

The Basics of Using z/VM and CMS

Or, a Day in the Life of an IBM z/VM Virtual Machine

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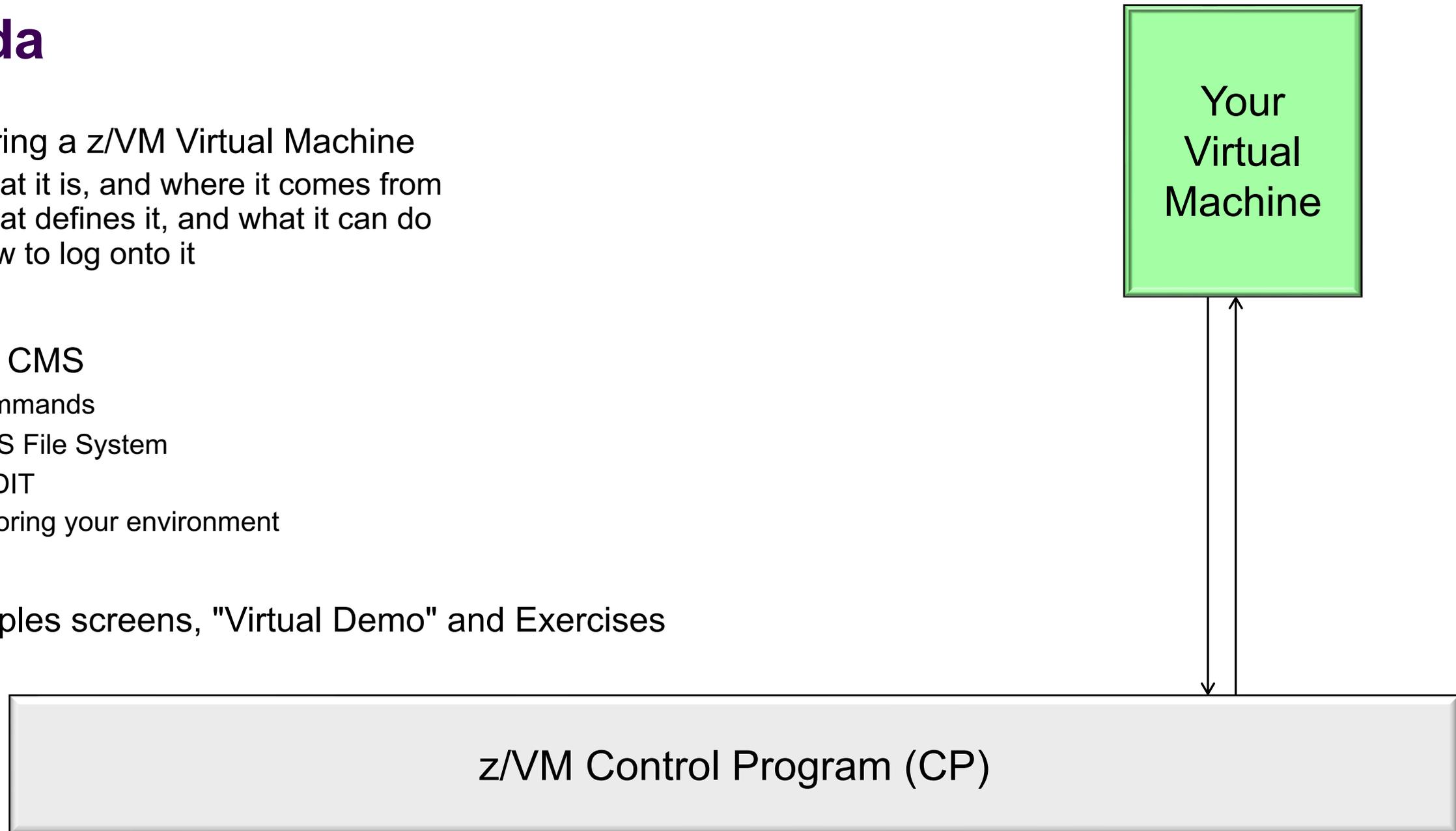
V7.2.f – last updated 13 May 2022

Agenda

- Exploring a z/VM Virtual Machine
 - What it is, and where it comes from
 - What defines it, and what it can do
 - How to log onto it

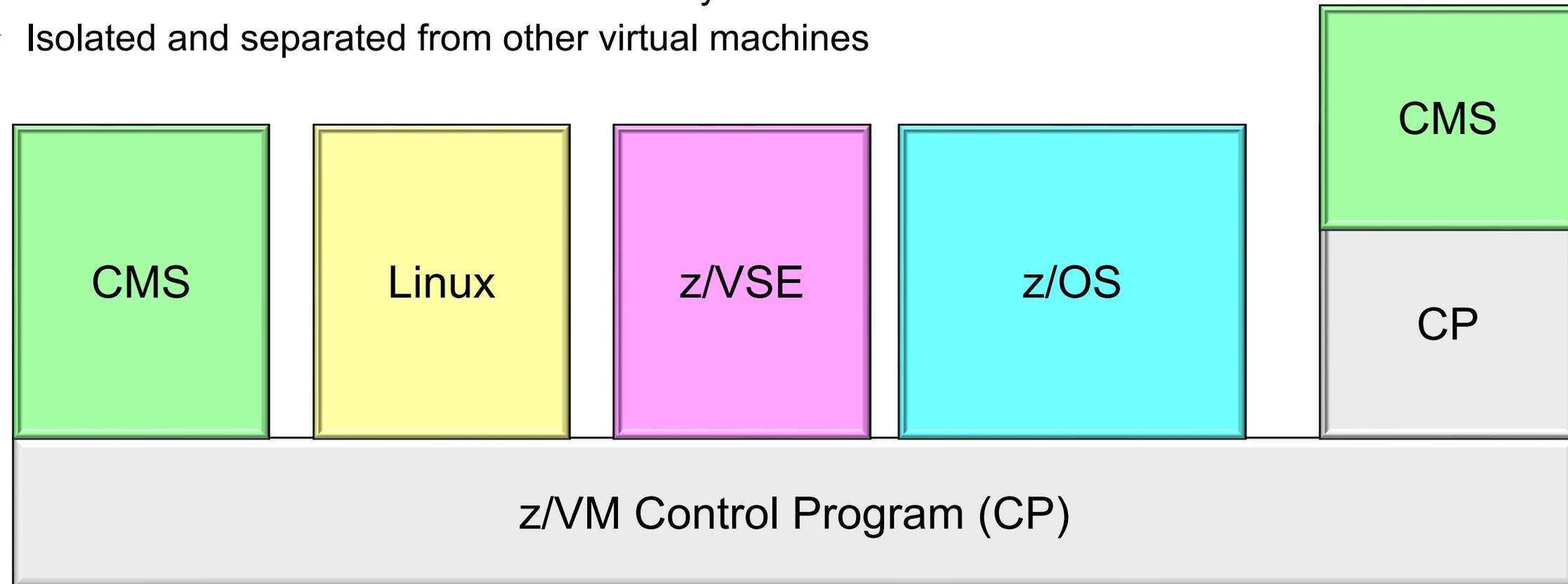
- Using CMS
 - ▶ Commands
 - ▶ CMS File System
 - ▶ XEDIT
 - ▶ Tailoring your environment

- Examples screens, "Virtual Demo" and Exercises



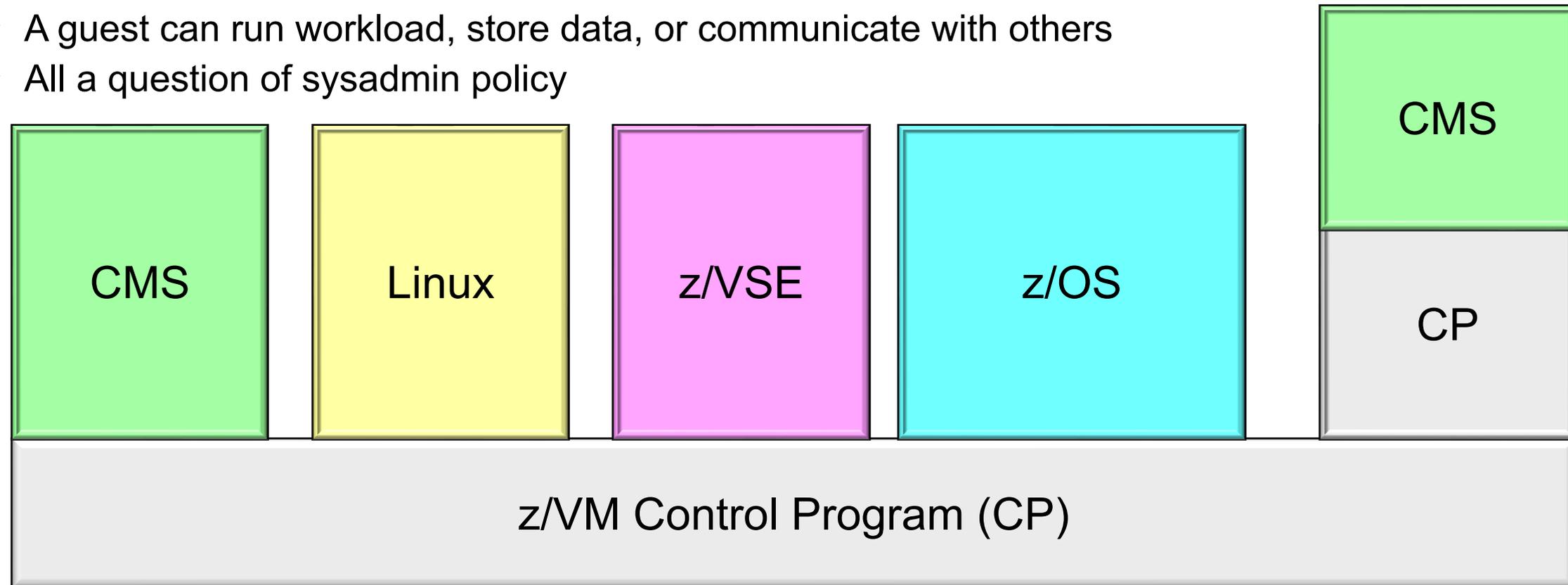
Overview – Virtual Machines

- z/VM contains two basic parts:
 - ▶ CP - **Control Program** (the Hypervisor layer)
 - ▶ **The guest** running under z/VM
 - ▶ Resides in a distinct location inside the system
 - ▶ Isolated and separated from other virtual machines



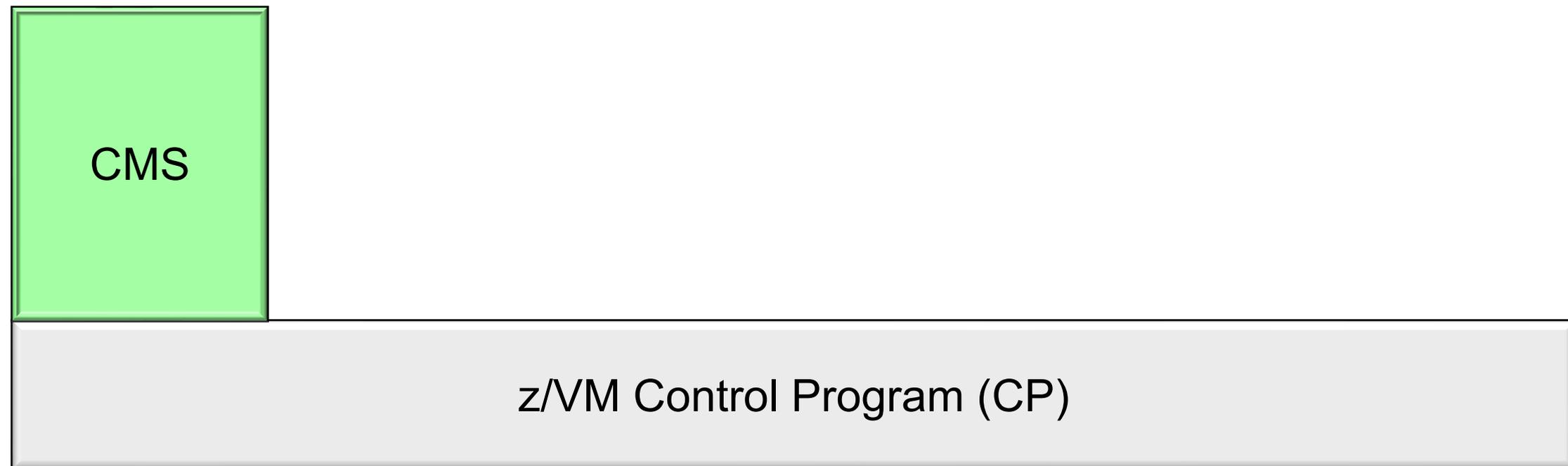
Overview – Virtual Machines

- ▶ The virtual machine is:
 - ▶ A discrete object on the system, distinct from the hypervisor
 - ▶ Isolated from other guests
 - ▶ **A place where workload runs**
 - ▶ A guest can run workload, store data, or communicate with others
 - ▶ All a question of sysadmin policy



Overview – Virtual Machines

- **CMS: Conversational Monitor System**
 - An operating system that runs as a guest of VM
 - Provides “a place to stand while you’re configuring the hypervisor”
 - IBM-defined virtual machines with special authorities, for example
 - Can also create files, execute programs, or run workload.



Overview – Hypervisor Parts 101

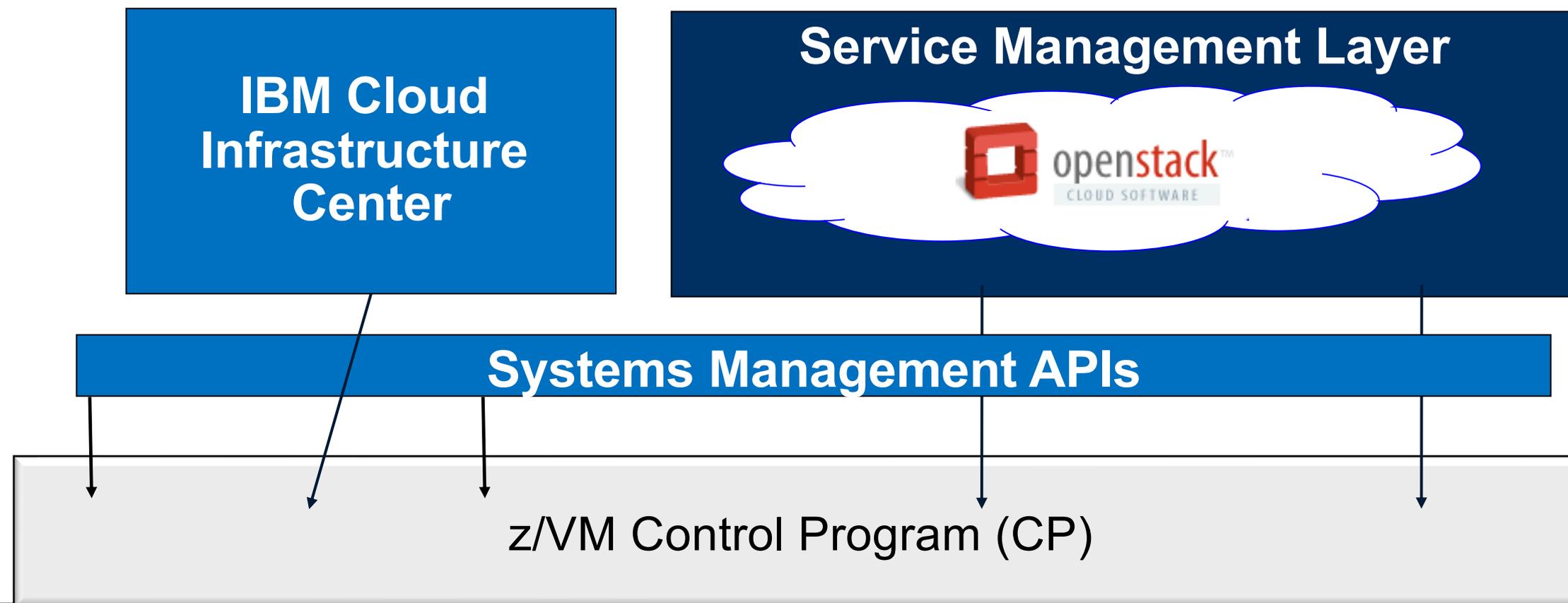
	z/VM	KVM	VMware	PowerVM
Hypervisor	Control Program (CP)	KVM kernel	ESX or ESXi	POWER Hypervisor
Interface	CMS	Virsh or VMM	VirtualCenter	IVM or PowerVC
Guests	CMS, Linux, z/OS, z/VM ...	Linux	As advertised	As advertised

Notes:

- CMS is both an **interface** to managing z/VM and a **guest of z/VM**
- The CMS "shell" is not the only way to manage z/VM, but it is a vital one

Overview – Virtual Machines

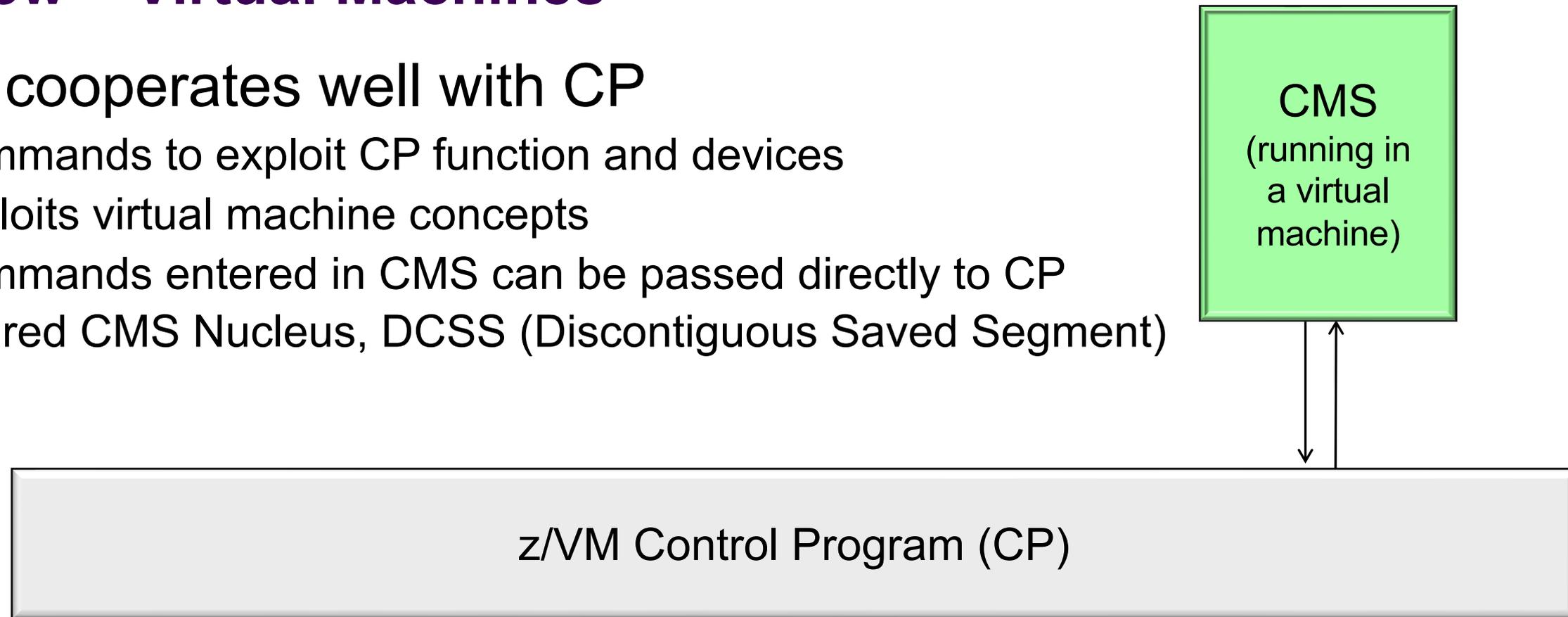
- **Frequently Asked Question:** Is CMS the only way to control my z/VM system?
 - *Answer:* No. Software is available for the management of your systems
 - Managing is relative to your skills and scope of responsibility
- **What CMS shows** is how z/VM works ... no matter how you control it!



Overview – Virtual Machines

■ CMS cooperates well with CP

- ▶ Commands to exploit CP function and devices
- ▶ Exploits virtual machine concepts
- ▶ Commands entered in CMS can be passed directly to CP
- ▶ Shared CMS Nucleus, DCSS (Discontiguous Saved Segment)

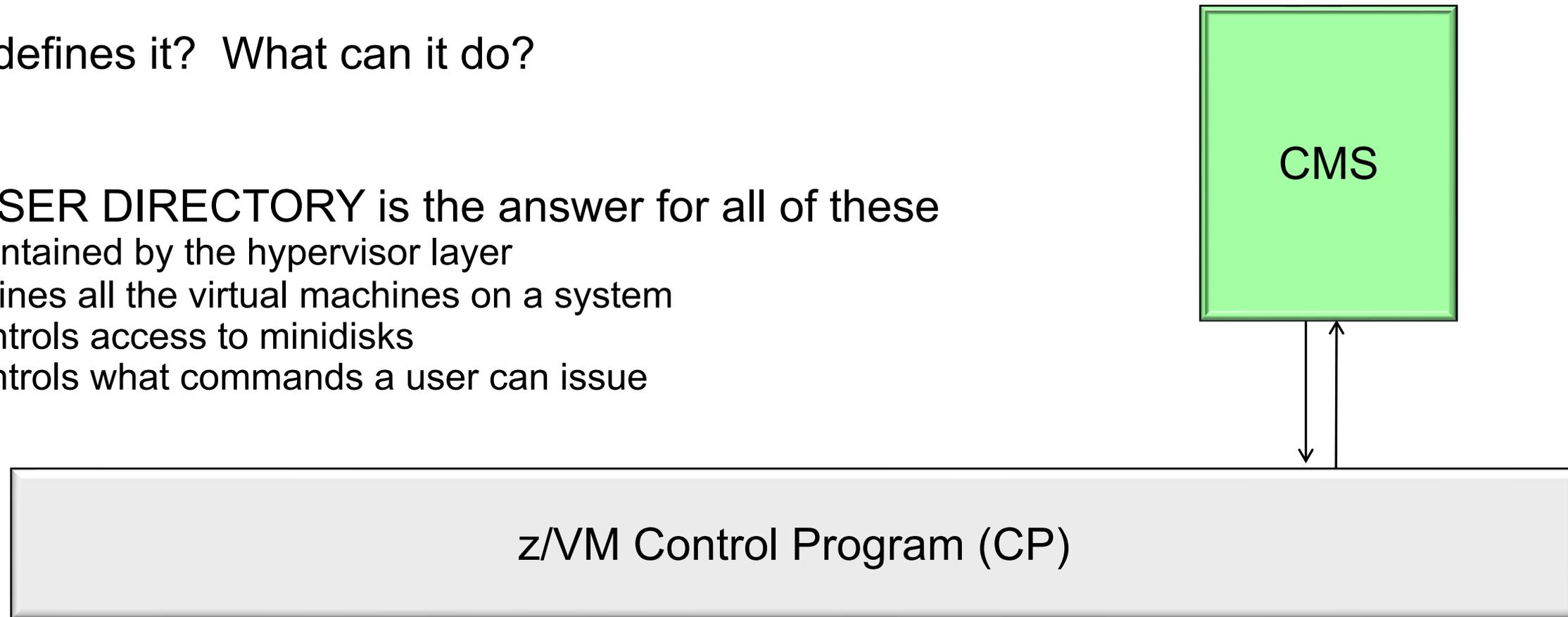


▶ Many productivity tools available

- ▶ IBM-supplied tools
- ▶ Vendor programs
- ▶ REXX programming language – design your own

Where do virtual machines come from?

- How does a virtual machine come to be?
- What defines it? What can it do?
- The USER DIRECTORY is the answer for all of these
 - Maintained by the hypervisor layer
 - Defines all the virtual machines on a system
 - Controls access to minidisks
 - Controls what commands a user can issue



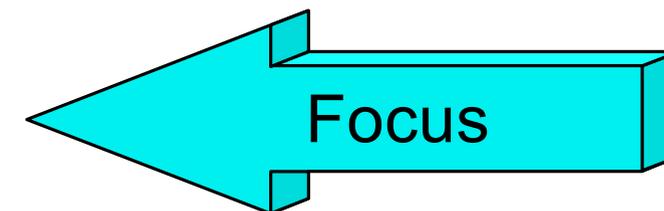
Defining a Virtual Machine

Sample User Directory Entry

```
USER IBMUSER IBMUSER 32M 32M ABCDEG
ACCOUNT SYSTEMS
MACH ESA
IPL CMS
```

```
CONSOLE 009 3215
SPOOL 00C 2540 READER *
SPOOL 00D 2540 PUNCH A
SPOOL 00E 1403 A
```

```
LINK MAINT 0190 0190 RR * CMS system disk
LINK MAINT 019E 019E RR * Product code disk
LINK 7VMRAC20 29E 29E RR
LINK 7VMRAC20 505 305 RR
LINK 7VMRAC20 191 391 RR
MDISK 1191 3390 2078 001 72CRES MR READ WRITE MULTIPLE
MDISK 191 3390 0895 030 72CUR MR READ WRITE MULTIPLE
```



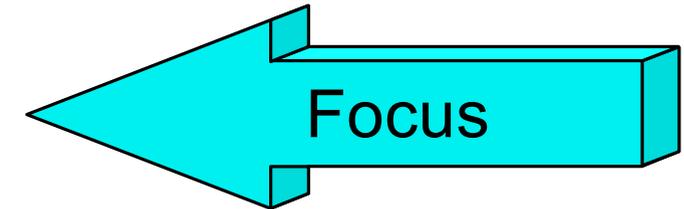
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```



Overview – CMS

- To establish a z/VM session:
 - z/VM Logo Screen
 - ▶ One at a time - 3270 emulation (for example, PComm or x3270)
 - ▶ **LOGON <userid> HERE** -- move a signon to another terminal session
 - ▶ **LOGON <userA> by <userB>** -- signon using different credentials

Esc for 'Sys Attn'

Pause for 'Clear'



No brackets [] defined

Enter for 'Newline'

Ctrl for 'Enter'

Select a Key-Action

Macro/Script:

Function:

Character:

Dead Key

! " # \$ % & ' () * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V

Change Current Actions for Selected Key

Esc

Shift

Ctrl

Alt

AltGr

CtrlShift

Default

Undo

[sys attn]

[sys req]

[pass]

[pass]

[pass]

[pass]

x3270 Keyboard Profile

```

! x3270 profile
! File created Wed Mar  9 08:37:27 2011 by x3270 v3.3.10ga4 Thu May 13 10:00:03 UTC 2010 builddd
! This file overrides xrdb and .Xdefaults.
! To skip reading this file, set NOX3270PRO in the environment.
!
! emulator font  (-efont)
x3270.emulatorFont: 3270-20
! model  (-model)
x3270.model: 3
! oversize  (-oversize)
x3270.oversize: 150x60
! Ignore prefix when pasting
x3270.marginedPaste: true
x3270.keymap: default
x3270.keymap.default: \
<Key>Pause:      PA(1) \n\
<Key>Escape:     Clear() \n\
<Key>Insert:     ToggleInsert() \n\
<Key>Return:     Enter() \n\
<Key>Control_R:  Enter() \n\
Ctrl<Key>End:    EraseEOF() \n\
<Key>End:        FieldEnd() \n\
<Key>Home:       BackTab() \n\
Shift<Key>6:     CircumNot() \n\
Shift<Key>Prior: PF(19) \n\
Shift<Key>Next:  PF(20) \n\
<Btn4Down>:     PF(7) \n\
<Btn5Down>:     PF(8) \n\
<Key>Prior:     PF(7) \n\
<Key>Next:      PF(8) \

```

Session B - [24 x 80]

File Edit View Communication Actions Window Help

z/VM ONLINE

```
      ZZZZZ      11      9999      666      #####
        Z        1 1      9 9      6        ##        ##
        Z        1 1      9999      6666      # 0 0 #
        Z          1          9 6 6      # ##### #
      ZZZZZ      11111      9      666      #   ##   #
#####          #####          #####          #####          #####          #####
#              ##              ##              ##              ##              ##
#              ##              ##              ##              ##              ##
#              ##              #####          #####          ##              ##
#              ##              ##              ##              ##              ##
#              ##              ##              ##              ##              ##
#              ##              ##              ##              ##              ##
#              #####          #####          ##              #####          #####
#####          #####          #####          #####          #####          #####
```

built on IBM Virtualization Technology
IBM Washington System Center Gaithersburg, Maryland

Fill in your USERID and PASSWORD and press ENTER
(Your password will not appear when you type it)

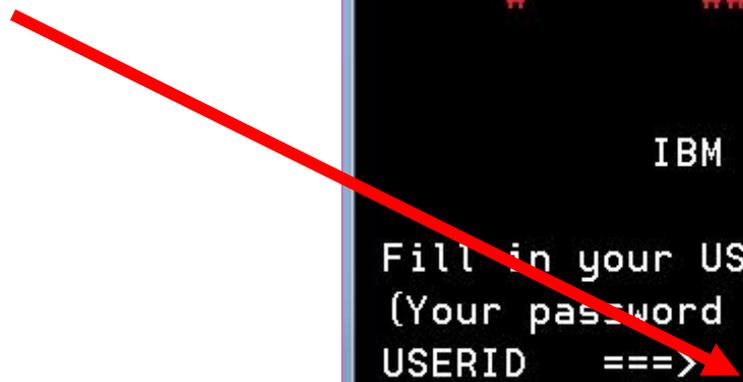
USERID ==>

PASSWORD ==>

COMMAND ==>

RUNNING TOSP1B

MA B 20/017



Session B - [24 x 80]

File Edit View Communication Actions Window Help

Enter one of the following commands:

LOGON userid	(Example: LOGON VMUSER1)
DIAL userid	(Example: DIAL VMUSER2)
MSG userid message	(Example: MSG VMUSER2 GOOD MORNING)
LOGOFF	

CP READ TOSP1B

Overview – CMS Execution Modes

- Status appears at the bottom right of screen
 - ▶ **CP Read** (CP is waiting for a command)
 - ▶ **VM Read** (CMS is waiting for a command)
 - ▶ **Running** (Ready for cmds or working on some)
 - ▶ **More...** (More info than can fit on the screen)
 - 50 seconds then beep then 10 seconds
 - Determine setting: Query Term
 - Page without waiting: Term More 0 0
 - ▶ **Holding** (Waiting for you to clear the screen)
 - ▶ **Not Accepted** (Too many commands in buffer; wait for executing command to complete)

```
Session B - [24 x 80]
File Edit View Communication Actions Window Help
[Icons]
Enter one of the following commands:
    LOGON userid          (Example: LOGON VMUSER1)
    DIAL userid           (Example: DIAL VMUSER2)
    LOGOFF
l hugen2

Enter your password,
or
To change your password, enter: ccc/nnn/nnn
    where ccc = current password, and nnn = new password

ICH70001I HUGEN2    LAST ACCESS AT 07:59:00 ON THURSDAY, JUNE 10, 2010
z/VM Version 5 Release 4.0, Service Level 1001 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES: 0006 RDR,    NO PRT,    NO PUN
LOGON AT 10:03:16 EDT THURSDAY 06/17/10
z/VM V5.4.0    2010-04-07 15:56
*****
*   Data classified as IBM CONFIDENTIAL may be processed on this system.   *
HOLDING  GD/LVM7
MA b                               DDC ↓ 23/001
Connected to remote server/host gdlvm7.pok.ibm.com using port 23
```

Session B - [24 x 80]

File Edit View Communication Actions Window Help

Hit [Enter] to continue

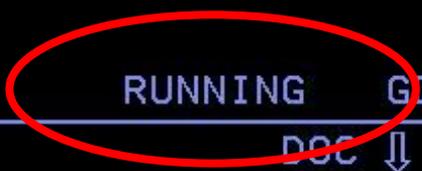
MA b VM READ GDLVM7
DOC ↓ 23/001

Connected to remote server/host gdlvm7.pok.ibm.com using port 23 #IBMz #zVM

VM READ GDLVM7
DOC ↓ 23/001

```
Session B - [24 x 80]
File Edit View Communication Actions Window Help
HUGEN2 AT GDLVM7 VIA RSCS 06/17/10 10:03:58 EDT THURSDAY
CP LEVEL:
z/VM Version 5 Release 4.0, service level 1001 (64-bit)
Generated at 04/14/10 15:11:35 EDT
IPL at 04/17/10 10:05:57 EDT
CMS LEVEL:
z/VM Version 5 Release 4.0
STORAGE = 32M
Adjunct Status: UNAVAILABLE
FILES: 0006 RDR, 0001 PRT, NO PUN
Ready; T=0.07/0.09 10:03:58

RUNNING GDLVM7
DOC ↓ 23/001
```



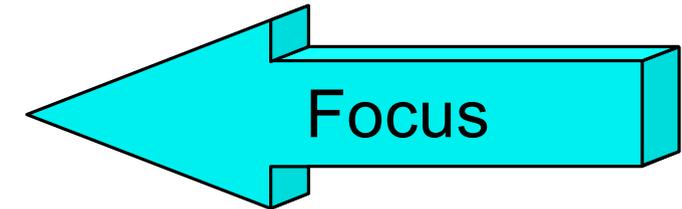
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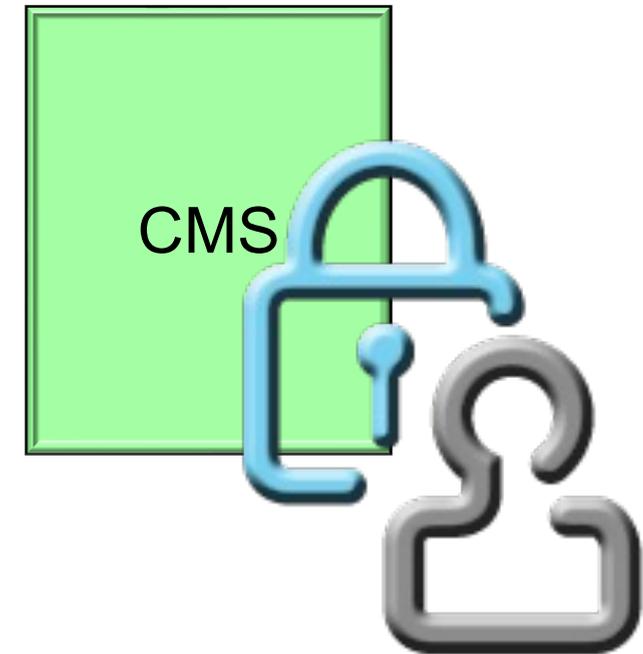
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LINK 7VMRAC20 191 391 RR
MDISK 1191 3390 2078 001 72CRES MR READ WRITE MULTIPLE
MDISK 191 3390 0895 030 72CUSR MR READ WRITE MULTIPLE
```



Defending a Single Virtual Machine

There are seven IBM-defined Privilege Classes:

- A:** Commands for *System Operators*
- B:** Commands for *System Resource Operators*
- C:** Commands for *System Programmers*
- D:** Commands for *Spooling Operators*
- E:** Commands for *System Analysts*
- F:** Commands for *Service Representatives*
- G:** Commands for *General CMS Users*
- ANY:** Commands available to *everyone*



The capabilities of a virtual machine can therefore be defined based upon the role or roles it is expected to carry out (**Role-Based Access Control**). System administrators can define their own privilege classes

- **QUERY PRIVCLASS**
 - Lists current privilege class for your virtual machine
- **QUERY COMMANDS**
 - Provides a list of all the commands to which your VM is authorized
 - **Note:** a security product may refine security policy on your VM system

Try for yourselves! (5-minute exercise)

- Change your PComm keyboard layouts to something you find useful

- LOGON <userid> /* Remember, CTRL is default Enter key */
 /* ... Until you change it, that is. */
- QUERY PRIVCLASS /* Your security context ... */
- QUERY COMMANDS

```
Session B - [24 x 80]  
File Edit View Communication Actions Window Help  
q privclass  
Privilege classes for user PIPUSR02  
    Currently: GP  
    Directory: GP  
The privilege classes are not locked against changes.  
Ready; T=0.01/0.01 14:06:05  
  
RUNNING TOSP1B
```

```
Session B - [24 x 80]
File Edit View Communication Actions Window Help
q commands
ADJUNCT ADSTOP ATTN BEGIN CHANGE CLOSE
COMMANDS COUPLE CPFORMAT CPU DEFINE DETACH
DIAL DISCONNECT DISPLAY DUMP ECHO EXTERNAL
FLASHCOPY FOR INDICATE IPL LINK LOADVFCB
LOCATE LOCATEVM LOCK LOGON LOGOFF MESSAGE
NOTREADY ORDER PURGE QUERY READY REDEFINE
REQUEST RESET RESTART REWIND SCREEN SEND
SET SIGNAL SILENTLY SLEEP MSG SPOOL
SPXTAPE STOP STORE SYSTEM TAG TERMINAL
TRACE TRANSFER UNCOUPLE UNDIAL UNLOCK VDELETE
VINPUT VMDUMP XAUTOLOG XSPOOL
DIAG00 DIAG04 DIAG08 DIAG0C DIAG10 DIAG14
DIAG18 DIAG20 DIAG24 DIAG28 DIAG40 DIAG44
DIAG48 DIAG4C DIAG54 DIAG58 DIAG5C DIAG60
DIAG64 DIAG68 DIAG70 DIAG7C DIAG88 DIAG8C
DIAG90 DIAG94 DIAG98 DIAG9C DIAGA0 DIAGA4
DIAGA8 DIAGB0 DIAGB4 DIAGB8 DIAGBC DIAGC8
DIAGD0 DIAGDC DIAGE0 DIAGE4 DIAGEC DIAGF0
DIAGF8 DIAG204 DIAG210 DIAG214 DIAG218 DIAG220
DIAG224 DIAG238 DIAG23C DIAG240 DIAG244 DIAG248
DIAG250 DIAG254 DIAG258 DIAG260 DIAG264 DIAG268
MORE... TOSP1B
```

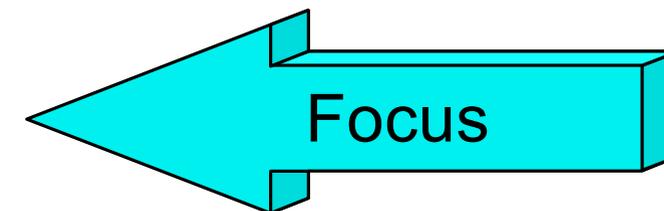
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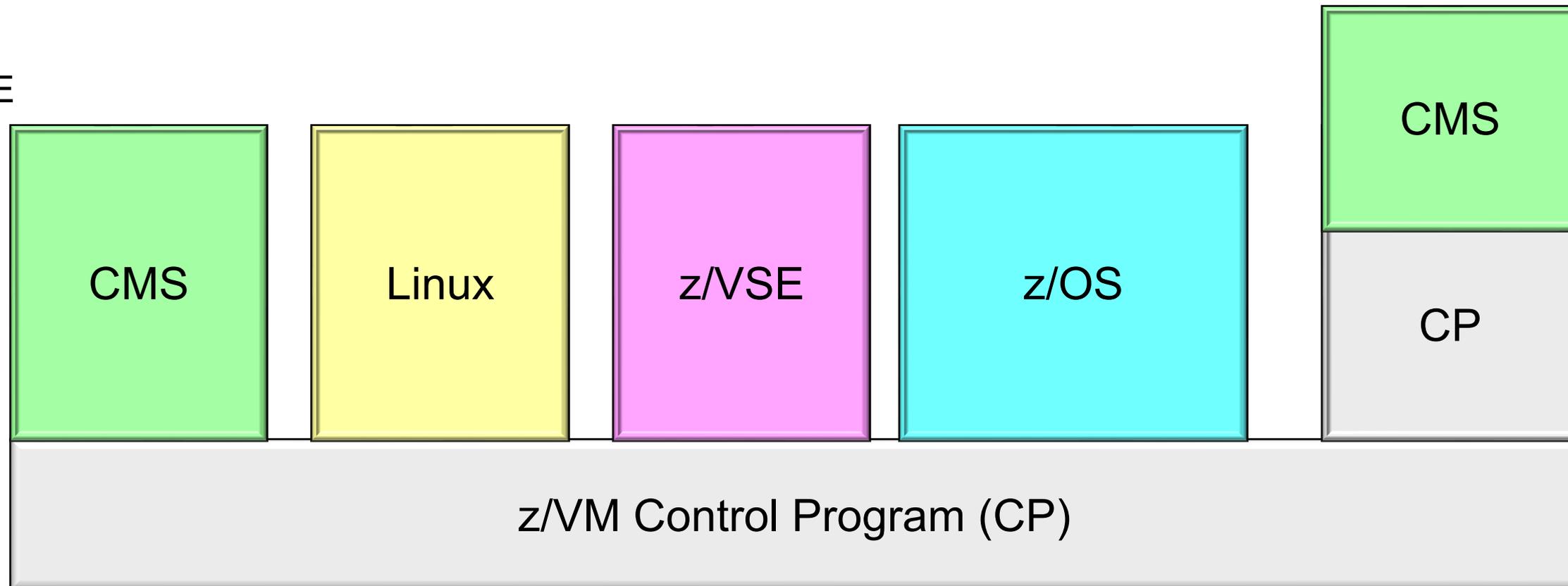
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LINK 7VMRAC20 191 391 RR
MDISK 1191 3390 2078 001 72CRES MR READ WRITE MULTIPLE
MDISK 191 3390 0895 030 72CUR MR READ WRITE MULTIPLE
```



Defining a Virtual Machine

Sample User Directory Entry

- CMS
- zCMS (the 64-bit version of CMS)
- Linux (often on its own separate disk)
- z/OS
- z/VSE



CMS Commands

- CMS commands control the virtual machine
 - Manipulate disks and files
 - Adjust the operating environment

- Commands are blank-delimited

- Commands are case-insensitive
 - ▶ CMS will automatically uppercase and pass to command parser

- ▶ General syntax:
Command name [operand(s)...] [(options.... [])]]

Examples:

```
copy Profile Exec A = = C
Rdrlist
LISTFILE (Date
```

CMS Commands

- Command Search Order -- when a command is entered, CMS has to locate it
 - ▶ Search for an EXEC with the specified command name
 - EXECs in storage
 - Command name with Filetype EXEC on accessed disk or directory (A-Z)
 - ▶ Search for translation or synonym
 - ▶ Search for a module with the specified command name
 - Nucleus extension, transient area, nucleus resident, on accessed disk/directory
 - ▶ If Command not found in CMS, it will be passed to CP for execution
 - ▶ SET IMPCP (Implied CP) can enable or disable this behavior

CMS Commands and CP Commands

- CP (the hypervisor) and CMS (the guest) have their own sets of commands

- ▶ Commands can be passed directly to CP, rather than going through the CMS search order
 - ▶ Useful if CMS is "stuck" (e.g., NOT ACCEPTED)
 - ▶ **#CP <command> (options**

- **#CP IPL CMS** – restarts your entire CMS guest
 - "Reboot button" / "percussive maintenance"
 - Destroys any unsaved work

CMS Commands

■ Immediate Commands

- ▶ Can be entered while another command is running
- ▶ Interrupts the running command and executes immediately
- ▶ 10 system immediate commands:
HB, HI, HO, HT, HX, RT, RO, SO, TE, TS

Tip: HX is the equivalent of ^C or ^X in other operating systems

- ▶ Advanced users can define their own immediate commands (IMMCMD)

CMS File System

- Files are named using a file identifier (file ID) consisting of 3 fields:
 - ▶ File name (FN)
 - ▶ File type (FT)
 - ▶ File mode (FM) or Directory name (dirname) – **a letter A through Z.**

- Files can be stored in a few different ways:
 - ▶ On Minidisks (fn ft fm)
 - Standard file modes: A - user's disk, S - system disk
 - ▶ In an SFS (Shared File System) filespace: **GPLSRV2:HUGENBRU.REXX.**
 - ▶ On the BFS (Byte File System) **../../../../home/userid/**
 - hierarchical file structure
 - ▶ In NFS (Network File System)

Try for yourselves! (8-minute exercise)

- QUERY DISK /* Your resources ... */
- QUERY ACCESSED
- FILELIST * * A
- LISTFILE * * A
- SET FILEPOOL GPLSRV2 /* connect to an SFS */
- ACCESS GPLSRV2:HUGENBRU.NEWHIRE. D /* or another free filemode */
- FILELIST * * D /* see what's out there */
- QUERY AUTH .NEWHIRE /* is this different from ... */
- QUERY AUTH GPLSRV2:HUGENBRU.NEWHIRE /* who has access? */
- LISTFILE FOREVER * * /* and if file exists, then ... */
- EXEC FOREVER
- /* Now, break out of the EXEC ... */
- /* Question: are you in RUNNING state? If not ... */
- B

```
Session B - [24 x 80]
File Edit View Communication Actions Window Help
query dist
LABEL  VDEV M  STAT  CYL TYPE BLKSZ  FILES  BLKS USED-(%)  BLKS LEFT  BLK TOTAL
-      DIR  A   R/W   -   -  4096    6             -           -           -
TCM592 592  C   R/O   140 3390 4096   858          11818-47    13382      25200
MNT190 190  S   R/O   207 3390 4096   704          18095-49    19165      37260
MNT19E 19E  Y/S  R/O   500 3390 4096  1124          30404-34    59596      90000
Ready; T=0.01/0.01 14:10:34
query accessed
Mode  Stat  Files  Vdev  Label/Directory
A     R/W   6     DIR   VMPSFS:PIPUSR02.
C     R/O   858   592   TCM592
S     R/O   704   190   MNT190
Y/S   R/O   1124  19E   MNT19E
Ready; T=0.01/0.01 14:10:36
RUNNING  TOSP1B
```



HUGENBRU FILELIST A0 V 169 Trunc=169 Size=32 Line=1 Col=1 Alt=0

Cmd	Filename	Filetype	Fm	Format	Lrecl	Records	Blocks	Date	Time
	RACF	DATA	A1	V	76	1	1	7/09/15	11:34:22
	LASTING	GLOBALV	A1	V	93	33	1	7/09/15	11:34:21
	HUGENBRU	NETLOG	A0	V	108	530	11	2/11/15	12:30:41
	PI31200	INSPECT	A1	F	204	5830	291	2/11/15	12:30:32
	COMMTXT	TXTLIB	A2	F	80	10655	209	11/14/14	12:01:54
	COMMTXT	GENUSEDT	A1	F	57	144	3	11/14/14	12:01:48
	COMMTXT	TXTUSED	A1	F	57	34	1	11/14/14	12:01:48
	COMMTXT	GENUSEDM	A1	F	57	2	1	11/14/14	12:01:45
	COMMTXT	MACUSED	A1	F	57	1	1	11/14/14	12:01:45
	SSLGSKCF	620POODL	A1	F	150	26	1	10/20/14	21:38:36
	QUERY	HELPSLA	A1	V	81	393	4	9/26/13	10:14:10
	PROJECT	EXEC	A1	V	62	80	1	3/20/13	9:01:27
	VDISK	EXEC	A1	V	66	17	1	12/17/12	16:14:33
	PFEXTRA	EXEC	A1	V	63	38	1	12/13/11	15:04:25
	PFSET	EXEC	A1	V	61	19	1	7/30/09	13:57:55
	PFDISP	EXEC	A0	V	72	17	1	7/30/09	13:57:03
	VMWEB	EXEC	A1	V	65	2	1	7/30/09	13:27:24

1= Help 2= Refresh 3= Quit 4= Sort(type) 5= Sort(date) 6= Sort(size)
7= Backward 8= Forward 9= FL /n 10= 11= XEDIT/LIST 12= Cursor

====>

X E D I T 1 File

MA B 03/001

Overview – CMS

- CMS supports multiple internal environments:
- CMS
 - ▶ `IPL CMS` or `Begin` will run `Profile Exec`
 - ▶ Linemode or Fullscreen mode
- XEDIT Environment
 - ▶ XEDIT *fn ft fm*,
 - ▶ Tailorable (**Profile Xedit**)
 - ▶ CMS Subset mode
- Extensions*
 - ▶ Open Extensions (Posix Shell & Utilities)
 - ▶ Byte File System, Network File System
 - ▶ z/OS and z/VSE simulation modes

Session B - [24 x 80]

File Edit View Communication Actions Window Help

This exec will print the same line forever.
hx
CMS

VM READ GD LVM7

MA b DDC ↓ 23/001

Connected to remote server/host gdlvm7.pok.ibm.com using port 23

Session B - [24 x 80]

File Edit View Communication Actions Window Help

This exec will print the same line forever.
hx
CMS
b
Ready; T=0.01/0.01 10:08:18

RUNNING GDLVM7
MA b DOC ↓ 23/001

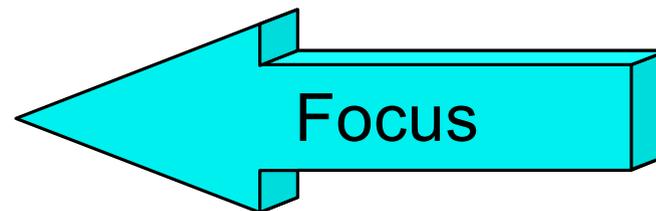
Connected to remote server/host gdlvm7.pok.ibm.com using port 23

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CONSOLE 009 3215
SPOOL 00C 2540 READER *
SPOOL 00D 2540 PUNCH A
SPOOL 00E 1403 A
```

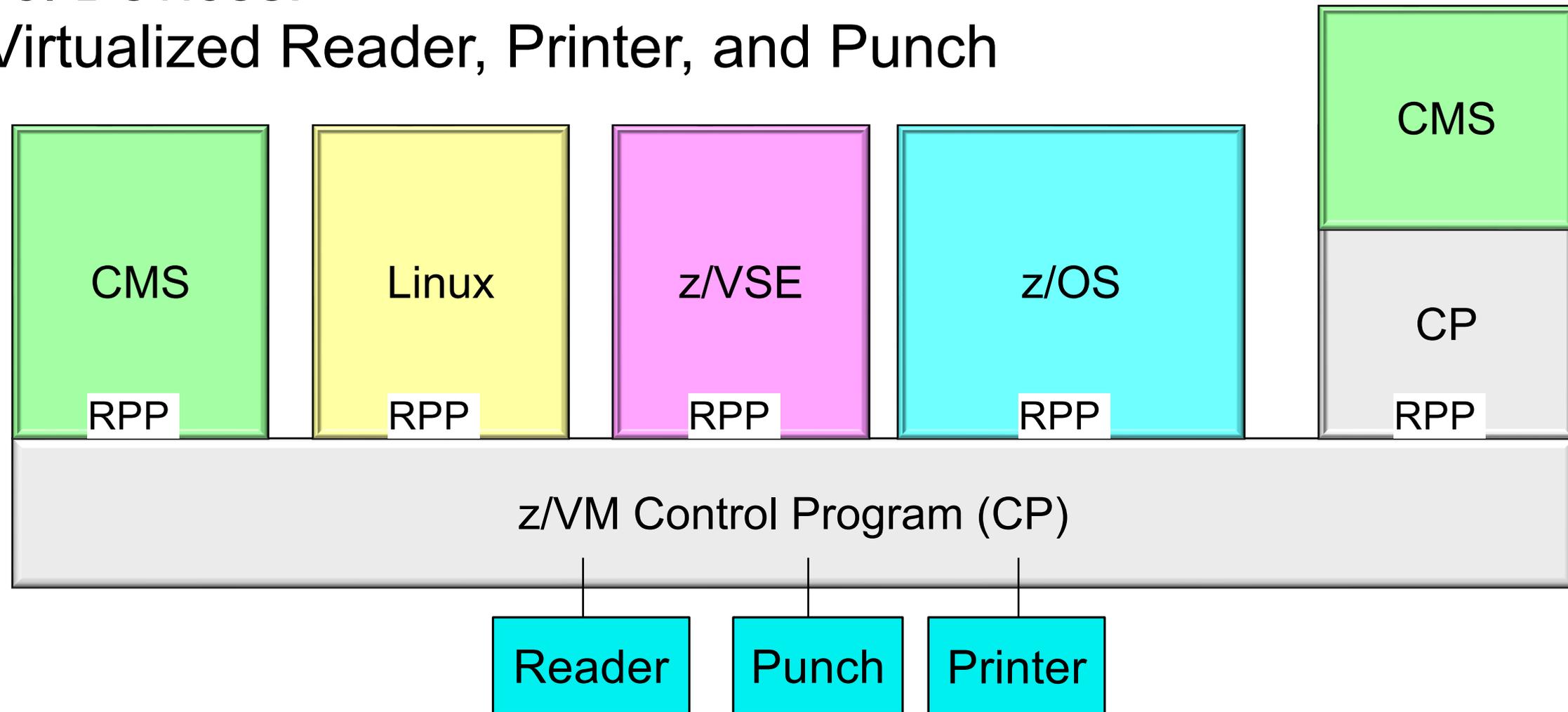


```
LINK MAINT 0190 0190 RR * CMS system disk
LINK MAINT 019E 019E RR * Product code disk
LINK 7VMRAC20 29E 29E RR
LINK 7VMRAC20 505 305 RR
LINK 7VMRAC20 191 391 RR
MDISK 1191 3390 2078 001 72CRES MR READ WRITE MULTIPLE
MDISK 191 3390 0895 030 72CUR MR READ WRITE MULTIPLE
```

Defining a Virtual Machine

Sample User Directory Entry

- Spool Devices:
Virtualized Reader, Printer, and Punch



```

Session A - [24 x 80]
File Edit View Communication Actions Window Help
query files
FILES: 0034 RDR, NO PRT, NO PUN
Ready; T=0.01/0.01 21:12:34
query rdr all
ORIGINID FILE CLASS RECORDS CPY HOLD DATE TIME NAME TYPE DIST
HUGENBRU 2615 A PUN 00000008 001 NONE 02/05 17:31:40 DVHRLN SRCCEXEC HUGENBRU
HUGENBRU 2614 A PUN 00000030 001 NONE 02/05 17:31:40 DVHPURGE D1627DY0 HUGENBRU
HUGENBRU 2613 A PUN 00000035 001 NONE 02/05 17:31:40 DVHCHADR D1627DY0 HUGENBRU
HUGENBRU 2612 A PUN 00000119 001 NONE 02/05 17:31:40 DVHCHGID D1627DY0 HUGENBRU
HUGENBRU 2611 A PUN 00000008 001 NONE 02/05 17:31:40 DVHGETMD SRCCREXX HUGENBRU
HUGENBRU 2610 A PUN 00000020 001 NONE 02/05 17:31:40 DVHBLDDP D1627DY0 HUGENBRU
HUGENBRU 2609 A PUN 00000062 001 NONE 02/05 17:31:40 DVHLINK D1627DY0 HUGENBRU
HUGENBRU 2606 A PUN 00000586 001 NONE 02/05 17:31:40 DVHRLN $EXEC HUGENBRU
HUGENBRU 2605 A PUN 00000312 001 NONE 02/05 17:31:40 DVHGETMD $REXX HUGENBRU
HUGEN2 0115 T CON 00000027 001 NONE 06/04 08:16:28 HUGEN2
HUGEN2 0103 T CON 00000027 001 NONE 03/05 09:24:31 HUGEN2
HUGEN2 0242 T CON 00000143 001 NONE 05/06 14:01:45 HUGEN2
HUGENBRU 2608 A PUN 00000183 001 NONE 02/05 17:31:40 DVHRLN EXEC HUGENBRU
HUGEN2 0104 T CON 00000176 001 NONE 03/21 09:22:35 HUGEN2
DIRMAINT 0112 A PUN 00000031 001 NONE 04/19 16:24:11 HUGEN2 DIRECT REVIEW
HUGEN2 0220 T CON 00000045 001 NONE 06/10 08:28:28 HUGEN2
HUGENBRU 2391 A PUN 00000607 001 NONE 10/17 14:40:51 QKDAR LIST3270 HUGENBR
MORE... GDLVM7

```



```
Session B - [24 x 80]
File Edit View Communication Actions Window Help
HUGENBRU RDRLIST AU V 164 Trunc=164 Size=12 Line=1 Col=1 Alt=0
Cmd  Filename Filetype Class User  at Node   Hold  Records  Date    Time
DIRMAINI NEWMAIL  PUN A  HUGENBRU GDLVME  NONE   149  12/22   7:54:04
CLASVM2  NOTE     PUN A  CLASVM2  GDLVME  NONE   19   7/25   13:34:14
RETAIN   CONLOG   CON A  PSFRET3  GDLVME  NONE   5    7/24   15:34:07
RETAIN   CONLOG   CON A  PSFRET3  GDLVME  NONE   5    7/24   16:25:07
UIDSER   875996   PUN A  CLASRPT2 PKEDVM9 NONE  128   1/12   13:45:53
MDSER    875996   PUN A  CLASRPT2 PKEDVM9 NONE  117   1/12   13:47:20
HUGENBRU NOTIFY   PUN A  RACFVM   GDLVME  NONE   9     2/02   5:41:24
PI29130C PACKLIB  PUN A  PBCHART  GDLVME  NONE  33140 11/24   21:21:00
PI31202  INSPECT  PRT A  HUGENBRU GDLVME  NONE  1569  2/12   10:16:47
PI31200  INSPECT  PRT A  HUGENBRU GDLVME  NONE  2895  2/12   10:23:52
VM65580  INSPECT  PRT A  HUGENBRU GDLVME  NONE  16827 2/12   11:38:55
PI31200  INSPECT  PRT A  HUGENBRU GDLVME  NONE  5953  2/13   16:41:38

1= Help      2= Refresh  3= Quit      4= Sort(type) 5= Sort(date) 6= Sort(user)
7= Backward  8= Forward  9= Receive   10=           11= Peek      12= Cursor

====>

X E D I T  1 File
MA B 03/001
```

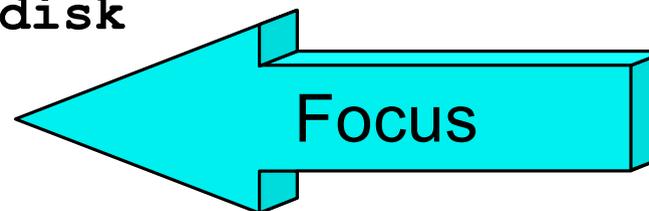
Defining a Virtual Machine

Sample User Directory Entry

```
USER IBMUSER IBMUSER 32M 32M ABCDEG
ACCOUNT SYSTEMS
MACH ESA
IPL CMS
```

```
CONSOLE 009 3215
SPOOL 00C 2540 READER *
SPOOL 00D 2540 PUNCH A
SPOOL 00E 1403 A
```

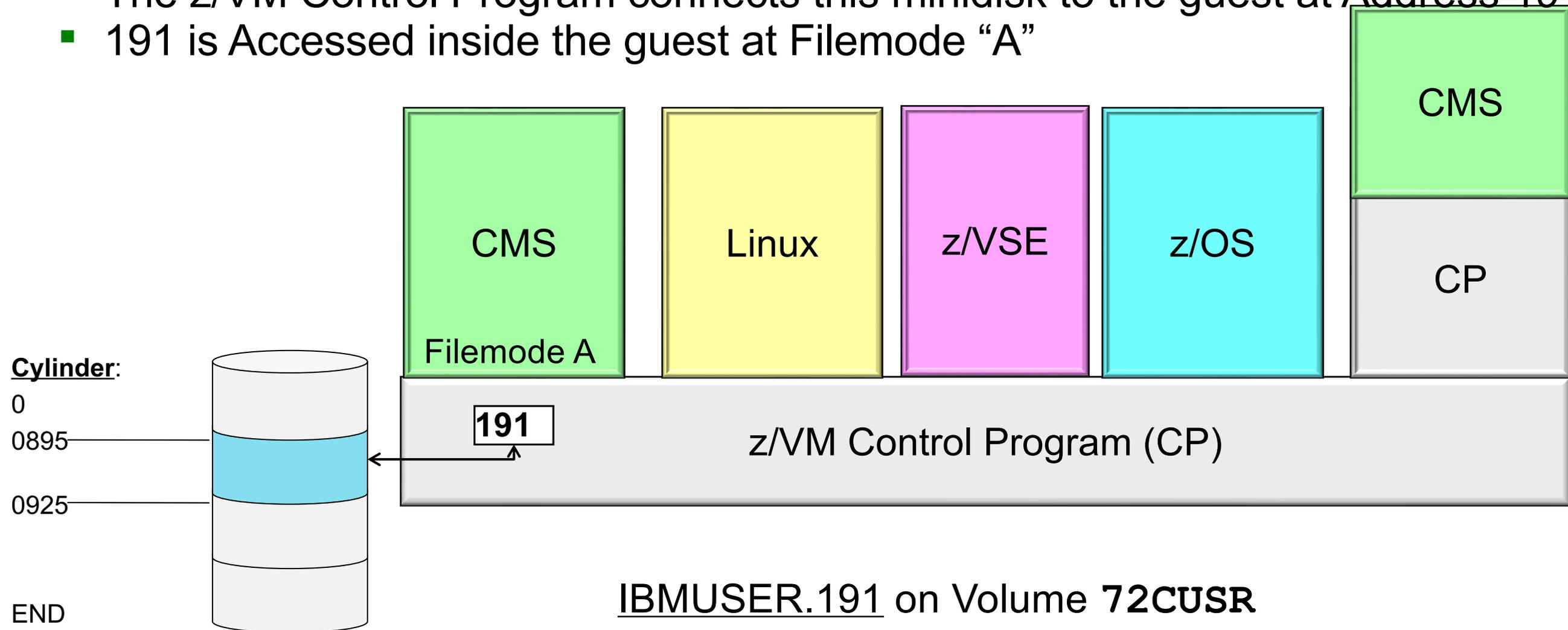
```
LINK MAINT 0190 0190 RR * CMS system disk
LINK MAINT 019E 019E RR * Product code disk
LINK 7VMRAC20 29E 29E RR
LINK 7VMRAC20 505 305 RR
LINK 7VMRAC20 191 391 RR
MDISK 1191 3390 2078 001 72CRES MR READ WRITE MULTIPLE
MDISK 191 3390 0895 030 72CUR MR READ WRITE MULTIPLE
```



Defining a Virtual Machine

Sample User Directory Entry

- Our CMS guest is running under z/VM
- The z/VM Control Program connects this minidisk to the guest at Address 191
- 191 is Accessed inside the guest at Filemode "A"



More About Minidisks

- A location on real DASD which has been allocated for storage of a user's files
- Three (3) types of minidisks:
 - ▶ Permanent
 - lasts across sessions (logons); defined in the User Directory
 - ▶ Temporary (T-disks)
 - Created inside a z/VM session
 - Destroyed at logoff!
 - use CP DEFINE command or ATTACH by operator
 - ▶ Virtual disks in storage (V-disks)
 - Temporary **simulation** of a minidisks in system storage
 - **not** allocated on real DASD (for example, on 3390 DASD)
 - Avoids I/O overhead
 - Good swap space for Linux guests

More About Minidisks – Commands

- CP DEFINE and FORMAT

- ▶ Defines a virtual device or virtual disk in storage

```
-- DEFINE T3390 as 815 cyl 10
```

- ▶ **Minidisks must be formatted before first time using!**

```
-- FORMAT 815 D
```

- CP LINK, CMS ACCESS

- ▶ Link to other user's minidisks to share files

```
-- LINK HUGENBRU 191 391 rr
```

- ▶ Once linked, a disk can be accessed

```
-- ACCESS 391 C
```

More About Minidisks – Commands

■ RELEASE, CP DETACH

- ▶ Release frees an accessed disk
 - Release C
- ▶ Detach removes the device from your VM configuration
 - Detach 815 -Or- Release c (detach

■ CP QUERY VIRTUAL DASD

- ▶ Shows what your machine has linked; displays status

■ Q ACCESSED, Q DISK, Q SEARCH

- ▶ Shows various status information for accessed disks/directories

■ LISTFILE, FILELIST

- ▶ Lists the files on an accessed minidisk or directory

```
Session B - [24 x 80]
define t3390 as 815 cyl 10
DASD 0815 DEFINED
Ready; T=0.01/0.01 14:36:40
format 815 d
DMSFOR603R FORMAT will erase all files on disk D(815). Do you wish to continue?
Enter 1 (YES) or 0 (NO).
1
DMSFOR605R Enter disk label:
PIP815
DMSFOR733I Formatting disk D
DMSFOR732I 10 cylinders formatted on D(815)
Ready; T=0.01/0.01 14:36:51
q disk
LABEL  VDEV M  STAT  CYL TYPE BLKSZ  FILES  BLKS USED-(%)  BLKS LEFT  BLK TOTAL
-      DIR  A   R/W   -   -  4096    6             -           -           -
TCM592 592  C   R/O   140 3390 4096    858    11818-47    13382    25200
PIP815 815  D   R/W    10 3390 4096     0         7-00     1793     1800
MNT190 190  S   R/O   207 3390 4096    704    18095-49    19165    37260
MNT19E 19E  Y/S  R/O   500 3390 4096   1124    30404-34    59596    90000
Ready; T=0.01/0.01 14:36:55

RUNNING  TOSP1B
```

Developing Programs in a z/VM Environment

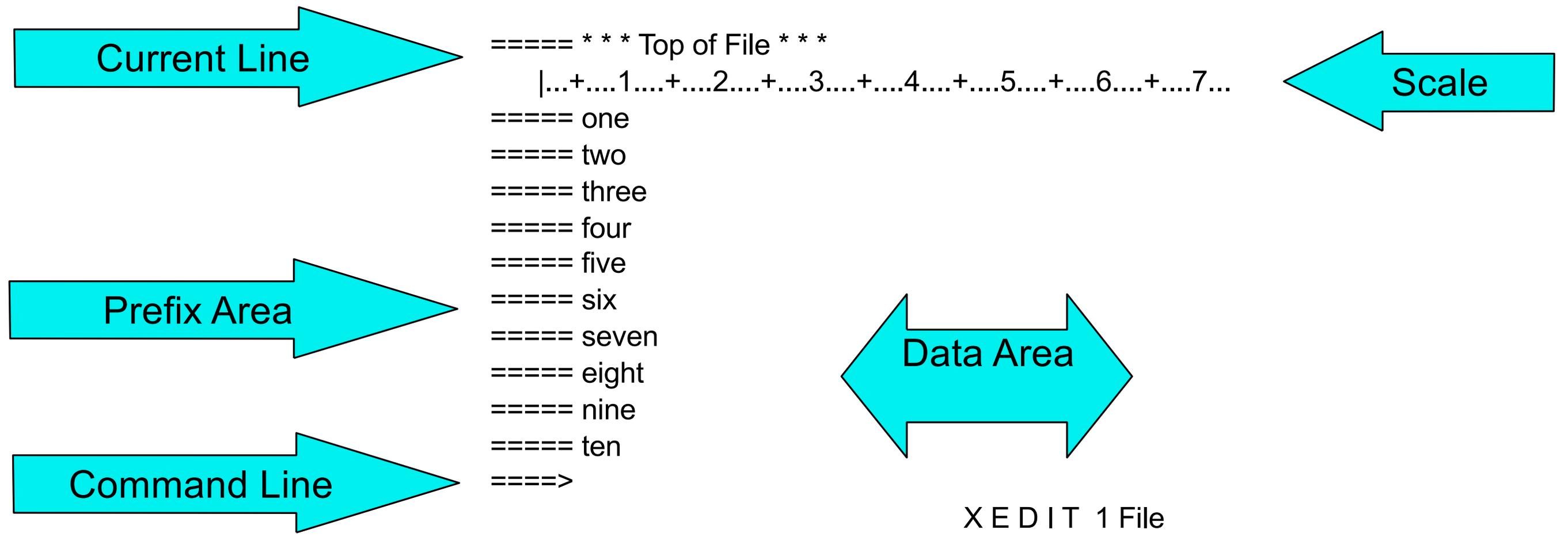
■ Creating and Compiling

- ▶ Filetype indicates name of programming language you are using
 - Assemble, Fortran, C, Cobol, PLI, Pascal, Rexx, etc.
- ▶ Invoke the compiler by typing compiler name followed by File name of the program
- ▶ LISTING and TEXT files are produced
command: **ASSEMBLE ASM1**

result: **ASM1 LISTING**
 ASM1 TEXT
- ▶ Use **XEDIT** to create the program like any other file

Developing Programs with XEDIT

- Command: `Xedit fn ft fm TEST FILE A1 F 80 Trunc=80 Size=45 Line=0 Col=1 Alt=0`
- Each line is a record
- Screen Layout:



Developing Programs with XEDIT

■ Prefix Commands (subset)

- m, mm..mm move, block move
- c, cc..cc copy, block copy
- f following
- p preceding
- a add
- si sequential insert
- d, dd..dd delete, block delete
- ", "" "" repeat previous command

Developing Programs with XEDIT

- Command-line commands
 - ▶ screen format
 - ▶ change /xxx/yyy/ * *
 - ▶ /zzz/ (find zzz in text)
 - ▶ all /zzz/ (find all zzz at once)

- Write your own XEDIT commands
 - ▶ Name: yourcmdn XEDIT
 - ▶ Write using REXX
 - ▶ Can use Pipelines

- Saving and Quitting your XEDIT Session
 - ▶ QQuit - leave without saving changes
 - ▶ SAVE - saves changes without exiting program
 - ▶ FILE - leave and save changes

Developing Programs with XEDIT

- PROFILE XEDIT runs when XEDIT is invoked
- Sample: PROFILE XEDIT

```
/* PROFILE XEDIT */  
'SET VERIFY OFF 1 72'  
'SET NUMBER ON'  
'SET PREFIX NULL'  
'SET CASE MIXED IGNORE'  
'SET CURLINE ON 4'  
'SET SCALE OFF'  
'SET AUTOSAVE 1'
```

- Note: Xedit is very tailorable !

Developing Programs with XEDIT

Current Line

No Scale

Prefix Area

Data Area

Command Line

```

Session B - [24 x 80]
File Edit View Communication Actions Window Help
PROFILE XEDIT A1 V 255 Trunc=255 Size=14 Line=0 Col=1 Alt=0
0 * * * Top of File * * *
1 /* PROFILE XEDIT */
2 'SET VERIFY OFF 1 72'
3 'SET NUMBER ON'
4 'SET PREFIX ON LEFT' /* Place prefix area at left side of screen */
5 'SET PREFIX NULL'
6 'SET NULLS ON'
7 'SET CASE MIXED IGNORE'
8 'SET CURLINE ON 4'
9 'SET SCALE OFF'
10 'SET AUTOSAVE 1'
11
12 'SET COLOR PREFIX BLUE' /* To make Pref area distinct from filearea */
13 'SET COLOR ARROW WHITE' /* Color of command line arrow is white */
14 'SET COLOR FILEAREA GREEN' /* To ensure filearea is diff from prefix */
15 * * * End of File * * *
=> _
XEDIT 1 File
MA b DOC 23/007
Connected to remote server/host gdlvm7.pok.ibm.com using port 23

```

Developing Programs with XEDIT – Synonyms

- ISPF prefixes - PROFILE XEDIT

- `/* to mimic ISPF` `*/`
- `'SET PREFIX SYNONYM B P` `'`
- `'SET PREFIX SYNONYM A F` `'`
- `'SET PREFIX SYNONYM R "` `'`
- `'SET PREFIX SYNONYM RR ""` `'`

A Note on Programming in Rexx

- Scripting language useful for writing productivity tools
 - Available on z/OS, Linux, Unix, Windows ...
- Quick notes on REXX:
 - ▶ `/* always starts with a comment */`
 - ▶ Filetypes: EXEC (most common), EXEC2, REXX
 - ▶ Contains Variables and Stemmed Arrays
 - Stores Strings and Numbers as strings
 - ▶ Has 'flow control'
 - do and do...while
 - If...then, else, select
 - ▶ Allows Functions and Procedures
 - ▶ Allows for Pipelines
 - ▶ Issues CP/CMS commands (in quotes)

A Note on Programming in Rexx

- **PROFILE EXEC** runs when you sign on
- Contains all the tailoring and configuration desired for this virtual machine
- Can also issue commands at start-up

Try for yourselves! (5-minute exercise)

- LISTFILE PROFILE EXEC *
- XEDIT PROFILE EXEC A

```
PROFILE EXEC A2 V 130 Trunc=130 Size=33 Line=5 Col=1 Alt=2
0 *** Top of File ***
1 /* profile exec for Brian's personal ID */
2
3 Signal on NOVALUE
4
5 'SYNONYM HUGENBRU SYNONYM A'
6
7 'EXEC VDISK' /* grab a V-disk */
8 'EXEC PFSET' /* SET PF keys. On my A-disk */
9 'EXEC PROJECT' /* prompt for today's work */
10
11 'CP SP PRI TO *'
12 'CP SET LINEDIT ON'
13 'CP SET RETRIEVE MAX'
14 'CP TERM HILIGHT ON'
15
16 /* Set Brian's Ready message - Use DMSUME EXEC to change it */
17 'SET RDYMSG LMSG'
18 'SET LANG AMENG ( ADD DMS USER '
19
20 'CP SET EMSG ON'
21 /* 'BATCH ADDRESS SQVBATCH GDLVM7' */
22 'globalv init'
23
24 /* colors */
25 'CP SCREEN CPOUT WHITE '
26 'CP SCREEN VMOUT BLUE '
27 'CP SCREEN INREDISP YELLOW '
28 'CP SCREEN STATAREA RED '
29
30 'CP QUERY CPLEVEL'
31 'CP QUERY V STOR'
32 'CP QUERY FILES'
33 Exit
34 *** End of File ***
```

```
Session B - [24 x 80]
File Edit View Communication Actions Window Help
TDISK EXEC A1 V 130 Trunc=130 Size=7 Line=0 Col=1 Alt=0

0 * * * Top of File * * *
1 /* creates a tdisk */
2
3 'DEFINE T3390 AS 0292 CYL 1'
4
5 queue '1'
6 queue 'BWHDSK'
7 'FORMAT 0292 D'
8 * * * End of File * * *

====> _

XEDIT 1 File
MA b DOC 23/007
```

Connected to remote server /host gdlvm7.pok.ibm.com using port 23

Debugging A Virtual Machine

- Record your console

- `spool console to * start` (to start recording)
- `...` (do work here)
- `spool console stop close` (punch console to reader)
- `query reader all` (to get the spool id)
 - `rdrlist`
- `peek {spool id} (for *` (to look at the console)
- `receive {spool id} fn ft fm` (to save console in a file)

Debugging A Virtual Machine

■ HELP Facility

- ▶ HELP /* main menu */
 - ▶ HELP command /* for a specific command */
 - ▶ HELP msg DMSxxxE /* for a specific message */
-
- ▶ **CP LINK MAINT 19D 19D RR**
 - link for HELP disk
-
- *Most virtual machines that IBM ships by default already have this disk linked*

HELP

```

A - Small VM7 - [40 x 80]
File Edit View Communication Actions Window Help
HELP TASKS Task Help Information line 1 of 40
(c) Copyright IBM Corporation 1990, 2013

z/VM HELP, main panel

The help panels listed below provide information about various
z/VM functions, topics, and tasks.
To view a help panel, move the cursor to any character of the name
or description and press the ENTER key or the PF1 key.

HELP - z/VM HELP Facility topics
MENUS - z/VM help menus
TASKS - Basic z/VM tasks
AVS - AVS commands
CMS - CMS commands
CP - CP commands
DIRMAINT - DirMaint commands
DIRMAINT - DirMaint topics
DUMPS - Dump commands, subcommands, and utilities
DYNIO - Dynamic I/O tasks
GLOSSARY - Definitions of terms
LE - Language Environment commands
LIBRARY - z/VM bibliography
MACROS - CMS assembler macros (menu)
MACROS - Assembler macros and functions (types)
MESSAGES - Messages and codes
OPEN - OpenExtensions services and APIs
PERFKIT - Performance Toolkit topics
PIPE - CMS Pipelines stages and subcommands
PIPE - CMS Pipelines tasks
QUERYSET - QUERY and SET commands and subcommands
ROUTINES - CMS callable services (menu)
ROUTINES - CMS routines (types)
RSCS - RSCS Networking commands and link parameters
PF1= Help 2= Top 3= Quit 4= Return 5= Clocate 6= ?
PF7= Backward 8= Forward 9= PFkeys 10= 11= 12= Cursor

====> _
Macro-read 1 File
MA A 39/007
Connected to remote server/host gdlvm7.endicott.ibm.com using port 23

```

HELP

Note: the coloration of the help panels can be adapted for ease of reading.

```

B - GDLMV7 - [43 x 80]
HELP TASKS                               Task Help Information          line 1 of 40
(c) Copyright IBM Corporation 1990, 2013

z/VM HELP, main panel

The help panels listed below provide information about various
z/VM functions, topics, and tasks.
To view a help panel, move the cursor to any character of the name
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HELP      - z/VM HELP Facility topics
MENUS     - z/VM help menus
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AVS       - AVS commands
CMS       - CMS commands
CP        - CP commands
DIRMAINT  - DirMaint commands
DIRMAINT  - DirMaint topics
DUMPS     - Dump commands, subcommands, and utilities
DYNIO     - Dynamic I/O tasks
GLOSSARY  - Definitions of terms
LE        - Language Environment commands
LIBRARY   - z/VM bibliography
MACROS    - CMS assembler macros (menu)
MACROS    - Assembler macros and functions (types)
MESSAGES  - Messages and codes
OPEN      - OpenExtensions services and APIs
PERFKIT   - Performance Toolkit topics
PIPE      - CMS Pipelines stages and subcommands
PIPE      - CMS Pipelines tasks
QUERYSET  - QUERY and SET commands and subcommands
ROUTINES  - CMS callable services (menu)
ROUTINES  - CMS routines (types)
RSCS     - RSCS Networking commands and link parameters
STATEMTS  - REXX, EXEC 2, and EXEC statements
SUBCMDS   - Subcommand groups, such as XEDIT
TCP/IP    - TCP/IP commands

PF1= Help      2= Top      3= Quit      4= Return      5= Clocate      6= ?
PF7= Backward  8= Forward  9= PFkeys  10=           11=           12= Cursor

====> _

Macro-read 1 File
MA B
42/007
  
```

```
Session A - [24 x 80]
File Edit View Communication Actions Window Help
21:49:50 * MSG FROM HUGENBRU: STOP SLACKING OFF AND TEACH YOUR CLASS
21:50:06 * MSG FROM HUGENBRU: TYPE 'MSG <USERID> <TEXT>'
21:50:21 * MSG FROM HUGENBRU:
21:50:28 * MSG FROM HUGENBRU: P.S. HI MOM
RUNNING GDLVM7
MA A DOC ↓ 23/001
```

Logging Off of a Virtual Machine

- **CP LOGOFF**
 - Terminates activity inside the virtual machine
 - Temporary and virtual disks are erased
 - User returns to logon screen

- **CP DISCONNECT**
 - Virtual machine and programs inside of it continue to run
 - User returns to logon screen

Try for yourselves!

- SPOOL CONS TO * START
- QUERY ACCESSED
- QUERY LAN
- LISTFILE * EXEC *
- SPOOL CONS TO * STOP CLOSE
- QUERY RDR
- RDRLIST, *then hit PF11 on the last file to view*
- HELP LINK
 - Q ACCESSED
 - LINK MAINT 19D 19D RR
 - ACC 19D <filemode>
- HELP LINK
- LOGOFF

For more information ...

z/VM Internet Library

- <https://www.ibm.com/vm/library>

- Includes:
 - z/VM Knowledge Center
 - Useful when unsure which book or for searching tasks
 - z/VM Information Center (being replaced by z/VM Knowledge Center)
 - z/VM PDF bookshelf
 - Useful for when you know the book you need and prefer PDFs
 - z/VM Program Directories
 - z/VM Education and Presentations
 - z/VM data areas and control blocks
 - z/VM monitor records
 - Select IBM Redbooks®
 - White papers and other documents

z/VM Library Overview

Overview

[z/VM 6.x PDFs](#)

[z/VM 7.1 PDFs](#)

[z/VM 7.2 PDFs](#)

[z/VM Related PDFs](#)

[Indexed PDFs](#)

z/VM

Last Updated: 17 December 2021

News

Update: Revised publications are now available for new or upcoming [z/VM 7.2 New Function APARs](#) released between September and December 2021. An updated [collection kit](#) containing all the updates is also available.

About z/VM

Events calendar

Products and features

You can now get all IBM z/VM PDF files directly from the z/VM Library web site. All documentation pertaining to a specific supported version and release will be available regardless of the New Function APARs you have installed on your z/VM system. PDF files are available for [z/VM 6.x](#) and [z/VM 7.1](#) releases as well as [z/VM related](#) publications.

Downloads

The z/VM Library also offers [complete PDF collections](#) of the documentation on a near quarterly basis. These collections are indexed, meaning you can search for any terms and it will return all matches from any document within the collection. No more hunting for a specific manual to find exactly what you need.

Technical resources

Library

z/VM product information

[z/VM 6.x PDFs](#)

→ [z/VM 7.2 PDFs](#)

[z/VM 7.1 PDFs](#)

→ [z/VM 7.1 PDFs](#)

→ [z/VM 6.x PDFs](#)

→ [z/VM Related PDFs](#)

z/VM CMS Primer

- Primer walks through getting started with CMS
- Key content:
 - Logging on and off of z/VM
 - CMS minidisk file system and SFS (Shared File System) background
 - Editing files using XEDIT
 - Managing files and several productivity aids included in CMS for this
 - Like other platforms, there is often more than one way to do things.
- Content you can probably skip when you read for first time:
 - Printing from CMS
 - NAMES files

<https://www.vm.ibm.com/library/720pdfs/72626501.pdf> [PDF]

For More Information ...

▪ Web sites:

- <https://www.vm.ibm.com/> -- zVM on the Web
- <https://www.vm.ibm.com/library> -- the online zVM Library
- <https://www.vm.ibm.com/library/presentations/> -- links to presentations like this one!
- https://www.youtube.com/playlist?list=PL_4RxtD-BL5uGoq629H8IDxzfuvAN3IpF
- “z/VM How-To Guides” YouTube Channel

▪ Via mailing lists:

- IBMTCP-L@VM.MARIST.EDU
- IBMVM@LISTSERV.UARK.EDU
- LINUX-390@VM.MARIST.ED

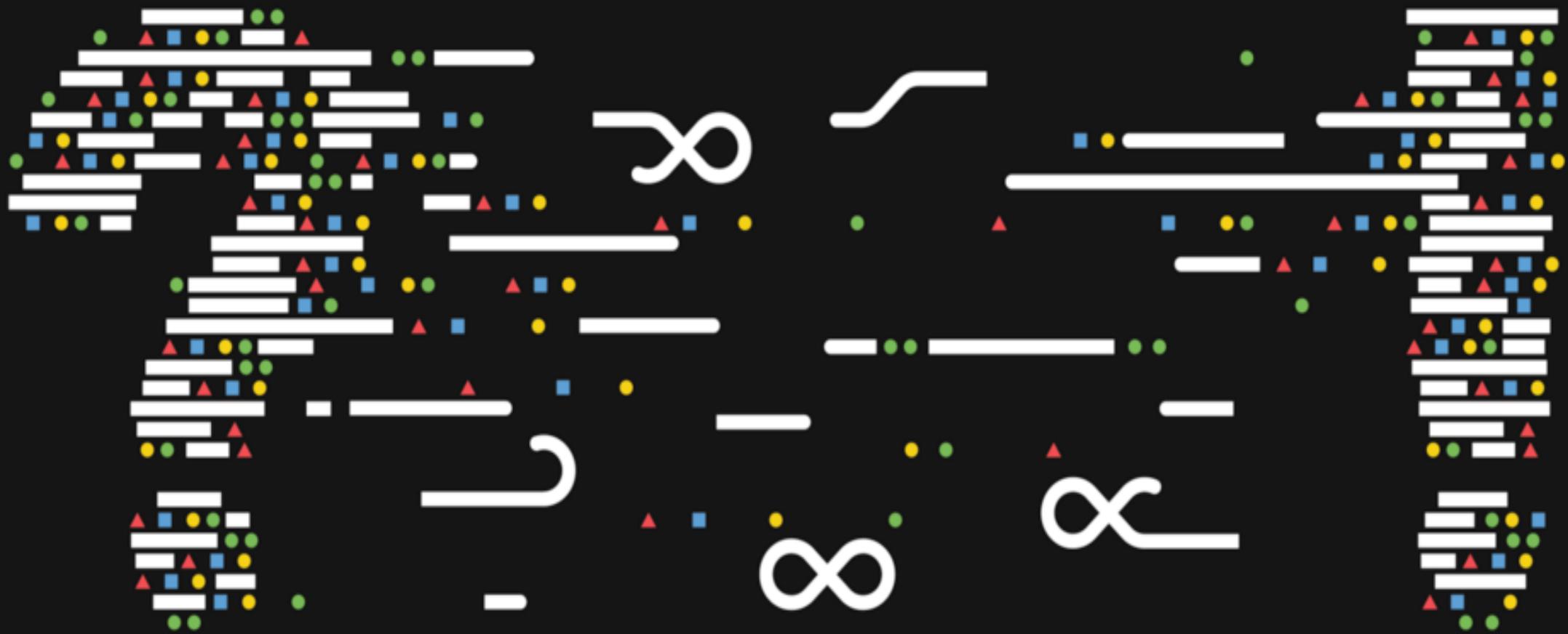
Contact Information:

[Brian W. Hugenbruch](#), CISSP

IBM zSystems Security for Virtualization and Cloud

[bwhugen at us dot ibm dot com](mailto:bwhugen@us.ibm.com)

 [@Bwhugen](#)



Backup Slides

Debugging A Virtual Machine

■ Tracing

- trace i r12345.10
 - trace instructions @ location 12345 for x'10' bytes
- display g (display general registers)
- d t12345.20 (display translated storage for x20)
- b (begin execution)
- trace end (end tracing)

■ Dumps

- VMDUMP
- VM Dump Tool

Try for yourselves!

- LOGON <userid> /* Remember, CTRL is your Enter key */
- SPOOL CONS TO * START
- QUERY PRIVCLASS /* Your security context ... */
- QUERY COMMANDS
- QUERY DISK /* Your resources ... */
- QUERY ACCESSED
- QUERY LAN
- SPOOL CONS TO * STOP CLOSE
- RDRLIST, *then hit PF11 on the last file to view ... look familiar?*
- PURGE RDR ALL
- QUERY RDR
- HELP LINK
- LINK MAINT 19D 19D RR
- HELP LINK
- LOGOFF

FAQ: “What are those numbers on my filemode?”

- You may see a second character (0-6) appear in the *filemode* field when doing a FILELIST on your minidisk or SFS directory. It's okay, it's meant to be there.
 - The number is a functional marker. The default is '1'. CMS system disks are a special case and should be '2'.
 - Function sometimes differs depending on if it's a minidisk or an SFS directory:

	Minidisk	SFS
0	File is private, unless a user has R/W access to the disk	No meaning
1	Default: normal read and/or write access	
2	Same Function as 1; conventionally used for files on shared disks.	Same Function as 1; no conventional purpose.
3	File is erased after it is read (be careful with this one)	
4	OS simulated data set format	OS simulated data set format
5	Same Function as 1; conventionally used for filegroups.	Same Function as 1; no conventional purpose.
6	Indicates “Update in place” is in effect.	Same Function as 1; no conventional purpose. (Update-In-Place handled via extended file attributes)

Brian's Cheat Sheet v1.2: "Where is it?"

(z/VM 7.2 edition)

File	Where It Is	What It Is
LOGO.CONFIG	PMAINT CF0	z/VM Logo Screen
SYSTEM.CONFIG	PMAINT CF0	z/VM System Configuration File
CPLOAD.MODULE	MAINT CF1 MAINT CF3 (backup)	z/VM Control Program (the "kernel")
USER.DIRECT	PMAINT 2CC	All virtual machine definitions (Note: resides in different place if you're using a Directory Manager)
Help Files	MAINT 19D	Access to HELP command
Sample Utilities	MAINT720 2C2	Access to z/VM utilities