The Basics of Using z/VM and CMS

Brian Hugenbruch, CISSP
z/VM Development, IBM: Endicott, NY, US
bwhugen@us.ibm.com

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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
- ***Demo / lab – try the commands for yourselves!***

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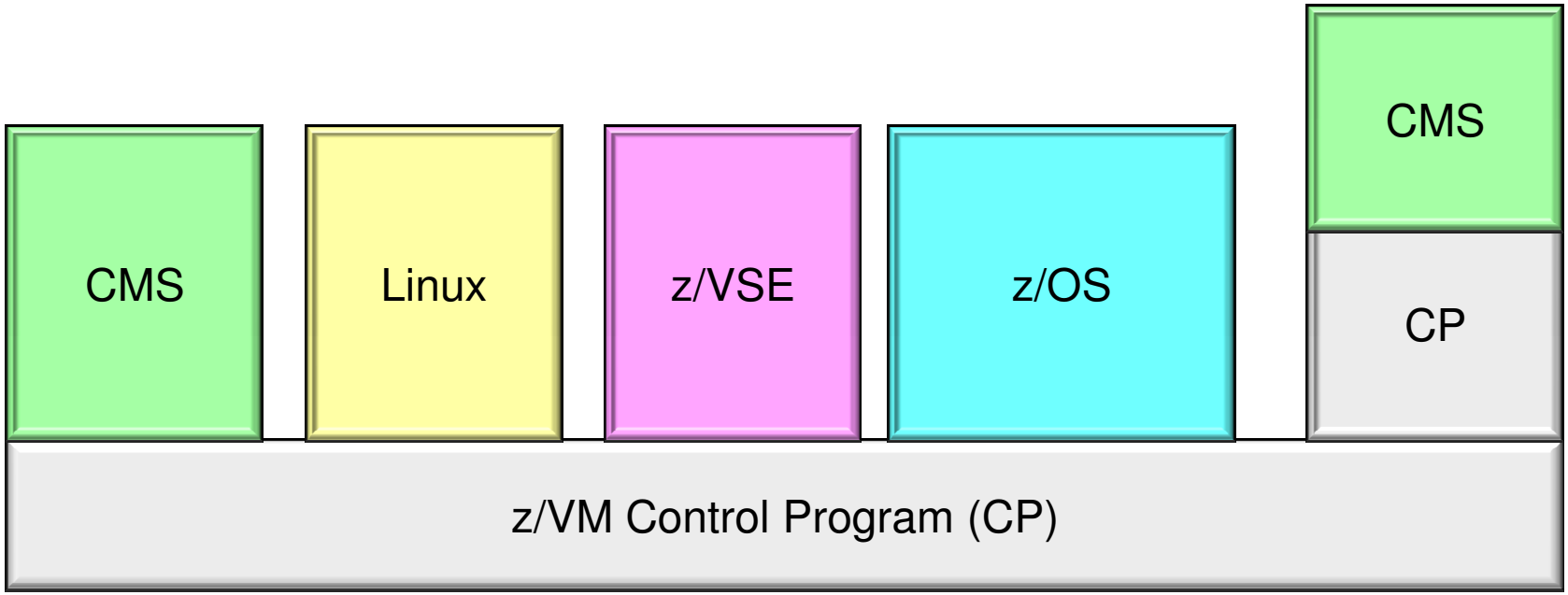
Overview – Virtual Machines

- z/VM contains two basic parts:
  - CP - Control Program (the Hypervisor)
  - The guest running under z/VM
    - Resides in a discrete “container” inside the system
    - Isolated and separated from other guest operating systems



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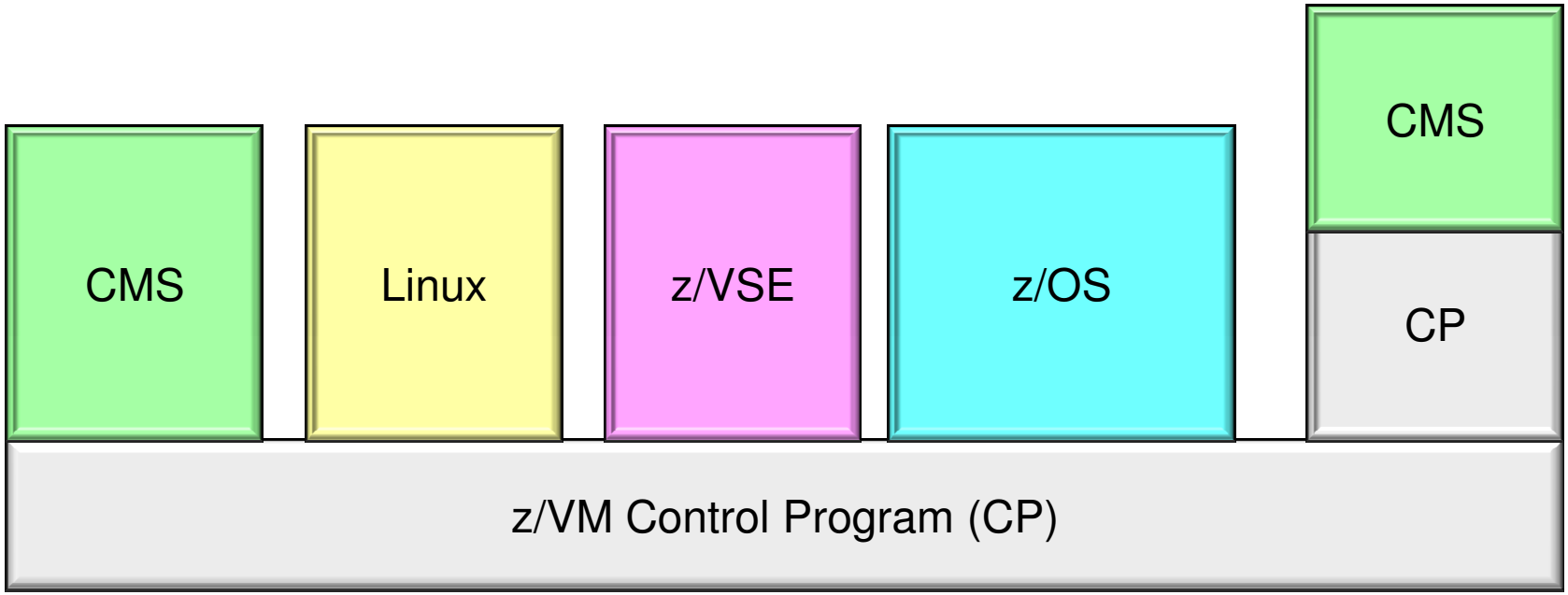
Overview – Virtual Machines

- 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



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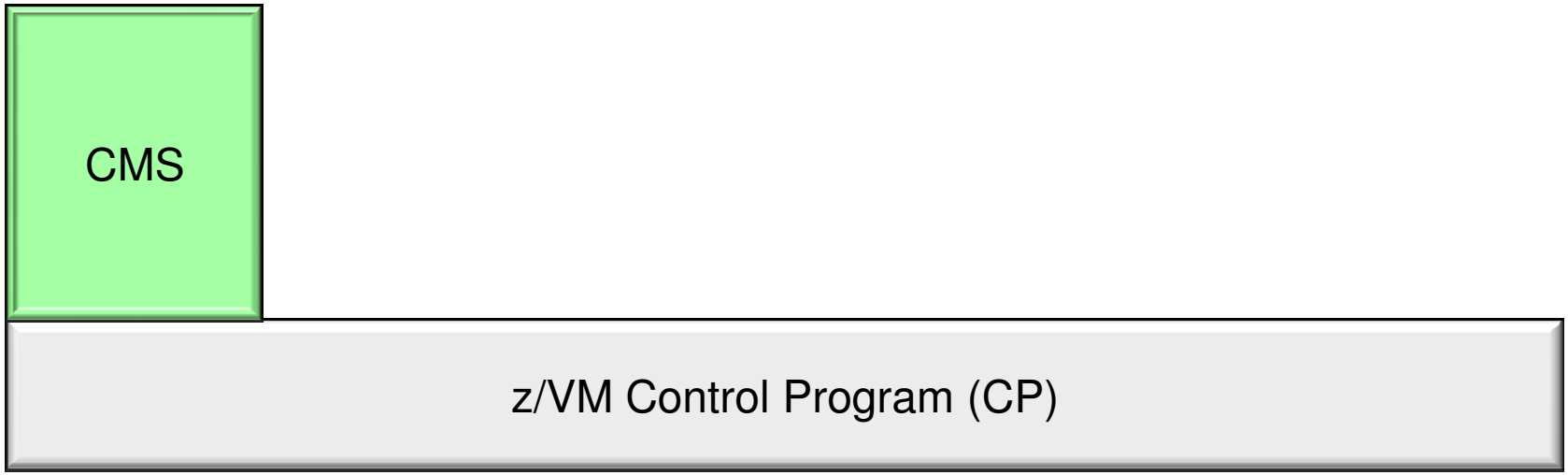
Overview – Virtual Machines

- **CMS: Conversational Monitor System**
  - An operating system that can run 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.



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Overview – Virtual Machines

- **Frequently Asked Question:** Is CMS the only way to control my z/VM system?
  - *Answer*: No. Other guests can issue limited z/VM commands, and software is available for the management of your systems
  - What CMS illustrates, in the context of this presentation, is how z/VM works
    - All these virtual machine concepts apply, no matter how you're controlling the system!

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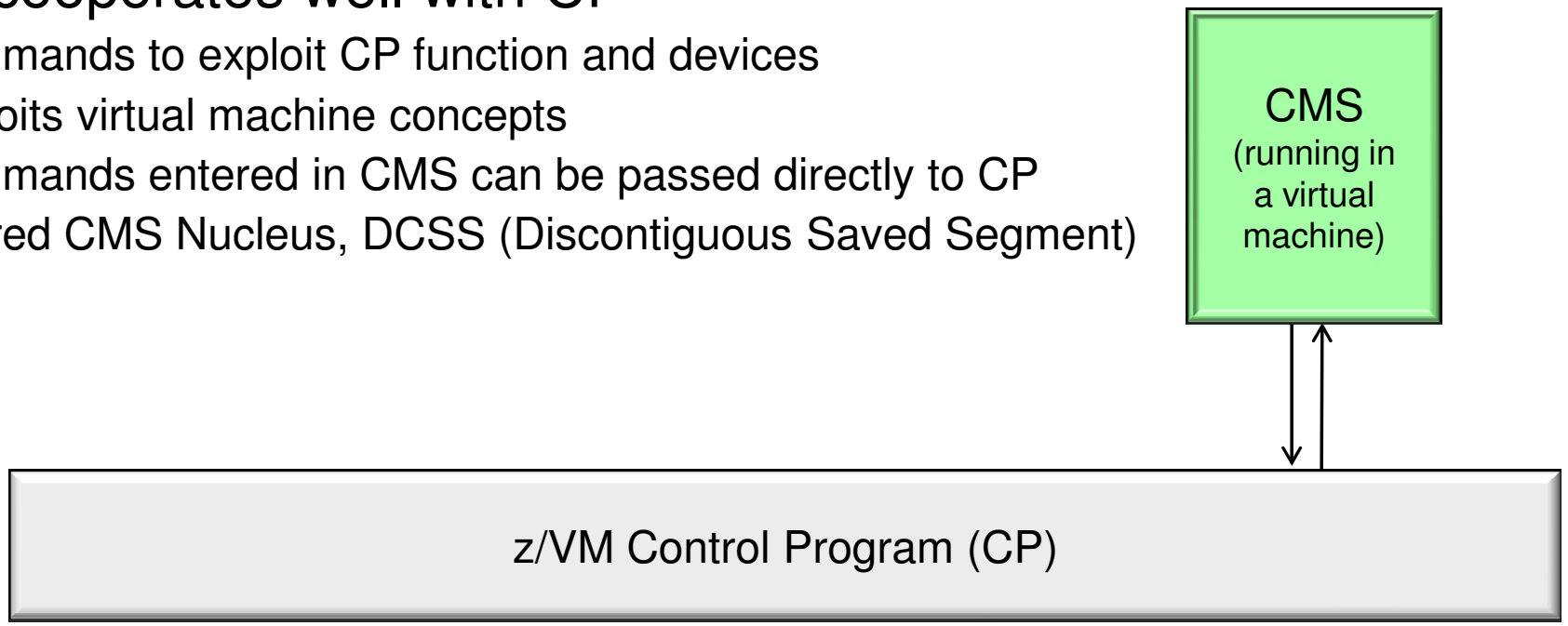
Overview – CMS

- 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

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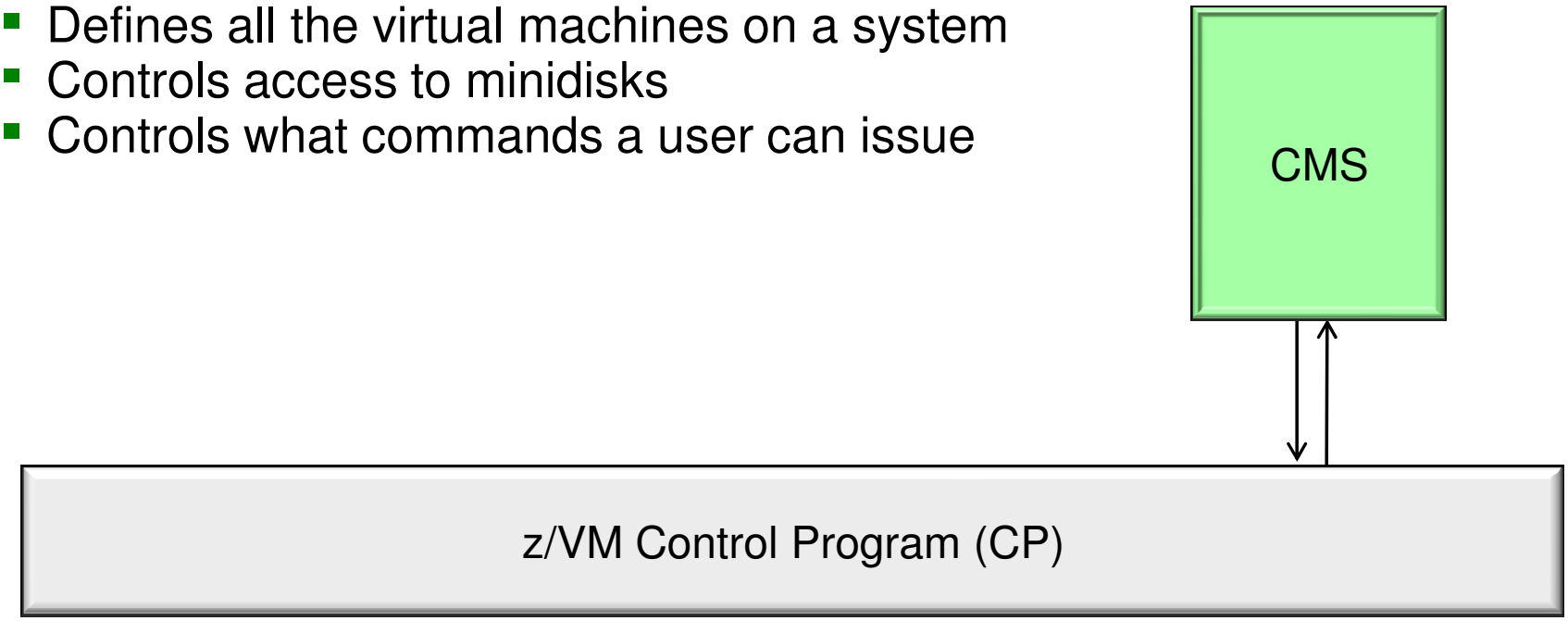
So where does a virtual machine come from?

- 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



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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 6VMRAC10 29E 29E RR
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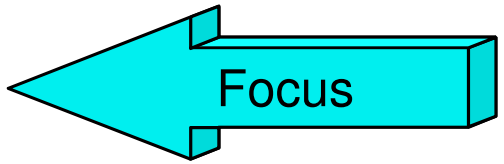

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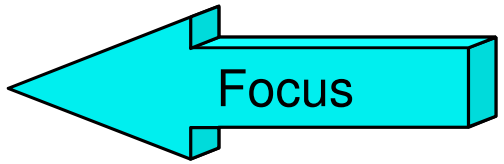

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Overview – CMS

To establish a z/VM session:

- z/VM Logo Screen
  - One at a time - 3270 emulation (for example, PComm)
  - `LOGON <userid> here` -- move a signon to another terminal session
  - `LOGON <userA> by <userB>` -- signon using different credentials
- Using CP to control the Virtual Machine
  - #CP IPL CMS - restart your entire CMS session
    - PROFILE EXEC exec runs to customize your session
- ***For today's session: Userids are by your terminals***
  - ***Passwords are the same as your userids.***

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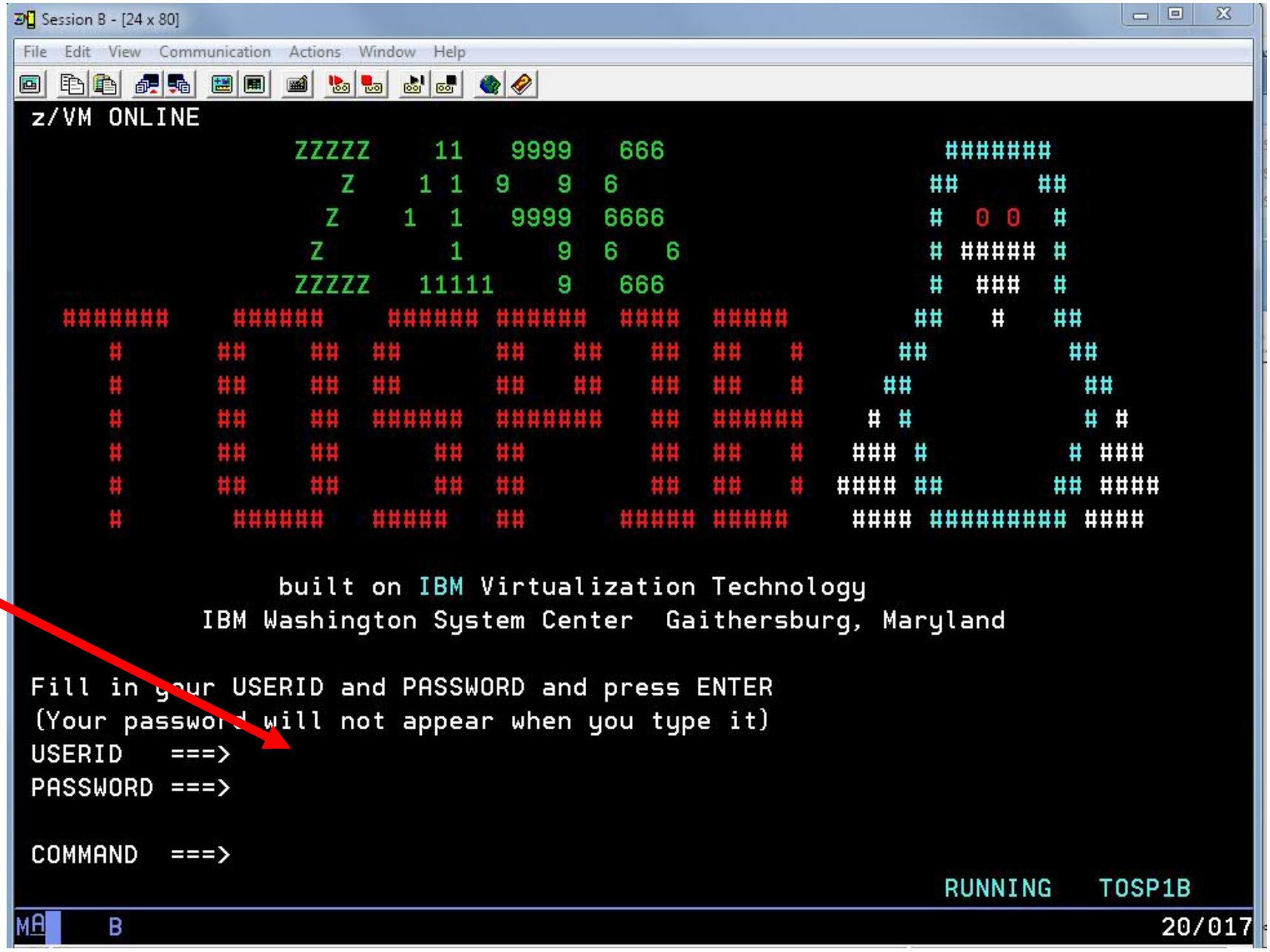

#WAVV #zVM

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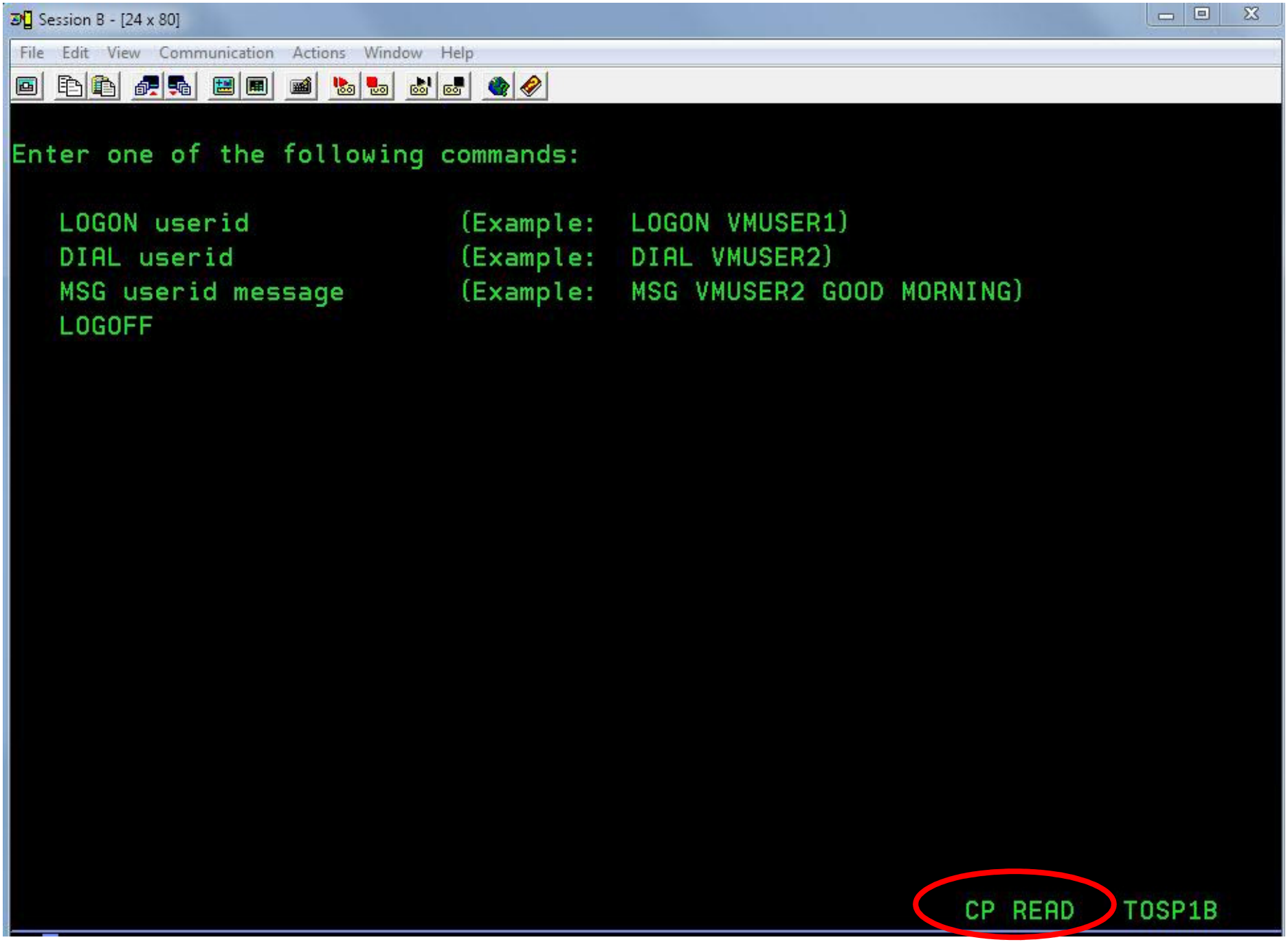

#WAVV #zVM

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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)

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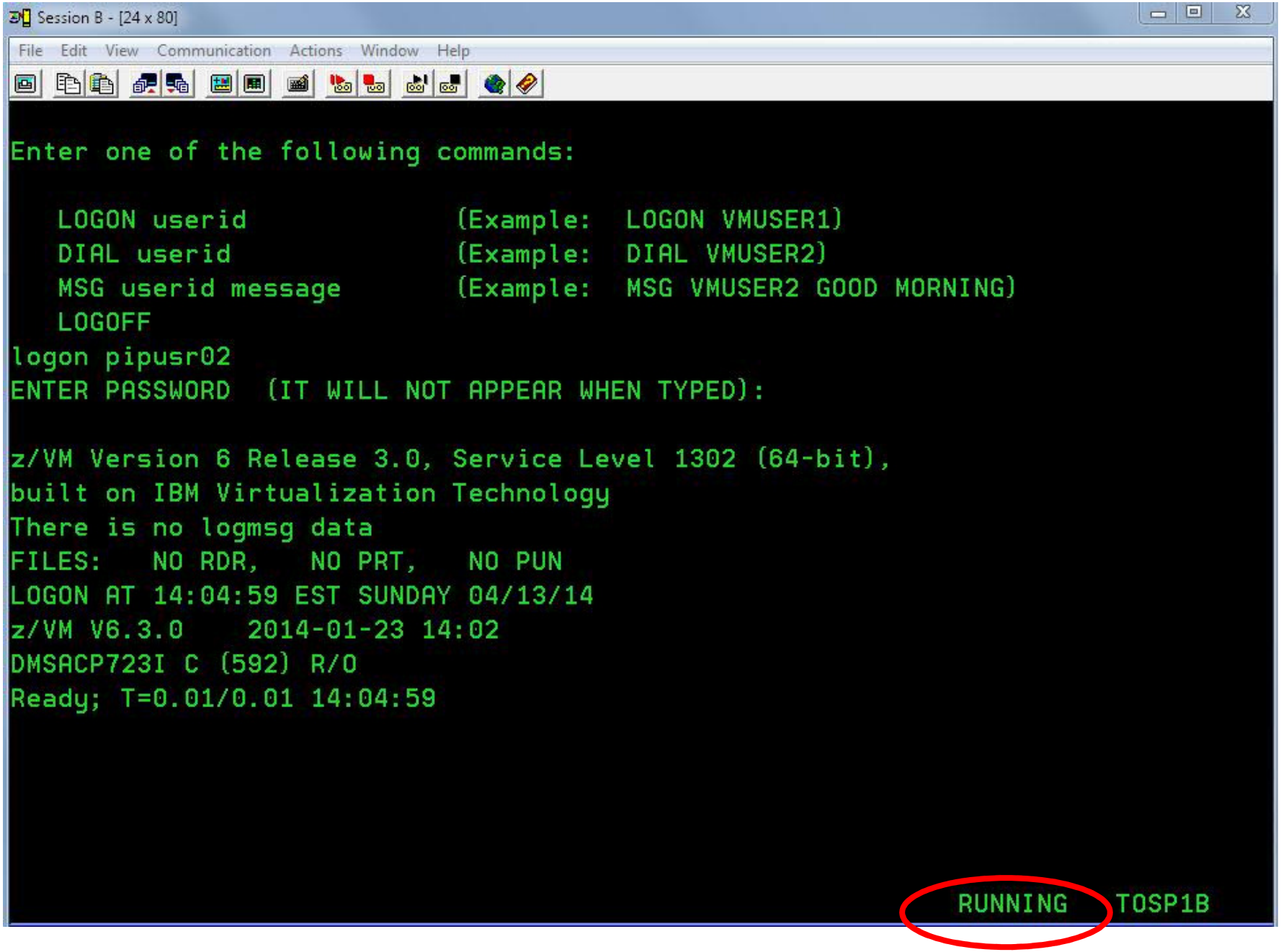

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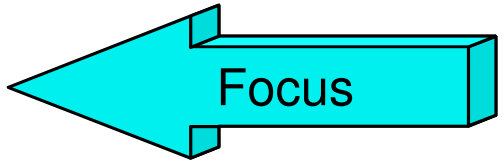

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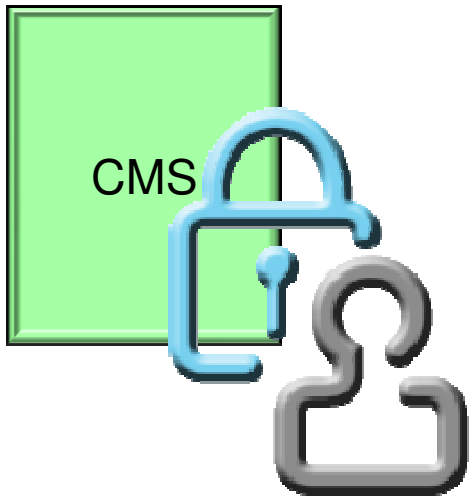
Defending a Single Virtual Machine

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 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

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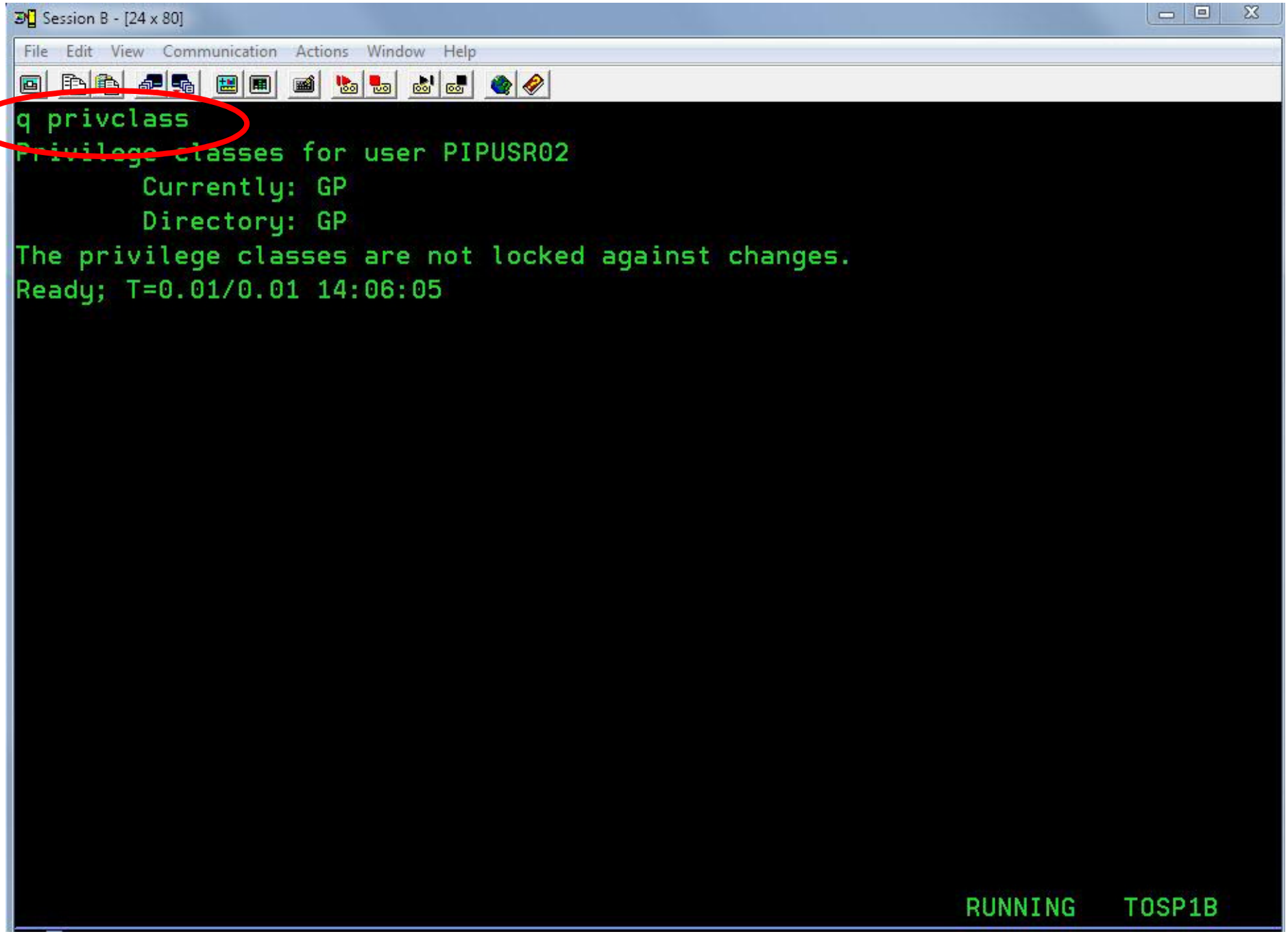

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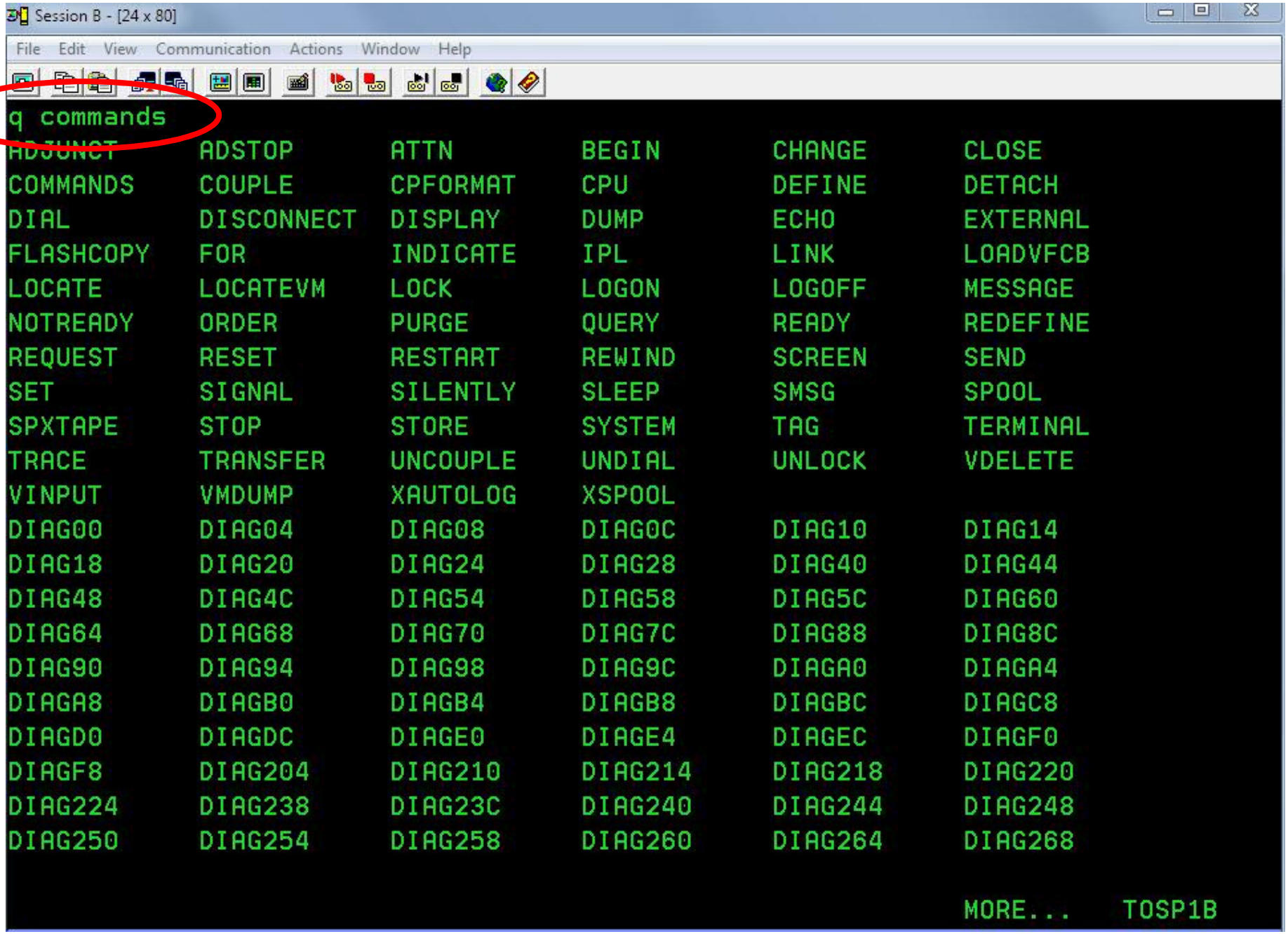

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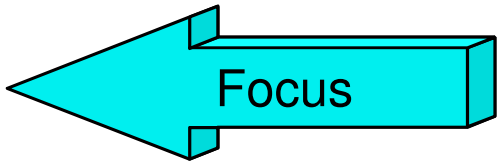

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Overview – CMS

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
    - SET DOS ON command simulates a VSE (DOS) environment

*not a full duplication of function

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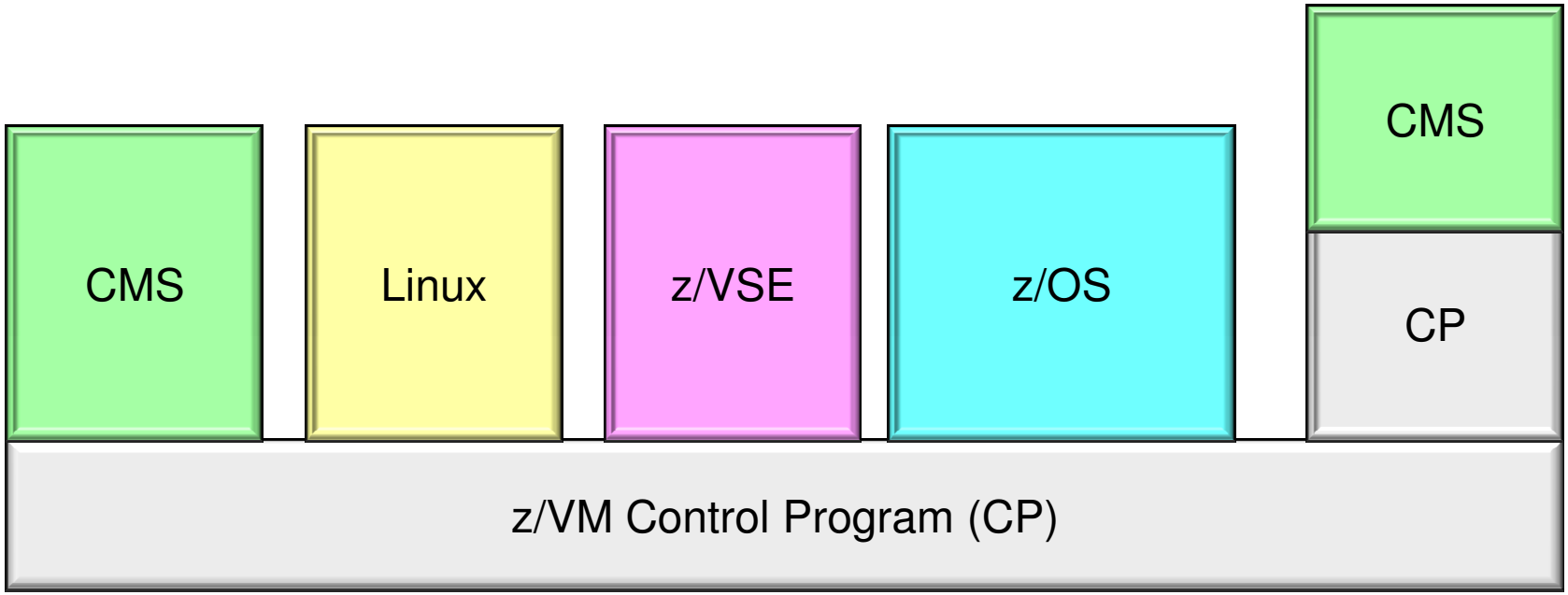
Defining a Virtual Machine – Sample User Directory Entry

- CMS
- zCMS
- Linux (often on its own separate disk)
- z/OS
- z/VSE



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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
```


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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 behaviour
  - Commands can be passed directly to CP
    - `#CP <command> (options`

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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
  - Users can define their own immediate commands
    - IMMCMD Macro from an Assembler program
    - IMMCMD Command from an EXEC
    - IMMCMD option on NUCXLOAD command

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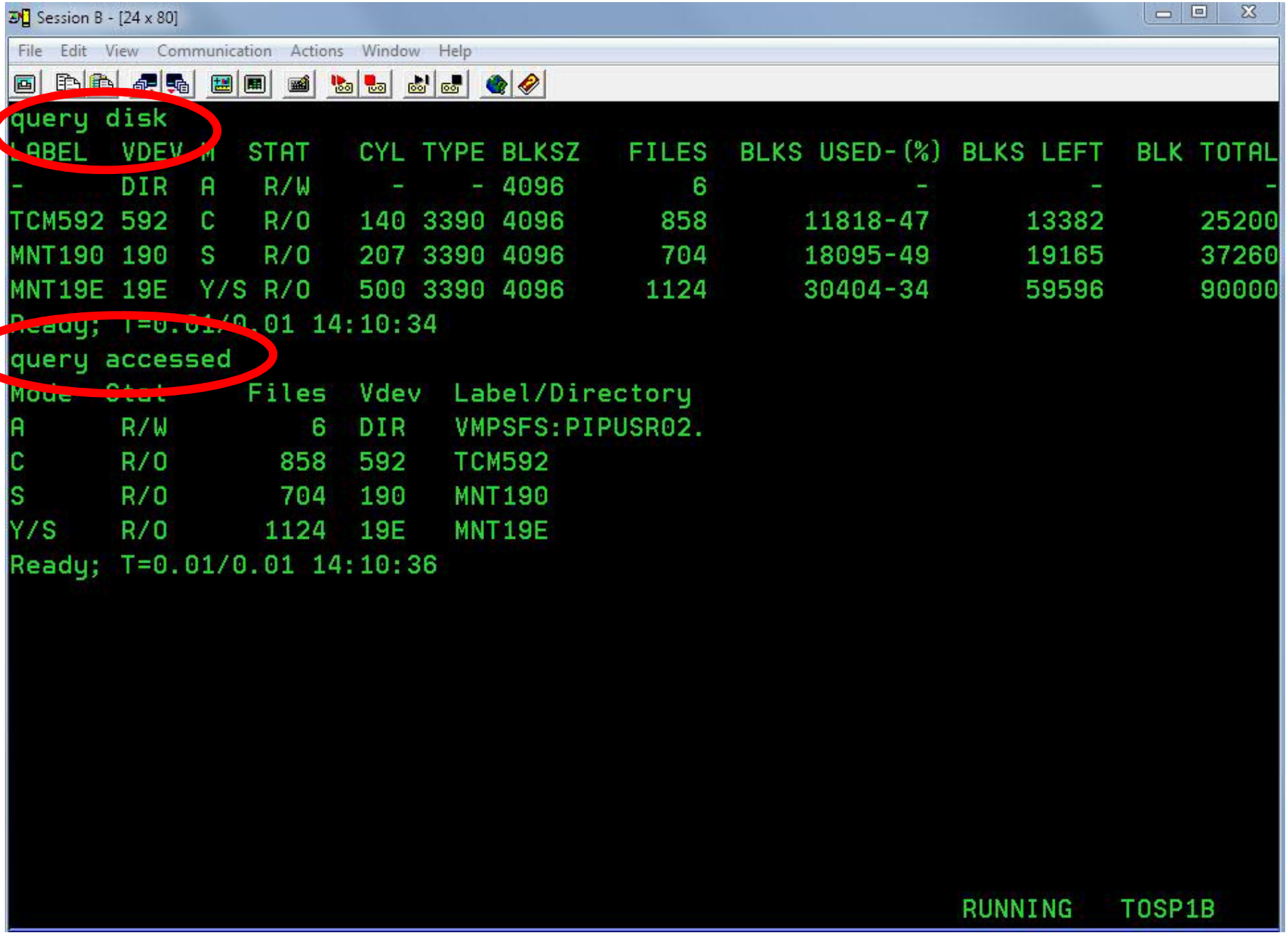

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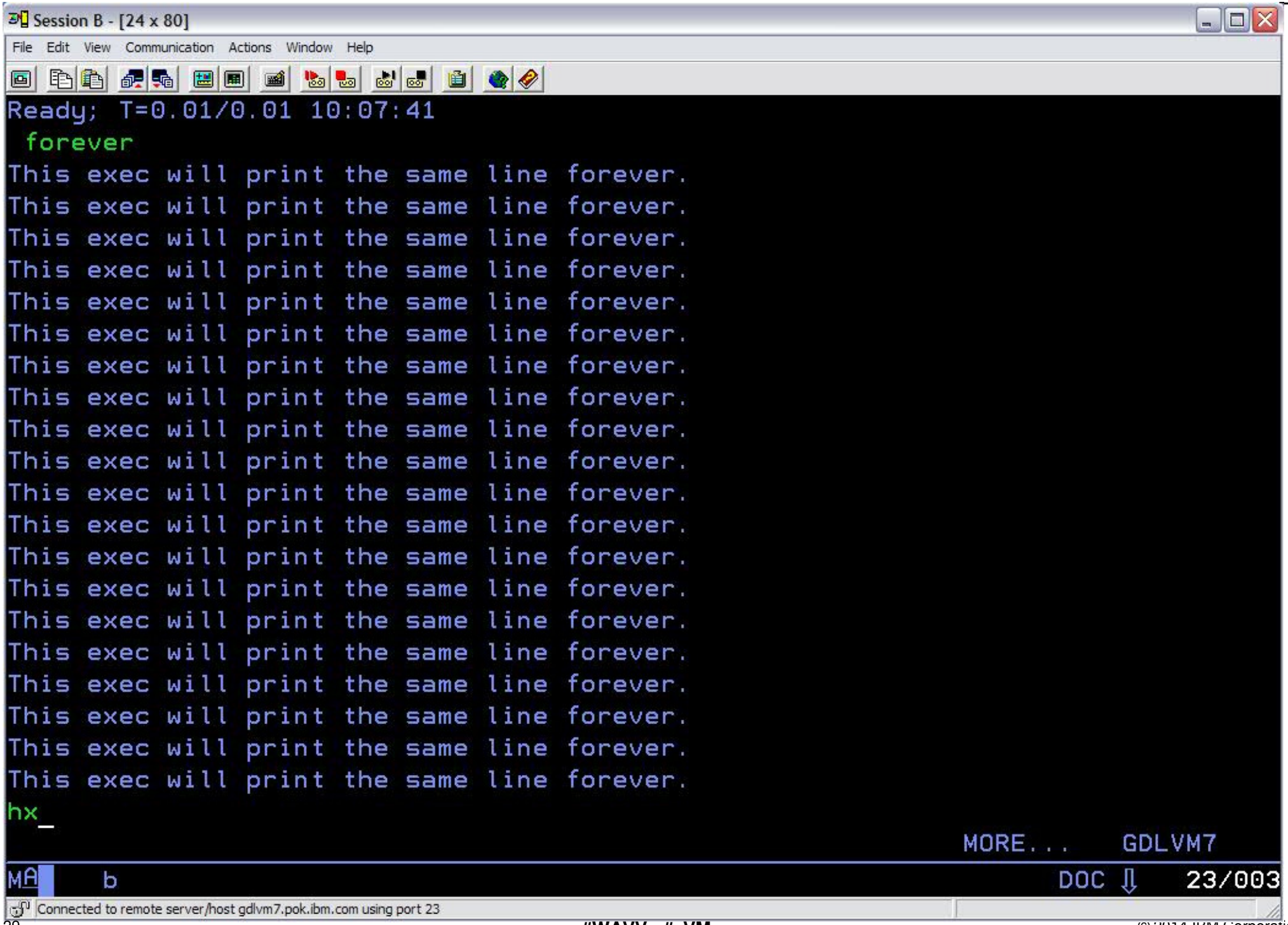

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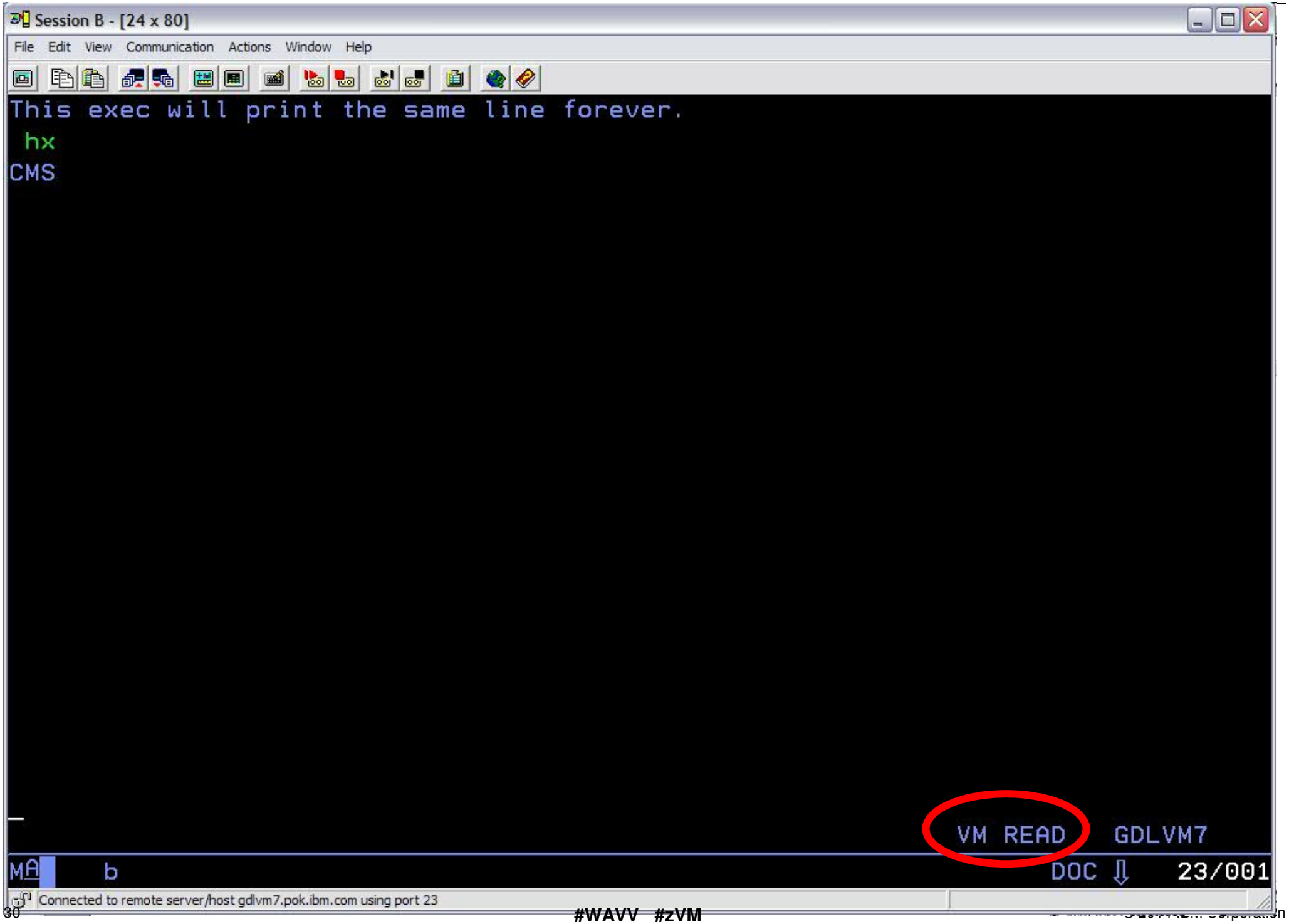
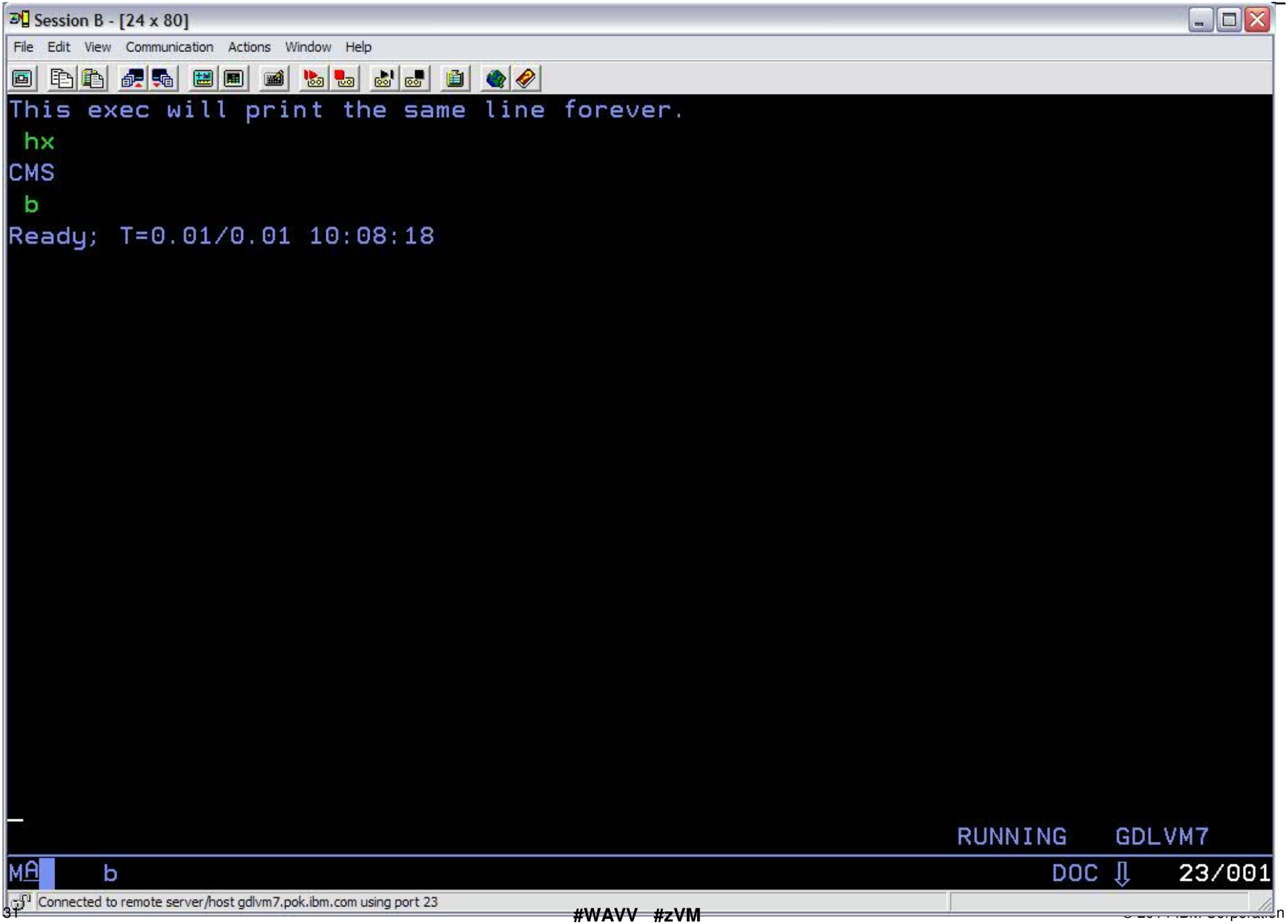

Session B - [24 x 80]
File Edit View Communication Actions Window Help
This exec will print the same line forever.
hx
CMS
VM READ GDLVM7
MA b
DOC 23/001
Connected to remote server/host gdlvm7.pok.ibm.com using port 23


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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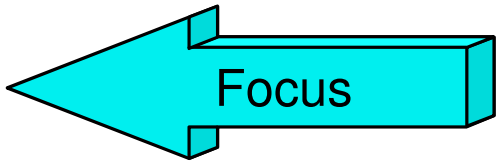

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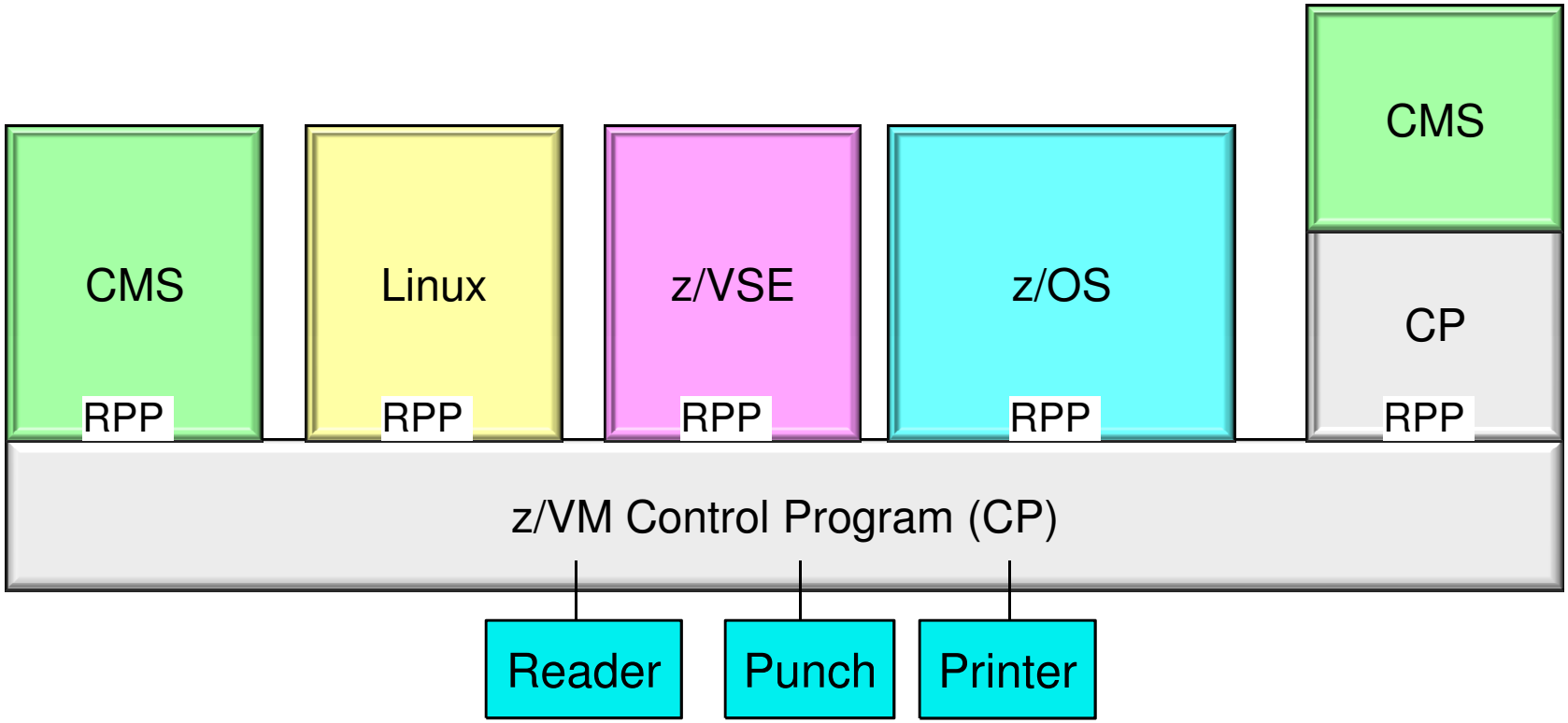
Defining a Virtual Machine – Sample User Directory Entry

- Spool Devices:
  Virtualized Reader, Printer, and Punch



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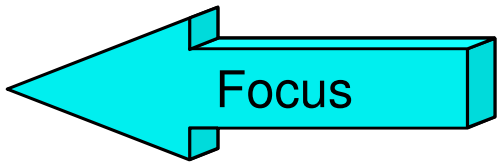

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CMS File System

- CMS files are unique and generally cannot be read or written by other operating systems
- 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)
    - file mode letter A-Z where minidisk or directory resides, established by ACCESS command
    - file mode number 0-6 assigned when file is created or renamed (default = 1), used to identify or operate on a subset of files

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CMS File System

- 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)

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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'.
  - 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)

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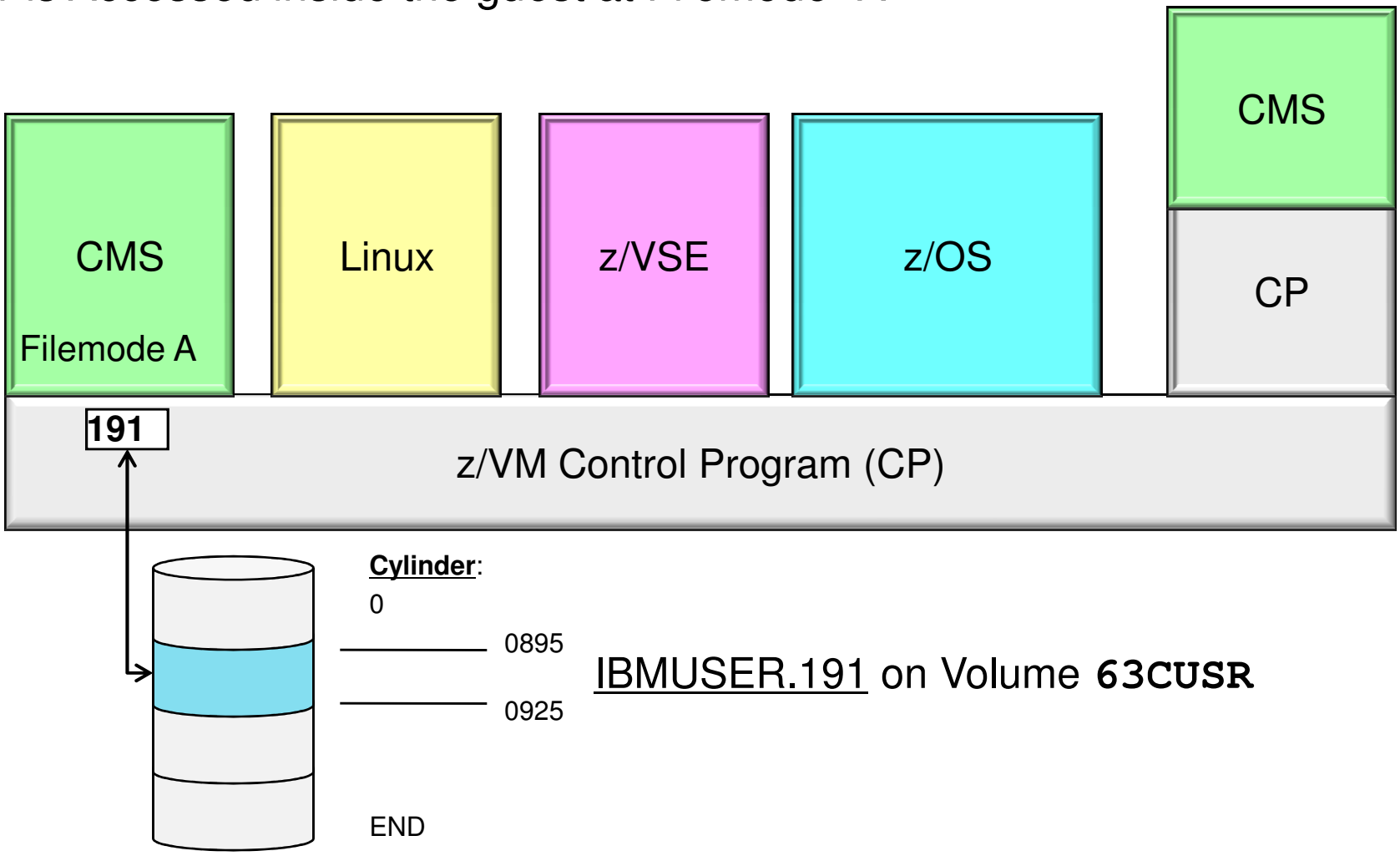
Defining a Virtual Machine – Sample User Directory Entry

- 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”



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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

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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`

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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

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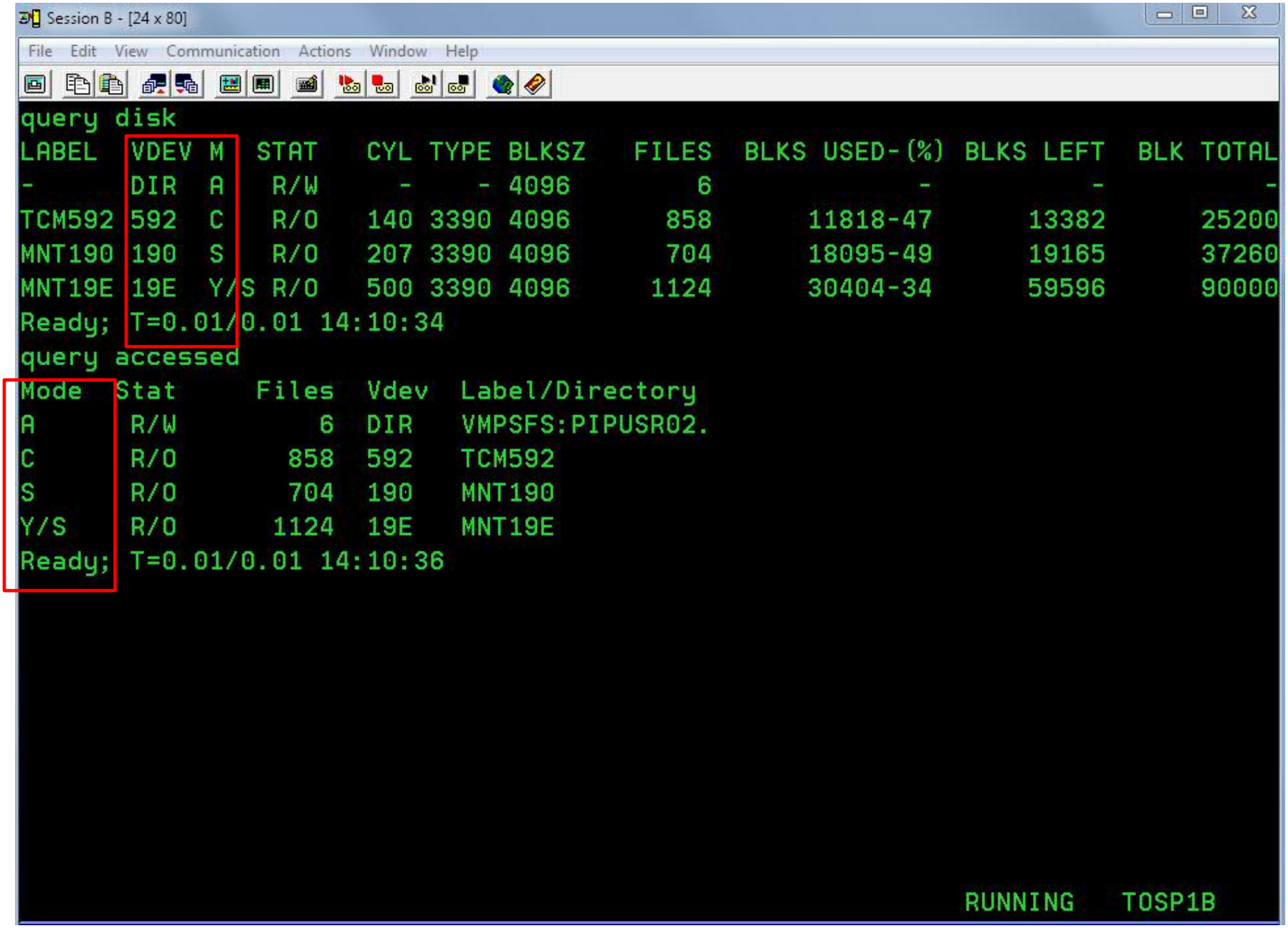

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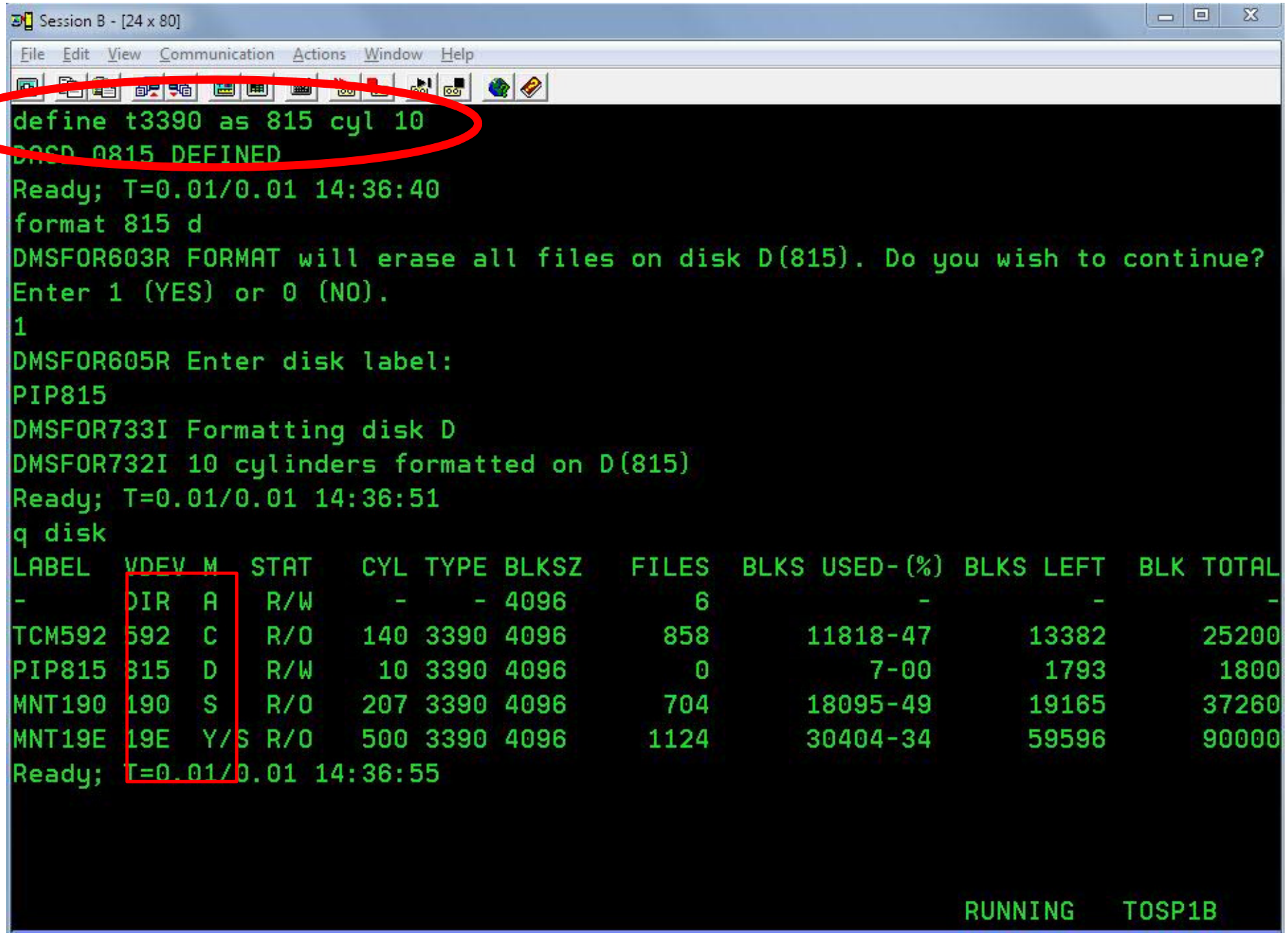

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Developing Programs in the z/VM Environment

- 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

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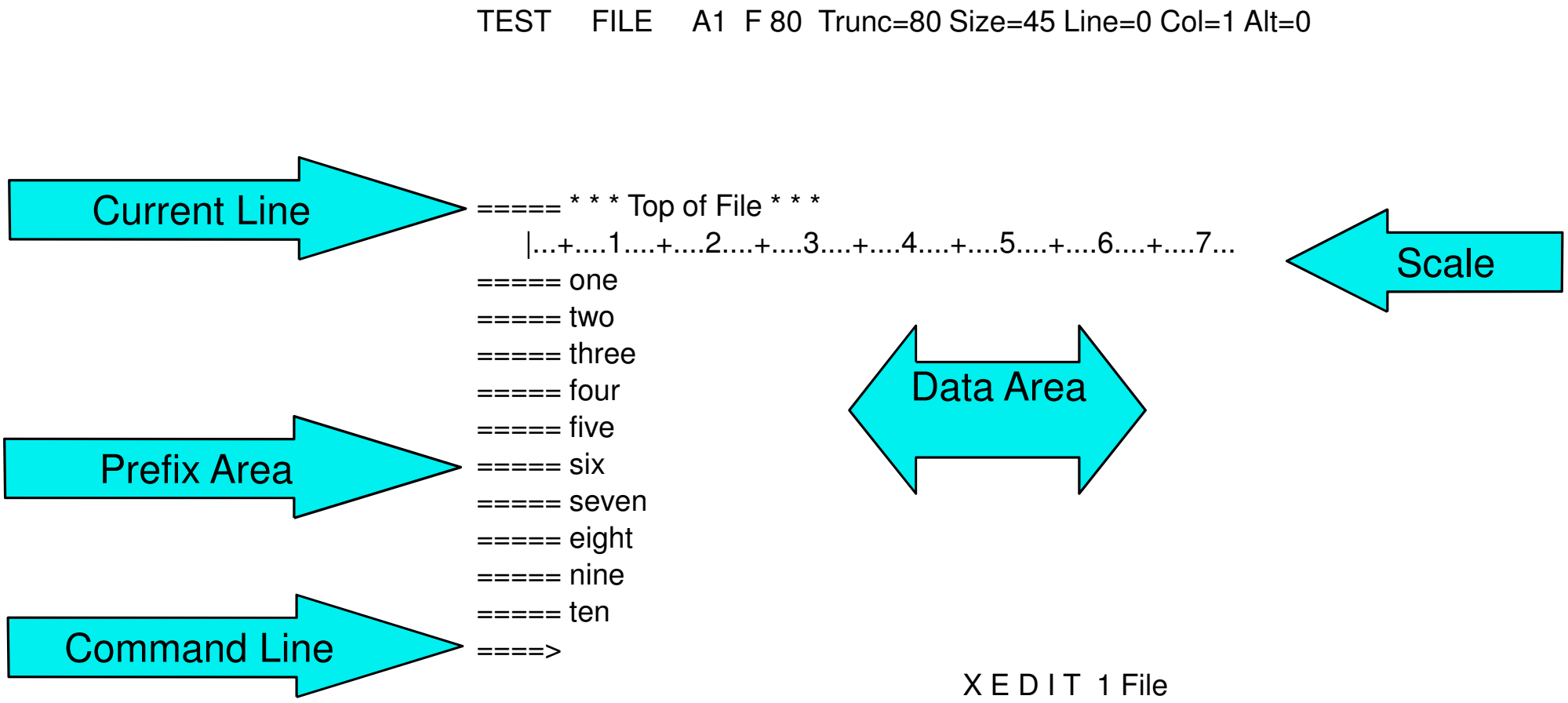
Developing Programs Using XEDIT

- Command: `Xedit fn ft fm`
- Each line is a record
- Screen Layout:



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Developing Programs Using 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

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Developing Programs Using 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

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Developing Programs Using 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 !

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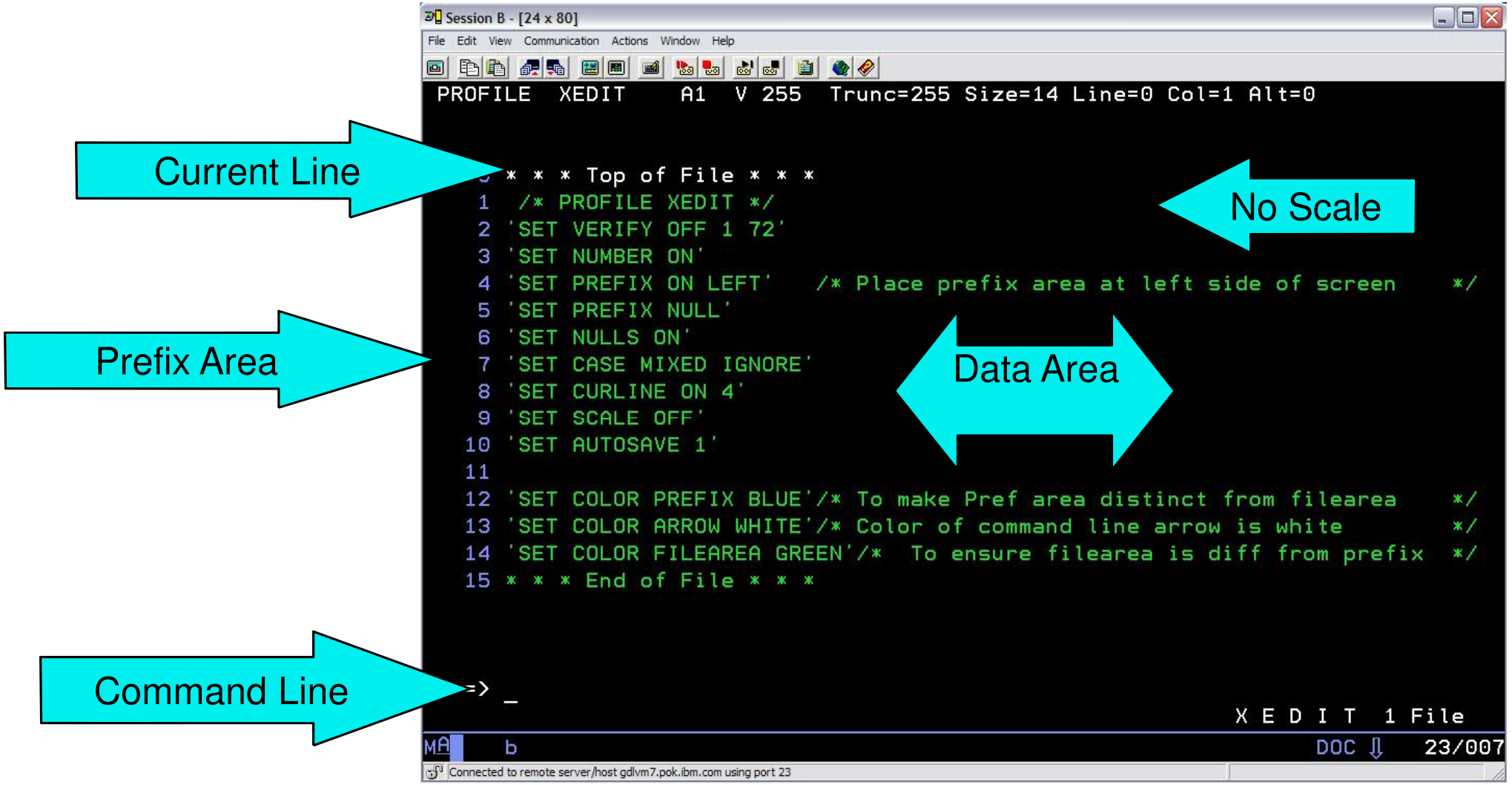

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Developing Programs Using XEDIT – Synonyms

- 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 ""        '
```


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A Note on 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)

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A Note on 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

```
"Introduction to Rexx Programming on z/VM"
Coming up in the next session, in this very room!
```


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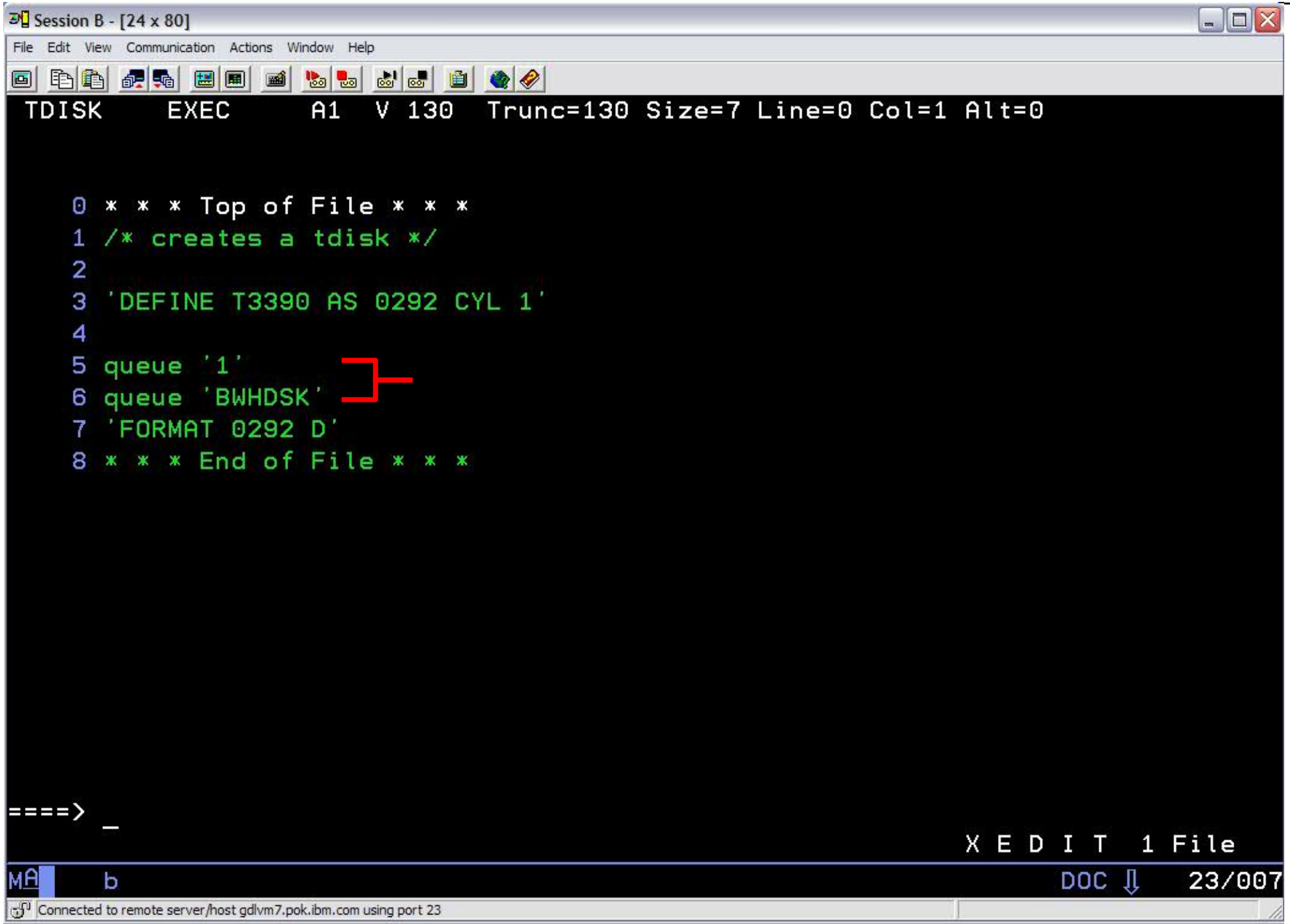

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Basic Debugging in z/VM

- 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)

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Basic Debugging in z/VM

- 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

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Help!

- HELP Facility
  - HELP command
  - HELP msg DMSxxxE
  - CP Link MAINT 19D 19D rr
    - link for HELP disk

- *Most virtual machines that IBM ships by default already have this disk linked*

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Logging Off Your 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

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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**

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For More Information …

Web sites:

- http://www.vm.ibm.com/ -- zVM on the Web
- http://www.vm.ibm.com/library -- the online zVM Library
- http://www.vm.ibm.com/education -- presentations, classes and information

Via mailing lists:

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

Contact Information:

Brian W. Hugenbruch, CISSP
z/VM Security Design and Development
bwhugen at us dot ibm dot com
+1 607.429.3660
@Bwhugen

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Dutch

Merci
French

Спасибо
Russian

Gracias
Spanish

شكراً
Arabic

감사합니다
Korean

Tack så mycket
Swedish

धन्यवाद
Hindi

תודה רבה
Hebrew

Obrigado
Brazilian Portuguese

谢谢
Chinese

Dankon
Esperanto

Thank You

ありがとうございます
Japanese

Trugarez
Breton

Tak
Danish

Danke
German

Grazie
Italian

நன்றி
Tamil

děkuji
Czech

ขอบคุณ
Thai

go raibh maith agat
Gaelic

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