What's New
for Linux on System z

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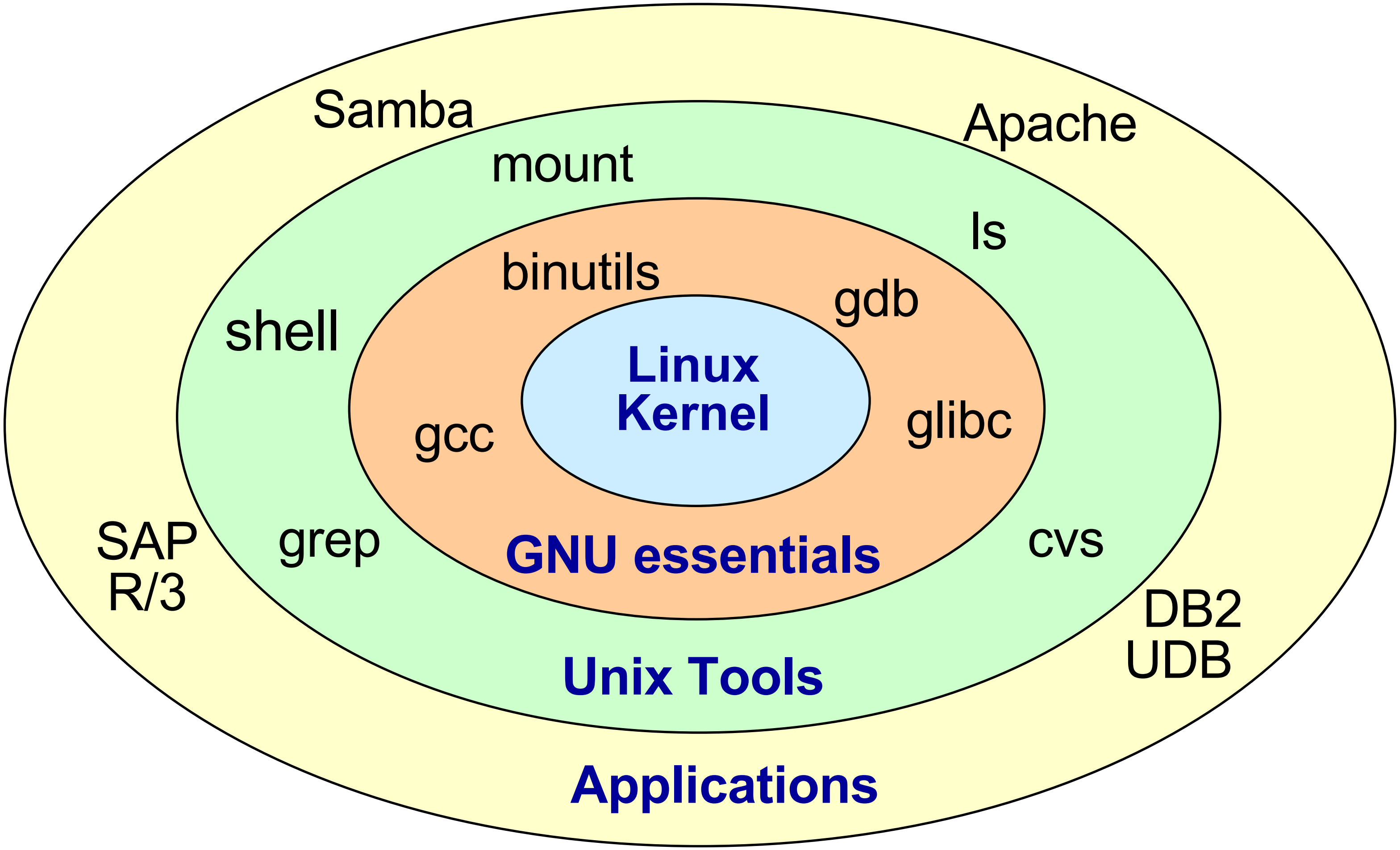
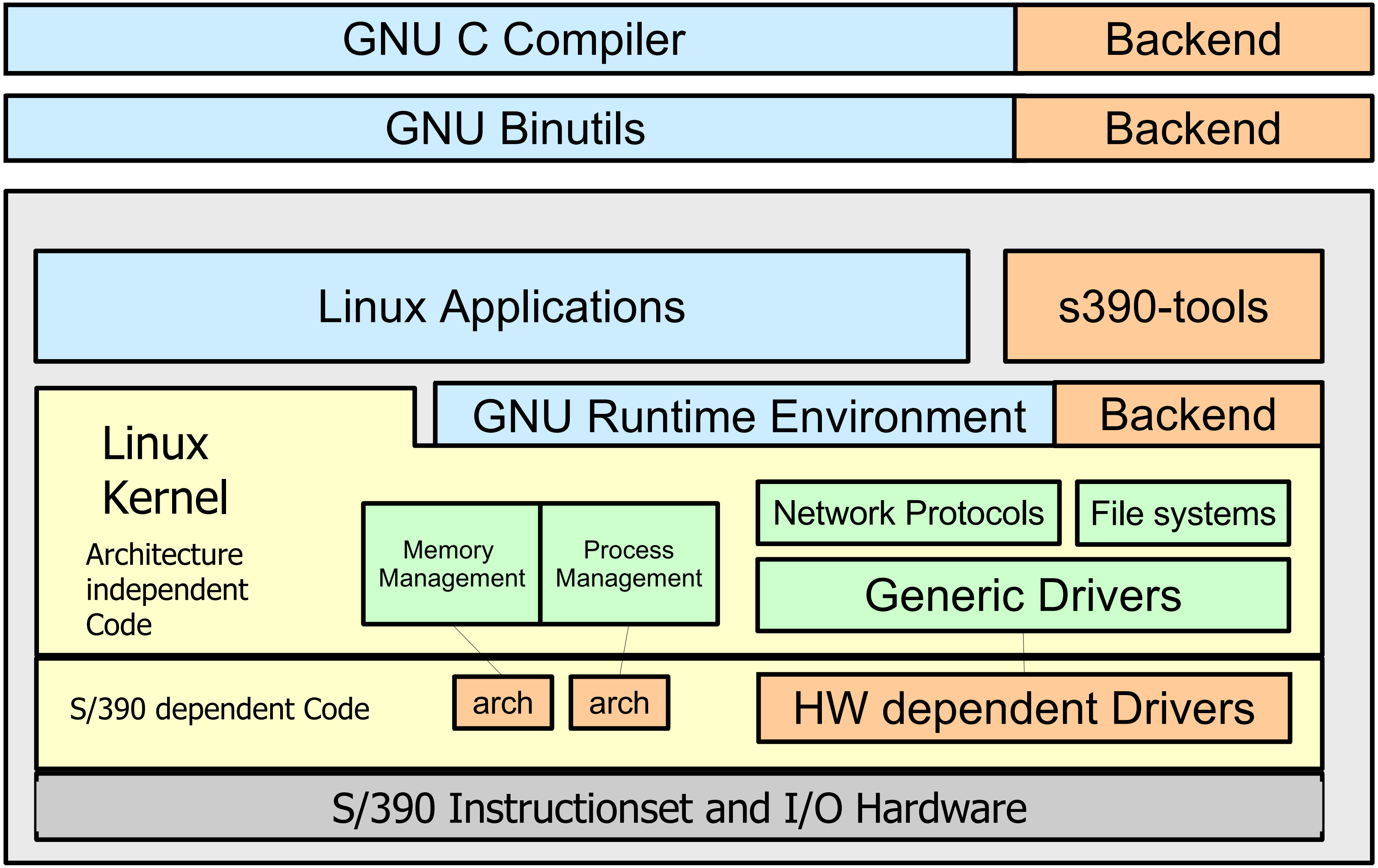
Agenda

- Linux on System z Overview
- Compiler News
- Linux Kernel News
- Linux on System z News

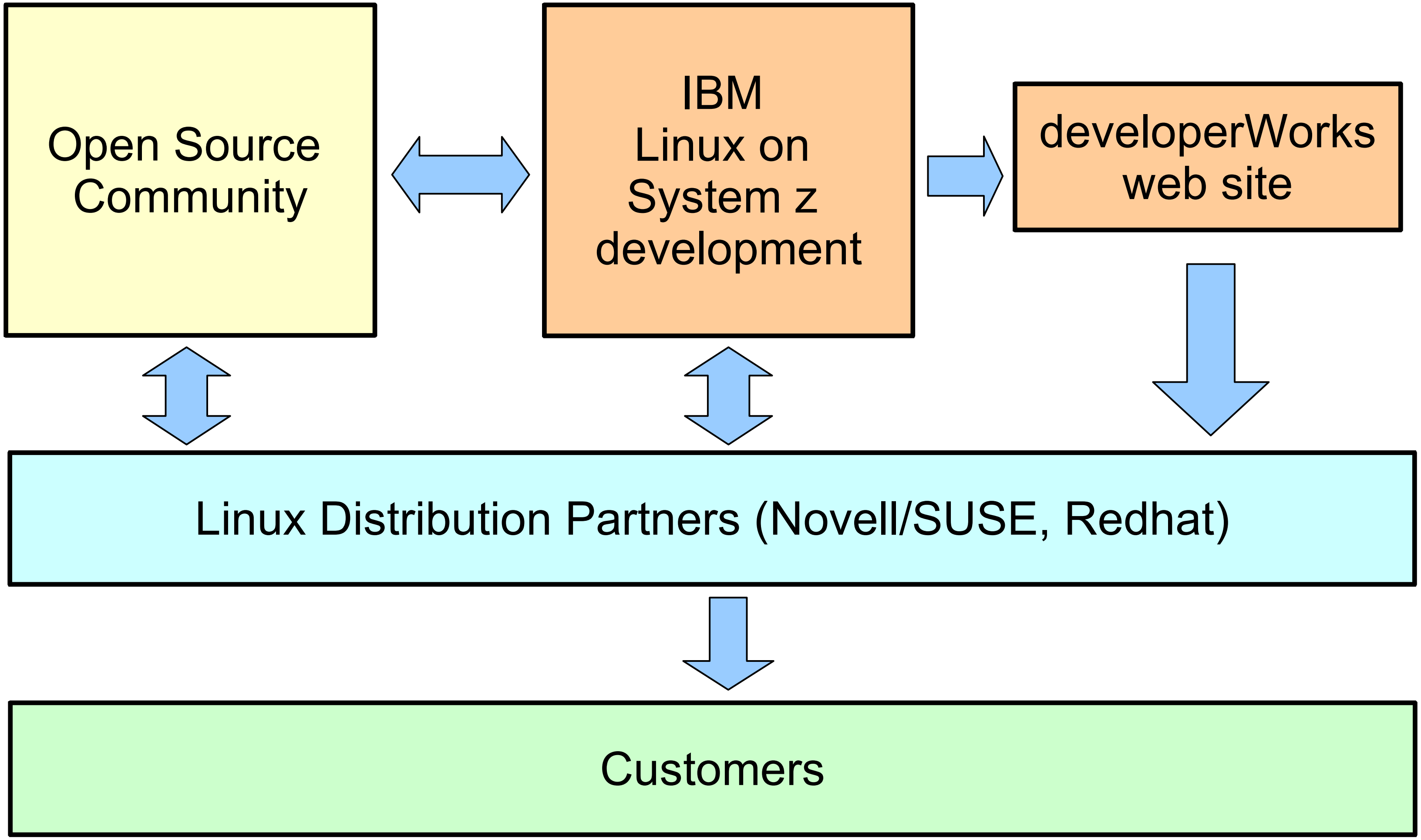
Linux system components



Linux on System z system structure



Linux on System z development process



Open Source Community

IBM Linux on System z development

developerWorks web site

Linux Distribution Partners (Novell/SUSE, Redhat)

Customers

Linux on System z distributions (Kernel 2.6 based)

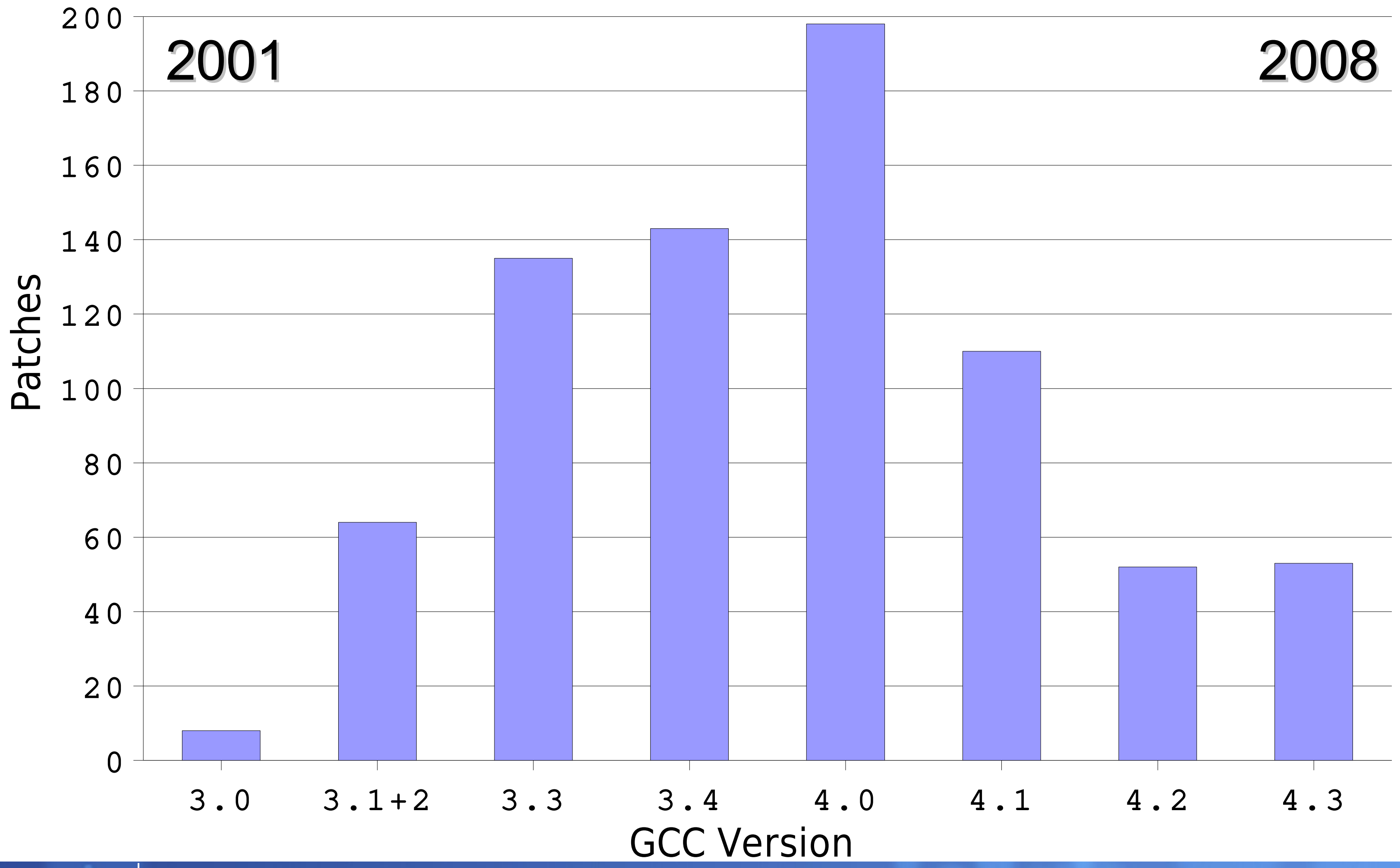
- **SUSE Linux Enterprise Server 9 (GA 08/2004)**
  - Kernel 2.6.5, GCC 3.3.3
  - Service Pack 4 (GA 12/2007)
- **SUSE Linux Enterprise Server 10 (GA 07/2006)**
  - Kernel 2.6.16, GCC 4.1.0
  - Service Pack 1 (GA 06/2007)
- **Red Hat Enterprise Linux AS 4 (GA 02/2005)**
  - Kernel 2.6.9, GCC 3.4.3
  - Update 6 (GA 11/2007)
- **Red Hat Enterprise Linux AS 5 (GA 03/2007)**
  - Kernel 2.6.18, GCC 4.1.0
  - Update 1 (GA 11/2007)
- **Others**
  - Debian, Slackware, ...
  - Support may be available by some third party

Compiler

Open Source development process GCC

- **Centralized development model**
  - Master repository hosted by the Free Software Foundation
    - Read access to the general public, write access to maintainers
    - All copyright owned by / transferred to the FSF
  - Global maintainers (ca. 12), Subsystem maintainers (ca. 130)
- **Release process**
  - New major release every 8-12 months
  - “Dot releases” every 2 months containing regression fixes only
- **System z integration**
  - Back-end maintainers from Böblingen:
    Ulrich Weigand, Hartmut Penner, Andreas Krebbel

GNU Compiler Collection - System z contributions



Compiler News – System z machine support

- **System z10 processor support (> GCC 4.3)**
  - Exploit instruction new to z10
  - Selected via `-march=z10` / `-mtune=z10`
- **System z9 109 processor support (GCC 4.1)**
  - Exploit instructions provided by the *extended immediate facility*
  - Selected via `-march=z9-109` / `-mtune=z9-109`
- **Support for 128-bit IEEE "long double" data type (GCC 4.1)**
  - Provide extended range of floating point exponent and mantissa
  - Selected via `-mlong-double-128`
- **Decimal floating point support (GCC 4.3)**
  - For newer machines with hardware DFP support
  - Selected via `-march=z9-ec, -mhard-dfp/-mnohard-dfp`
  - Software support for older machines without hardware DFP support

Compiler News - System z features

- **Kernel stack overflow avoidance/detection (GCC 4.0)**
  - Compile / Run-time time detection
  - Stack frame size reduction

- **GCC support for the z/TPF OS (GCC 4.0/4.1)**
  - z/TPF uses Linux / GCC as cross-build environment

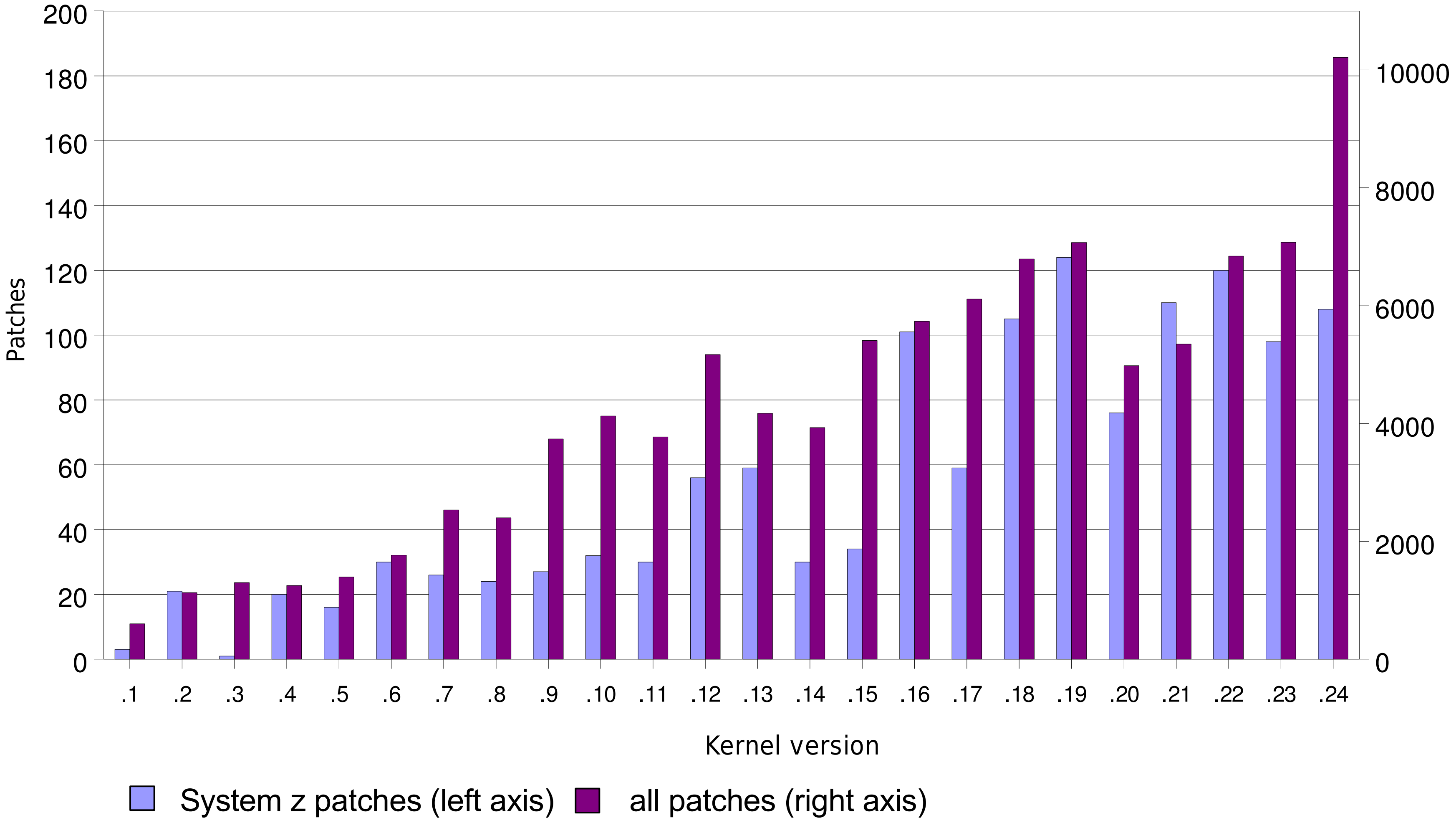
- **Performance enhancements on z9 (compiled code)**
  - Industry-standard integer performance benchmark
  - 8% comparing GCC 3.4 and GCC 4.1
  - 5.9% comparing GCC 4.1 and GCC 4.2
  - 0.5% comparing GCC 4.2 and GCC 4.3

Kernel

Open Source development process - Linux Kernel

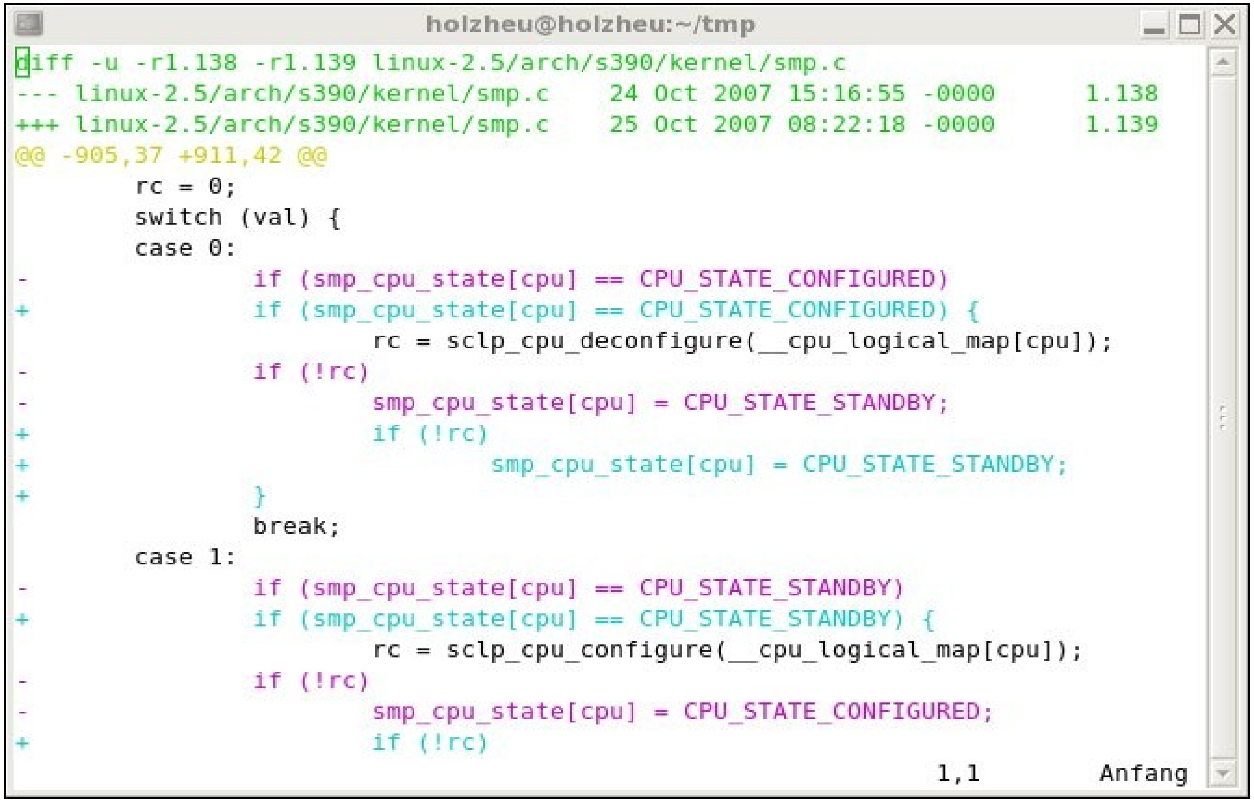
- **Distributed development model**
  - Source code control tool: git
  - 'Master' repository maintained by Linus Torvalds
  - 'Experimental' repository maintained by Andrew Morton
  - Flow of code tracked via “Signed-Off” and “Acked-By” statements
- **Release process**
  - New 2.6.x version released every 2-3 months by Linus
  - First two weeks to merge new features, leading to first -rc
  - Sequence of multiple release candidates to stabilize
- **System z integration**
  - Platform subsystem maintainer in Böblingen:
    - Martin Schwidefsky, Heiko Carstens
  - Repository for System z features hosted on non-IBM site
    - Staging area for IBM and third-party System z patches

Linux kernel – System z contributions



Kernel Patches (Development from 2.6.23 to 2.6.24)

- Patch Size: 1.697.585 lines
- Change Log: 154.444 lines



holzheu@holzheu:~/tmp

```
diff -u -r1.138 -r1.139 linux-2.5/arch/s390/kernel/smp.c
--- linux-2.5/arch/s390/kernel/smp.c    24 Oct 2007 15:16:55 -0000      1.138
+++ linux-2.5/arch/s390/kernel/smp.c    25 Oct 2007 08:22:18 -0000      1.139
@@ -905,37 +911,42 @@
        rc = 0;
        switch (val) {
        case 0:
-               if (smp_cpu_state[cpu] == CPU_STATE_CONFIGURED)
+               if (smp_cpu_state[cpu] == CPU_STATE_CONFIGURED) {
                        rc = sclp_cpu_deconfigure(__cpu_logical_map[cpu]);
-               if (!rc)
-                       smp_cpu_state[cpu] = CPU_STATE_STANDBY;
+                       if (!rc)
+                               smp_cpu_state[cpu] = CPU_STATE_STANDBY;
+               }
                break;
        case 1:
-               if (smp_cpu_state[cpu] == CPU_STATE_STANDBY)
+               if (smp_cpu_state[cpu] == CPU_STATE_STANDBY) {
                        rc = sclp_cpu_configure(__cpu_logical_map[cpu]);
-               if (!rc)
-                       smp_cpu_state[cpu] = CPU_STATE_CONFIGURED;
+                       if (!rc)
                                                              1,1        Anfang
```

How to get new features into distributions

- **Upstream feature (ideal case)**
  - Develop feature against mainline kernel, accepted in kernel version 2.6.x
  - Distribution release based on 2.6.x or later will usually include feature
- **Backport of upstream feature (usually acceptable)**
  - Code already accepted in some kernel version 2.6.x
  - Develop back-port against previous kernel release, provide on developerWorks and/or to distributor
  - Distribution release/update based on earlier kernel may add the feature as additional patch
- **Feature not upstream (difficult)**
  - Code provided only on developerWorks and/or to distributor, not yet accepted in any upstream kernel
  - Distributors are generally reluctant to add such features as additional patches due to maintenance concerns

Kernel news - Linux version 2.6.20 - 2.6.24

- **Virtualization:**
  - Kernel Virtual Machine (KVM)
  - Lguest and Xen
- **New Functions:**
  - New Filesystems: GFS2, Ext4, ecryptfs
  - Read-only bind mounts
- **Performance:**
  - High resolution timers
  - Better kernel memory allocator (SLUB)

Kernel news - Linux version 2.6.20 - 2.6.24

- **Performance (cont.):**
  - Completely Fair Scheduler (CFS)
  - On-demand read-ahead
  - Anti-memory-fragmentation
  - Per-device dirty memory thresholds
- **Measurement:**
  - Process footprint measurement facility
  - I/O Accounting for processes

Kernel directions

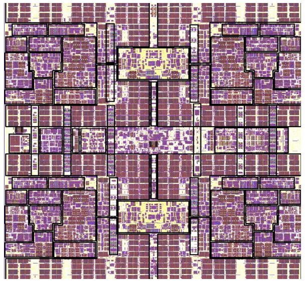
- **Diversity: now 24 architectures**
- **Bigger servers (Mainframes, large SGI machines, ...)**
- **Embedded systems, real-time (Cell-phones, PDAs)**
- **Appliances (network router, digital video recorder)**
- **Virtualization (KVM, XEN, etc.), stronger than ever**

- **Linux is Linux, but**
  - Features, properties and quality differ dependent on your platform

Kernel (System z)

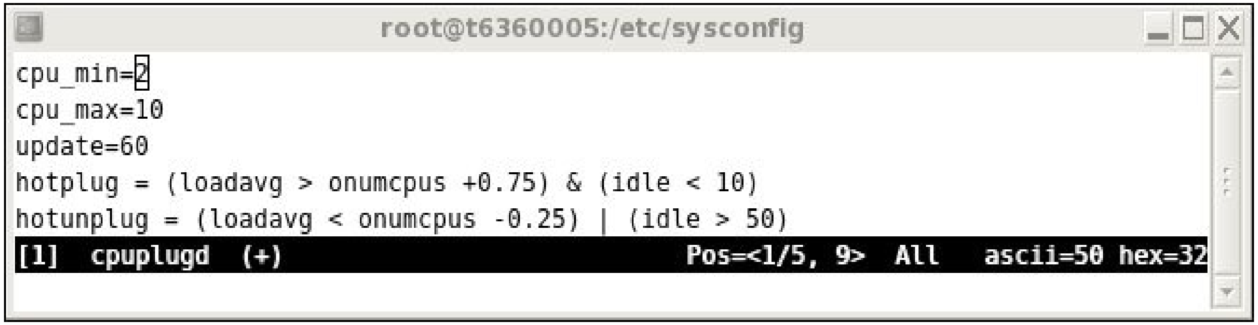
System z kernel features - CPU

- **CPU node affinity**
  - Exploits LPAR hardware interface to query cpu topology
  - Gives hints to Linux scheduler
  - /sys/devices/system/cpu/cpuX/topology/core_siblings
- **STSI changes for capacity provisioning**
  - Permanent and temporary capacity
  - /proc/sysinfo
- **Standby CPU activation / deactivation**
  - echo 0 > /sys/devices/system/cpu/cpuX/configure
  - echo 0 > /sys/devices/system/cpu/cpuX/online



System z kernel features - CPU

- **Dynamic CPU hotplug daemon**
  - Automatically configures guest/LPAR resources
    - Sets CPUs online and offline
    - Adjusts Linux memory footprint (z/VM - CMM1)
  - Rules defined in /etc/sysconfig/cpuplugd:



```
cpu_min=2
cpu_max=10
update=60
hotplug = (loadavg > onumcpus +0.75) & (idle < 10)
hotunplug = (loadavg < onumcpus -0.25) | (idle > 50)
[1]  cpuplugd  (+)                    Pos=<1/5, 9>  All   ascii=50 hex=32
```

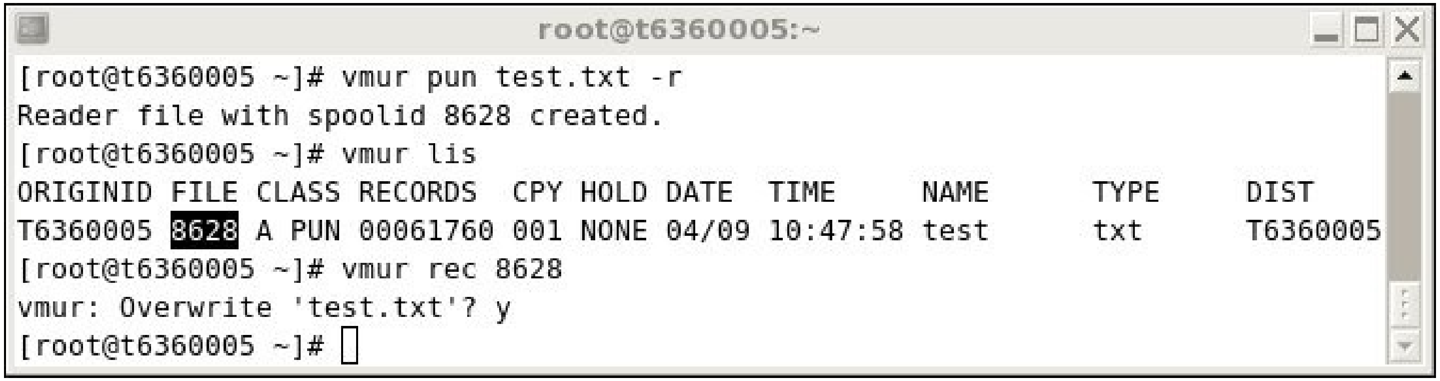
- **Support for processor degradation**
  - Kernel message + Userspace Events

System z kernel features - Crypto

- **New hardware support – System z10 processor**
  - New crypto instructions for:
    - AES 192/256
    - SHA 384/512
  - “Libica” userspace support → Faster ssh!
  - Kernel support → Faster IPSEC!
- **Generic algorithm fallback**
  - Use software implementation for key lengths not supported by hardware
- **Crypto driver**
  - Support for long random numbers
    - Character device driver: /dev/hwrng
  - Capability for dynamic crypto device add

System z kernel features - z/VM

- **Linux process data in monitor APPLDATA**
  - Write Linux process specific data to monitor stream
- **Unit record device support**
  - Vmur character device driver and vmur user space tool
  - Support for z/VM punch, printer and reader



```
[root@t6360005 ~]# vmur pun test.txt -r
Reader file with spoolid 8628 created.
[root@t6360005 ~]# vmur lis
ORIGINID FILE CLASS RECORDS  CPY HOLD DATE  TIME     NAME      TYPE     DIST
T6360005 8628 A PUN 00061760 001 NONE 04/09 10:47:58 test      txt      T6360005
[root@t6360005 ~]# vmur rec 8628
vmur: Overwrite 'test.txt'? y
[root@t6360005 ~]# 
```

- **IUCV access to z/VM services (user space netcat / nc6)**

System z kernel features – Networking / SCSI

- **QETH network driver**
  - HiperSockets MAC layer routing
  - QETH componentization
- **Support for skb scatter-gather**
  - Increases performance for inbound traffic
- **FCP performance**
  - FCP performance data collection - I/O statistics + adapter statistics
    - New sysfs attributes for throughput, latency etc.
  - 4G FICON Express support for FCP

System z kernel features - Usability and RAS

- **IPL**
  - IPL through IFCC / multipath IPL
  - Shutdown actions interface
- **System dump**
  - Cleanup SCSI dumper for upstream integration
- **DASD sense data reporting**
  - SIM/MIM handling for ECKD DASD
- **Dynamic CHPID reconfiguration via SCLP**
  - User space tools to modify and list chpids:
    - chchp
    - lschp

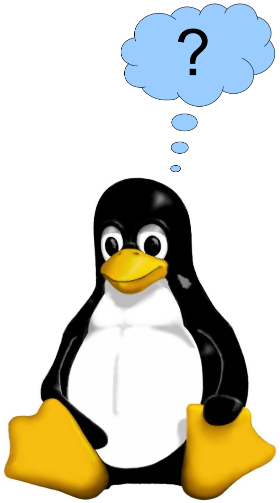
System z kernel features - Performance

- **Kernel Large Page Support**
  - System z10 hardware support (1MB pages instead of 4KB)
  - Benefits:
    - Reduce page table memory consumption (2KB per MB / process)
    - Speed up address translation
  - Software emulation for older machines
  - SysV shared memory (shmget / SHM_HUGETLB)
  - hugetlbfs filesystem (mmap)
  - Java option for using large pages (-Xlp)
- **DASD Hyper PAV (Parallel Access Volume)**
  - Base & Alias Devices
  - Start multiple channel programs on a single DASD in parallel
  - Alias devices are not assigned to specific base devices
  - User space multipath setup is now obsolete

Outlook

- **New hardware exploitation**
- **Enhanced Linux – z/VM synergy**
- **Basic support for KVM virtualization**
- **Keep current with open source**

Questions?



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