COMP 3400 Mainframe Administration[1]

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[1]These slides are based in part on materials provided by IBM's Academic Initiative.

The Mainframe World: RAS

The acronym RAS summarizes the key goals of mainframe systems:

- Reliability

- Availability

- Serviceability

Keep these goals in mind whenever you look at mainframe technology.

z/VM Overview

Two basic parts:

- CP – Control Program

- CMS – Conversational Monitor System

- History – CP-67, VM/370, VM/SP, VM/HPO, VM/XA, VM/ESA, z/VM

CMS is a mainframe operating system like z/OS, but rather primitive (used to administer z/VM systems).

z/VM vs. VMware

- VMware can emulate a few (common) PC configurations with few variations

- z/VM can emulate any IBM mainframe hardware configuration since S/360 that has ever been on the market

z/VM in Practice
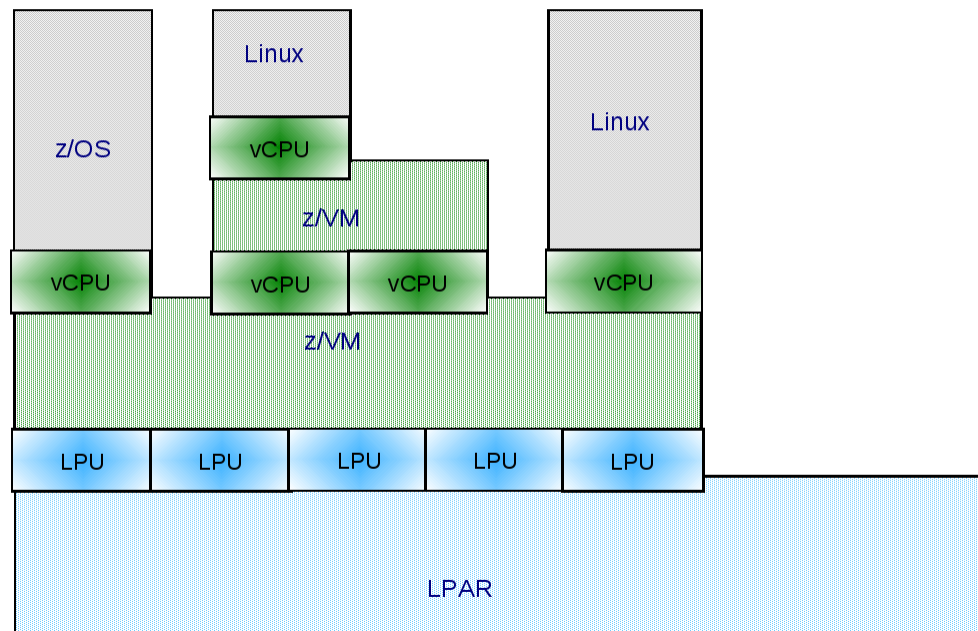
z/VM Terminology

- Guest: system running in a VM (also known as user)

- Running second level: guest in a VM which itself is a guest in a VM

- Logical Partition (LPAR): VM in hardware

- Logical Processor: LPAR equivalent of a virtual processor

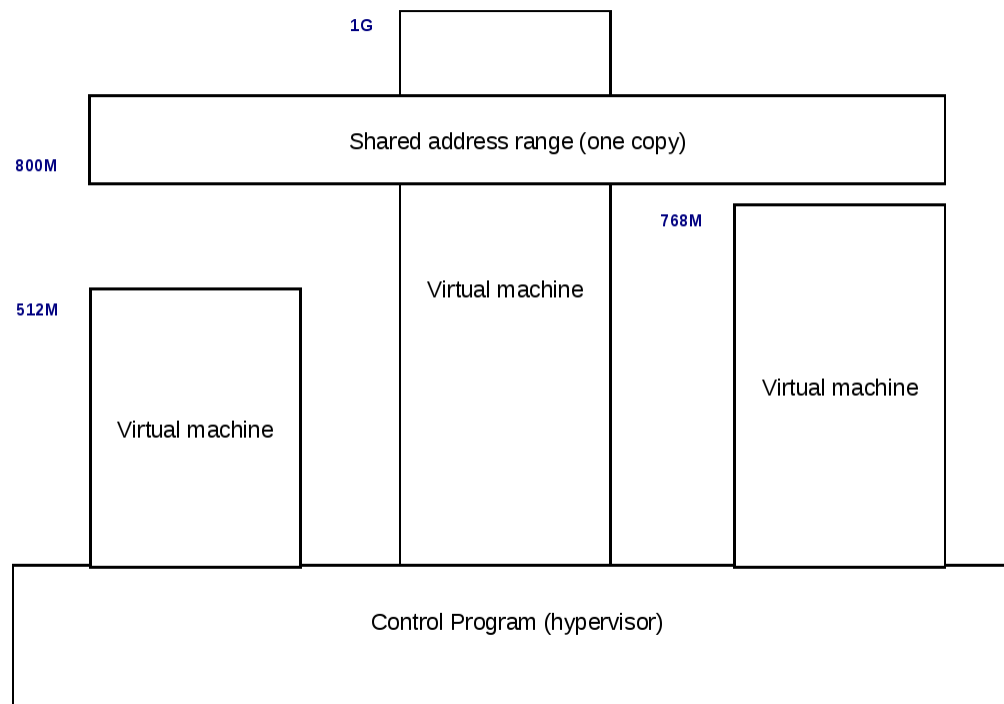- Running native or in BASIC mode: running without LPAR

IML and IPL

- IML: Initial Machine/Microcode Load; analogous to LPAR image activation

- IML starts CP

- IPL: Initial Program Load; analogous to booting an operating system

- IPL loads a kernel (CMS, Linux); initiated via CP's IPL command

SIE

- SIE $\equiv$ Start Interpretive Execution (assembly instruction)

- z/VM (and the LPAR hypervisor) uses SIE to "run" guests

- SIE has access to a control block with virtual processor state and dynamic address translation tables

- Control returns to z/VM on page faults, certain types of I/O, CPU timer expiration, etc.

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Shared Memory

1G

Shared address range (one copy)

800M

768M

512M

Virtual machine

Virtual machine

Virtual machine

Control Program (hypervisor)

Name Saved Segments (NSS)

NSS and Discontiguous Shared Segments (DCSS) allow groups of users to share applications, data and operating systems.

• Accessed using names ("LNXTST", "CMS") instead of virtual device numbers ("IPL 580")

• A list of all NSS can be obtained using "Q NSS ALL"

• NSS contain IPL-able operating systems

• DCSS contain shared data or code

VMSES/E

The Virtual Machine Serviceability Enhancements Staged/Extended (VMSES/E) subsystem helps with:

- Installation of z/VM, VMSES/E products and patches

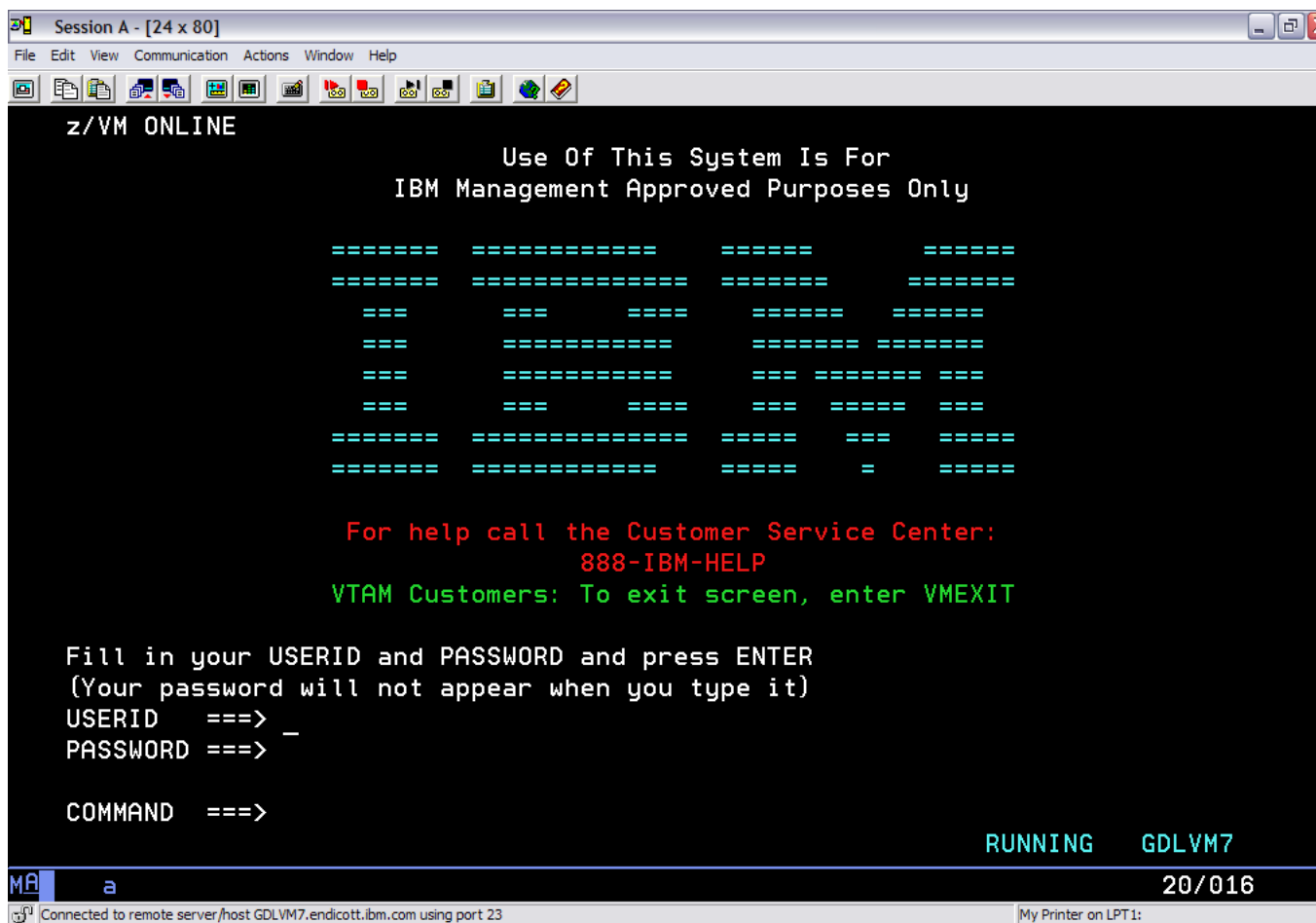- Definition, building and managing of NSS

Memory Management Responsibilities

- VM:
  - Paging between storage classes (central and expanded)
  - Stealing from central and expanded storage based on LRU
  - Paging activity is considered normal

- LPAR:
  - Dedicated storage, no paging

- Linux:
  - Pages on per-page basis to swap disks
  - Does not swap entire processes
  - Paging considered bad (let z/VM do it!)

Device Management Concepts

- Dedicated or attached:
  - The guest has exclusive use of the entire real device.

- Virtualized:
  - Present a slice (in time or space) of a real device to multiple virtual machines
  - Examples: DASD, crypto devices, CPs

- Simulated:
  - Provide a device without the help of real hardware
  - Examples: vitual disks, guest LANs, spool devices

- Emulated:
  - Provide a device of one type on top of a device of a different type

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z/VM logon

Login Information

- IP: 192.86.33.79

- Use x3270 to LOGON

- IPL CMS

- LOGOFF

Execution Modes

- CP Read – CP is waiting for a command

- VM Read – CMS is waiting for a command

- Running – Ready for commands or working

- More... – More info than can fit on screen (ALT-2)

- Holding – Waiting for you to clear the screen (ENTER)

- Not Accepted – Too many commands in buffer

Starting and Stopping CMS

- #CP IPL CMS – (re)start entire CMS session

- #CP LOGOFF – sign off

z/VM User Directory

A z/VM user directory defines:

- Memory

- Architecture

- Processors

- Spool devices

- Network devices

- Disk devices

- ...

z/VM User Directory: Example

```
USER LINUX01 MYPASS 512M 1024M G
MACHINE ESA 2
IPL 190 PARM AUTOCR
CONSOLE 01F 3270 A
SPOOL 00C 2540 READER *
SPOOL 00D 2540 PUNCH A
SPECIAL 500 QDIO 3 SYSTEM MYLAN
LINK MAINT 190 190 RR
MDISK 191 3390 012 001 ONEBIT MW
MDISK 200 3390 050 100 TWOBIT MR
```

Directory Maintenance Facility (DirMaint)

DIRMAINT consists of a command ("DIRMAINT") and the "DIRMAINT" service machine (a guest in the sysplex). The DIRMAINT command routes commands to the DIRMAINT service machine.

```
EXEC DIRMAINT [PREFIX] OPERATION ARGUMENTS
```

More details are in z/VM Basics, chapter 9.11 and "z/VM: Directory Maintenance Facility Tailoring and Administration Guide, SC24-6135".

Adding Users with DIRMAINT

```
EXEC DIRMAINT ADD userid LIKE prototype PW newpa
EXEC DIRMAINT ADD profile
EXEC DIRMAINT FOR userid GET
EXEC DIRMAINT FOR userid REPLACE
```

By default, GET locks the user directory and REPLACE automatically unlocks it (LOCK prevents retrieval or modification by other users).

CP Commands

Information about all CP commands is in the "CP Commands and Utilities Reference", chapter 2.

- DEFINE – defines virtual device or disk

- LINK – link minidisks (give local number)

- DETACH – opposite of LINK

- QUERY – obtain information

CP Commands: DEFINE

DEFINE can change the configuration of the VM or OS, including adding new commands and virtual hardware.

```
DEFINE NIC vdev TYPE QDIO
```

Define a Network Interface Card (NIC) of type OSA Direct Express (QDIO).

CP Commands: LINK

Use LINK to make a device associated with another virtual machine available to your VM configuration:

```
LINK [TO] userid vdev1 [AS] vdev2 MODE [[PASS=] password]
```

Links to `userid`'s `vdev1` (virtual device number as defined in the user's entry in the system directory), making the device available as `vdev2` with access mode "MODE" (i.e. "RR" − read only).

CP Commands: **DETACH**

Use DETACH to detach a real device from a virtual machine:

```
DETACH CRYPTO 1
DETACH CPU 1-3
```

If the guest is using the device, this can cause problems (and may require re-IPL-ing).

CP Commands: QUERY

Use QUERY STUFF to obtain information about "STUFF". Examples include:

```
QUERY DASD
QUERY [VIRTUAL] CRYPTO
QUERY CPLEVEL
QUERY CMSLEVEL
QUERY USERS
QUERY VIRTUAL CPUS
QUERY TIME
```

Other CP Commands

- ENABLE – enable access to terminal devices, try this if users can not logon

- DISABLE – disable access to terminal devices

- FORCE – disconnect or logoff active users

- CPACCESS – access special PRAM disks used by CP

- AUTOLOG – log on another virtual machine automatically, useful for "daemons" like DIRMAINT)

- WARNING – send message to users

- SET – change various properties of the system

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Spool Devices

Spool devices are used to read, write or process an ordered list of files (data) kept in a queue.

The canonical spool devices are:

- Reader (000C) – virtual punch card reader

- Punch (000D) – virtual punch card punch

- Printer (000E) – virtual printer

Modern Use of Spool Devices

- Mail box for files

- Booting of operating systems (Linux)

Managing spool devices

- DEFINE READER 00C – define device 00C as reader

- DETACH 00C – remove reader

- QUERY READER ALL – list files in reader queue

- PURGE READER NUMBER/ALL – remove file from queue

- TRANSFER yourID READER fileNumber destID READER

Data Facility Storage Management (DFSMS)

- Integrity checking of CMS minidisks

- Migration of CMS minidisks between DASDs

- Assignment of storage classes to SFS storage; manual and automatic migration of SFS storage between DASDs

- Data compression

- Performance analysis (DFSMS Optimizer)

z/VM Components

- CP – Control Program (already discussed)

- DirMaint – Directory Maintenance (already discussed)

- DFSMS – Data Facility Storage Management (already discussed)

- CMS – Conversational Monitor System (next lecture)

- TCP/IP – TCP/IP support (lecture 15)

- RACF – Security manager (lecture 16)

- Performance monitoring toolkit (lecture 17)

- Many more – overview now!

Communications support

z/VM includes various subsystems related to remote login and communication between applications:

- Virtual Telecommunications Access Method (VTAM) is the basic package for SNA communications (including remote login)

- Group Control System (GCS) supports certain VTAM-related needs of SNA networks

- Advanced VTAM Support (AVS) provides "Advanced Program-to-Program Communication" (APPC, related to the APPN extension of SNA) on top of GCS

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Hardware Configuration Definition and Manager (HCD/HCM)

- Alternative (graphical) method for managing z/VM hardware configuration

- HCM is a graphical interface (running on W32)

- HCD is part running inside of z/VM (and/or z/OS) using the configuration

- HCD can also be used to change the configuration

HCD stores configuration in the input/output definition file (IODF),

a single source for all hardware and software definitions for an entire system (multiple LPARs / VMs or even entire sysplex environment).

Open Systems Adapter Support Facility (OSA/SF)

OSA is a network controller (in the mainframe's I/O cage) supporting up to 10 Gbps data transfers.

OSA/SF is the z/VM subsystem for supporting this hardware.

Remote Spooling Communication Subsystem (RSCS)

• Used for communication with remote users and printers

• Like SMTP – queues messages locally until remote communication is available

• Protocol used is the network job entry (NJE) protocol

• RSCS can run over SNA and TCP/IP networks

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Questions

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