What's New in Linux on System z

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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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IBM collaborates with the Linux community

- has been an active participant since 1999
- is one of the leading commercial contributors to Linux
- has over 600 full-time developers working with Linux and open source

- **Linux Kernel & Subsystem Development**
  - Kernel Base
  - Security
  - Systems Mgmt
  - Virtualization
  - Filesystems, and more...

- **Expanding the Open Source Ecosystem**
  - Apache
  - Eclipse
  - Mozilla Firefox
  - OpenOffice.org, 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...
The IBM Linux development process

- IBM Linux on System z development contributes in the following areas: Kernel, s390-tools, open source tools (e.g. eclipse, ooprofile), gcc, glibc, binutils
Facts on Linux

- 2009, **75%** of the Linux code was developed by programmers working for corporations.
- **$1.14 billion**: estimated total value of the Linux kernel 2.6.30
- **$7.37 billion**: projected cost to produce the 283 million lines of code which are contained in Linux Distribution in a commercial environment.
- IDC forecasts show that Linux server revenue will grow by **85.5%** between 2008 and 2012 in the non-x86 server space equalling a four year compound annual growth rate of 16.7%.
- **Linux is Linux**, but …features, properties and quality differ dependent on your platform

Linux kernel development: rate of change

Average: 6683 lines added, 3774 lines removed, 1797 lines changed every day for the last 5 1/2 years.

Source: http://www.linuxfoundation.org/docs/lf_linux_kernel_development_2010.pdf
Linux kernel development: System z contributions

- Changesets per 2.6.x/3.0 kernel release
Linux on System z distributions (Kernel 2.6 based)

- SUSE Linux Enterprise Server 9 (GA 08/2004)
  - Kernel 2.6.5, GCC 3.3.3, Service Pack 4 (GA 12/2007)
- SUSE Linux Enterprise Server 10 (GA 07/2006)
  - Kernel 2.6.16, GCC 4.1.0, Service Pack 4 (GA 05/2011)
- SUSE Linux Enterprise Server 11 (GA 03/2009)
  - Kernel 2.6.27, GCC 4.3.3, Service Pack 1 (GA 06/2010), Kernel 2.6.32
- Red Hat Enterprise Linux AS 4 (GA 02/2005)
  - Kernel 2.6.9, GCC 3.4.3, Update 9 (GA 02/2011)
- Red Hat Enterprise Linux AS 5 (GA 03/2007)
  - Kernel 2.6.18, GCC 4.1.0, Update 6 (GA 01/2011)
- Red Hat Enterprise Linux AS 6 (GA 11/2010)
  - Kernel 2.6.32, GCC 4.4.0, Update 1 (GA 05/2011)
- Others
  - Debian, Slackware,
  - Support may be available by some third party
## Supported Linux Distributions

<table>
<thead>
<tr>
<th>Distribution</th>
<th>zEnterprise 196</th>
<th>System z10</th>
<th>System z9</th>
<th>zSeries</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHEL 6</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>X</td>
</tr>
<tr>
<td>RHEL 5</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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</tr>
<tr>
<td>RHEL 4 (*)</td>
<td>✔️ (1)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>SLES 11</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>X</td>
</tr>
<tr>
<td>SLES 10</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>SLES 9 (*)</td>
<td>✔️ (2)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

- ✔️ Indicates that the distribution (version) has been tested by IBM on the hardware platform, will run on the system, and is an IBM supported environment. Updates or service packs applied to the distribution are also supported.
- (1) RHEL 4.8 only. Some functions have changed or are not available with the z196, e.g. the Dual-port OSA cards support to name one of several. Please check with your service provider regarding the end of service.
- (2) SLES 9 SP4 + latest maintenance updates only. Some functions have changed or are not available with the z196, e.g. the Dual-port OSA cards support to name one of several. Please check with your service provider regarding the end of service.
- X Indicates that the distribution is not supported by IBM.
- (*) Also available as 31-bit distribution.
Kernel news – Common code

Linux version 2.6.35 (2010-08-01)
- Filesystems: btrfs improvements, XFS delayed logging
- Support for multiple multicast route tables
- Support for Layer 2 Tunneling Protocol L2TP Version 3
- Memory compaction

Linux version 2.6.36 (2010-10-20)
- Tilera architecture support
- Concurrency-managed workqueues
- Improve VM-related desktop responsiveness
- Integration of AppArmor
- New out-of-memory killer (OOM)
Kernel news – Common code

Linux version 2.6.37 (2011-01-04)
- Filesystems: better SMP scalability for ext4, XFS scalability improvements
- Removal of the BKL: Big Kernel Lock
- I/O throttling support for process groups
- Jump labels: performance optimization for disabled tracepoints

Linux version 2.6.38 (2011-03-14)
- Automatic process grouping (SCHED_AUTOGROUP)
- RCU-based path name lookup (dcache scalability)
- Transparent huge pages
- Transmit packet steering (XPS) for multiqueue devices
Kernel news – Common code

Linux version 2.6.39 (2011-05-18)
- Ext4 SMP scalability
- IPset network resource groups
- Transcendent memory
- Unicore32 architecture

Linux version 3.0 (2011-07-21)
- New kernel version numbering scheme
- Cleancache (was transcendent memory) support for ext4, btrfs and XFS
- Preemptible mmu_gather for reduced latency
- Enhancements for the memory cgroup controller
System z kernel features – Core

- **Breaking event address for user space programs (kernel 2.6.35)**
  - Store the breaking-event-address for user space programs
  - Valuable aid in the analysis of wild branches

- **z196 enhanced node affinity support (kernel 2.6.37)**
  - Allows the Linux scheduler to optimize its decisions based on the z196 topology.

- **Performance indicator bytes (kernel 2.6.37)**
  - Display capacity adjustment indicator introduced with z196 via /proc/sysinfo.

- **QDIO outbound scan algorithm (kernel 2.6.38)**
  - Improved scheduling of QDIO tasklets, OSA / HiperSockets / zfcp need different thresholds.

- **Two stage dumper / kdump support (> kernel 3.0)**
  - Enhanced dump support that is able to reduced dump size, share disk space, dump to network, etc.
  - Integrated into the System z stand-alone dump tools and shutdown actions framework
Two stage dumper / kdump support

- 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
- Use the makedumpfile tool to filter the memory of the crashed system
System z kernel features – z/VM

- CMSFS user space file system support (s390-tools 1.9.0/1.12.0)
  - Implement a FUSE file system that allows to read from and write to CMSFS minidisks.
  - Writing is difficult, the record based CMSFS does not fit well into the byte steam oriented Linux VFS
  - Attention: you can inadvertently damage files and lose data when directly operating on files within the cmsfs file system. To avoid damaging files, copy the file to a location outside the cmsfs-fuse file system, edit the file, and then copy it back to its original location.

- CMSFS configurable code page conversion (s390-tools 1.12.0)
  - Adds a configuration file to CMSFS that defines which CMS files are automatically converted from EBCDIC to ASCII.
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)
- The 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/fuse/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
```

- Use fusermount to unmount the file system again

```
# fusermount -u /mnt/cms
```
System z kernel features – Storage FICON

- Unit check handling (kernel 2.6.35)
  - Improve handling of unit checks for internal I/O started by the common-I/O layer
  - After a unit check certain setup steps need to be repeated, e.g. for PAV

- Dynamic PAV toleration (kernel 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 (kernel 2.6.36)
  - Provide a user interface to specify the timeout for missing interrupts for standard I/O operations on DASD

- Query DASD reservation status (kernel 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 Linux
System z kernel features – Storage FICON

- Multi-track extension for HPF (kernel 2.6.38)
  - Allows to read from and write to multiple tracks with a single CCW

- Improve handling of stolen DASD reservation (kernel 2.6.38)
  - Provide alternatives to handle unit checks that indicate stolen reservations
    - Fail any request to a device until it is set offline
    - Queue I/O until reservation is released again

- Access to raw ECKD data from Linux (kernel 2.6.38)
  - This item allows to access ECKD disks in raw mode
  - Use the 'dd' command to copy the disk level content of an ECKD disk
  - Storage array needs to support the read-track and write-full-track commands.
System z kernel features – Storage FICON

- Automatic menu support in zipl (s390-tools 1.11.0)
  - Zipl option that will create a boot menu for all eligible non-menu sections in the zipl configuration file

- reIPL from device-mapper devices (s390-tools 1.12.0)
  - The automatic re-IPL 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
System z kernel features – Storage FCP

- **Store I/O status and initiate logging (SIOSL) (kernel 2.6.36)**
  - Enhance debug capability for FCP attached devices
  - Enables operating system to detect unusual conditions on an FCP channel

- **SAN utilities (trace, ping, ..) (kernel 2.6.36, lib-zfcp-hbaapi 2.1)**
  - Two new utilities have been added: zfcp_ping and zfcp_show
  - They are useful to discover a storage area network

- **Automatic LUN scanning (kernel 2.6.37)**
  - Scan and attach accessible LUNs automatically
  - Available only for a NPIV FCP attachment

- **Add NPIV information to symbolic port name (kernel 2.6.39)**
  - Add the device bus-ID and the network node to the symbolic port name if the NPIV mode is active.

- **SCSI device management tool (> s390-tools 1.14.0)**
  - Implement a tool analog chccwdev which allows to enable/disable a SCSI LUN addressed by HBA/target port/LUN.
SAN Utilities: zfcp_show

- Query Fibre Channel nameserver about ports available for my system:

```sh
# 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:

```sh
# 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
...
SAN Utilities: 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:

System z kernel features – Networking

- **Offload outbound checksumming (kernel 2.6.35)**
  - Move calculation of checksum for non-TSO packets from the driver to the OSA network card

- **Toleration of optimized latency mode (kernel 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

- **OSX (OSM) CHPIDs for hybrid data network (kernel 2.6.35)**
  - The OSA cards for the zBX Blade Center Extension will have a new CHPID type
  - Allows communication between zBX and Linux on System z

- **NAPI support for QDIO and QETH (kernel 2.6.36)**
  - Convert QETH to the NAPI interface, the “new” Linux networking API
  - NAPI allows for transparent GRO (generic receive offload)

- **New default qeth configuration values (kernel 2.6.39)**
  - Receive checksum offload, generic receive offload & number of inbound buffers
System z kernel features – Networking

- **QETH debugging per single card (kernel 2.6.36)**
  - Split some of the global QETH debug areas into separate per-device areas
  - Simplifies debugging for complex multi-homed configurations

- **Support for assisted VLAN null tagging (kernel 2.6.37)**
  - Close a gap between OSA and Linux to process null tagged frames correctly
  - z/OS may sent null-tagged frames to Linux

- **IPv6 support for the qetharp tool (kernel 2.6.38)**
  - Extend the qetharp tool to provide IPv6 information in case of a layer 3 setup.
  - This is required for communication with z/OS via HiperSockets using IPv6.

- **Configuration tool for System z network devices (s390-tools 1.8.4)**
  - Provide a shell script to ease configuration of System z network devices
znetconf network device configuration tool

- Allows to list, add, remove & configure System z network devices
- For example: list all potential network devices:

```
# znetconf -u
Device Ids       Type    Card Type  CHPID  Drv.
---------------------------------------------------
0.0.f500,0.0.f501,0.0.f502 1731/01 OSA (QDIO) 00  qeth
0.0.f503,0.0.f504,0.0.f505 1731/01 OSA (QDIO) 01  qeth
```

- Configure device 0.0.f503

```
znetconf -a 0.0.f503
```

- Configure device 0.0.f503 in layer2 mode and portname “myport”

```
znetconf -a 0.0.f503 -o layer2=1 -o portname=myport
```

- Remove network device 0.0.f503

```
znetconf -r 0.0.f503
```
System z kernel features – Usability / RAS / Security

- **CHPID reconfiguration handling (kernel 2.6.37)**
  - Update data structures after channel-path related information change
  - Inform device drivers about relevant changes

- **4096 bit RSA fast path (kernel 2.6.38)**
  - Make use of 4096 bit RSA acceleration available with Crypto Express 3 GA2 cards.

- **Address space randomization (kernel 2.6.38)**
  - Enable flexible mmap layout for 64 bit
  - Randomize start address for the runtime stack and the mmap area

- **New libica APIs for supported crypto modes**
  - Provide a programmatic way to query for supported crypto ciphers, modes and key sizes.
  - Deliver information whether the cryptographic features are implemented in hardware or in software
System z kernel features – Usability / RAS / Security

- Get CPC name (kernel 2.6.39)
  - Useful to identify a particular hardware system in a cluster
  - The CPC name and HMC network name are provided

- CP ACF exploitation of System z196 (kernel 2.6.39)
  - Add support for new HW crypto modes: cipher feedback mode (CFB), output feedback mode (OFB), counter mode (CTR), Galois counter mode (GCM), XEX based Tweaked Code Book with Cipher Text Stealing (XTS), cipher based message authentication mode (CMAC), and counter with cipher block chaining message authentication (CCM)

- Removal of data execution protection
  - “no execute” support relies on the secondary space mode for data separation
  - With System z10 the new instructions LRL, LGRL and LGFRL for pc-relative data access have been added
  - These new instructions access the memory operand in the same address space from where the instructions has been fetched.
System z toolchain

- zEnterprise 196 exploitation (gcc 4.6)
  - Use option `-march=z196` to utilize the new instructions added with z196
  - Use `-mtune=z196` to schedule the instruction appropriate for the new out-of-order pipeline of z196

- 64 bit register in 31 bit compat mode
  - Make use of 64 bit registers in 31 bit application running in z/Architecture mode.
  - Allows to use instruction operating on 64 bits, e.g. 64 bit multiplication
  - Needs kernel support for asynchronous signals

- Oprofile support for hardware sampling introduced with z10 (2.6.39)
  - Provide CPU measurement data to applications for performance tuning
  - Based on hardware counters and samples built into the CPU
  - Use oprofile to communicate the information to user space programs

- Valgrind System z support
  - Valgrind is a generic framework for creating dynamic analysis tools and can be used for memory debugging, memory leak detection and profiling (e.g. cachegrind)
  - Valgrind is in essence a virtual machine using just-in-time (JIT) compilation techniques
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

- `valgrind --tool=massif`
  - Profile heap usage, takes regular snapshots of program's heap
  - Produces a graph showing heap usage over time

Binary

```
80000554 <main>:
stmg %r14,%r15,112(%r15)
larl %r2,80000698 <string>
aghi %r15,-160
brasl %r14,800003f4 <puts@plt>
lmg %r14,%r15,272(%r15)
lghi %r2,0
br %r14
```
s390-tools package: what is it?

- s390-tools is a package with a set of user space utilities to be used with the Linux on System z distributions.
  - It is the essential tool chain for Linux on System z
  - It contains everything from the boot loader to dump related tools for a system crash analysis.

- This software package is contained in all major (and IBM supported) enterprise Linux distributions which support s390
  - RedHat Enterprise Linux 4
  - RedHat Enterprise Linux 5
  - RedHat Enterprise Linxu 6
  - SuSE Linux Enterprise Server 9
  - SuSE Linux Enterprise Server 10
  - SuSE Linux Enterprise Server 11


- Feedback: linux390@de.ibm.com
s390-tools package: the content

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

- **DASD**
  - dasdfmt
  - dasdinfo
  - dasdview
  - fdasd
  - tunedasd

- **MONITOR**
  - mon_fsstatd
  - mon_procd
  - ziomon
  - hyptop

- **NETWORK**
  - ip_watcher
  - osasnpd
  - qetharp
  - qethconf

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

- **TAPE**
  - tape390_display
  - tape390_crypt

- **DUMP & DEBUG**
  - dbginfo
  - dumpconf
  - zfcpdump
  - zfcpdfb
  - zgetdump
  - scsi_logging_level

- **BOOT**
  - vmconvert
  - vmcp
  - vmur
  - cms-fuse
  - cpuplugd
  - iucvconn
  - iucvtty
  - ts-shell
  - ttyrun

- **MISC**
  - zip1
s390-tools package

- **Version 1.10.0 (2010-09-16)**
  - chchp: Use `/proc/cio_settle`
  - znetconf: Add support for new CHPIDs OSX and OSM

- **Version 1.11.0 (2010-10-22)**
  - cmsfs-fuse: Add write support
  - zipl: Add support for automatic menus

- **Version 1.12.0 (2011-01-27)**
  - **hyptop**: Provides real-time view of System z hypervisor environment
  - chreipl: Various enhancements
  - cio_ignore: Add query option
  - cmsfs-fuse: Configurable code page conversion
  - tunedasd: Add option to query reservation status of a device
  - zgetdump: Add kdump support for –info option
  - zfcpdump/zipl: Disable automatic activation of LUNs
s390-tools package

- Version 1.13.0 (2011-05-19)
  - qetharp: Support IPv6 for query ARP cache for HiperSockets
  - zfcpdbf: Adjust to 2.6.38 zfcp driver changes

- Version 1.14.0 (2011-06-30)
  - fdasd: Implement new partition types
hyptop: Display hypervisor utilization data

- The hyptop command is a top-like tool that displays a dynamic real-time view of the hypervisor environment
  - It works with both the z/VM and the LPAR hypervisor
  - Depending on the available data it can display information about CPU and memory
  - running LPARs or z/VM guest operating systems

- The following is 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 guests your instance requires additional privileges
    - For z/VM: The user ID requires privilege class B
    - For LPAR: The global performance data control box in the LPAR activation profile needs to be selected
### Example of z/VM utilization data

<table>
<thead>
<tr>
<th>system</th>
<th>#cpu</th>
<th>cpu (%)</th>
<th>Cpu+ (hm)</th>
<th>online (dhm)</th>
<th>memuse (GiB)</th>
<th>memmax (GiB)</th>
<th>wcur (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T6360003</td>
<td>6</td>
<td>506.92%</td>
<td>3404:17</td>
<td>44:20:53</td>
<td>7.99</td>
<td>8.00</td>
<td>100</td>
</tr>
<tr>
<td>T6360017</td>
<td>2</td>
<td>199.58%</td>
<td>29:37:30</td>
<td>29:23:50</td>
<td>0.75</td>
<td>0.75</td>
<td>100</td>
</tr>
<tr>
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<td>0:16:17</td>
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<td>61:17:35</td>
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<td>0.06%</td>
<td>1:04:23</td>
<td>48:19:08</td>
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hyptop: Display hypervisor utilization data

- Example of single LPAR utilization data

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

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=:=V:N  185.46  4.30
```
## Documentation for Development stream

### Development stream
- Novell SUSE
- Red Hat

### Linux on System z documentation for 'Development stream'

#### Base documentation
- Device Drivers, Features, and Commands (kernel 2.6.33) - SC33-8414-01 [PDF, 4.4MB] - March 2010
- Using the Dump Tools (kernel 2.6.33) - SC33-8414-02 [PDF, 0.9MB] - March 2010

#### How to documents
- How to use Execute-in-Place Technology with Linux on z/VM - SC34-2594-01 [PDF, 0.5MB] - March 2010
- Download a tarball with sample scripts.
- How to Set up a Terminal Server Environment - SC34-2595-00 [PDF, 0.3MB] - June 2009
- Kernel Messages
  - Kernel Messages (Kernel 2.6.33) [PDF, 0.4MB] - March 2010
- Libc Programmer's Reference - SC34-2602-00 [PDF, 0.3MB] - June 2009

### Linux on System z

## How to use Execute-in-Place Technology with Linux on z/VM
March, 2010

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

## How to Set up a Terminal Server Environment on z/VM
June 2009

### Using the Dump Tools

### Kernel Messages

### Device Drivers, Features, and Commands
New Redbooks

z/VM and Linux on IBM System z
The Virtualization Cookbook for Red Hat Enterprise Linux 6.0

Hands-on instructions for installing z/VM and Linux on the mainframe
Updated information for z/VM V6.1 and Red Hat Enterprise Linux 6.0
New, more versatile file system layout

Brad Hinson
Michael MacIsaac

Visit http://www.redbooks.ibm.com
Questions?

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schwidefsky@de.ibm.com

Linux on System z
Development