

z/VM Security Essentials

Security Policy Development

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Topics

- Basic Assumptions
- Roles
- Authentication
- Authorization
- Security-sensitive commands and interfaces
- Audit
- Protecting the integrity of the CP kernel
- Centralized security management

Basic Assumptions

- The z/VM[®] system must generally conform to company and applicable regulatory policies
 - Evidence: SYSTEM CONFIG, USER DIRECT, audit trail
- A set of roles will be established
 - All virtual machines will have an assigned role
- An external security manager (ESM) will be used
- Every person accessing the system has their own user ID

Basic Assumptions

- System Programmers have the ability and the system-level authority to disable or bypass security controls
- System Programmers can access any data in the system
- System Programmers are trustworthy
 - Will obey security policy
- Violation of security policy has consequences to individuals

Roles

- Every virtual machine has a role to play
 - Security administrator
 - System programmer
 - System operations
 - Network administrator
 - Storage administrator
 - Service Virtual Machine
 - Workload (non-administrative)
 - Linux, CMS, z/OS[®], etc.

Roles

- If it has no purpose, it does not belong.
 - NOLOG it.
- Administrators, system programmers, operations staff, and SVMs are trusted
 - All others (workload) are untrusted

Roles: Delegation and Separation

- Some people have multiple roles
 - Their user ID is authorized to perform all needed tasks
- Authority often delegated
 - E.g. DIRMAINT can be configured and authorized to issue privileged RACF® command (the Connector)
 - Separation of Duties may limit delegation
- Separation Of Duties
 - Security administration and system programming are handled by different people
 - Configuration does not implicitly create authorization
 - Driven by policy
 - Strict separation prohibits fully automated provisioning

Role: Security Administrator

- Assign each new virtual machine its proper role
- Establish and maintain effective password controls
- Establish and maintain security alerting procedures
- Ensure audit data is collected and archived as required by corporate policy
- Establish internal audit schedule
- Delegate any ESM rule definition to system programmers, as required
- Manage and monitor the ESM database
- Remain educated

Role: Security Administrator

- Privilege class G
- No provisioning authority
- Read access to ESM database
- No global data access rights
- Allowed to LOGON BY to ESM server(s)
- Shall have console monitored and recorded
- Can FORCE any user
- Shall have use of LINK command monitored

Role: System Programmer

- Responsible for the general well-being of the z/VM system
 - Provisioning of real and virtual resources
 - Monitoring and alerting
 - Performance
 - Disaster recovery and high availability
 - Automation
 - Security and integrity enablement
 - ...
- May delegate some aspects to self-service applications
- Has complete access to all data

Role: System Programmer

- Privilege class: All
- Can add/delete/change resources in the ESM
- Full global data access rights
- Allowed to LOGON BY to any virtual machine except those designated as personal
- Shall have console monitored and recorded
- Shall have use of LINK command monitored

Authentication

- Access to system requires user ID and password or password phrase
 - Password is 1-8 characters, upper case, no special characters
 - Phrase is 9 or more characters, mixed case, any character
 - Longer passwords mean fewer rules are needed
- Only people have passwords or phrases
 - Exceptions for automated processes
 - Use XAUTOLOG or LOGON BY for others

Authentication

- Password and phrases must be
 - Non-trivial
 - Changed on a regular basis
 - The more powerful the user, the more often the password is changed.
 - Changed immediately after reset or new deployment
 - Encrypted
 - At rest: ESM encryption
 - In flight: z/VM SSL

Authentication: Fallback

- When ESM is down, only a small subset of users are allowed to login
 - Enables repair of the ESM
- For them, the password in the CP directory (USER DIRECT) is used
- Rules vary by ESM. RACF allows
 - Primary system operator (OPERATOR)
 - The RACF servers (RACFVM, RACMAINT)
 - The users identified by
ALTERNATE_SYSTEM_OPERATORS in SYSTEM CONFIG

Authentication: Fallback

- Restrict access to USER DIRECT, as it contains sensitive data, even when an ESM is installed

Authorization

- Which CP commands or functions can a virtual machine use?
 - Privilege class
 - OPTIONS in the user directory
 - Those that can be controlled by the ESM
 - COUPLE, FOR, LINK, MDISK, STORE HOST, TAG, TRANSFER, TRSOURCE
 - Diagnose 0x88, 0xA0, 0xD4, 0xE4, 0x280, 0x290
 - Restricted DCSS/NSS

Authorization: Escalation of Privilege

- Escalation of privilege: Performing functions that your user ID is not duly authorized to perform
 - SET PRIVCLASS
 - Service Virtual Machines (SVMs)

Escalation of Privilege: SET PRIVCLASS

- Used to add or delete privileges
 - Only class C user can add privileges that are not in the target user's directory entry
- Very useful to confirm intent
 - Change SHUTDOWN to class S
 - `COMMAND SET PRIVCLASS * -S` in OPERATOR's directory entry
 - Requires `SET PRIVCLASS * +S` before issuing SHUTDOWN
 - Not accidental

Escalation of Privilege: SET PRIVCLASS

- Do not use this command to escalate a user's privilege unless there is an accompanying update to USER DIRECT
 - Only if needed to avoid painful logoff/logon (e.g. lost T-disk)

Escalation of Privilege: Service Virtual Machines

- Service Virtual Machines (SVMs) run programs that are used to help manage the activities of the system
 - RACFVM
 - DIRMAINT
 - TCPIP
 - PERFSVM
 - FTPSERVE
 - ...
- They are privileged, so they should only run code from a trusted source

Escalation of Privilege: Service Virtual Machines

- Some SVMs accept arbitrary CP or other sensitive commands from an SVM-authorized user
 - NETSTAT CP, SMSG RSCS CP, DIRM CP, SSLADMIN SYSTEM
 - DIRM CMS RAC SETROPTS or PERMIT (!!)
 - Automation tools
- Accountability may be lost or blurred
 - Requires SVM audit log
- May be able to use exits to control

Escalation of Privilege: Service Virtual Machines

- Do not artificially force administrators to use SVMs
 - Not any safer than giving them the privilege they need
 - Promotes privilege escalation for convenience
 - "Attractive nuisance"
- However....

Escalation of Privilege: Service Virtual Machines

- Every rule has an exception (except this one?)
 - Escalation of privilege is allowed with management permission
 - If time is of the essence and permission cannot be reasonably obtained, management must be notified afterwards.
 - After the crisis is past, privileges are returned to normal
 - Repeated escalation indicates a problem with privilege assignments

Authorization: Access Rights

- Virtual machines with the same role need access to the same resources
- To simplify, use a group structure.
 - Authorize group
 - Add users to the group

Security-Sensitive Commands and Interfaces

- **STORE HOST – Class C**
 - Alters CP memory, data or code
 - Turn off the fences
 - Only use it when directed by Support Center
- **SET SYSOPER – Class A**
 - Can be used to effectively bypass OPERATOR confirmation or to hide notifications

Security-Sensitive Commands and Interfaces

- SET SECUSER – Class A, C, G
 - Take the virtual console from a user (A, C)
 - Give the virtual console to another user (G)
 - Issue commands and see output
- SET OBSERVER – Class A, C, G
 - See output of another virtual machine
 - Works while other virtual machine logged on, too

Security-Sensitive Commands and Interfaces

- SEND – Class C, G
 - Send command or replies to virtual machine console
 - Guest or CP
 - Class G requires SECUSER
 - Class C can send to any disconnected user
- XAUTOLOG ... ON – Class A, B
 - Place virtual console on OSA-ICC or TN3270 session
 - Can give access to virtual machines you do not have LOGON BY or SECUSER access to

Security-Sensitive Commands and Interfaces

- FOR – Class C, G
 - Synchronously issue CP commands on another user ID
 - Class G requires LOGON BY or SECUSER
 - Class C can issue to anyone

Security-Sensitive Commands and Interfaces

- **DEFINE MDISK – Class A**
 - Must also be current system operator (SYSOPER)
or
 - Must have OPTION DEVMAINT in the directory
 - Creates minidisk on any volume attached to SYSTEM
 - No ESM controls, so can DEFINE MDISK to create a minidisk overlay on a disk the issuer is not permitted to LINK
- **Diagnose 0x04 – Class C, E**
 - Programming equivalent of DISPLAY HOST
 - Treat them the same from an auditing perspective

Security-Sensitive Commands and Interfaces

- Diagnose 0x84 – Class B
 - Updates the active user directory without running DIRECTXA
 - OPTION D84NOPAS allows issuer to avoid the need to have the target user's password.
 - Only give to directory manager.
- Diagnose 0x88 – Class G (ESM control)
 - Validate passwords, verify LOGON BY authority, LINK to minidisks
 - If ESM defers, OPTION DIAG88 required.

Security-Sensitive Commands and Interfaces

- Diagnose 0xA0 – Class G (ESM control)
 - Perform privileged ESM-specific functions
- Diagnose 0xD4 – Class B (ESM control)
 - Allows issuer to change its identity for purpose of linking to minidisks, making IUCV or APPC connections, or creating spool files

Security-Sensitive Commands and Interfaces

- Diagnose 0xE4 – Class ANY (ESM control)
 - Obtain information about minidisks
 - Limited to own minidisks unless issuer has OPTION DEVMAINT or OPTION DEVINFO in the directory
 - With OPTION DEVMAINT, can also create fullpack minidisk overlays (similar to DEFINE MDISK)

Security-Sensitive Commands and Interfaces

- Diagnose 0x2C4 – Class B or OPTION LXAPP
 - Used to transfer data to/from Support Element
 - Used by FTP server
 - Can be used to transfer data outside of traffic monitors
- All of the preceding commands and functions need to be audited to ensure that they are not being misused

System Events

- Events recorded by ESM that indicate "something happened"
- DIRECTORY_CMD event
 - Generated when COMMAND statement is processed during LOGON
 - Issue any command, even those guest cannot itself issue
- SNIFFER_MODE event
 - Tells you when a guest that has promiscuous authorization on a VSWITCH enters/exits sniffer mode

Audit

- The audit trail is how you demonstrate conformance to the security policy
- You must define
 - Access restrictions
 - How often it will be collected
 - How often it will be reviewed
 - Where it will be archived and for how long

Audit

- With RACF, these are SMF records that can be sent to z/OS for processing or processed directly on z/VM
 - RACF Report Writer
 - zSecure for RACF
 - Vanguard
- Other ESMs have their own procedures

Audit

- If audit record cannot be written, then authorization must be denied
- "If there is no record of it, then it NEVER HAPPENED!"
- For RACF, specify SEVER YES in the SMF CONTROL file

Protecting the integrity of the CP kernel

- In addition to commands like STORE HOST, the CP kernel can be affected by other configuration items
- CPXLOAD
 - Loads code or data into the CP kernel
- CP_ADDON_INITIALIZE_ROUTINES
 - Run code in the CP kernel at IPL

Protecting the integrity of the CP kernel

- **DEFINE COMMAND and ASSOCIATE EXIT**
 - Add new commands or exits to the system
- **MODIFY COMMAND, MODIFY DIAGNOSE**
 - Alter the privilege class of commands and diagnose instructions

Protecting the integrity of the CP kernel

- QUERY IPLPARMS to find out what IPL parameters were used
- QUERY CPLOAD to find
 - The name and location of the CP load module
 - Location of PARM disk
 - Reason for system start
 - IPL
 - SHUTDOWN REIPL
 - System error
- QUERY CPLEVEL
 - Level of CP running
 - When system was IPLed
 - When CP load module was created

Protecting the integrity of CP

Duplicate Volume Labels

- When there are duplicate volumes with the same label, CP chooses the volume with the lowest device number with the matching label (default behavior)
- Traditionally controlled using

```
OFFLINE_AT_IPL 0000-FFFF
ONLINE_AT_IPL ...
```

and subsequently ATTACH others to SYSTEM in AUTOLOG1
- In z/VM 6.3, use the RDEV option on CP_OWNED statement

```
CP_OWNED SLOT 1 630RES RDEV 11F0
```

Centralized Access Controls

It's not just for CP!

- Applications (SVMs) can access ESM by using the RACROUTE macro
 - It is part of the formal z/VM interface specification
 - CSL routine available from IBM Lab Services
- Each SVM must be configured separately
 - DIRMAINT
 - Operations Manager
 - Backup and Restore Manager
 - Tape Manager
 - DFSMS
- Can eliminate separate authorization and audit files

Summary

- Your z/VM system needs to be bound by a cogent security policy
 - Roles
 - Authentication
 - Authorization
 - Accountability
 - Audit
- What is the point of securing the guests if you don't have demonstrable security of the hypervisor?
 - It doesn't matter whether you have one system programmer or a dozen!

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