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z/VM Security Policy Essentials

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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

• Passwords 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 by 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 password
  - Verify LOGON BY authority
  - LINK to any minidisk without LNKNOPAS
  - 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"

• DIRECTRY_CMD event
  – Generated when COMMAND statement is processed during LOGON
  – Issue any command, even those guest cannot itself issue

• SNIFTER_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
  – Stops RACF from making new security decisions
  – Only certain users can logon using directory password
  – Provides evidence of intent
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

- 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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