Linux on System z Update: Current & Future Linux on System z Technology

4th European GSE / IBM Technical University for z/VSE, z/VM and Linux on System z
25-27 October 2010, Hotel The Westin Grand München, Germany

IBM

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**	**Expanding the Open Source Ecosystem**	**Promoting Open Standards & Community Collaboration**	**Foster and Protect the Ecosystem**
Kernel Base	**Apache**	**The Linux Foundation**	**Software Freedom Law Center**
Security	**Eclipse**	**Linux Standards Base**	**Free Software Foundation (FSF),**
Systems Mgmt	**Mozilla Firefox**	**Common Criteria certification,**	**and more...**
Virtualization	**OpenOffice.org,**	**and more...**	
Filesystems,	**and more...**		
and more...			

IBM

Facts on Linux

- Last year, **75%** of the Linux code was developed by **programmers working for corporations**.

- **$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

IBM

IBM Linux on System z Development

IBM Linux on System z Development contributes in the following areas: Kernel, s390-tools, Open Source Tools (e.g. eclipse, ooprofile), GCC, GLIBC, Binutils
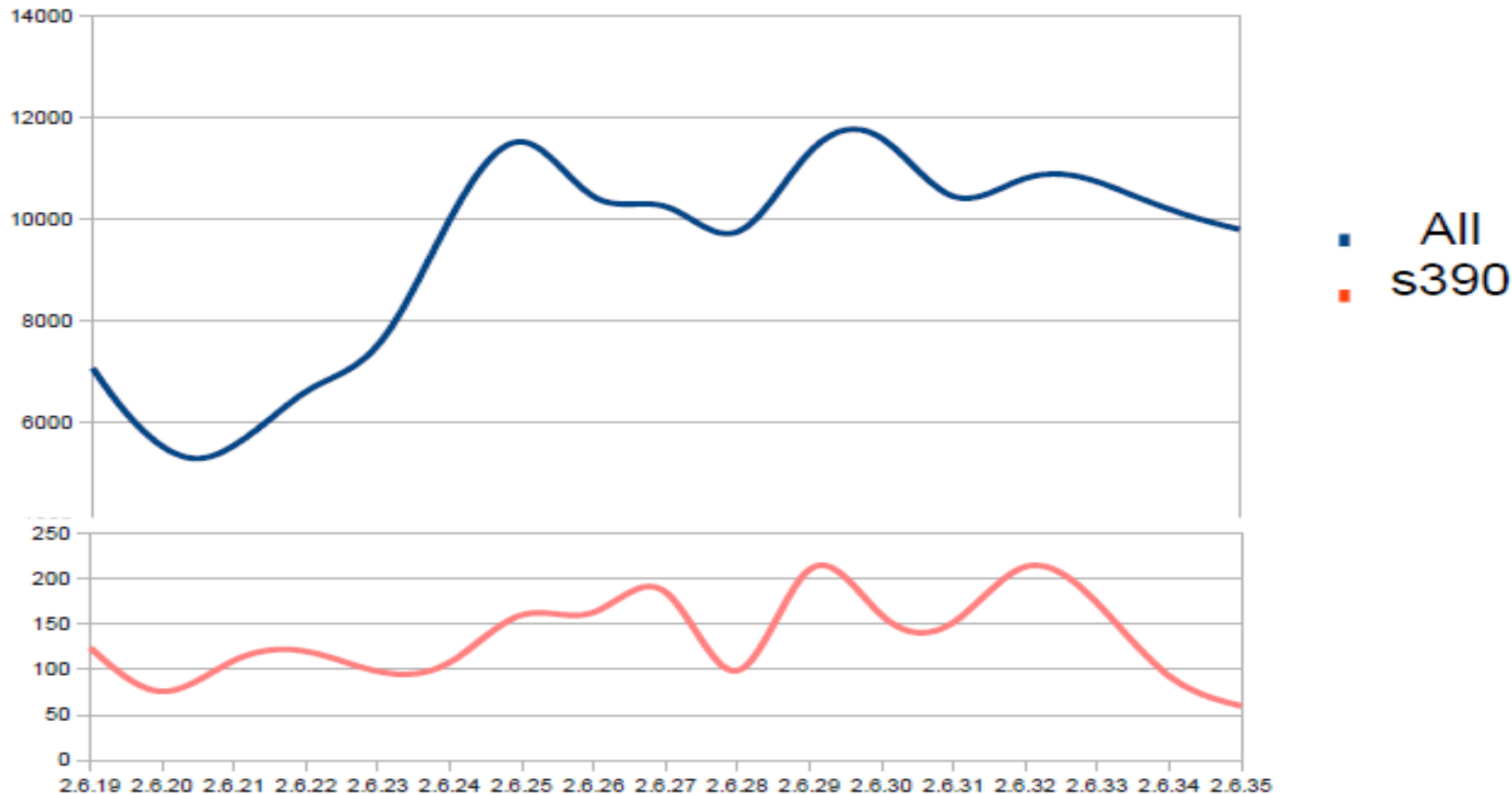

Developer Works Website

Upstream Kernel

open source TM
Community

redhat

Novell.

Customer
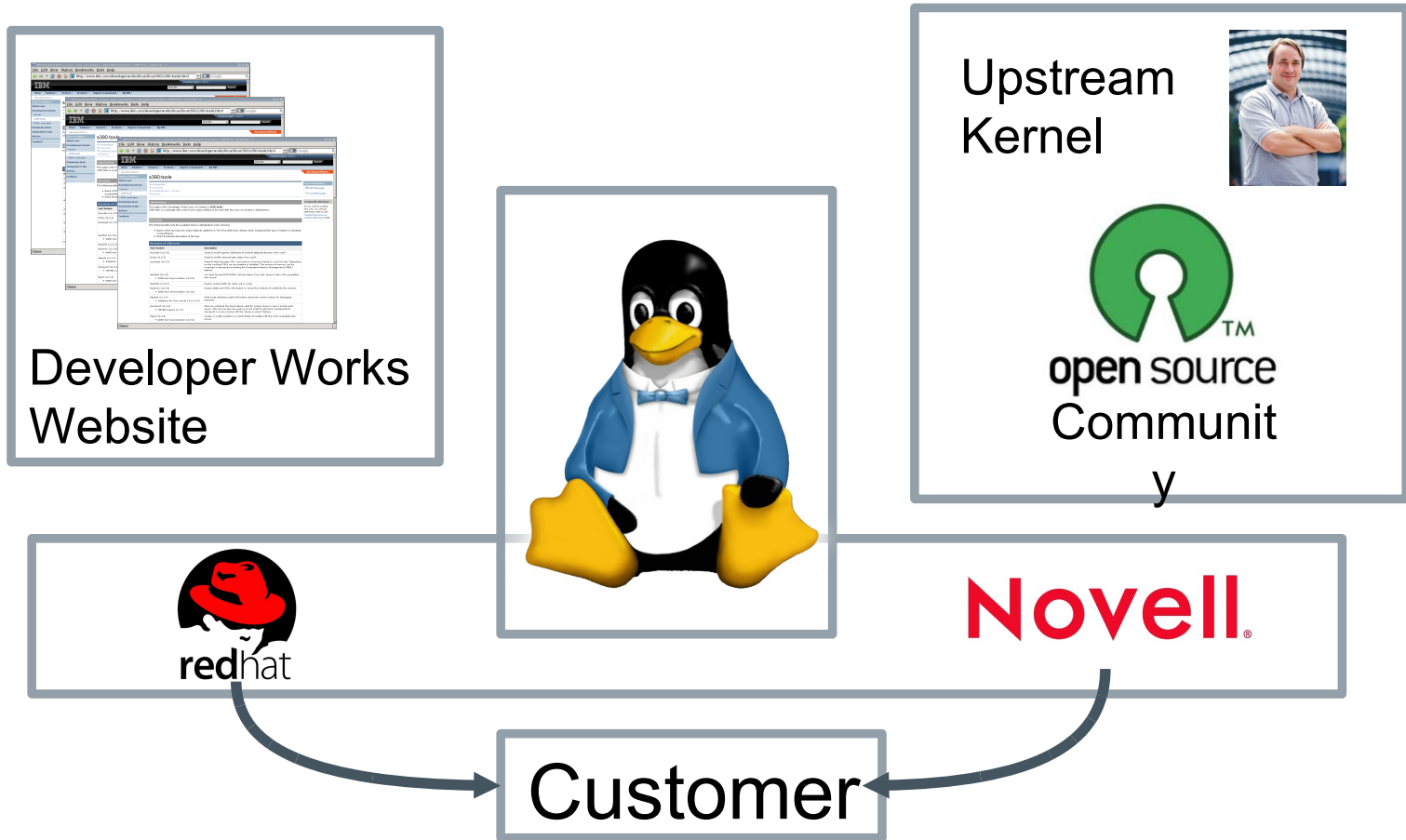
....the code you use is the result of the efforts of an anonymous army of blue penguins involved in developing, testing, documenting, ...

IBM
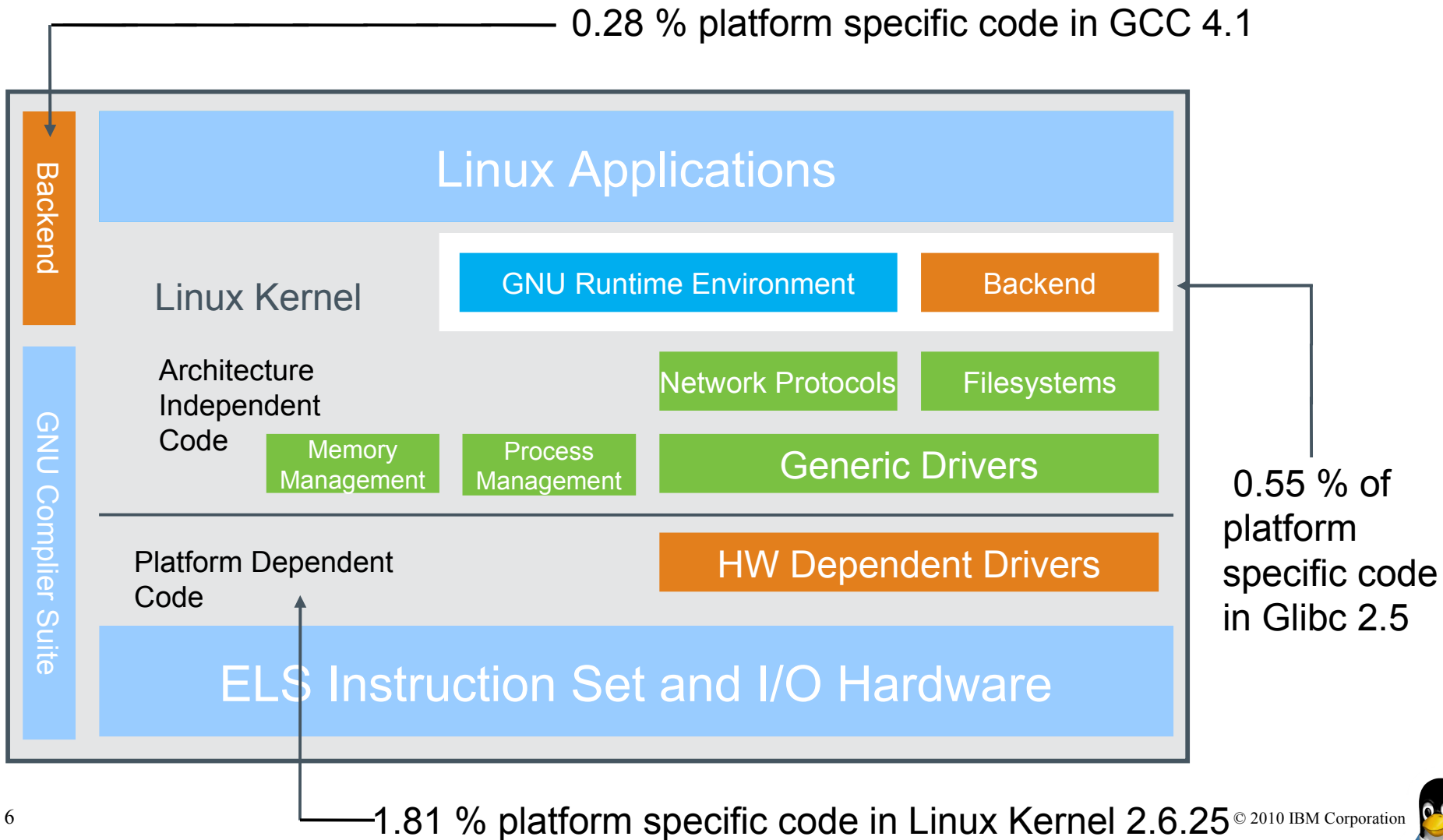
Linux kernel development: System z contributions

Changesets per release

Average: 6,422 lines added, 3,285 lines removed, and 1,687 lines changed every day for the past 4 1/2 years.

Structure of Linux on System z

Many Linux software packages did not require any code change to run on Linux on System z

0.28 % platform specific code in GCC 4.1

Backend

Linux Applications

GNU Compiler Suite

Linux Kernel

GNU Runtime Environment | Backend

Architecture Independent Code

Network Protocols | Filesystems

Memory Management | Process Management | Generic Drivers

0.55 % of platform specific code in Glibc 2.5

Platform Dependent Code

HW Dependent Drivers

ELS Instruction Set and I/O Hardware

1.81 % platform specific code in Linux Kernel 2.6.25

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Kernel news – Common code

Linux version 2.6.32 (2009-08-03)

- Per-backing-device based writeback (pdflush replaced by flush <major>)
- Kernel Samepage Merging (memory Deduplication)
- CFQ I/O scheduler low latency mode
- S+core architecture support

Linux version 2.6.33 (2010-02-24)

- DRDB
- Swappable KSM pages
- Compcache: memory compressed swapping

Linux version 2.6.34 (2010-05-16)

- Ceph distributed network file system
- LogFS flash memory file system
- Asynchronous suspend / resume
- 'Perf' performance analysis improvements, cross architecture support

Linux version 2.6.35 (2010-08-01)

- BKL removal work (incomplete)
- Intergration of AppArmor
- New out-of-memory killer
- Concurrency managed workqueues

Linux version 2.6.36 (2010-10-21)

- CIFS local caching

Linux on System z Development Focus

Integration

Application Serving
- z/OS & z/VSE integration

Data Hub
- Database Consolidation

Virtualization

Virtualization & Virtualization Management
- Ease of Use
- Serviceability
- Hosting capacity

Security

Security
- Certifications
- Data security & privacy

RAS

Continuous Availability & Data Replication
- RAS
- Differentiation for mission critical workloads

Base Tasks

Customer Requirements
- Address customer observed deficiencies

Competitiveness
- Close competitive gaps
- Differentiation / innovation that matters

Hardware Support
- Exploitation of new System z HW
- Storage exploitation

Linux
- Maintainership & code currency

IBM Supported Linux Distributions for System z

Distribution	zEnterprise 196	System z10	System z9	zSeries
RHEL 5	✔	✔	✔	✔
RHEL 4 [1]	—	✔	✔	✔
RHEL 3 [1]	—	—	*	✔
SLES 11	✔	✔	✔	✘
SLES 10	✔	✔	✔	✔
SLES 9 [1]	—	✔	✔	✔

(1) Also available as 31-bit distributions.

✔ 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.

✘ Indicates that the distribution is not supported by IBM.

— Indicates that the distribution has not been tested by IBM.

* Supported on customer request (RPQ).

Future Linux on System z Technology

Software which has already been developed and integrated into the Linux Kernel – but is **not** yet available in any Enterprise Linux Distribution

The IBM zEnterprise System -- A new dimension in computing
...is supported by Linux on System z

- The IBM zEnterprise 196 (z196) was announced 2010-07-22

- The following new features of the z196 are supported in the upstream kernel:

- Third subchannel set

- Up to 32 HiperSockets

- Support for the new OSA CHPID types OSX and OSM is accepted upstream for integration into kernel 2.6.35 -- appropriate s390-tools updates will be published shortly.

-

Get all the important Hardware details at:
http://www.ibm.com/common/ssi/rep_ca/0/897/ENUS110-170/ENUS110-170.PDF

Upcoming zEnterprise Linux features

- **System z196 toolchain support (binutils + gcc)**

  Add new instructions to the gnu assembler and disassembler. Teach the gnu compiler about the new pipeline structure

- **System z196 enhanced node affinity (> kernel 2.6.36)**

  Create appropriate scheduling groups for the 2-level CPU topology of System z196. The extended CPU topology information is provided by a new STSI sub-command.

- **Performance indicator bytes (> kernel 2.6.36)**

  The static power savings mode of System z196 allows to lower the energy consumption of the machine. This reduces the performance and is indicated via STSI.

- **Access-Exception-Fetch/Store-Indication (> kernel 2.6.36)**

  Provide indication if an access exception has been due to a fetch or a store operation. This is used to avoid protection faults if the first access to a mapped page has been a write.

Virtualization

- ## Extra kernel parameter for SCSI IPL (kernel 2.6.32)
  Modify the SCSI loader to append append extra parameters specified
  with the z/VM VMPARM option to the kernel command line.

- ## Deliver z/VM CP special messages as uevent (kernel 2.6.34)
  Allows to forward SMSG messages starting with "APP" to user space. udev rules can be used to trigger application specific actions

- ## Automatic detection of read-only devices (2.6.34)
  Improve usability by automatically detection of read-only dasd devices with diagnose 210

- ## CMSFS user space file system support (s390-tools 1.9.0 for the read-only cmsfs support)
  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

Note: this list comprises selected items only

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-T:  UN(16)                                          ?=help
system    #cpu    cpu    Cpu+    online memuse memmax wcur
(str)     (#)    (%)    (hm)    (dhm)   (GiB)  (GiB)   (#)
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
FTPSERVE    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-T: IFL(18) CP(3) UN(2)                    ?=help
cpuid   type    cpu   mgm visual
(#)     (str)   (%)   (%) (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
```

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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)
- 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/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

```
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
```

Networking

- **OSA QDIO Data Connection Isolation (kernel 2.6.33)**
  Isolate data traffic from Linux on System z guests sharing an OSA card
  Communication between guests needs to go over via external entity

- **HiperSockets Network Traffic Analyser (kernel 2.6.34)**
  Trace HiperSockets network traffic for problem isolation and resolution.
  Supported for layer 2 and layer 3

- **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

Note: this list comprises selected items only

Networking (cont)

- **NAPI support for QDIO and QETH (> kernel 2.6.35)**
  Convert QETH to the NAPI interface, the "new" Linux networking API
  NAPI allows for transparent GRO (generic receive offload)

- **QETH debugging per single card (> kernel 2.6.35)**
  Split some of the global QETH debug areas into separate per-device areas
  Simplifies debugging for complex multi-homed configurations

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

Note: this list comprises selected items only

znetconf network device configuration tool

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

```
root@larsson:~> 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

```
root@larsson:~> znetconf -a 0.0.f503
```

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

```
root@larsson:~> znetconf -a 0.0.f503 -o layer2=1 -o
portname=myport
```

- Remove network device 0.0.f503

```
root@larsson:~> znetconf -r 0.0.f503
```

New Linux on System z Storage Features

- **FCP adjustable queue depth (kernel 2.6.31)**
  Customizable queue depth for SCSI commands in zfcp

- **Resume reordered devices (kernel 2.6.34)**
  Allow resume of a guest with different subchannels for individual
  devices. Allow suspend of a system with devices in the disconnected state

- **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

- **Store I/O status and initiate logging (SIOSL) (> kernel 2.6.35)**
  Enhance debug capability for FCP attached devices
  Enables operating system to detect unusual conditions on a device of channel path

Note: this list comprises selected items only

New Linux on System z Storage Features (cont)

- **Automatic LUN scanning (> kernel 2.6.35)**
  Scan and attach accessible LUNs automatically
  Available only for a NPIV FCP attachment

- **Automatic menu support in zipl (> s390-tools 1.9.0)**
  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 1.9.0)**
  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

Note: this list comprises selected items only

Usability / RAS

- **Dump on panic – prevent reipl loop (s390-tools 1.8.4)**
  Delay arming of automatic reipl after dump
  Avoids dump loops where the restarted system crashes immediately

- **Add support for makedumpfile tool (kernel 2.6.34, s390-tools 1.9.0)**
  Convert Linux dumps to the ELF file format
  Use the makedumpfile tool to remove user data from the dump
  Multi-volume tape dump will be removed

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

- **Precise process accounting (> kernel 2.6.36)**
  Extend the taskstats interface to provide better process accounting values
  Quality goal is a resolution of 10ths of microseconds

System z toolchain

- ## 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 hardware customer mode sampling
  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
  Valgrind is in essence a virtual machine using just-in-time (JIT) compilation techniques
  Valgrind can be used for memory debugging, memory leak detection, and profiling (e.g. cachegrind)

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
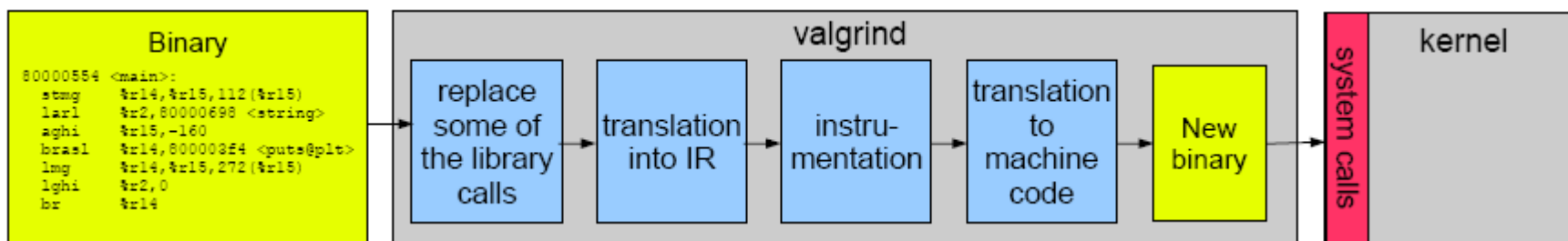
- **valgrind –tool=cachegrind**
  Profile cache usage, simulates instruction and data cache of the cpu
  Identifies the number of cache misses

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

System z kernel features - Misc

- **Kernel image compression (kernel 2.6.34)**

  The kernel image size can be reduced by using one of three compression algorithms: gzip, bzip2 or lzma.

- **KULI (2009-06-24)**

  kuli is experimental userspace sample to demonstrate that KVM can be used to run virtual machines on Linux on System z.

  This experimental proof of concept is unsupported and should not be used for any production purposes.

- **Oprofile**

  Starting with version 0.9.4, oprofile suppors sampling of Java byte code applications for Linux on System z.

- **Eclipse 3.3**

  Starting with Eclipse 3.3, Linux on System z is officially supported.

Current Linux on System z Technology

Features & Functionality contained in the Novell
& Red Hat Distributions

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 3 (GA 09/2009)
- 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 8 (GA 05/2009)
- Red Hat Enterprise Linux AS 5 (GA 03/2007)
    - Kernel 2.6.18, GCC 4.1.0, Update 5 (GA 03/2010)
- Others
    - Debian, Slackware, Fedora
    - Support may be available by some third party

Red Hat Enterprise Linux 6 Beta 2 has been published as a public download as of July 21, 2010 at http://www.redhat.com/rhel/beta/ using Kernel 2.6.32 GCC 4.4.3

Integration

- **AF_IUCV SOCK_SEQPACKET support**
  Introduce AF_IUCV sockets of type SOCK_SEQPACKET that map read/write
  operations to a single IUCV operation.
  The socket data is not fragmented.
  The intention is to help application developers who write applications
  using the native IUCV interface, e.g. Linux to z/VSE.

  10.3 & 11
  5.5

- **HiperSockets Layer3 support for Ipv6**
  Providing Layer3 IPv6 communication, for communication to z/OS

  10.3 & 11
  5.4

- **Linux to add Call Home data if running in LPAR**
  Also referred to as Control Program Identification (CPI) or SCLP_CPI
  Allows the user to set information about the LPAR which will be displayed on
  the HMC/SE

  10.3 & 11
  5.4

Note: this list comprises selected items only

Virtualization

- **TTY terminal server over IUCV**

  Provide central access to the Linux console for the different guests of a z/VM.
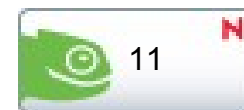
  Fullscreen applications like *vi* are usable on the console.

  Access Linux instances with no external network because IUCV is independent from TCP/IP

  10.3 & 11

  5.4

- **Dynamic memory attach/detach**

  11

  Allows to attach/detach memory for Linux as a guest without needing to reipl.
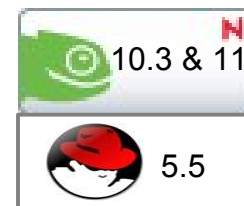
- **Extra kernel parameter via VMPARM**

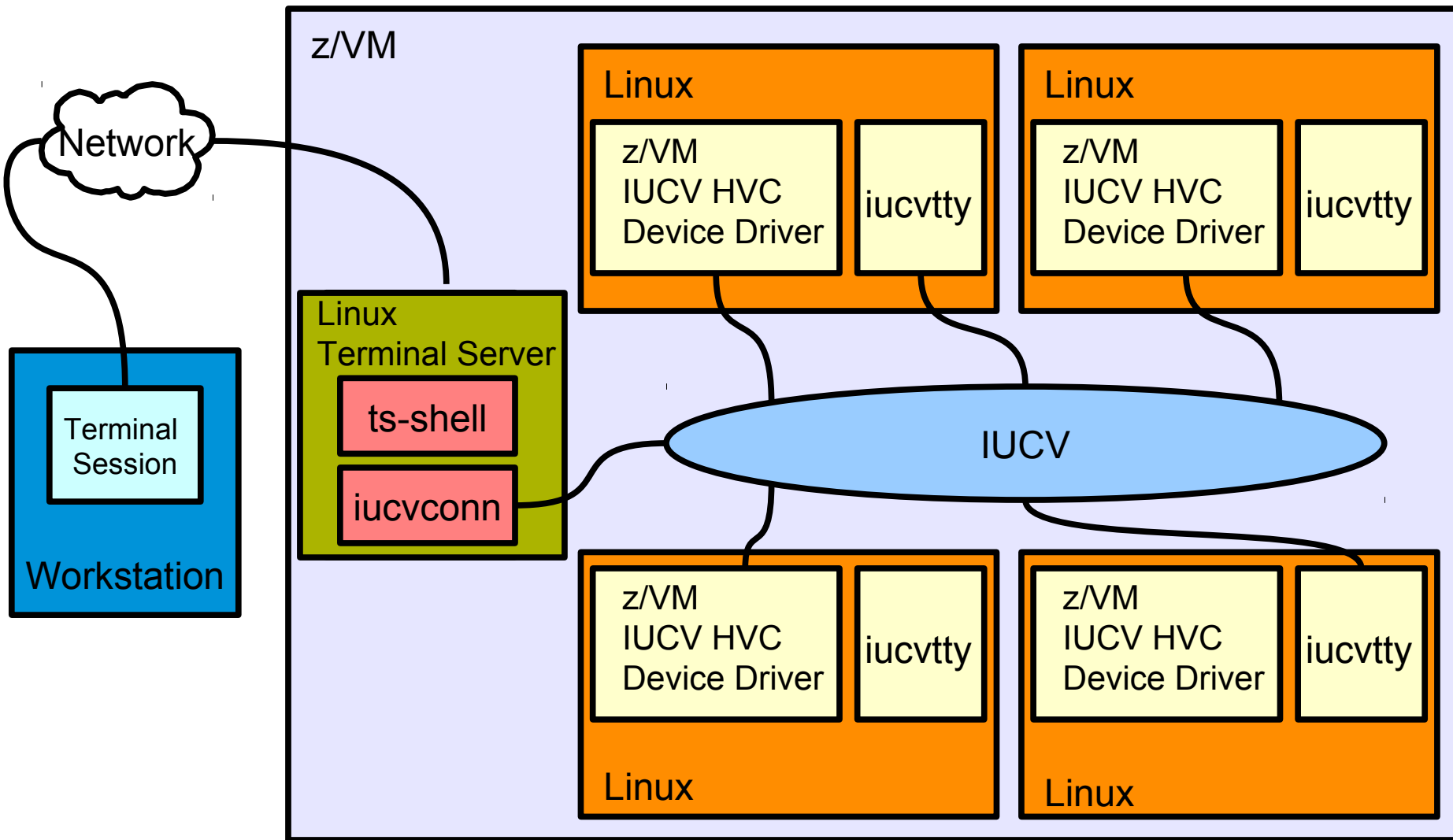 Allows to use z/VM VMPARM variable to add or substitute the kernel command line.

  10.3 & 11

  5.4

- **Provide CMS script for initial IPL**

  Avoids having to create an script to start a new installation under z/VM.

  10.3 & 11

  5.5

Note: this list comprises selected items only

# IUCV terminal environment

Virtualization (cont.)

- ## Exploitation of DCSSs above 2G
  Solves restriction to use DCSS above or greater than 2GB.

- ## Provide service levels of HW & Hypervisor in Linux
  Improves serviceability by providing uCode and z/VM levels via /proc interface

```
root@larsson:~> cat /proc/service_levels
VM: z/VM Version 5 Release 2.0
service level 0801(64-bit)
qeth: 0.0.f5f0 firmware level 087d
```

Note: this list comprises selected items only © 2010 IBM Corporation
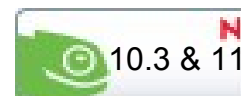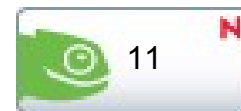
Security

- **Long Random Numbers Generation**
  Provide access to the random number generator feature on the Crypto card (high volume random number generation, compared to a CPU based solution)

   10.3 & 11
   5.3

- **Crypto Express3 cards enablement**
  Support for Crypto Express3 Accelerator (CEX3A) and Crypto Express3 Coprocessor (CEX3C)

   10.3 & 11

- **Crypto device driver use of thin interrupts**
  Provides better performance and lower CPU consumption.

   10.3 & 11
   5.4

Note: this list comprises selected items only

RAS

- **Shutdown Actions Interface**
  The shutdown actions interface allows the specification of a certain shutdown action (stop, ipl, reipl, dump, vmcmd) for each shutdown trigger (halt, power off, reboot, panic)
  Possible use cases are e.g. to specify that a vmdump should be automatically triggered in case of a kernel panic or the z/VM logoff command should be executed on halt.

  10.3 & 11

  5.4

- **Automatic IPL after dump**
  The new shutdown action dump_reipl introduces a system configurations which allows to create a dump in case of a Linux panic, followed by a re-ipl of the system, once the dump was successfully created.
  Allows to configure system to re-ipl after a dump is taken.

  10.3 & 11

  5.4

Note: this list comprises selected items only

RAS

- **Suspend / resume support (kernel 2.6.31)**

  Add the ability to stop a running Linux system and resume operations later on. The image is stored on the swap device and does not use any system resource while suspended.

  Only suspend to disk is implemented, <u>suspend to RAM is not supported</u>.

- **Add Call Home data on halt and panic if running in LPAR (kernel 2.6.32)**

  Report system failures (kernel panic) via the service element to the IBM service organization. Improves service for customers with a corresponding service contract. (by default this features is deactivated)

- **Large image dump on DASD**

  Solves restriction to dump only 48GB of memory to DASD. Now up to 32 ECKD DASDs can be used in a multiple volume configuration

Note: this list comprises selected items only

Suspend / resume support

- Ability to stop a running Linux on System z instance and later continue operations
- Memory image is stored on the swap device specified with a kernel parameter: **resume=/dev/dasd<x>**
- Lower the swap device priority for the resume partition

```
root@larsson:~> grep swap /etc/fstab
/dev/dasdb1 swap swap pri=-1 0 0
/dev/dasdc1 swap swap pri=-2 0 0
```

- Suspend operation is started with a simple echo:

```
root@larsson:~> echo disk > /sys/power/state
```

- Resume is done automatically on next IPL
- Use signal quiesce to automatically suspend a guest

```
ca::ctrlaltdel:/bin/sh -c "/bin/echo disk > \
/sys/power/state || /sbin/shutdown -t3 -h now"
```

Storage

- **FICON DS8000 Large Volume (EAV) Support**
  Large Volume Support is a feature that allows to use ECKD devices
  with more than 65520 cylinders (>50GB).
  This features is available with DS8000 R4.0 Allows to exploit

- **DS8000 Disk Encryption Support**
  Shows the encryption status of the DS8000 Storage.

- **EMC Symmetrix DASD Format Record 0**
  Allows to initialized unformatted disks on EMC storage arrays

- **FCP LUN discovery tool**
  New LUN discovery tool: lsluns (e.g. used by yast)

- **FCP performance data collection & reports:**
  Fibre Channel Protocol (FCP) performance data can now be measured.

10.3 & 11

5.4

Note: this list comprises selected items only

Red Hat Enterprise Linux 5 Update 5

- ## GA since 03/30/2010
  - Kernel GA: 2.6.18-194

- ## New Features:

  - ***FICON DS8000 Large Volume (EAV) Support:*** Allows to exploit DS8000 Storage feature to use DASD volumes >50GB.

  - ***AF_IUCV SOCK_SEQPACKET support:*** Enhances existing AF_IUCV to allow customer to develop using SOCK_SEQPACKET.

  - ***Provide CMS script for initial IPL:*** Avoids having to create an script to start a new installation under z/VM.

  - ***Installer re-IPL support:*** Solves past restriction and allows the installer to direct reboot in the installed system right after installation

- ## Bugfixes

SuSE Linux Enterprise Server 11 SP1

- ## GA since June 2, 2010
    - Kernel GA:kernel 2.6.32

- ## New Features:
    - **ALL Linux on System z upstream kernel features since 2.6.27**
    - **Suspend / Resume support:** stop a running instance and later continue operations. A suspended Linux instance does not require memory or processor cycles. gives you better performance, resource utilization, and power savings
    - **Automatic IPL after dump:** extension to the shutdown action interface which combines the actions dump and re-ipl, helps increase availabity and minimize downtime, as well as keepmanagement and service costs low
    - **DS8000 support - Large volume support architecture:** use one large volume, instead of multiple small volumes, for your large amount of data. You no longer need to combine and manage various small disks anymore.
    - **Support of HPF:** increases performance for database serving
    - **Next generation crypto HW device driver exploitation:** new System z crypto hardware features and performance improvements are exploited by SUSE Linux Enterprise Server for System z. Hardware-driven crypto acceleration functions help reduce operations and maintenance costs.

SuSE Linux Enterprise Server 11 SP1 (cont)

New Features:

– **AF_IUCV SOCK_SEQPACKET support:** improves close collaboration between SUSE Linux Enterprise Server for System z and z/VM in the networking area. This provides better performance for intra machine / VM communication.

– **TTY terminal server over IUCV:** provides central access to the Linux console for the different guests of a z/VM. Fullscreen applications like vi are usable on the console.

– **System z kernel message documentation:** Cleanup messages in System z related code, script to generate a man page for every kernel message

– **FCP adjustable queue depth:** Customizable queue depth for SCSI commands in zfcp. In the past was at constant 32 queue entries. Improves performance

- **Bugfixes**
- **More Information:**
  http://www.ibm.com/developerworks/linux/linux390/documentation_novell_suse.html

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✦ Introduction
✦ Linux on System z documentation for 'Development stream'
✦ General Linux on System z documentation
✦ Documentation for IBM System z

Linux on System z

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

Linux on System z

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

Development stream (Kernel 2.6.33)

Linux on System z

Using the Dump Tools

Development stream (Kernel 2.6.33)

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

Kernel Messages

Development stream (Kernel 2.6.33)

Linux on System z

Device Drivers, Features, and Commands

Development stream (Kernel 2.6.33)

SC34-2594-01

SC33-8413-04

New: Distribution specific Documentation

Questions?

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Linux on System z Initiatives

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Your Linux on System z Requirements?

Are you missing a certain feature, functionality or tool? **We'd love to hear from you!**
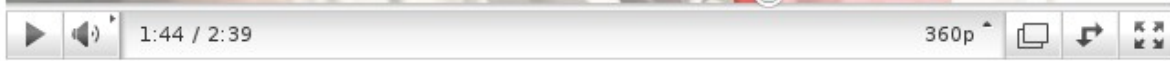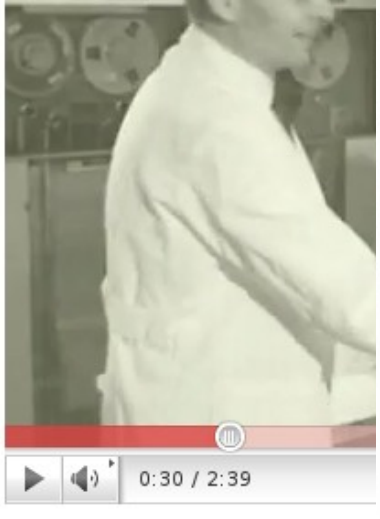
We will evaluate each request and (hopefully) develop the additional functionality you need.

Send your input to hans@de.ibm.com

How to explain the benefits of running Linux on System z in 2:39?
http://www.youtube.com/watch?v=0i7kBnhN3Lg

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