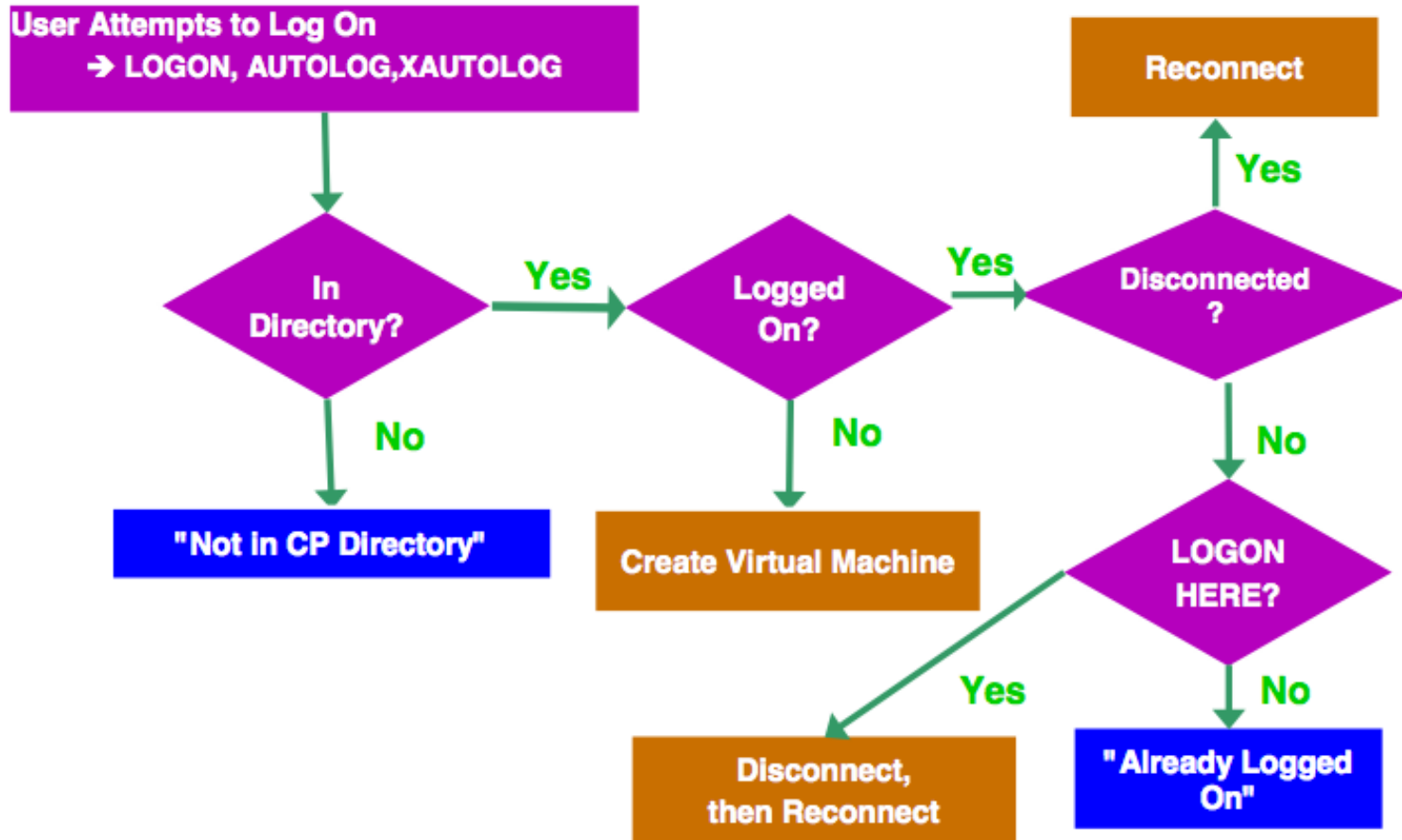


Running Linux on System z as a z/VM Guest: Useful Things to Know

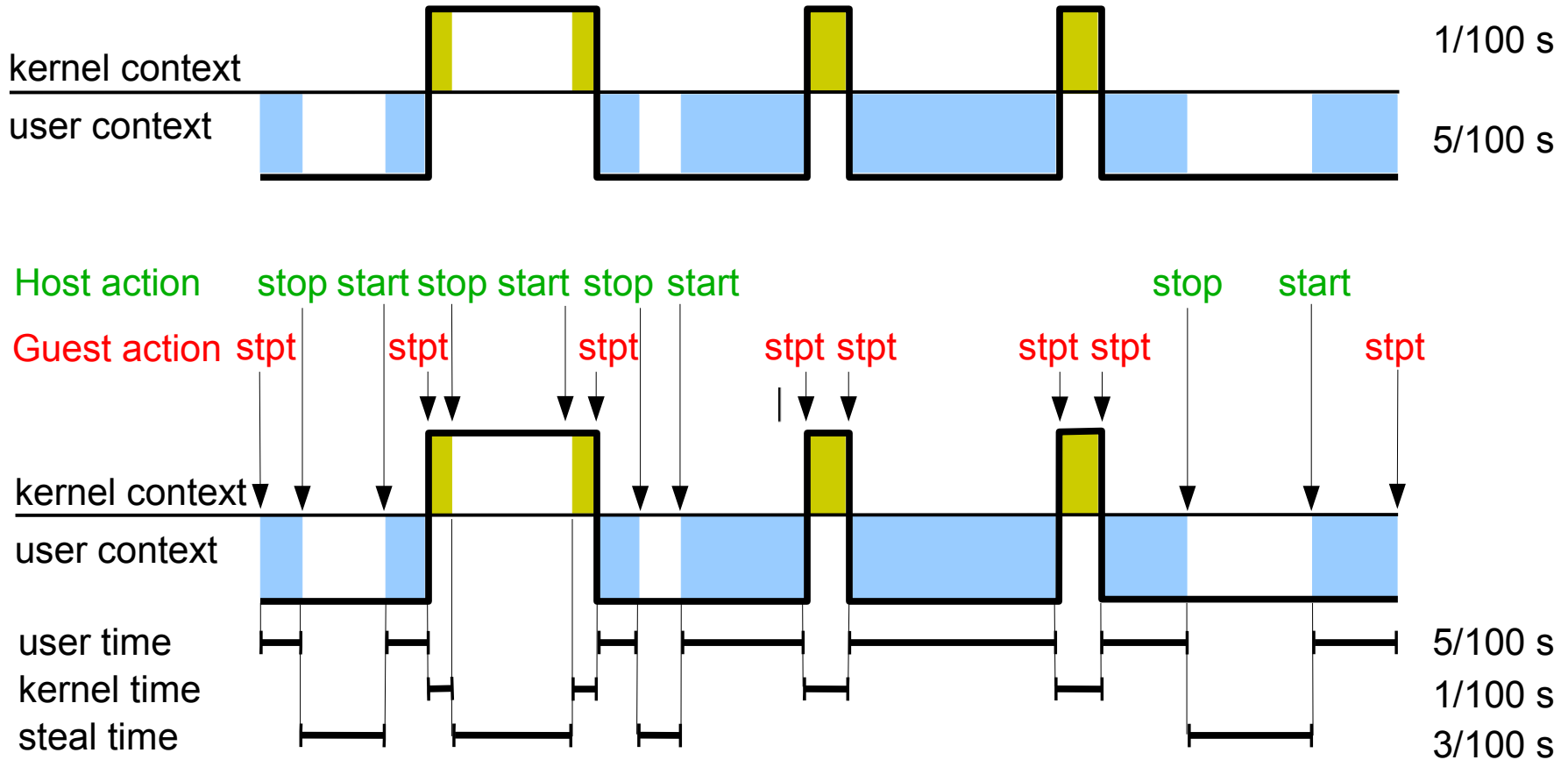
Frühjahrstagung 2011 der Arbeitsgruppen z/VSE mit CICS und DB2 z/VM mit Linux on System z
Hilton Düsseldorf, 02.-04. Mai 2011



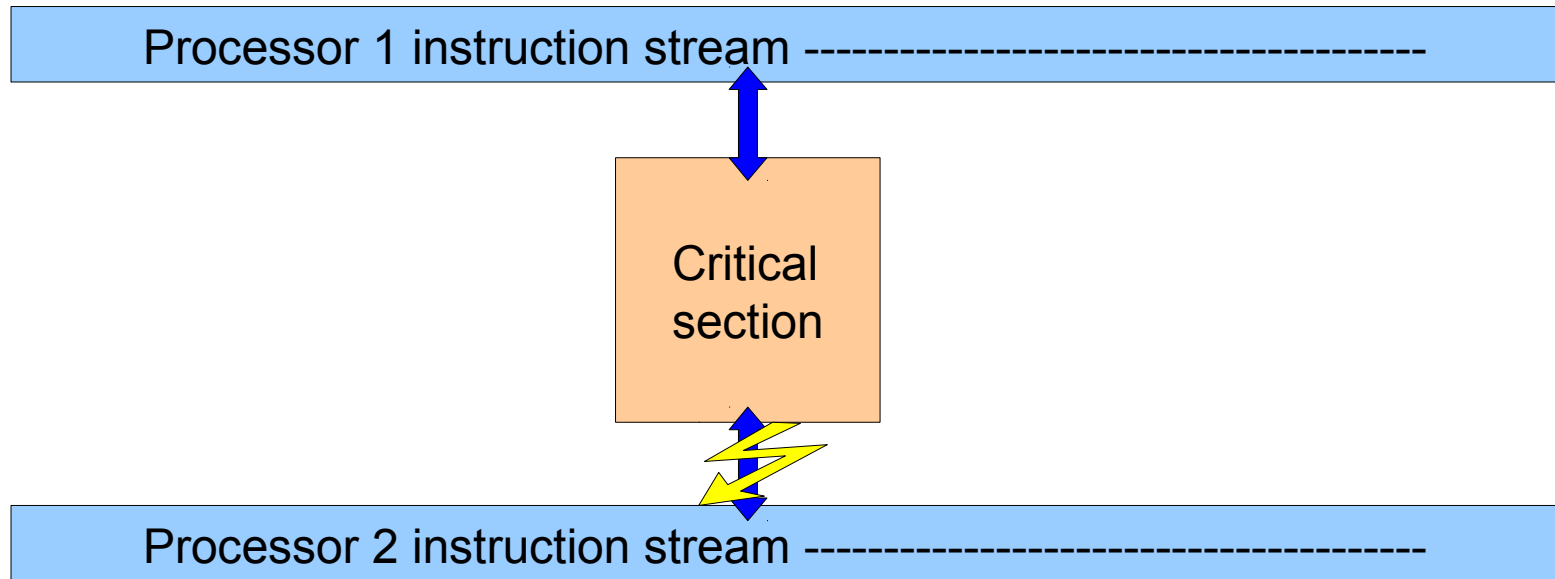
Logging on to z/VM (creating a virtual machine)



Timer based CPU accounting & virtual CPUs



z/VM – Linux Locking



- Linux kernel uses spin locks for exclusive use of kernel resources
- Traditional implementation uses busy waiting (“spinning”) if lock cannot be acquired
 - Bad idea with virtual CPU's



z/VM – Linux Locking Improvements

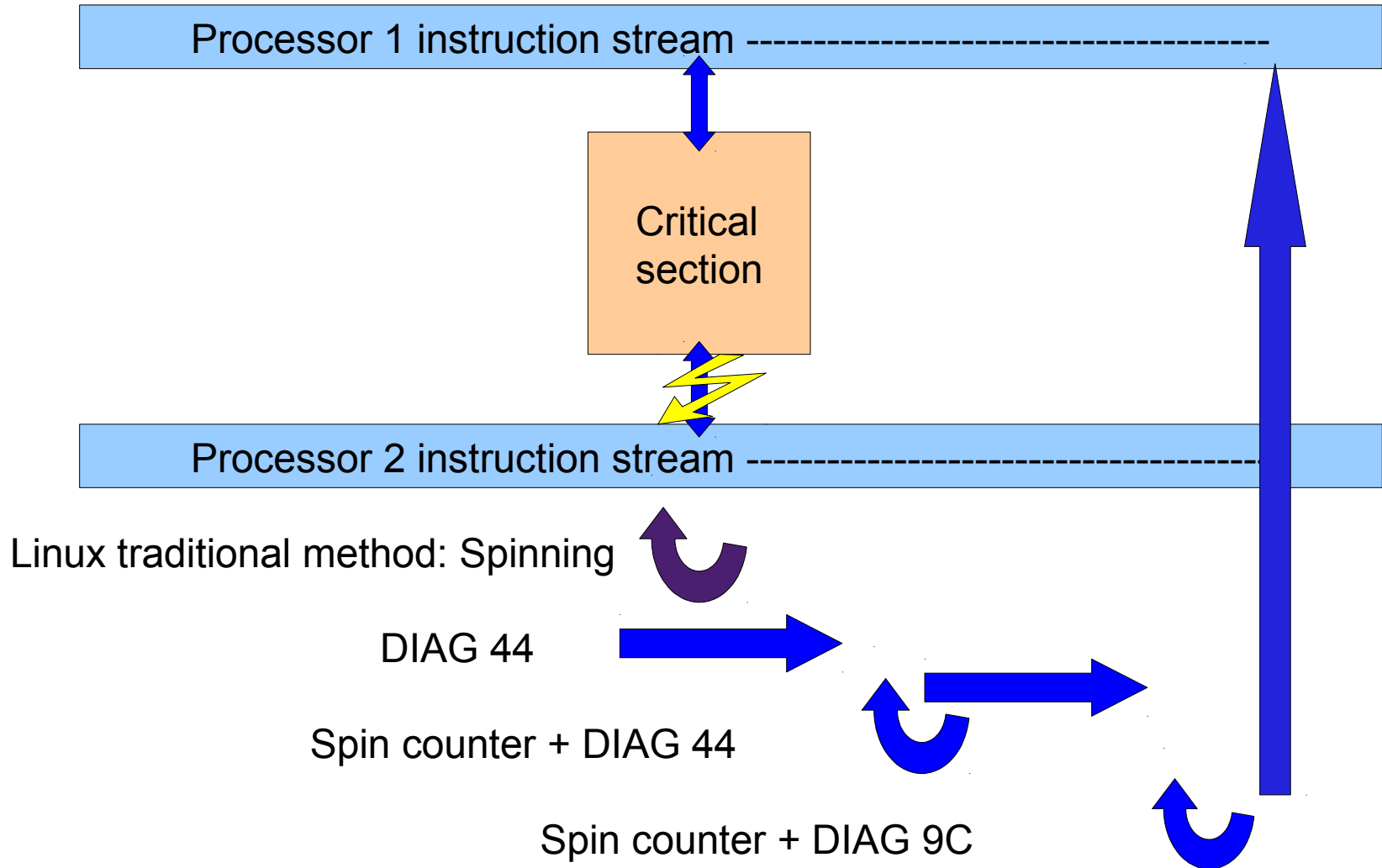
- DIAG 44: to the LPAR hypervisor or to z/VM to give the processor back instead of looping on the lock, to allow other more useful work to be done
spin_retry counter in Linux to avoid excessive use of diagnose instructions

```
[root@h4245005 ~]# cat /proc/sys/kernel/spin_retry  
1000
```

- DIAG 9C: remember CPU that has the lock and tell z/VM who should get the processor
 - Available since RHEL5 U1 and SLES10 SP1



z/VM – Linux Locking with diag



top

```

top - 09:50:20 up 11 min,  3 users,  load average: 8.94, 7.17, 3.82
Tasks:  78 total,   8 running,  70 sleeping,   0 stopped,   0 zombie
Cpu0  : 38.7%us,  4.2%sy,  0.0%ni,  0.0%id,  2.4%wa,  1.8%hi,  0.0%si, 53.0%st
Cpu1  : 38.5%us,  0.6%sy,  0.0%ni,  5.1%id,  1.3%wa,  1.9%hi,  0.0%si, 52.6%st
Cpu2  : 54.0%us,  0.6%sy,  0.0%ni,  0.6%id,  4.9%wa,  1.2%hi,  0.0%si, 38.7%st
Cpu3  : 49.1%us,  0.6%sy,  0.0%ni,  1.2%id,  0.0%wa,  0.0%hi,  0.0%si, 49.1%st
Cpu4  : 35.9%us,  1.2%sy,  0.0%ni, 15.0%id,  0.6%wa,  1.8%hi,  0.0%si, 45.5%st
Cpu5  : 43.0%us,  2.1%sy,  0.7%ni,  0.0%id,  4.2%wa,  1.4%hi,  0.0%si, 48.6%st
Mem:   251832k total,  155448k used,   96384k free,   1212k buffers
Swap:  524248k total,  17716k used,  506532k free,   18096k cached

```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
20629	root	25	0	30572	27m	7076	R	55.2	11.1	0:02.14	cc1
20617	root	25	0	40600	37m	7076	R	47.0	15.1	0:03.04	cc1
20635	root	24	0	26356	20m	7076	R	42.3	8.4	0:00.75	cc1
20638	root	25	0	23196	17m	7076	R	27.0	7.2	0:00.46	cc1
20642	root	25	0	15028	9824	7076	R	18.2	3.9	0:00.31	cc1
20644	root	20	0	14852	9648	7076	R	17.0	3.8	0:00.29	cc1
26	root	5	-10	0	0	0	S	0.6	0.0	0:00.03	kblockd/5
915	root	16	0	3012	884	2788	R	0.6	0.4	0:02.33	top
1	root	16	0	2020	284	1844	S	0.0	0.1	0:00.06	init



z/VM – Linux Idle Guests

- Many applications use timeouts to check for work
- Modern distributions come with many background processes (daemons) that wake up regularly
- Older kernels had a regular timer interrupt of up to 1000 times per second
 - Unnecessary CPU load in z/VM that also influences z/VM scheduler decisions
- Linux now uses Dynamic ticks for event-based wakeup

```
[root@h4245005 ~]# cat /proc/interrupts
```

	CPU0	CPU1	CPU2	CPU3	CPU4	CPU5
EXT:	269258	27381	100415	46332	19236	181209
I/O:	7990	7330	6246	7852	7067	6011



z/VM Linux Idle Guests

```

root@h4245005: ~
PowerTDP version 1.10      (C) 2007 Intel Corporation
< Detailed C-state information is not P-states (frequencies)

Wakeups-from-idle per second : 1.2      interval: 10.0s

Top causes for wakeups:
45.2% ( 2.8) <kernel core> : hrtimer_start_range_ns (tick_sched_timer)
19.4% ( 1.2)      multipathd : hrtimer_start_range_ns (hrtimer_wakeup)
16.1% ( 1.0) <kernel core> : __enqueue_rt_entity (sched_rt_period_timer)
 9.7% ( 0.6) <kernel core> : hrtimer_start (tick_sched_timer)
 3.2% ( 0.2)      sendmail : hrtimer_start_range_ns (hrtimer_wakeup)
 1.6% ( 0.1) <kernel core> : run_timer_softirq (sync_supers_timer_fn)
 1.6% ( 0.1)      cpuplugd : hrtimer_start_range_ns (hrtimer_wakeup)
 1.6% ( 0.1)      flush-94:0 : bdi_writeback_task (process_timeout)
 1.6% ( 0.1)      bdi-default : bdi_forker_task (process_timeout)

Suggestion: Enable the CONFIG_USB_SUSPEND kernel configuration option.
This option will automatically disable UHCI USB when not in use, and may
save approximately 1 Watt of power.
Q - Quit  R - Refresh

```

Recommendation:

Turn off any unneeded services and daemons

Watch out for applications with bad wakeup behaviour



How can you read files on a CMS disk with Linux?

About the CMS user space file system (fuse) support

- Allows to mount a z/VM minidisk to a Linux mount point
- z/VM minidisk needs to be in the enhanced disk format (EDF)
- The cmsfs fuse file system transparently integrates the files on the minidisk into the Linux VFS, no special command required

```
root@larsson:~> cmsfs-fuse /dev/dasde /mnt/cms
root@larsson:~> ls -la /mnt/cms/PROFILE.EXEC
-r--r----- 1 root root 3360 Jun 26 2009
/mnt/fuse/PROFILE.EXEC
```

- By default no conversion is performed
 - Mount with '-t' to get automatic EBCDIC to ASCII conversion

```
root@larsson:~> cmsfs-fuse -t /dev/dasde /mnt/cms
```

- Write support is work in progress, almost completed
 - use “vi” to edit PROFILE.EXEC anyone ?
- Use fusermount to unmount the file system again

```
root@larsson:~> fusermount -u /mnt/cms
```



vmcp

Using the z/VM CP interface device driver (vmcp), you can send control program (CP) commands to the VM hypervisor and display VM's response.

```
root@larsson:~> modprobe vmcp
root@larsson:~> vmcp q v cpus
CPU 02  ID  FF20012320978000 CP          CPUAFF ON
CPU 00  ID  FF00012320978000 (BASE) CP    CPUAFF ON
CPU 01  ID  FF10012320978000 CP          CPUAFF ON
root@larsson:~> vmcp q priv
Privilege classes for user HANS
    Currently: GU
    Directory: GU
The privilege classes are not locked against changes.
root@larsson:~> vmcp def store 32G
HCPDST094E Storage size (32G) exceeds directory maximum (5G)
Error: non-zero CP response for command 'DEF STORE 32G': #94
```

Be careful, when executing disruptive commands!



lsmem - Show online status information about memory blocks



11.1

The lsmem command lists the ranges of available memory with their online status.

- The listed memory blocks correspond to the memory block representation in sysfs.
- The command also shows the memory block size, the device size, and the amount of memory in online and offline state.

The output of this command, shows ranges of adjacent memory blocks with similar attributes.

```

root@larsson:~> lsmem
Address range                               Size (MB) State Removable Device
=====
0x0000000000000000-0x000000000ffffffff 256      online   no       0
0x0000000010000000-0x000000002ffffffff 512      online   yes      1-2
0x0000000030000000-0x000000003ffffffff 256      online   no       3
0x0000000040000000-0x000000006ffffffff 768      online   yes      4-6
0x0000000070000000-0x00000000ffffffff 2304     offline  -       7-15
Memory device size : 256 MB
Memory block size : 256 MB
Total online memory : 1792 MB
Total offline memory: 2304 MB

```



Configuring standby memory

To see how much central and expanded storage (memory) are installed and allocated to a system use the QUERY STORAGE and QUERY XSTOR commands. For example:

```
--> q stor  
STORAGE = 16G CONFIGURED = 16G INC = 256M STANDBY = 0  
RESERVED = 0
```

Modify the directory entry by adding a `COMMAND` statement. This will give the virtual machine an additional 768 MB of standby memory:

```
USER LINUX01 LNX4VM 256M 2G G  
INCLUDE LNXDFLT  
COMMAND DEFINE STORAGE 256M STANDBY 768M  
OPTION APPLMON  
MDISK 100 3390 3339 3338 UM63A9 MR LNX4VM LNX4VM LNX4VM  
MDISK 101 3390 6677 3338 UM63A9 MR LNX4VM LNX4VM LNX4VM
```



chmem – Setting memory online or offline



- **The chmem command sets a particular size or range of memory online or offline**
 - Setting memory online might fail if the hypervisor does not have enough memory left
 - For example, because memory was overcommitted
 - Setting memory offline might fail if Linux cannot free the memory
 - If only part of the requested memory could be set online or offline, a message tells you how much memory was set online or offline instead of the requested amount
- **To request 1024 MB of memory to be set online, issue:**

```
root@larsson:~# chmem --enable 1024
```

- **To request the memory range starting with 0x00000000e4000000 and ending with 0x00000000f3ffffff to be set offline, issue:**

```
root@larsson:~# chmem --disable 0x00000000e4000000-0x00000000f3ffffff
```

- **This command requests 1024 MB of memory to be set online.**

```
root@larsson:~# chmem --disable 512
```



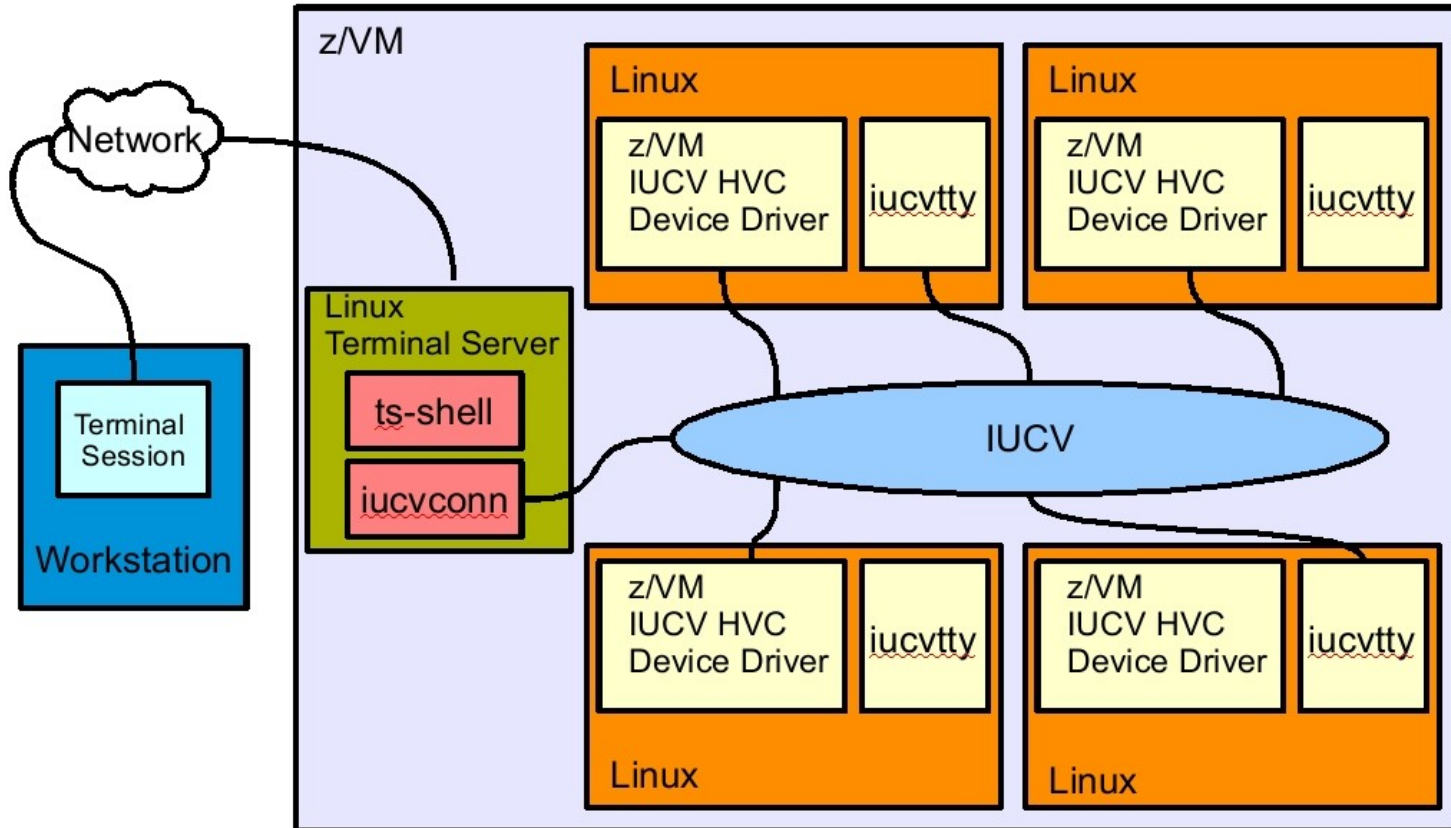
How can the terminal server using IUCV help you?

- **Full-screen terminal access to Linux instances on the same z/VM**
- **Access to Linux instances that are not connected to an Internet Protocol (IP) network**
- **Use cases**
 - Provide an alternative terminal access to 3270 and 3215 line-mode terminals
 - Increase availability by providing emergency access if the network for a system fails
 - Centralize access to systems by providing a terminal server environment
 - Heighten security by separating user networks from administrator networks or by isolating sensitive Linux instances from public IP networks



IUCV Terminals

- Full-screen terminal access to Linux guest operating systems on the same z/VM
- Access Linux instances with no external network because IUCV is independent from TCP/IP



IUCV terminal applications – examples

Using the `iucvconn` program: To access the first z/VM IUCV HVC terminal on the Linux instance in z/VM guest LNXSYS02

```
root@larsson:~> iucvconn LNXSYS02 lnxhvc0
```

To create a transcript of the terminal session to the Linux instance in z/VM guest LNXSYS99

```
root@larsson:~> iucvconn -s ~/transcripts/lnxsys99 LNXSYS99  
lnxhvc0
```

Using the `iucvtty` program: To allow remote logins using the terminal identifier „lnxterm“

```
root@larsson:~> iucvtty lnxterm
```

To access the „lnxterm“ terminal on the Linux instance in z/VM guest LNXSYS01

```
root@larsson:~> iucvconn LNXSYS01 lnxterm
```

To use `/sbin/sulogin` instead of `/bin/login` for terminal “suterm”

```
root@larsson:~> iucvtty suterm -- /sbin/sulogin
```



How can you enable a terminal server for iucvconn?

- **Authorizing the z/VM guest virtual machine for IUCV**
 - Adding an IUCV user directory statement, for example, `IUCV ANY`
 - The z/VM user directory for a terminal server might look like:

```
USER LNXTS      XSECRETX 768M 1G G
* General statements
  IPL 0150
  MACH ESA 8
* IUCV authorization
  IUCV ANY
  OPTION MAXCONN 128
* Generic device statements
  CONSOLE 0009 3215 T
  SPOOL 000C 2540 READER *
*      . . .
```



Multi Volume Dump

How to prepare a set of ECKD DASD devices for a multi-volume dump? (32-bit systems only).



10.3

- We use two DASDs in this example:



5.4

```
root@larsson:~> dasdfmt -f /dev/dasdc -b 4096  
root@larsson:~> dasdfmt -f /dev/dasdd -b 4096
```

- Create the partitions with fdasd. The sum of the partition sizes must be sufficiently large (the memory size + 10 MB):

```
root@larsson:~> fdasd /dev/dasdc  
root@larsson:~> fdasd /dev/dasdd
```

- Create a file called sample_dump_conf containing the device nodes (e.g. /dev/dasda1) of the two partitions, separated by one or more line feed characters
- Prepare the volumes using the zipl command.

```
root@larsson:~> zipl -M sample_dump_conf  
[...]
```



How to obtain a dump

To obtain a dump with the multi-volume DASD dump tool, perform the following steps:

- Stop all CPUs, Store status on the IPL CPU.
- IPL the dump tool using one of the prepared volumes, either 4711 or 4712.
- After the dump tool is IPLed, you'll see a messages that indicates the progress of the dump. Then you can IPL Linux again

```
==> cp cpu all stop
==> cp cpu 0 store status
==> cp ipl 4711
```

- Copying a multi-volume dump to a file
- Use zgetdump command without any option to copy the dump parts to a file:

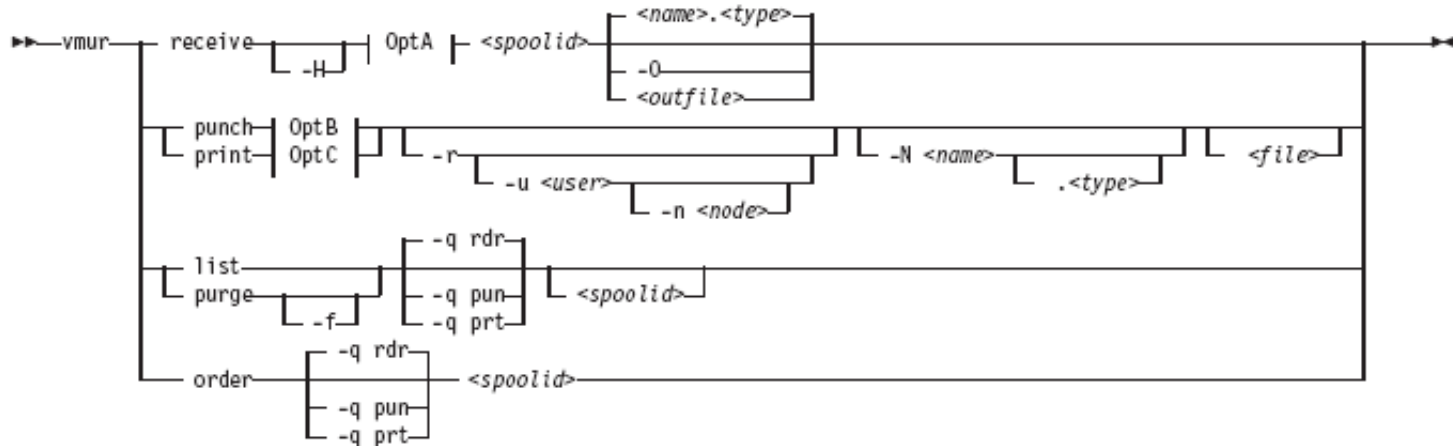
```
root@larsson:~> zgetdump /dev/dasdc > mv_dump_file
```



vmur – Working with z/VM unit record devices



- **The vmur command provides functions required to work with z/VM spool file queues**
 - *Receive*: Read data from the z/VM reader file queue
 - *Punch* or *print*: Write data to the z/VM punch or printer file queue and transfer it to another user's virtual reader, optionally, on a remote z/VM node
 - *List*: Display detailed information about one or all files on the specified spool file queue
 - *Purge*: Remove one or all files on the specified spool file queue
 - *Order*: Position a file at the top of the specified spool file queue



vmur – Working with z/VM unit record devices

Logging and reading console output of Linux guest operating systems

- Begin console spooling with:

```
root@larsson:~# vmcp sp cons start
```

- Produce output to z/VM console (for example, with CP TRACE)
- Close the console spool file and transfer it to the reader queue, find the spool ID behind the FILE keyword in the corresponding CP message:

```
root@larsson:~# vmcp sp cons clo \* rdr
RDR FILE 0398 SENT FROM T6360025 CON WAS 0398 RECS 1872 CPY
001 T NOHOLD NOKEEP
```

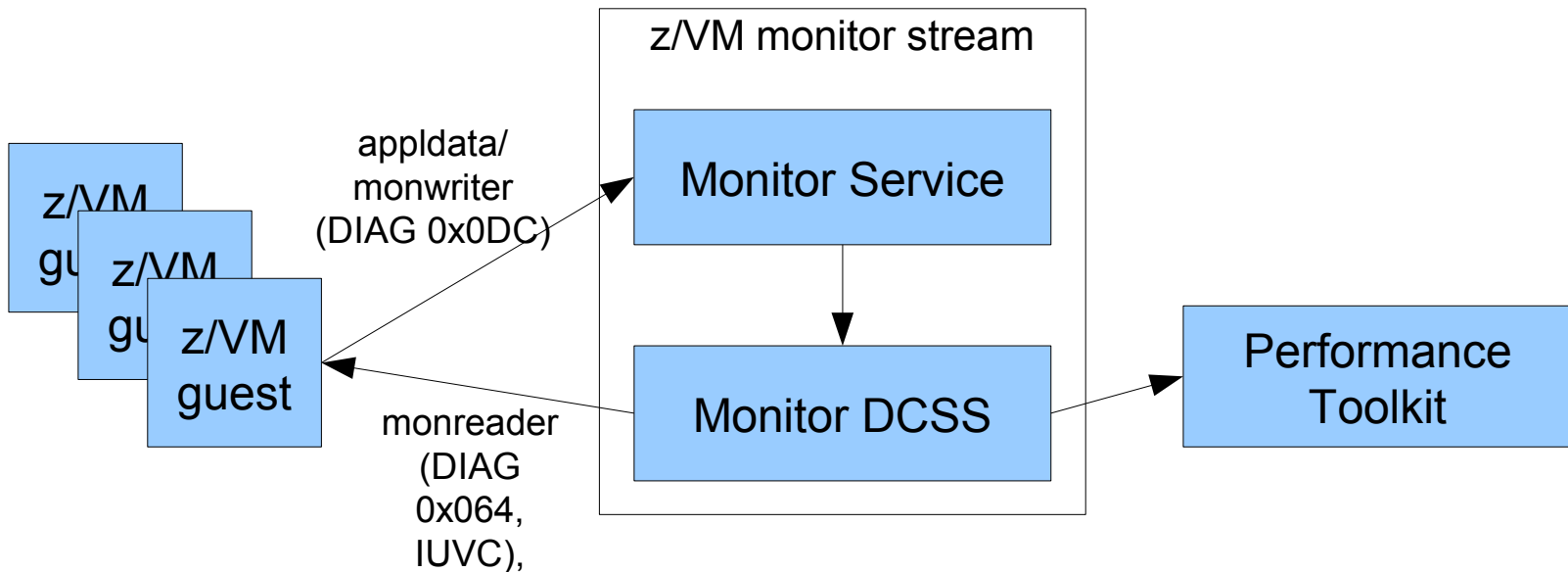
- Receive the console spool file and save it on the Linux file system in the current directory:

```
root@larsson:~# chccwdev -e 000c
root@larsson:~# vmur re -t 398 linux_cons
```



z/VM Monitor Service Infrastructure

- **Provides monitor data through the monitor stream**
 - z/VM monitor service collects data in a shared memory segment (DCSS)
 - Producer: a range of facilities, e.g. Linux through apldata / monwriter
 - Consumer: Performance Toolkit, or Linux application through monreader



apldata - Linux monitoring modules

- Kernel modules which gather information from the Linux kernel
- `apldata_os`
 - CPU utilization, processes
- `apldata_mem`
 - memory, paging, cache
- `apldata_net_sum`
 - packets, bytes, errors
- Usage:

```
root@larsson:~# modprobe apldata_os
root@larsson:~# modprobe apldata_os
root@larsson:~# echo 1 > /proc/sys/apldata/os
root@larsson:~# modprobe apldata_mem
root@larsson:~# echo 1 > /proc/sys/apldata/mem
root@larsson:~# modprobe apldata_net_sum
root@larsson:~# echo 1 > /proc/sys/apldata/net_sum
```



apldata – os monitor

Linux monitoring data collected by apldata_os as processed and displayed by z/VM Performance Toolkit:

```
FCX243      CPU 2097  SER FC03F  Interval 13:50:14 - 13:51:14  Perf. Monitor
-----
          <----- Total CPU -----> <-----
Linux      Virt <----- Utilization (%) -----> <-----
Userid    CPUs TotCPU  User  Kernel  Nice   IRQ  SoftIRQ  IOwait  Idle  Stolen  Runab
>System<  3.0   297.1 270.5   26.3   .0   .0     .3     .1   .3   2.6   5.
H4245028  3     297.2 271.3   25.5   .0   .0     .3     .0   .3   2.6
H4245029  3     296.9 269.7   27.0   .0   .0     .3     .1   .3   2.6
```

```
FCX243      CPU 2097  SER FC03F  Interval 13:50:14 - 13:51:14  Perf. Monitor
-----
          >
          >-----> <----- Processes ----->
Linux      Virt>-----> <----- Current -----> <----- Average Running -----> Nr of
Userid    CPUs>OWait  Idle  Stolen  Runabl  Waiting  Total  1_Min  5_Min  15_Min  Users
>System<  3.0> .1   .3   2.6   5.0   .0   93.0  3.45  2.66  1.68   2
H4245028  3   .0   .3   2.6   4     0    96   3.16  2.06  1.31
H4245029  3   .1   .3   2.6   6     0    90   3.74  3.25  2.04
```



apldata – memory monitor

Linux monitoring data collected by apldata_mem as processed and displayed by z/VM Performance Toolkit:

```
FCX244      CPU 2097  SER FC03F  Interval 13:53:49 - 14:02:32      Perf. Monitor
-----
<----- Memory Allocation (MB) -----> <----- Swapping
Linux <--- Main ---> <--- High --->          Buffers  Cache <-Space (MB)-> <-
Userid  M_Total %MUsed H_Total %HUsed Shared /CaFree  Used S_Total %SUsed
>System<  996.3  48.5   .0   .0   .0   39.6  354.4   3522   .0   .
H4245028  996.6  46.8   .0   .0   .0   42.3  340.7     .0   .0   .
H4245029  996.0  50.2   .0   .0   .0   36.8  368.1   7043   .0   .
```

```
FCX244      CPU 2097  SER FC03F  Interval 13:53:49 - 14:02:32      Perf. Monitor
-----
>
>----> <----- Swapping -----> <--- Pages/s ---> <-BlockIO->
Linux >Cache <-Space (MB)-> <-Pgs/sec->  Allo <-Faults--> <-kB/sec-> Nr of
Userid > Used S_Total %SUsed      In   Out  cates Major Minor  Read Write Users
>System< >354.4   3522   .0   .000 .000  6525  .000 16887  .365 275.6   2
H4245028  340.7     .0   .0   .000 .000  11.32 .000 163.8  .023 94.35
H4245029  368.1   7043   .0   .000 .000 80600 .000 207k  4.261 2336
```



Monitoring with hypfs

Virtual Linux file system

- Uses diagnose calls to gather guest data from hypervisor
- Works with LPAR hypervisor or z/VM
- resources controlled by hypervisor, i.e. physical CPUs
- resources provided to guest systems, i.e virtual CPUs

Preconditions

- LPAR: enable “Global performance data control” checkbox in HMC activation profile of the guest where hypfs is mounted
- z/VM: privilege class B required for the guest where hypfs is mounted

mounting hypfs:

```
root@larsson:~# mount -t s390_hypfs /sys/hypervisor/s390/
```

hypfs is populated with initial data when being mounted and hypfs data is only updated on request:

```
root@larsson:~# echo 1 > /sys/hypervisor/s390/update
```



Hypfs structure under z/VM

```
/sys/hypervisor/s390
```

```
|-- update
|-- cpus
|   |-- count
|-- hyp
|   |-- type
|-- systems
|   |-- <guest-name>
|       |-- onlinetime_us
|       |-- cpus
|           |-- capped
|           |-- count
|           |-- cputime_us
|           |-- dedicated
|           |-- weight_cur
|           |-- weight_max
|           |-- weight_min
|       |-- mem
|           |-- max_KiB
|           |-- min_KiB
|           |-- share_KiB
|           |-- used_KiB
|       |-- samples
|           |-- cpu_delay
|           |-- cpu_using
|           |-- idle
|           |-- mem_delay
|           |-- other
|           |-- total
```

- systems/onlinetime_us: time since guest activation
- systems/cpus:
 - capped: 0=off, 1=soft, 2=hard
 - count: number of virtual CPUs
 - cputime_us: actual use time
 - dedicated: 0=no, 1=yes
 - weight_cur, weight_min, weight_max: current, minimum and maximum share of guest (1-10000; 0=ABSOLUTE SHARE)
- systems/mem:
 - max_KiB: memory limit granted to guest
 - min_KiB: minimum memory requirement of guest
 - share_KiB: suggested guest memory size estimated by z/VM
 - used_KiB: current memory footprint of guest
- systems/samples:
 - cpu_delay: guest waiting for CPU
 - cpu_using: guest doing work
 - idle: guest being idle
 - mem_delay: guest waiting for memory to be paged in
 - other: other samples
 - total: total samples



Hypfs example under z/VM

```
[root@h4245005 ~]# find /sys/hypervisor/s390/systems/H4245005/  
-type f | while read f; do echo -n "$f: "; cat $f; done  
/sys/hypervisor/s390/systems/H4245005/samples/total: 500061  
/sys/hypervisor/s390/systems/H4245005/samples/other: 30152  
/sys/hypervisor/s390/systems/H4245005/samples/idle: 469694  
/sys/hypervisor/s390/systems/H4245005/samples/mem_delay: 0  
/sys/hypervisor/s390/systems/H4245005/samples/cpu_delay: 43  
/sys/hypervisor/s390/systems/H4245005/samples/cpu_using: 172  
/sys/hypervisor/s390/systems/H4245005/mem/share_KiB: 319004  
/sys/hypervisor/s390/systems/H4245005/mem/used_KiB: 319004  
/sys/hypervisor/s390/systems/H4245005/mem/max_KiB: 1048576  
/sys/hypervisor/s390/systems/H4245005/mem/min_KiB: 0  
/sys/hypervisor/s390/systems/H4245005/cpus/weight_cur: 100  
/sys/hypervisor/s390/systems/H4245005/cpus/weight_max: 10000  
/sys/hypervisor/s390/systems/H4245005/cpus/weight_min: 6  
/sys/hypervisor/s390/systems/H4245005/cpus/count: 6  
/sys/hypervisor/s390/systems/H4245005/cpus/dedicated: 0  
/sys/hypervisor/s390/systems/H4245005/cpus/capped: 0  
/sys/hypervisor/s390/systems/H4245005/cpus/cputime_us: 203792603  
/sys/hypervisor/s390/systems/H4245005/onlinetime_us: 166806841739
```



hyptop - Display hypervisor performance data

The hyptop command provides a dynamic real-time view of a hypervisor environment on System z.

- It works with both the z/VM and the LPAR PR/SM hypervisor.
- Depending on the available data it shows, for example, CPU and memory information about running LPARs or z/VM guest operating systems.

The following things are required to run hyptop:

- The debugfs file system must be mounted.
- The hyptop user must have read permission for the required debugfs files:
 - z/VM: <debugfs mount point>/s390_hypfs/diag_2fc
 - LPAR: <debugfs mount point>/s390_hypfs/diag_204
- To monitor all LPARs or z/VM guest operating systems of the hypervisor, your system must have additional permissions:
 - For z/VM: The guest must be privilege class B.
 - For LPAR: On the HMC or SE security menu of the LPAR activation profile, select the Global performance data control checkbox.



hyptop – Displaying hypervisor performance data

Displaying performance data for the z/VM hypervisor

```
10:11:56 CPU-I: UN(16) ?=help
```

system (str)	#cpu (#)	cpu (%)	Cpu+ (hm)	online (dhm)	memuse (GiB)	memmax (GiB)	wcur (#)
T6360003	6	506.92	3404:17	44:20:53	7.99	8.00	100
T6360017	2	199.58	8:37	29:23:50	0.75	0.75	100
T6360004	6	99.84	989:37	62:00:00	1.33	2.00	100
T6360005	2	0.77	0:16	5:23:06	0.55	2.00	100
T6360015	4	0.15	9:42	18:23:04	0.34	0.75	100
T6360035	2	0.11	0:26	7:18:15	0.77	1.00	100
T6360027	2	0.07	2:53	62:21:46	0.75	0.75	100
T6360049	2	0.06	1:27	61:17:35	0.65	1.00	100
T6360010	6	0.06	5:55	61:20:56	0.83	1.00	100
T6360021	2	0.06	1:04	48:19:08	0.34	4.00	100
T6360048	2	0.04	0:27	49:00:51	0.29	1.00	100
T6360016	2	0.04	6:09	34:19:37	0.30	0.75	100
T6360008	2	0.04	3:49	47:23:10	0.35	0.75	100
T6360006	2	0.03	0:57	25:20:37	0.54	1.00	100
NSLCF1	1	0.01	0:02	62:21:46	0.03	0.25	500
VTAM	1	0.00	0:01	62:21:46	0.01	0.03	100
T6360023	2	0.00	0:04	6:21:20	0.46	0.75	100
PERFSVM	1	0.00	2:12	7:18:04	0.05	0.06	0
AUTOVM	1	0.00	0:03	62:21:46	0.00	0.03	100
FTPSEVE	1	0.00	0:00	62:21:47	0.01	0.03	100
TCPIP	1	0.00	0:01	62:21:47	0.01	0.12	3000
DATAMOVE	1	0.00	0:06	62:21:47	0.00	0.03	100
VMSERVU	1	0.00	0:00	62:21:47	0.00	0.03	1500
OPERSYMP	1	0.00	0:00	62:21:47	0.00	0.03	100

hyptop – Displaying hypervisor performance data

Displaying performance data for a single LPAR

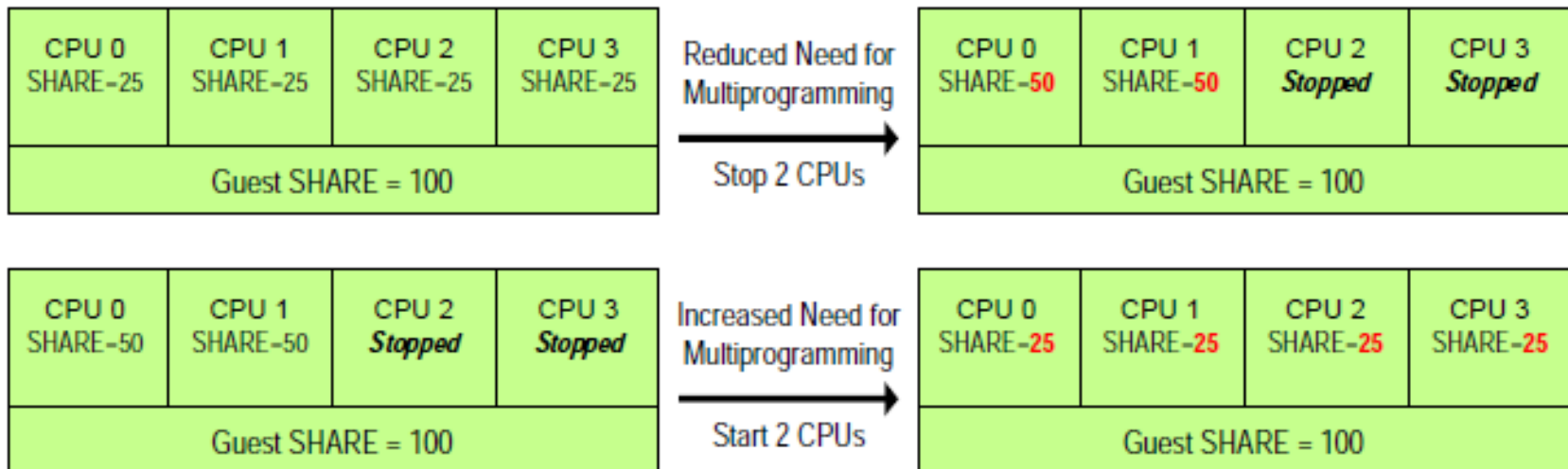
```
10:16:59 H05LP30 CPU-I: IFL(18) CP(3) UN(2)                                     ?=help
```

cpu_id (#)	type (str)	cpu (%)	mgm (%)	visual (vis)
0	IFL	29.34	0.72	#####
1	IFL	28.17	0.70	#####
2	IFL	32.86	0.74	#####
3	IFL	31.29	0.75	#####
4	IFL	32.86	0.72	#####
5	IFL	30.94	0.68	#####
6	IFL	0.00	0.00	
7	IFL	0.00	0.00	
8	IFL	0.00	0.00	
9	IFL	0.00	0.00	
=:V:N		185.46	4.30	



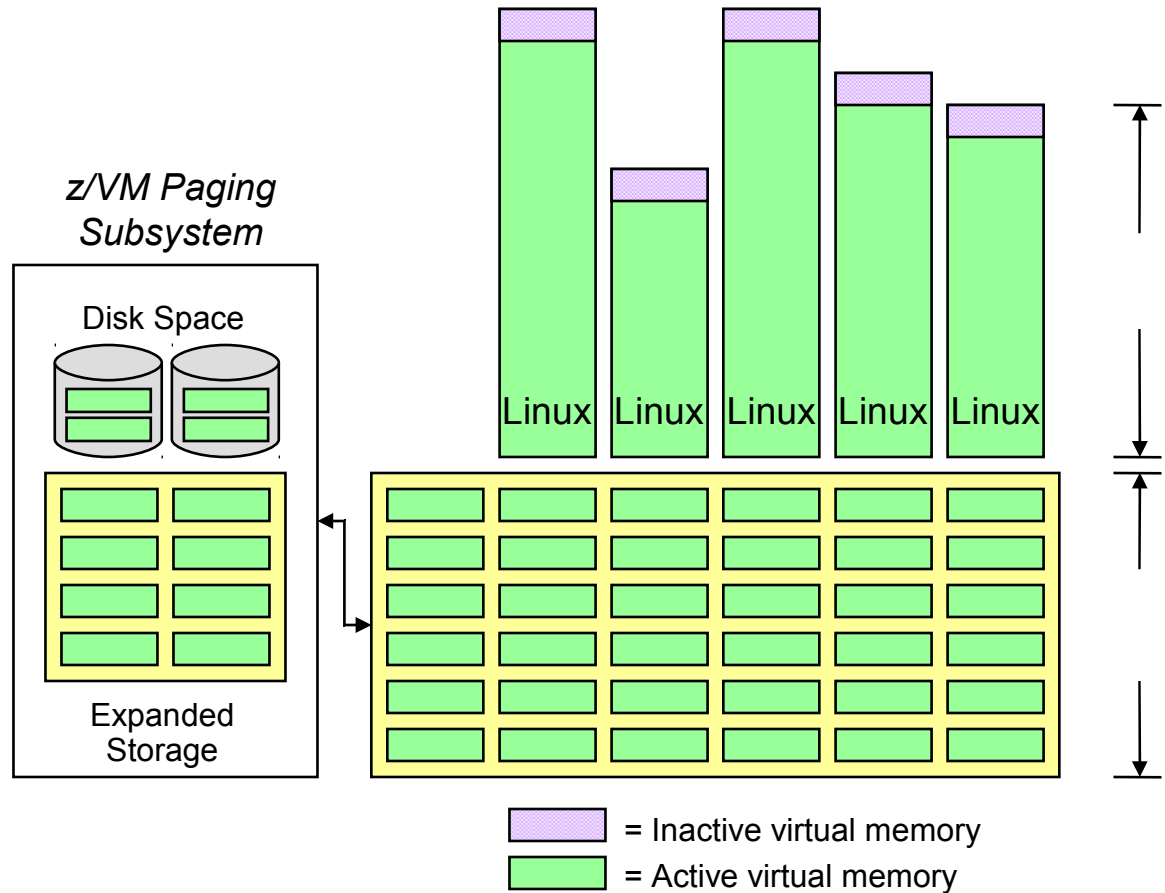
z/VM 5.4: Virtual CPU SHARE Redistribution

- Allows z/VM guests to expand or contract the number of virtual processors it uses without affecting the overall CPU capacity it is allowed to consume
 - Guests can dynamically optimize their multiprogramming capacity based on workload demand
 - Starting and stopping virtual CPUs does not affect the total amount of CPU capacity the guest is authorized to use
 - Linux CPU hotplug daemon starts and stops virtual CPUs based on Linux load average value
- Helps enhance the overall efficiency of a Linux-on-z/VM environment
- Previously, stopped virtual processors were given a portion of the guest share.



Cooperative Memory Management (CMM)

- The z/VM hypervisor maps guest virtual memory into the real memory storage of the System z machine.
- If there aren't enough real memory frames to contain all the active guests' virtual memory pages, some pages are moved to expanded storage
- When expanded storage is full, the pages of the guest are stored on the paging disk space (dasd)
- Inactive virtual memory pages inside the Linux guest must be recovered for use by other guest systems

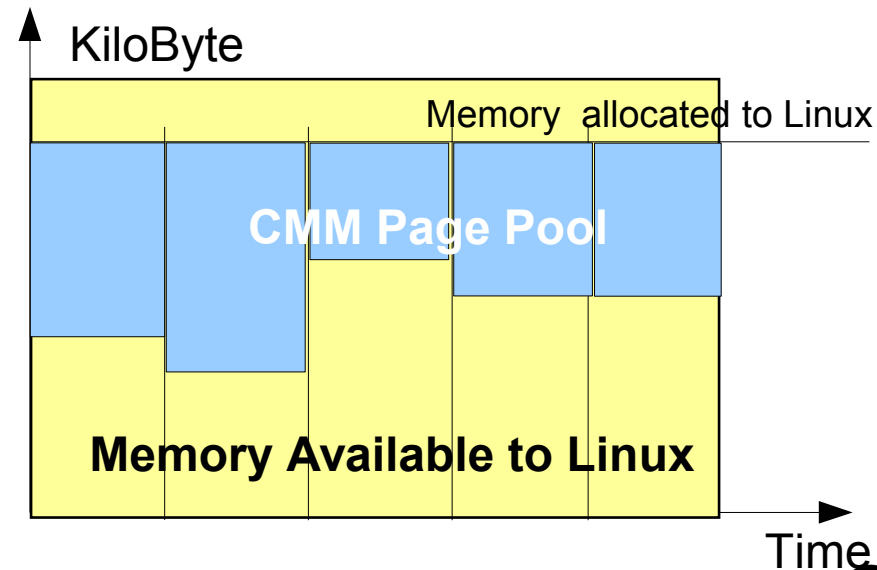
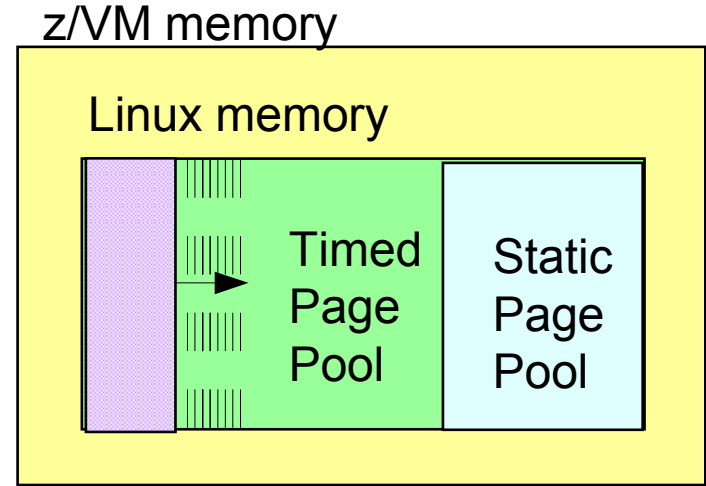


Learn more at: <http://ibm.com/servers/eserver/zseries/zvm/sysman/vmrm/vmrmcmm.html>



CMM: Linux Implementation

- To reduce Linux guest memory size CMM allocates pages to page pools (“balloon”) that make the pages unusable to Linux.
- Currently two such page pools exist for a Linux guest
 - **Timed page pool:** Pages are released from this pool at a speed set in the release rate. According to guest activity and overall memory usage on z/VM, a resource manager adds pages at intervals. If no pages are added and the release rate is not zero, the pool will empty
 - **Static page pool:** The page pool is controlled by a resource manager that changes the pool size at intervals according to guest activity as well as overall memory usage on z/VM



Cooperative Memory Management - Linux

- Linux uses a IUCV special message interface for z/VM interaction (CMMSHRINK/CMMRELEASE/CMMREUSE)
- Linux support is available since SLES9 SP3 and RHEL4 U7

```
root@larsson:~# modprobe cmm
root@larsson:~# echo 100 > /proc/sys/vm/cmm_timed_pages
root@larsson:~# echo 10 1 > /proc/sys/vm/cmm_timeout
root@larsson:~# cat /proc/sys/vm/cmm_timed_pages
60
root@larsson:~# echo 100 > /proc/sys/vm/cmm_pages
```

- /proc/sys/vm/cmm_pages
 - Read to query number of pages permanently reserved
 - Write to set new target (will be achieved over time)
- /proc/sys/vm/cmm_timed_pages
 - Read to query number of pages temporarily reserved
 - Write increment to add to target
- /proc/sys/vm/cmm_timeout
 - Holds pair of N pages / X seconds (read/write)
 - Every time X seconds have passed, release N temporary pages



cpuplugd: Example Configuration

```
UPDATE="60"
```

```
CPU_MIN="2"
```

```
CPU_MAX="10"
```

```
HOTPLUG = "(loadavg > onumcpus +0.75) & (idle < 10.0)"
```

```
HOTUNPLUG = "(loadavg < onumcpus -0.25) | (idle > 50)"
```

```
CMM_MIN="0"
```

```
CMM_MAX="8192"
```

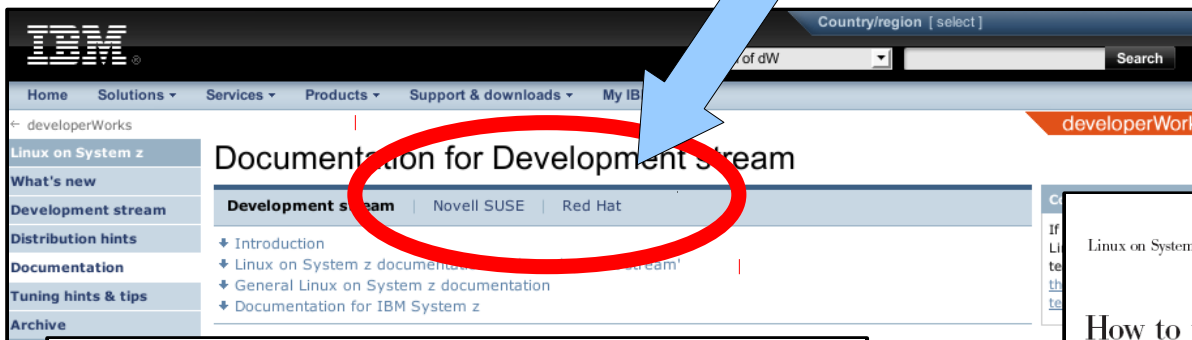
```
CMM_INC="256"
```

```
MEMPLUG = "swaprate > freemem+10 & freemem+10 < apcr"
```

```
MEMUNPLUG = "swaprate > freemem + 10000"
```



More Information



Linux on System z

How to use Execute-in-Place Technology with Linux on z/VM

March, 2010

Linux on System z

Using the Dump Tools

Development stream (Kernel 26.33)

Linux on System z

Kernel Messages

Development stream (Kernel 26.33)

Linux on System z

How to use FC-attached SCSI devices with Linux on System z

Development stream (Kernel 26.33)

Linux on System z

How to Set up a Terminal Server Environment on z/VM

June 2009

Linux Kernel 2.6 - Development stream

Linux on System z

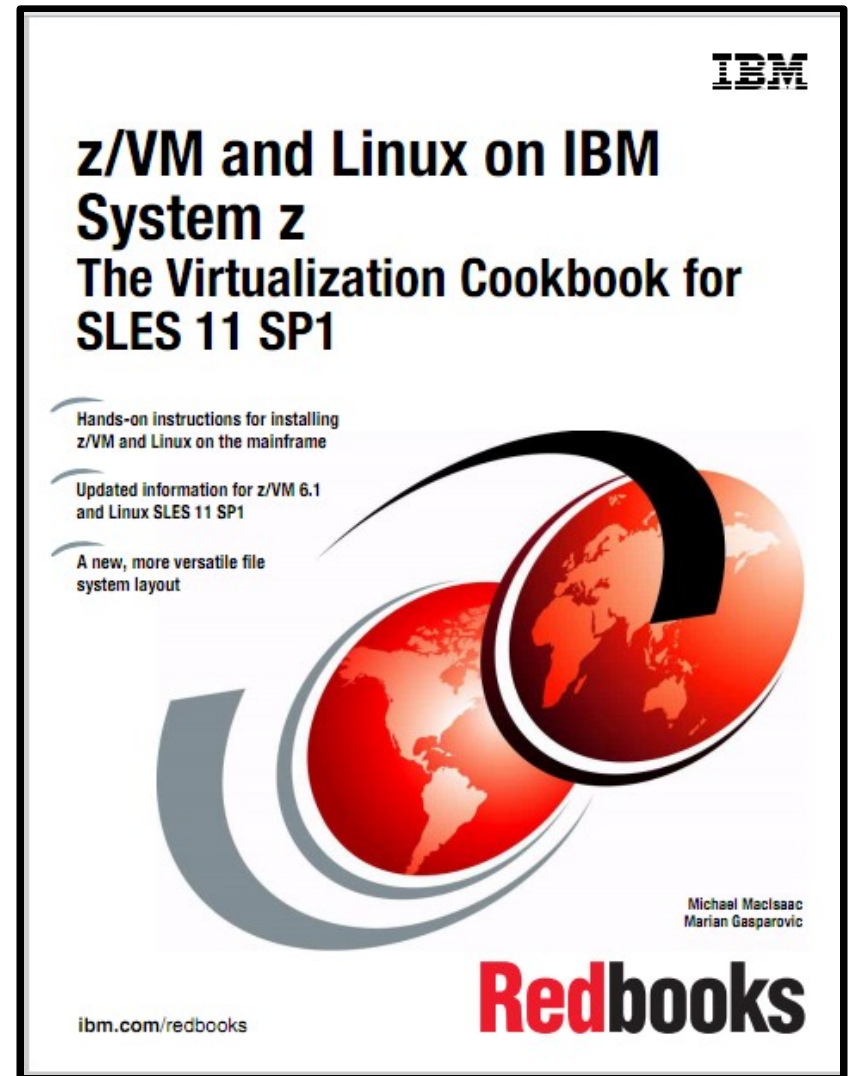
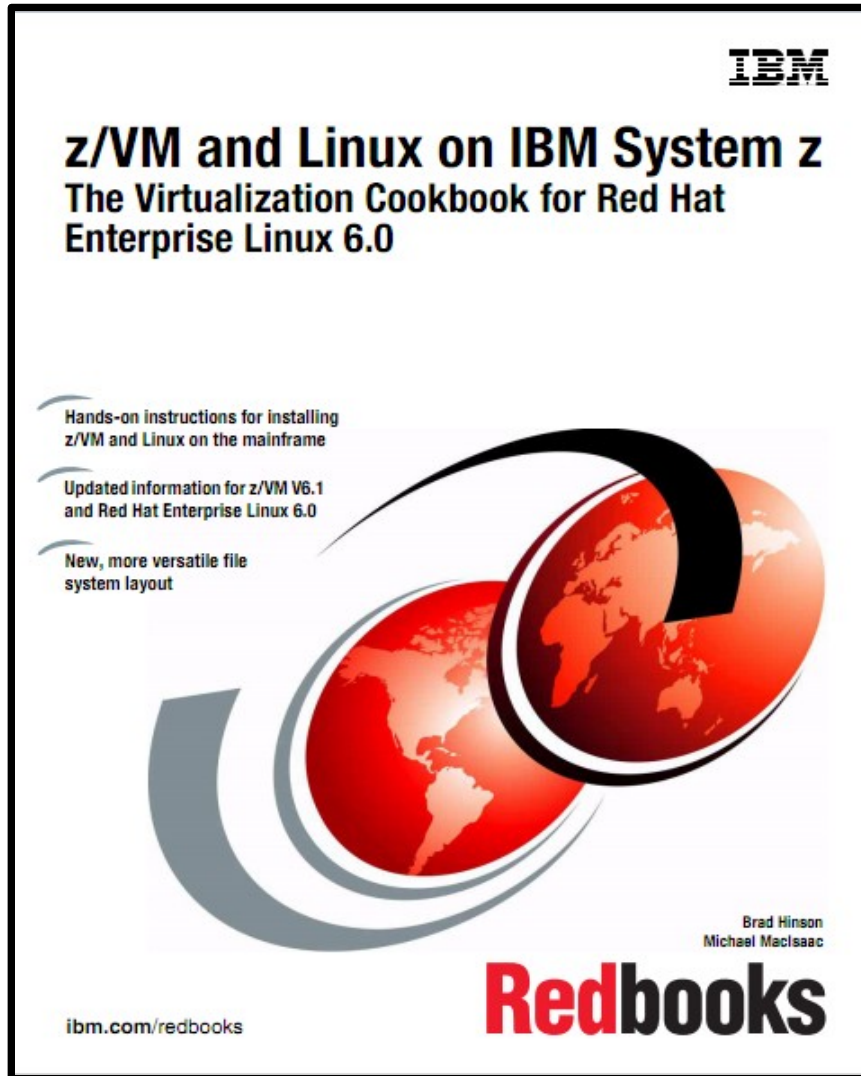
Device Drivers, Features, and Commands

Development stream (Kernel 26.33)

New: Distribution specific Documentation



More Information



Your Linux on System z Requirements?

Are you missing a certain feature, functionality or tool? **We'd love to hear from you!**

We will evaluate each request and (hopefully) develop the additional functionality you need.

Send your input to hans@de.ibm.com



Questions?



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NOTES: Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

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