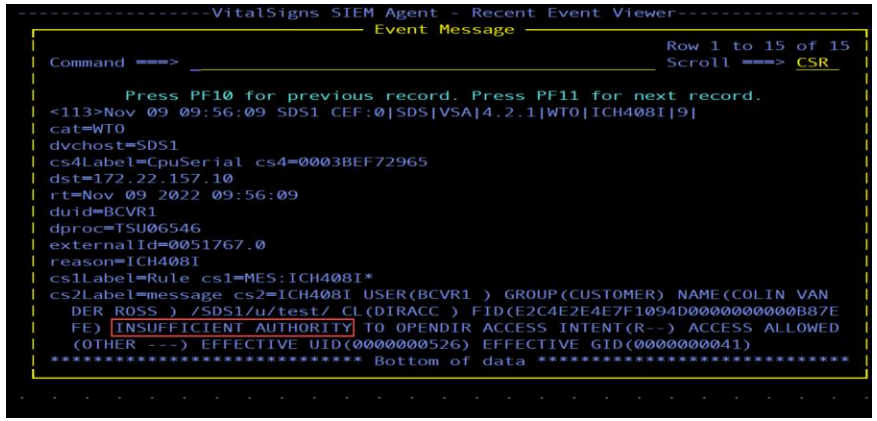
```
14:24:49.94 BCVR0     00000290  SETPROG APF,ADD,DSN=SDSQ.VSA.LOADLIB,VOL=SDSSY1
14:24:49.97 BCVR0     00000090  CSV410I DATA SET SDSQ.VSA.LOADLIB ON VOLUME SDSS
```

```
> <113>Oct 03 13:56:34 SDS1 CEF:0|SDS|VSA|4.2.1|SMF90 APFlist|Add|9|cat=SMF dvchost=SDS1 cs4Label=CpuSerial cs4=0003BEF72965 dst=172.22.157.10 rt=Oct 03 2022 13:56:34 duid=*MASTER* dproc=*MASTER* externalId=0187761.0 rawEvent=S
  MF90 APFlist cs1Label=Rule cs1=APF:* cs6Label=Function cs6=Add filePath=SDSQ.VSA.LOADLIB fileId=SDSSY1 cs3Label=Consol-Sufix cs3=01000021:** cs5Label=How cs5=UPDATE:via-SETPROG-Command|
```

- Now that the unauthorized user has discovered this “back door” he is free to add unauthorized modules to the APF library
- Any additions to APF should be investigated & escalated immediately

Vulnerability: Unauthorized Access to UNIX files

- Our unauthorized user attempts to add a UNIX file but is denied



- Attempts to alter authority using the SU command but is denied and captured by the SIEM Agent

Recommendations

- Enable and monitor type 80 SMF records which can be written for unsuccessful UNIX file access
- Enable and monitor type 80 SMF records which can be written for UNIX command attempts including
  - Check-ACCESS-to-DIRECTORY
  - Check-ACCESS-to-FILE
  - CHAUDIT (Change audit options)
  - KILL
  - SETEGID (Change effective GID)
  - SETEUID (Change effective UID)
  - SETGID (Change of GID)
  - SETUID (Change of UID)
- Enable SMF 109 records (Syslogd)

Vulnerability: Submitting JCL using FTP

- Unauthorized user logs in using FTP
- Then changes file type to JCL

```
 230 BCVR1 is logged on.  Working directory is "BCVR1.".
 Command:
site file=jes
 >>> SITE file=jes
 200 SITE command was accepted
 Command:
put 'bcvr1.colin.jcl(vipsamp)'
 >>> SITE VARrecfm LRECL=80 RECFM=VB BLKSIZE=27920
 200 SITE command was accepted
 >>> PORT 10,31,0,1,68,244
 200 Port request OK.
 >>> STOR 'bcvr1.colin.jcl(vipsamp)'
 ***
```

Vulnerability: Submitting JCL using FTP

- The batch job fails because the attempt to circumvent security did not work

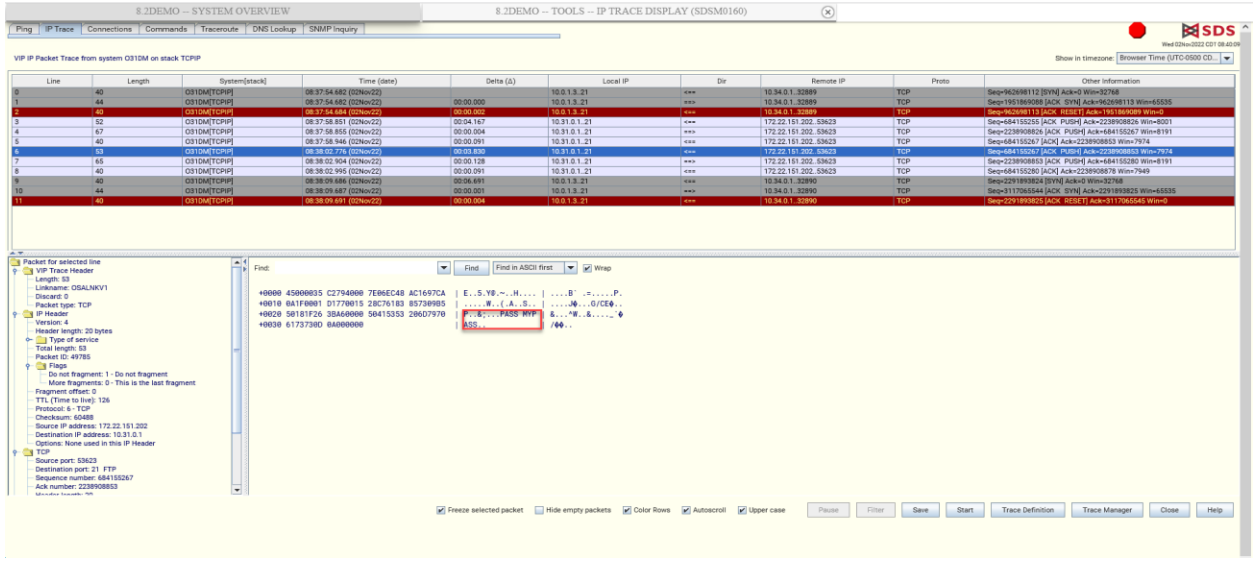
<113>Oct 13 10:56:59 SDS1 CEF:0|SDS|VSA|4.2.1|SMF80:02-01 RACF|RESOURCE-ACCESS|9|cat=SMF dvchost=SDS1 cs4Label=CpuSerial cs4=0003BEF72965 dst=172.22.157.10 rt=Oct 13 2022 10:56:59 duid=BCVR1 dproc=BCVR1 externalId=0000008.0 rawEvent=SMF80:02-01 RACF dpriv=CUSTOMER cs1Label=Rule cs1=BYP:Bypass Rule Checks reason=INSUFFICIENT-AUTHORITY EvtCd-EvtQual=02-01 cs2Label=descriptor cs2=VIOLATION spriv=Normal cs5Label=Reason1 cs5=Due-to-AUDIT,or-RACHECK-exit,or-Failsoft fileType=VIOLATIO requestClientApplication=AC169D0A filePath=SFM_SS.PORT DT001=Resource-name:SFM_SS.PORT DT003=ACCESS-Authority-requested:READ DT004=ACCESS-Type DT005=DataSet-level-number:00 DT017=Class-Name:XFACILIT DT033=Generic-Resource-or-Profile:Generic-Profile-is-used,New-DSN-renamed-by-DEFINE,SFM_SS.* DT038=User/Group-Owner-of-Profile:BAJZ1 DT049=User-on-ACEE:COLIN VAN DER ROSS DT053=User-security-Tokens:PORTofEntry:AC169D0A,OwningUser:BCVR1 ,OwningGroupId:CUSTOMER

Vulnerability: FTP Visibility

- What files are being sent to and from the mainframe?
- Are those users authorized to download & upload those files?
- READ access on a file will allow a user to download a file from the mainframe
- Subsequent dissemination of the files & information is out of your control

Vulnerability: FTP Visibility

- If you are not using Secure FTP (SFTP, FTPs, etc.), passwords and data can be "sniffed" using an IP packet trace. Are those users authorized to download & upload those files?



Recommendations

- Enable and monitor type 119 SMF records, which can be written for FTP and Telnet activity
- Monitor for increases in activity that are outside the norm and access from unexpected locations
- Evaluate FTP usage at your site
  - Intranet
  - Data that is of low importance
  - Any data that is being sent outside of your company firewall using FTP is a red flag
- Migrate to a secure form of FTP

Summary

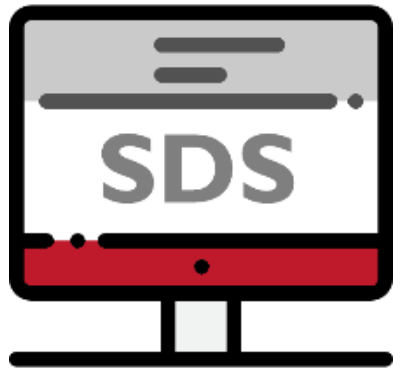
- Mainframes can be hacked
- Take stock of your organization's current situation
  - Do you have a SIEM in place?
  - Are z/OS event logs being sent to the SIEM?
  - How are you handling important WTORs and SMF records?
- Identify weaknesses and aim to improve
- We are here to help. Contact SDS for additional information on VSA and the visibility it provides

SDS MAINFRAME SECURITY

Would you like additional information?

info@sdsusa.com

(800) 443-6183
(763) 571-9000



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