2012
IBM System z Technical University

Enabling the infrastructure for smarter computing

What's New ?
Linux on System z

zLG02

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Agenda

- Linux Development
- Distributions
- System z Code News
- Tool-Chain

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Linux Trivia

- Kernel 1.0.0 176,250 lines of code
- Kernel 3.3 15,000,000 lines of code in 2012
- 3/4 is driver code
- 3 Billion USD estimated development costs
- 28 CPU architectures with many machine architectures
- 462 of the Top500 systems running Linux (performance 94.2%)
- 1.73% of desktop clients (browser stats)

source: http://en.wikipedia.org/wiki/Linux_kernel
http://www.top500.org
www.w3counter.com

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IBM Integration with Linux Community

- since 1999
- one of the leading contributors
- > 600 full-time developers in Linux and Open Source

Linux Kernel & Subsystem Development

- Kernel Base
- Security
- Systems Mgmt
- Virtualization
- Filesystems
- and more . . .

Expanding the OpenSource Ecosystem

- Apache
- Eclipse
- Firefox
- OpenOffice
- and more . . .

Promoting Open Standards & Community Collaboration

- The Linux Foundation
- Linux Standards Base
- Common Criteria Certification
- and more . . .

Foster and Protect the Ecosystem

- Software Freedom Law Center
- Free Software Foundation (FSF)
- and more . . .

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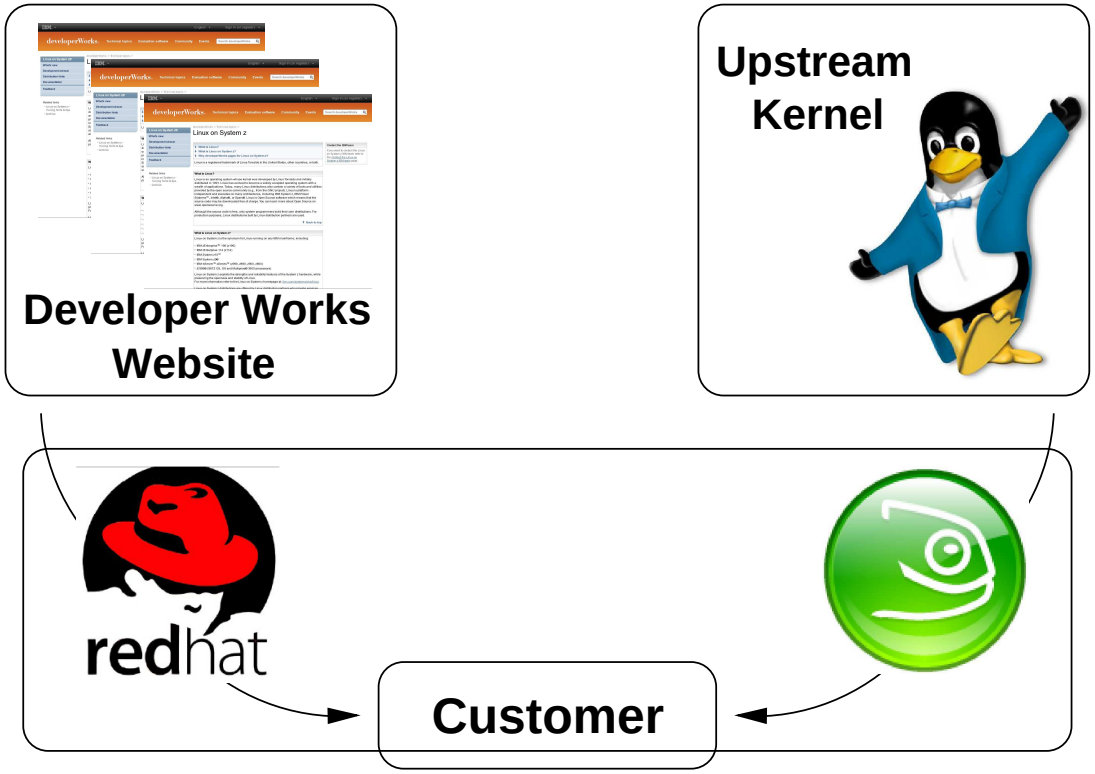
IBM Linux Development Process

IBM Linux on System z development contributes in the following areas

- kernel
- s390-tools
- open source tools (e.g. eclipse)
- gcc and glibc
- binutils



Distributions

- SUSE Linux Enterprise Server
  - SLES 9 Service Pack 4 (GA 12/2007) end of regular life cycle
  - SLES 10 Service Pack 4 (GA 05/2011)
  - SLES 11 kernel 2.6.32 gcc 4.3.3
    - Service Pack 1 (GA 06/2010) kernel 2.6.32 gcc 4.3.4
    - Service Pack 2 (GA 02/2012) kernel 3.0.13
- Red Hat Enterprise Linux AS
  - RHEL 4 Update 9 (GA 02/2011) end of regular life cycle
  - RHEL 5 Update 8 (GA 02/2012)
  - RHEL 6 (GA 11/2010) kernel 2.6.32 gcc 4.4.0
    - Update 3 (GA 06/2012)
- Others
  - Debian
  - Slackware

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Supported Linux Distributions

	zEnterprise EC12	zEnterprise z114 and z196	System z10	System z9	zSeries
RHEL 6	✓*	✓	✓	✓	X
RHEL 5	✓*	✓	✓	✓	✓
RHEL 4	X	✓*	✓	✓	✓
SLES 11	✓*	✓	✓	✓	X
SLES 10	✓*	✓	✓	✓	✓
SLES 9	X	✓*	✓	✓	✓

* specific release level recommended or required, some new functions may not be available
see http://www-03.ibm.com/systems/z/os/linux/resources/testedplatforms.html

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System z Linux Features - Core

- breaking event address for user space programs (2.6.35)
  - remember last break in sequential flow of instructions
  - valuable aid in analysis of wild branches
- z196 enhanced node affinity support (2.6.37)
  - allows Linux Scheduler to optimize decisions on z196 topology
- enable spinning mutex (2.6.28)
  - make use of new common code for adaptive mutexes
  - add new architecture primitive arch_mutex_cpu_relay to exploit sigp sense running to avoid mutex lock retries if hypervisor has not scheduled the CPU holding the mutex
- address space randomization (2.6.38)
  - enable flexible mmap layout for 64 bit to randomize start address for runtime stack and mmap area

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System z Linux Features - I/O

- unit check handling (2.6.35)
  - improve handling of unit checks for internal I/O started by common-I/O layer
  - after a unit check certain setup steps need to be repeated, e.g. for PAV
- dynamic PAV toleration (2.6.35)
  - tolerate dynamic Parallel Access Volume changes for base PAV
  - system management tools can reassign PAV alias device to different base devices
- tunable default grace period for missing interrupts in DASD (2.6.36)
  - provide a user interface to specify the timeout for missing interrupts for standard I/O operations on DASD

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System z Linux Features - I/O

- query DASD reservation status (2.6.37)
  - new DASD ioctl to read the ’Sense Path Group ID’ data
  - allows to determine the reservation status of a DASD in relation to the current system
- multi-track extension for HPF (2.6.38)
  - allows to read from and write to multiple tracks with a single CCW
- access to raw ECKD data from Linux (2.6.38)
  - allows to access ECKD disks in raw mode
  - use ’dd’ command to copy the disk level content of an ECKD disk to a Linux file and vice versa
  - storage array needs to support read-track and write-full-track command

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System z Linux Features - I/O

- store I/O and initiate logging - SIOSL (2.6.36)
  - enhance debug capability for FCP attached devices
  - enables operating system to detect unusual conditions on a FCP channel
- add NPIV information to symbolic port name (2.6.39)
  - add the device bus-ID and the network node to the symbolic port name if the NPIV mode is active
- SAN utilities (2.6.36)
  - two new utilities: zfcp_ping and zfcp_show
  - useful to discover a storage area network

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System z Linux Features - Network

- improved QDIO performance statistics (2.6.33)
  - Converts global statistics to per-device statistics and adds adds new counter for the input queue full condition
- QDIO outbound scan algorithm (2.6.38)
  - improve scheduling of QDIO tasklets
  - OSA, HiperSockets and zfcp need different thresholds
- offload outbound checksumming (2.6.35)
  - move calculation of checksum for non-TSO packets from the driver to the OSA network card
- OSX/OSM CHPIDs for hybrid data network (2.6.35)
  - OSA cards for zBX Blade Center Extension will have a new CHPID type
  - allows communication between zBX and Linux on System z

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System z Linux Features - Network

- toleration of optimized latency mode (2.6.35)
  - OSA devices in optimized latency mode can only serve a small number of stacks / users print a helpful error message if the user limit is reached
  - Linux does not exploit the optimized latency mode
- NAPI support for QDIO and QETH (2.6.36)
  - convert QETH to the NAPI interface, the ’new’ Linux networking API
  - NAPI allows for transparent GRO (generic receive offload)
- QETH debugging per single card (2.6.36)
  - split some of the global QETH debug areas into separate per-device areas
  - simplifies debugging for complex multi-homed configurations

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System z Linux Features - Network

- support for assisted VLAN null tagging (2.6.37)
  - z/OS may sent null-tagged frames to Linux
  - close a gap between OSA and Linux to process null tagged frames correctly
- new default qeth configuration values (2.6.39)
  - receive checksum offload
  - generic receive offload
  - number of inbound buffers

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System z Linux Features - Network

- IPv6 support for the qetharp tool (2.6.38)
  - extend the qetharp tool to provide IPv6 information in case of a layer 3 setup
  - required for communication with z/OS via HiperSockets using IPv6
- add OSA concurrent hardware trap (3.0)
  - for better problem determination the qeth driver requests a hardware trace when the device driver or the hardware detect an error
  - allows correlation between OSA and Linux traces

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System z Linux Features - Tools

- performance indicator bytes (2.6.37)
  - display capacity adjustment indicator introduced with z196 via /proc/sysinfo
- add support for makedumpfile tool (2.6.34)
  - convert Linux dumps to ELF file format
  - use makedumpfile tool to remove user data from dump
  - multi-volume dump will be removed
- get CPC name (2.6.39)
  - useful to identify a particular hardware system in a cluster
  - CPC name and HMC network name are provided

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CMSFS user space file system 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)
- cmsfs fuse file system transparently integrates the files on the minidisk into the Linux VFS, no special command required

```
# cmsfs-fuse /dev/dasde /mnt/cms
# ls -la /mnt/fuse/PROFILE.EXEC
-r--r----- 1 root root 3360 Jun 26 2009 /mnt/cms/PROFILE.EXEC
```

- by default no conversion is performed
  - mount with `-t` to get automatic EBCDIC to ASCII conversion

```
# cmsfs-fuse -t /dev/dasde /mnt/cms
```

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CMSFS user space file system support

- write support is work in progress - almost completed
- use fusermount to unmount the file system again

```
# fusermount -u /mnt/cms
```

- RHEL 6.1 and SLES 11 SP2

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Two stage dumper / kdump support

- use a Linux kernel to create a system dump
  - use a preloaded crashkernel to run in case of a system failure
  - can be triggered either as panic action or by the stand-alone dumper, integrated into the shutdown actions framework
- Pro
  - enhanced dump support that is able to reduce dump size, shared disk space, dump to network, dump to a file-system etc.
  - makedumpfile tool can be used to filter the memory of the crashed system
- Con
  - kdump is not as reliable as the stand-alone dump tools
  - kdump cannot dump a z/VM named saved system (NSS)
  - for systems running in LPAR kdump consumes memory
- kernel 3.2 - s390-tools-1.17.0

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Two stage dumper / kdump support

- add a crashkernel to the kernel command line

```
crashkernel=<size>@<offset>
```

- boot your system and check the reservation

```
# cat /proc/iomem
00000000-3fffffff : System RAM
00000000-005f1143 : Kernel code
005f1144-00966497 : Kernel data
00b66000-014c4e9f : Kernel bss
40000000-47ffffff : Crash kernel
48000000-7fffffff : System RAM
```

- load the kdump kernel with kexec

```
# kexec -p kdump.image initrd kdump.initrd --command-line="dasd=1234 root=/dev/ram0"
```

- manually trigger for kdump under z/VM

```
#cp system restart
```

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Changes Kernel 3.2

- Btrfs
  - faster scrubbing
  - automatic backup of tree roots
  - detailed corruption messages
  - manual inspection of metadata
- ext4
  - support 1 MB block size
- I/O-less dirty throttling - reduce filesystem writeback from page reclaim
- Network
  - TCP Proportional Rate Reduction
- New architecture
  - Hexagon

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Changes Kernel 3.3

- Btrfs
  - restriping between different RAID levels
  - improved balancing
  - improved debugging tools
- Open vSwitch
- teaming
  - Better bonding of network interfaces
- Network
  - Per-cgroup TCP buffer limits
  - Network priority control group
- Better ext4 online resizing
- New architecture
  - TI C6X

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Changes Kernel 3.4

- Btrfs updates
  - repair and data recovery tools
  - metadata blocks bigger than 4KB
  - performance improvements
  - better error handling
- remove *resize* mount option for ext4
  - no longer useful in the age of online resize2fs
- new X32 ABI - 64-bit mode with 32-bit pointers
- Virtualization
  - KVM - several changes including 1 s390 change
  - Hyper-V - several changes
  - Xen - ACPI change and netconsole support
  - virtio-pc - S3 support
  - rpmsg - remote processor message bus

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Changes Kernel 3.5

- Network
  - TCP connection repair
  - relocate a network connection to another host
  - TCP Early Retransmit
- Btrfs
  - I/O failure statistics
  - latency improvements
- task children info in /proc/<pid>/task/<tid>/children
  - useful for process checkpointing or relocation

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s390-tools

- a package with a set of user space utilities to be used with the Linux on System z distributions.
- THE essential tool chain for Linux on System z
- contains everything from the boot loader to dump related tools for a system crash analysis .
- contained in all major (and IBM supported) Enterprise Linux distributions which support s390
- RedHat Enterprise Linux
- SuSE Linux Enterprise Server
- Website: http://www.ibm.com/developerworks/linux/linux390/s390-tools.html
- Feedback: linux390@de.ibm.com

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s390-tools

- Dump on panic - prevent reIPL loop (1.8.4)
  - delay arming of automatic reIPL after dump
  - avoids dump loops where the restarted system crashes immediately
- automatic menu support in zipl (1.11.0)
  - zipl option to create a boot menu for all eligible non-menu sections in zipl.conf
- re-IPL from device-mapper devices (1.12.0)
  - automatic reIPL function only works with a physical device
  - enhance the zipl support for device-mapper devices to provide the name of the physical device if the zipl target is located on a logical device
- configuration tool for System z network devices (1.8.4)
  - provide a shell script to ease configuration of System z network devices

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s390-tools

CHANGE
- chccwdev
- chchp
- chreipl
- chshut
- chcrypt
- chmem

DISPLAY
- lscss
- lschp
- lsdasd
- lsluns
- lsqeth
- lsreipl
- lsshut
- lstape
- lszcrypt
- lszfcp
- lsmem

DASD
- dasdfmt
- dasdinfo
- dasdstat
- dasdview
- fdasd
- tunedasd

MONITOR
- mon_fsstatd
- mon_procd
- ziomon
- hyptop

NETWORK
- ip_watcher
- osasnmpd
- qetharp
- qethconf

TAPE
- tape390_display
- tape390_crypt

DEBUG
- dbginfo
- dumpconf
- zfcpdump
- zfcpdbf
- zgetdump
- scsi_logging_level

z/VM
- vmconvert
- vmcp
- vmur
- cms-fuse

MISC
- cpuplugd
- iucvconn
- iucvtty
- ts-shell
- ttyrun

BOOT
- zipl

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LNXHC - Linux Health Checker

- command line tool for Linux.
- to identify potential problems before they impact your system performance, availability or cause outages.
- collect and compare the active Linux settings and system status with the values provided by health-check authors or defined by the customer
- produces detailed messages, which describe potential problems and the suggests solutions
- Linux Health Checker runs on any Linux platform which meets the software requirements
- can be easily extended by writing new health check plug-ins
- The Linux Health Checker is an open source project sponsored by IBM. It is released under the Eclipse Public License v1.0. http://lnxhc.sourceforge.net

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SAN Utilities

- 2 new utilities
  - zfcp_show
  - zfcp_ping
- useful to discover a storage area network
- kernel 2.6.36 - lib-zfcp-hbaapi 2.1

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zfcp_show

- Query Fibre Channel nameserver about ports available for my system

```
# zfcp_show -n
Local Port List:
        0x500507630313c562 / 0x656000 [N_Port] proto = SCSI-FCP FICON
        0x50050764012241e4 / 0x656100 [N_Port] proto = SCSI-FCP
        0x5005076401221b97 / 0x656400 [N_Port] proto = SCSI-FCP
```

- Query SAN topology, requires FC management server access

```
# zfcp_show
Interconnect Element Name 0x100000051e4f7c00
Interconnect Element Domain ID 005
Interconnect Element Type Switch
Interconnect Element Ports 256
       ICE Port 000 Online
              Attached Port [WWPN/ID] 0x50050763030b0562 / 0x650000 [N_Port]
       ICE Port 001 Online
              Attached Port [WWPN/ID] 0x50050764012241e5 / 0x650100 [N_Port]
       ICE Port 002 Online
              Attached Port [WWPN/ID] 0x5005076303008562 / 0x650200 [N_Port]
       ICE Port 003 Offline
```

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zfcp_ping

- Check if remote port responds (requires FC management service access)

```
# zfcp_ping 0x5005076303104562
Sending PNG from BUS_ID=0.0.3c00 speed=8 GBit/s
       echo received from WWPN (0x5005076303104562) tok=0 time=1.905 ms
       echo received from WWPN (0x5005076303104562) tok=1 time=2.447 ms
       echo received from WWPN (0x5005076303104562) tok=2 time=2.394 ms
---------- ping statistics -----------
min/avg/max = 1.905/2.249/2.447 ms
----------------------------------------
```

- zfcp_show and zfcp_ping are part of the zfcp-hbaapi 2.1 package
  http://www.ibm.com/developerworks/linux/linux390/zfcp-hbaapi-2.1.html

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valgrind System z Support

- valgrind -tool=memcheck [–leak-check=full] [–track-origins] <program>
  - detects if your program accesses memory it shouldn't
  - detects dangerous uses of uninitialized values on a per-bit basis
  - detects leaked memory, double frees and mismatched frees
- valgrind -tool=cachegrind
  - profile cache usage, simulates instruction and data cache of the cpu
  - identifies the number of cache misses
  - needs cache line size, Extract Cache Attributes (ECAG) instruction introduced with z10
- valgrind -tool=massif
  - profile heap usage, takes regular snapshots of program's heap
  - produces a graph showing heap usage over time

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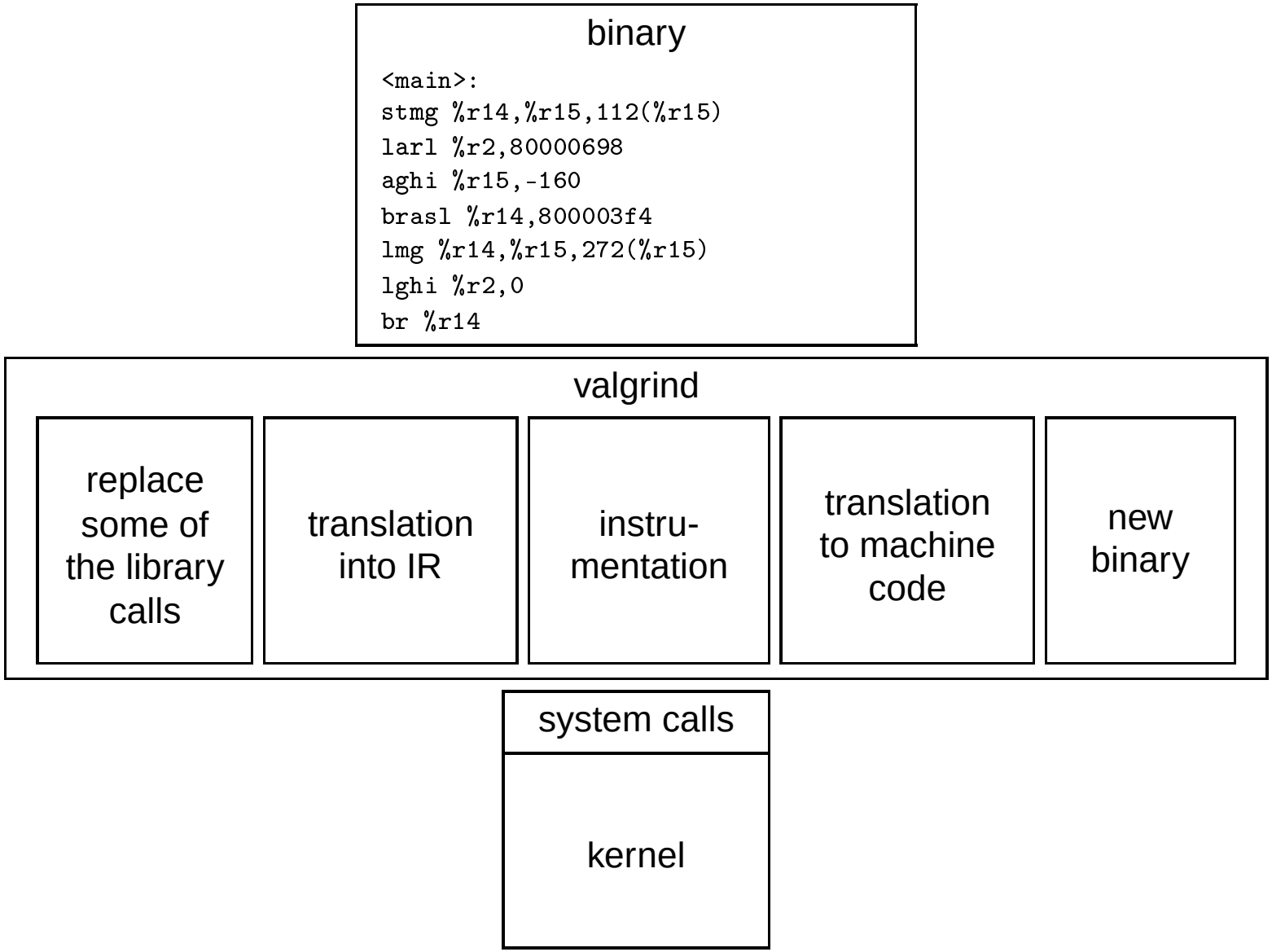
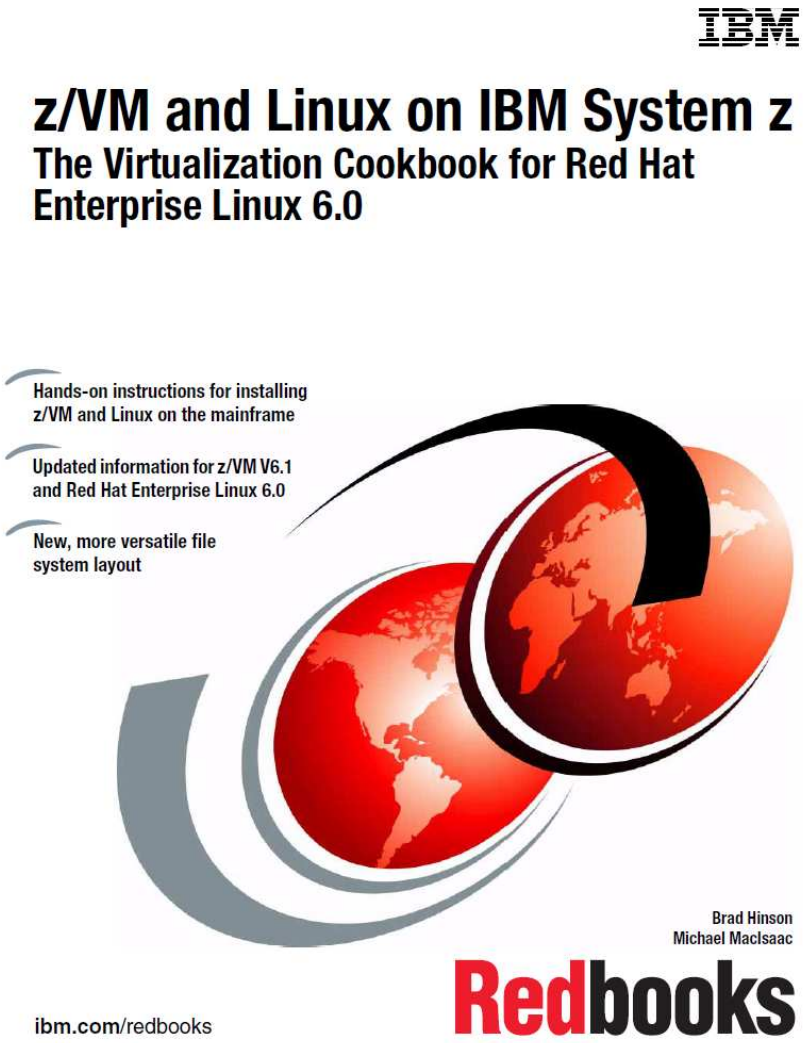
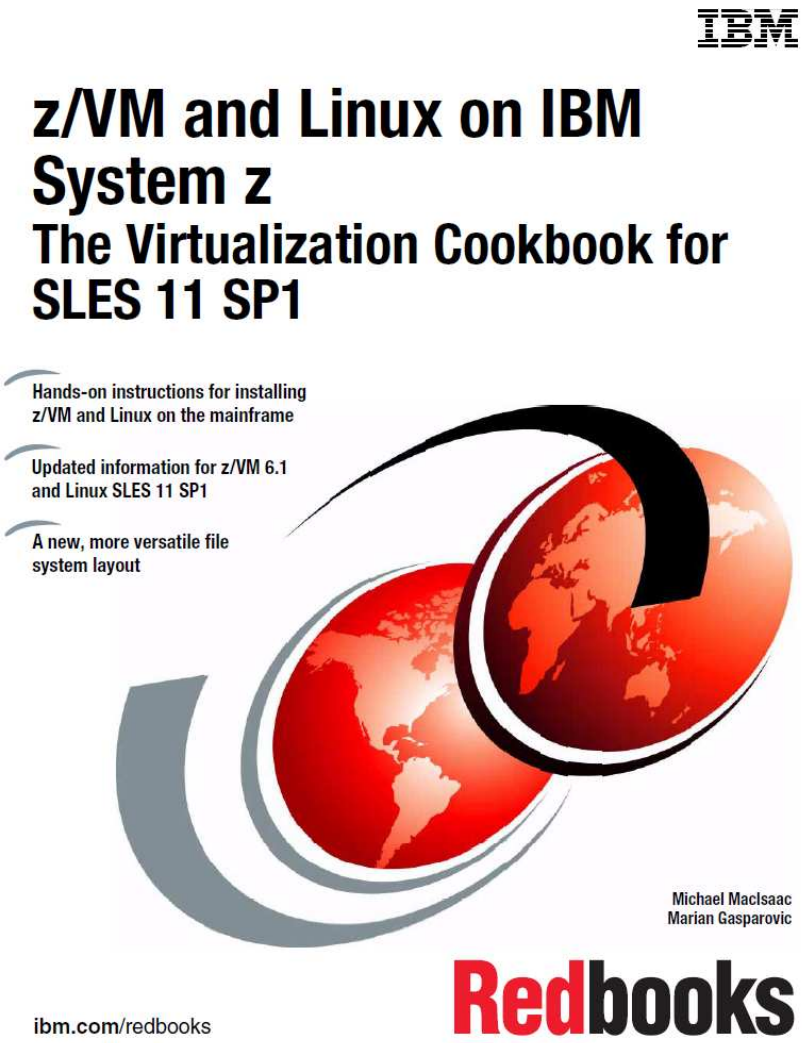
valgrind System z Support



RedBooks





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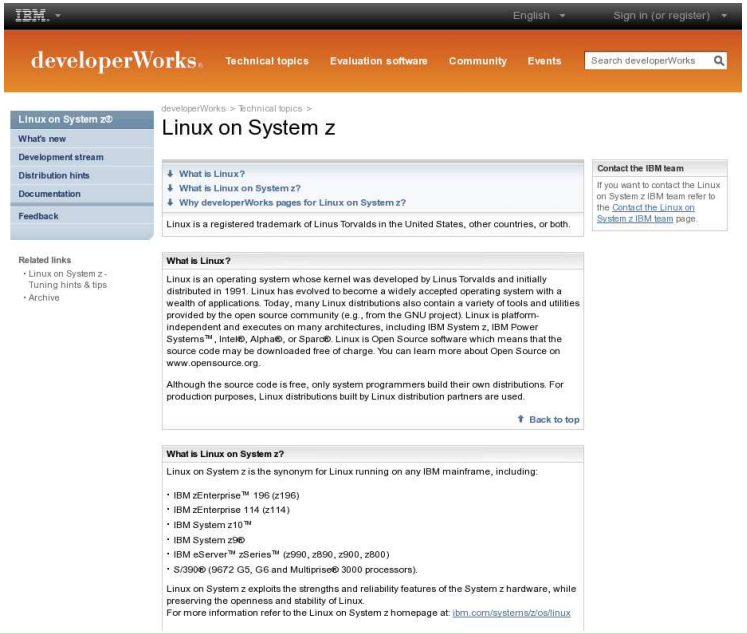
Links

- developerWorks
  `http://www.ibm.com/developerworks/linux/linux390`
- Resources for Linux on System z
  `http://www-03.ibm.com/systems/z/os/linux/resources/index.html`
- IBM Redbooks
  `http://www.redbooks.ibm.com`



Thank You !

- Martin Schwidefsky

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Questions ?

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Linux on System z Service

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