Using LXC and Btrfs with SUSE Linux Enterprise Server 11 SP2 on System z

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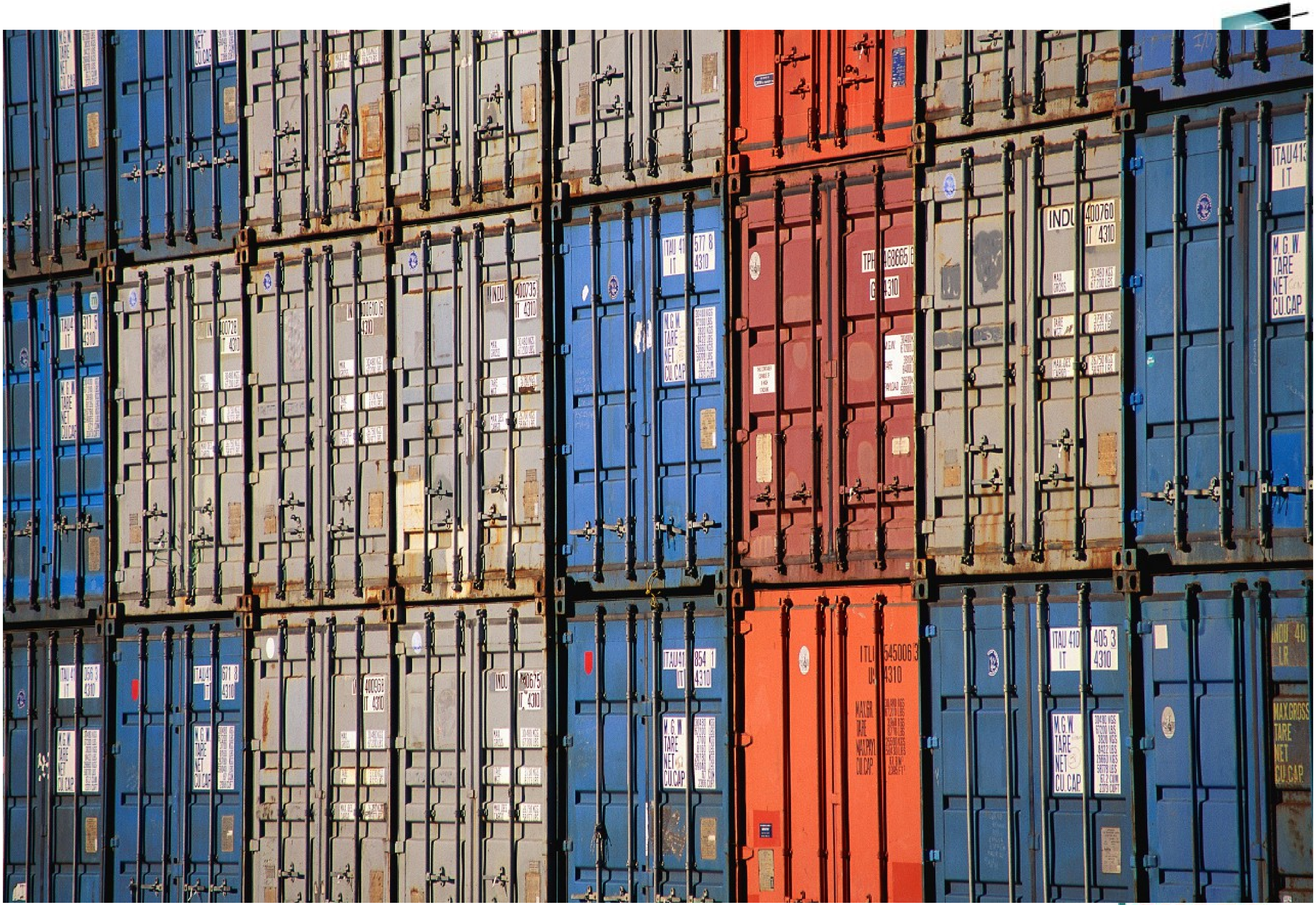
Session: 12876

Agenda

- Using Linux Containers (LXC)
  - What is LXC?
  - Demoing LXC on System z
- Why is Btrfs good for Linux on System z
  - Example how Btrfs is useful

Using Linux Containers (LXC)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What Are Control Groups?

Control Groups provide a mechanism for aggregating/partitioning sets of tasks, and all their future children, into hierarchical groups with specialized behavior.

- cgroup is another name for Control Groups
- Partition tasks (processes) into a one or many groups of tree hierarchies
- Associate a set of tasks in a group to a set subsystem parameters
- Subsystems provide the parameters that can be assigned
- Tasks are affected by the assigning parameters

Example of the Capabilities of a cgroup

Consider a large university server with various users - students, professors, system tasks etc. The resource planning for this server could be along the following lines:

CPUs

Top cpuset (20%)

/ \

CPUSet1 CPUSet2

| |

(Profs) (Students)

60% 20%

Memory

Professors = 50%

Students = 30%

System = 20%

Disk I/O

Professors = 50%

Students = 30%

System = 20%

Network I/O

WWW browsing = 20%

/ \

Prof (15%) Students (5%)

Network File System (60%)

Others (20%)

Source: /usr/src/linux/Documentation/cgroups/cgroups.txt

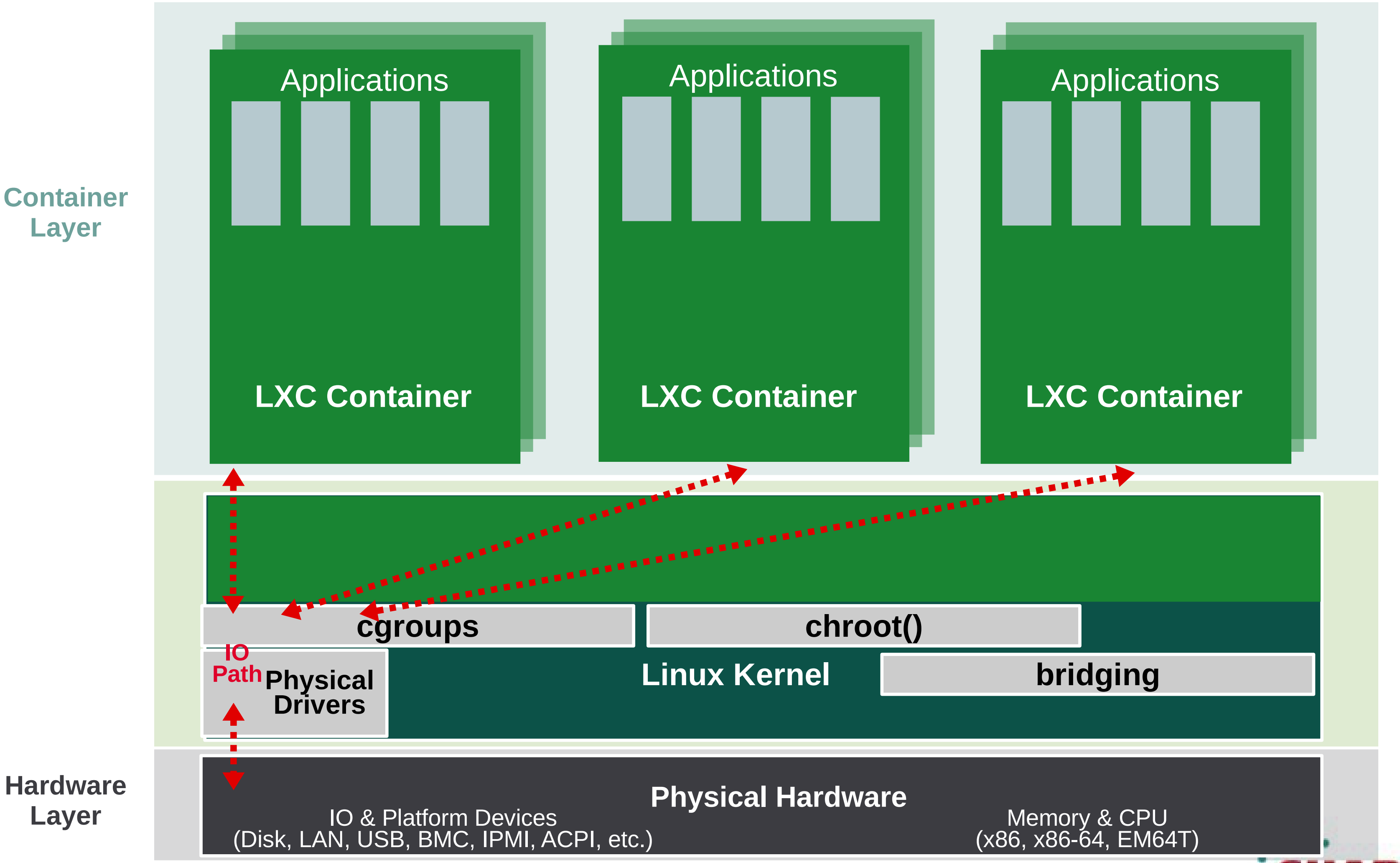
Control Group Subsystems

Two types of subsystems

- Isolation and special controls
  - cpuset, namespace, freezer, device, checkpoint/restart
- Resource control
  - cpu(scheduler), memory, disk i/o, network

Source: http://jp.linuxfoundation.org/jp_uploads/seminar20081119/CgroupMemcgMaster.pdf

Linux Containers



Linux Containers – Virtualization

- OS Level Virtualization – i.e. virtualization without a hypervisor (also known as “Lightweight virtualization”)
- Similar technologies include: Solaris Zones, BSD Jails, Virtuozzo or OpenVZ
- Advantages of OS Level Virtualization
  - Minor I/O overhead
  - Storage advantages
  - Dynamic changes to parameters without reboot
  - Combining virtualization technologies
- Disadvantages
  - Higher impact of a crash, especially in the kernel area
  - Unable run another OS that cannot use the host's kernel

Linux Containers – Feature Overview

- Supported in SUSE® Linux Enterprise Server 11 SP2:
  - Support for system containers
    - *A full SUSE Linux Enterprise Server 11 SP2 installation into a chroot directory structure*
  - Bridged networking required
  - Only SUSE Linux Enterprise Server11 SP2 supported in container
- Planned for SUSE Linux Enterprise Server 11 SP3 and future:
  - Filesystem copy-on-write (btrfs integration)
    - *Partial support in SLES11 SP2 LXC update*
  - Application containers support
    - *Just the application being started within the container*
  - Easy application containers creation and management
  - Research support for AppArmor and LXC

Linux Containers – Use Cases

- Hosting business
  - Give a user / developer (root) access without full (root) access to the “real” system.
- Datacenter use
  - Limit applications which have a tendency to grab all resources on a system:
    - *Memory (databases)*
    - *CPU cycles / scheduling (compute intensive applications)*
- Outsourcing business
  - Guarantee a specific amount of resources (SLAs!) to a set of applications for a specific customer without more heavy virtualization technologies

Demoing LXC on System z

Why is Btrfs good for Linux on System z

UNITED STATES OF AMERICA
IN GOD WE TRUST
E PLURIBUS UNUM
1 OZ. FINE GOLD~50 DOLLARS

DVD

Data is the customer's gold

Richard Jones, Gartner,

formerly Product Manager for

SUSE Linux Enterprise Server

Why Another Linux filesystem?

- Solve Storage Challenges
  - Scalability
  - Data Integrity
  - Dynamic Resources (expand and shrink)
  - Storage Management
  - Server, Cloud – Desktop, Mobile
- Compete with and exceed the filesystem capabilities of other Operating Systems

What People Say About Btrfs...

Chris Mason (lead developer Btrfs)

- General purpose filesystem that scales to very large storage
- Focused on features that no other Linux filesystems have
- Easy administration and fault tolerant operation

Ted Tso (lead developer Ext4)

- (Btrfs is) “... the way forward”

Others:

- “Next generation Linux filesystem”
- “Btrfs is the Linux answer to ZFS”

A Few Btrfs Concepts

- B-Tree
  - Index data structure
  - Fast search, insert, delete
- Subvolume
  - Filesystem inside the filesystem
  - Independent B-Tree linked to some directory of the root subvolume
- Metadata
  - “normal” metadata:
    size, Inode, atime, mtime, etc...
  - B-Tree structures
- Raw data
  - Actual content of files

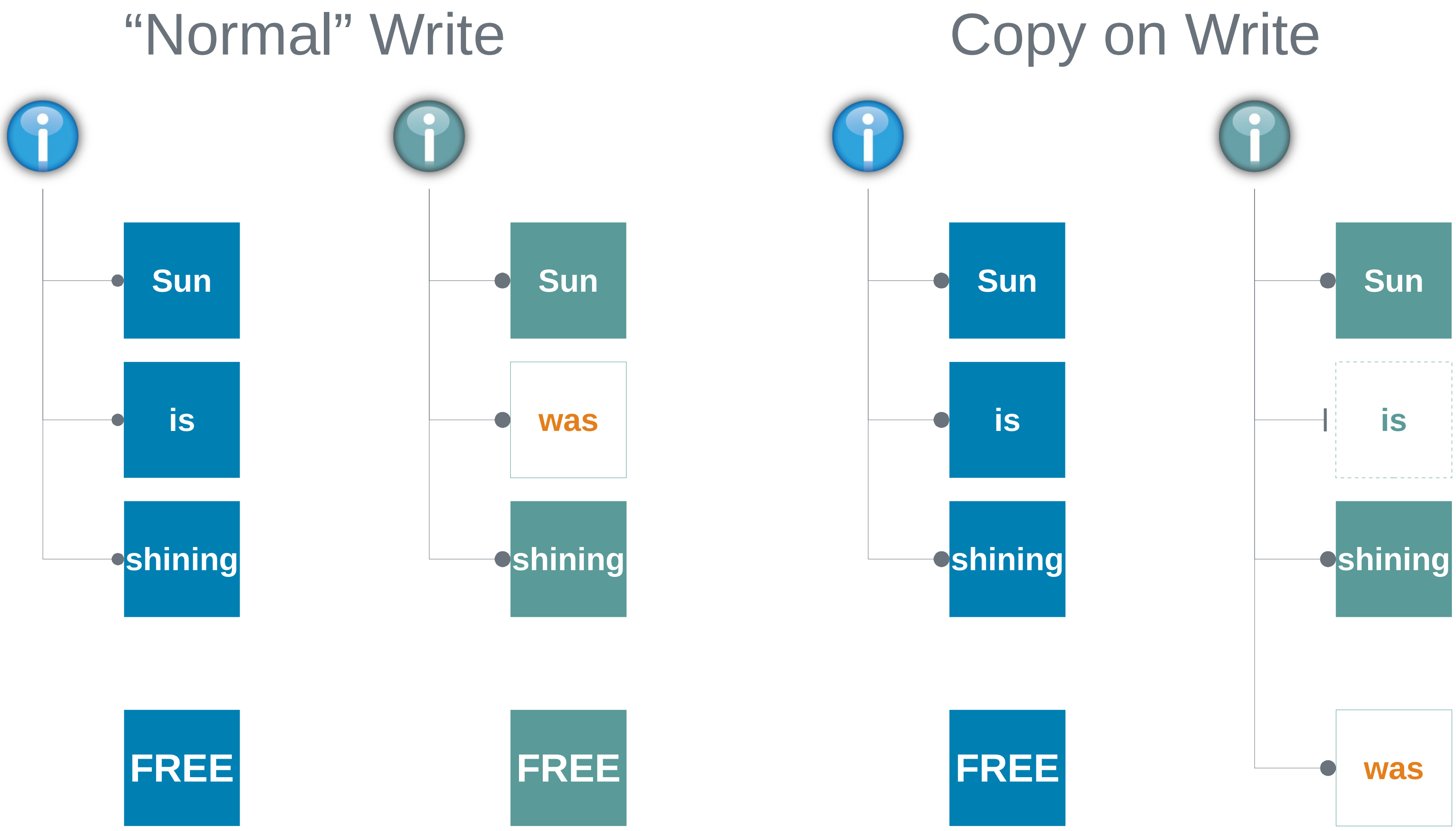
Btrfs Specs

- Max volume size: 16 EB (2^64 byte)
- Max file size : 16 EB
- Max file name size : 255 bytes
- Characters in file name : any, except 0x00
- Directory lookup algorithm : B-Tree
- Filesystem check : on- and off-line
- Compatibility
  - POSIX file owner/permission Hard- and symbolic links,
Access Control Lists (ACLs) Extended Attributes (xattrs),
Asynchronous and Direct I/O Sparse files

Btrfs Feature Summary

- Extents
  - Use only what's needed
  - Contiguous runs of disk blocks
- Copy-on-write
  - Never overwrite data!
  - Similar to CoW in VMM
- Snapshots
  - Light weight
  - At file system level
  - RO / RW
- Multi-device Management
  - mixed size and speed
  - on-line add and remove devs
- Object level RAID:
  - 0, 1, 10
- Efficient small file storage
- SSD support (optimizations, trim)

Copy on Write explained



Btrfs Feature Summary (cont.)

- Checksums on data and meta data
- On-line:
  - Balancing
  - Grow and shrink
  - Scrub
  - Defragmentation
- Transparent compression (gzip, lzo)
- In-place conversion from Ext[34] to Btrfs
- Send/Receive
  - Similar to ZFS' send/receive function
- Seed devices
  - Overlay a RW file system on top of an RO
- btrfsck
  - Offline FS repair

Btrfs Planned Features

- Quota support
  - Aug 2012: 1st implementation available
- Object-level RAID 5, 6
- Data de-duplication:
  - On-line de-dup during writes
  - Background de-dup process

- Tiered storage
  - Frequently used data on SDD(s)
  - “Archive” on HDD(s)

Btrfs integration in SLE 11 SP2

Basic integration into

- Installer
  - Btrfs as root file system
  - Recommendation for subvolume layout
- Partitioner
  - Create Btrfs
  - Create subvolumes

Tools

- Snapper
  - Manage snapshots
  - Automatically create snapshots
  - Display differences between snapshots
  - Roll-back

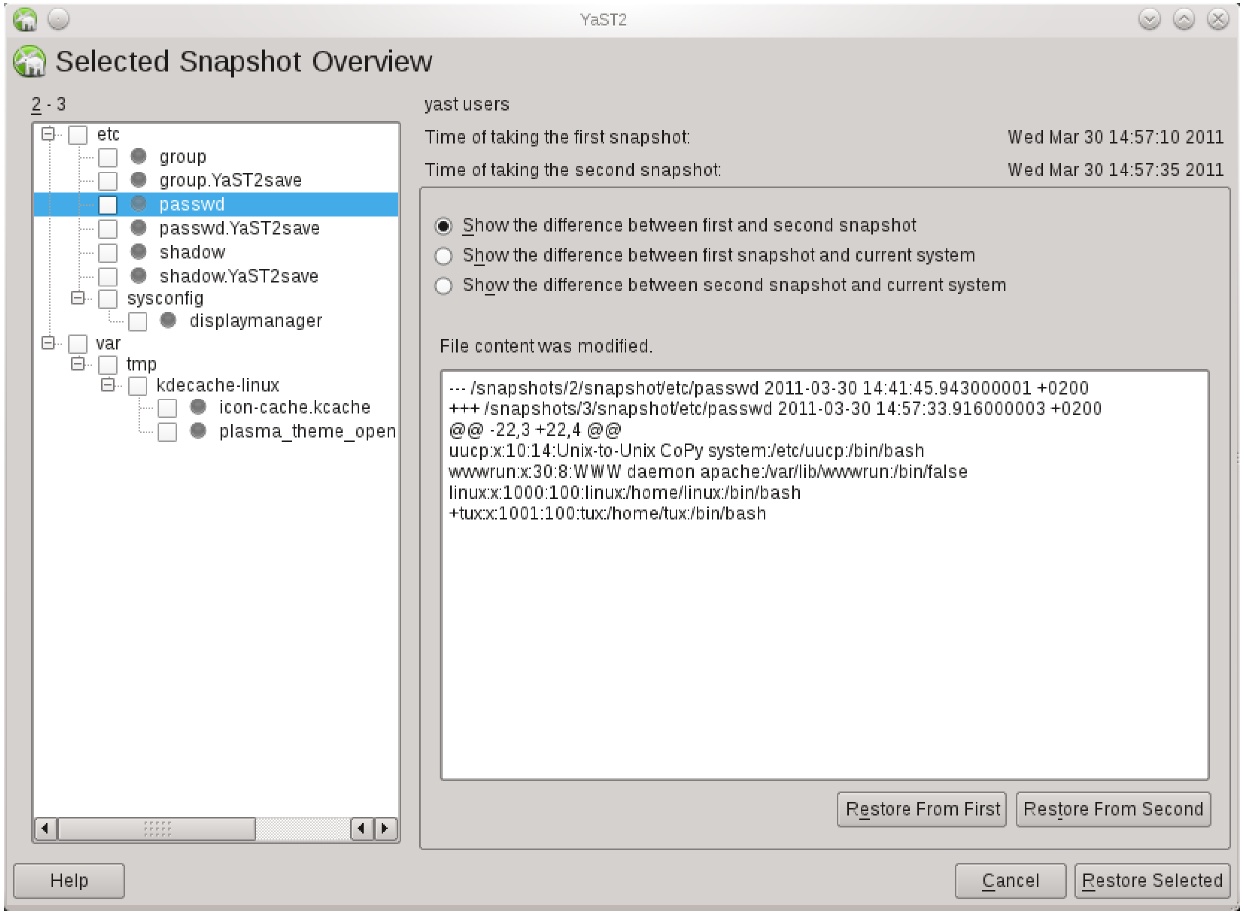
Btrfs integration in SLE 11
Future plans

- YaST partitioner support for:
  - Built-in multi-volume handling and RAID
  - Transparent compression
- Btrfs support in AutoYaST
- Bootloader support for /boot on btrfs
- Snapshot creation as non-root user (DBus support)

Snapshot management with Snapper

Functions

- Automatic snapshots
- Integration with YaST and Zypp
- Rollback
- Integration points



yast users

Time of taking the first snapshot: Wed Mar 30 14:57:10 2011

Time of taking the second snapshot: Wed Mar 30 14:57:35 2011

- ● Show the difference between first and second snapshot
- ○ Show the difference between first snapshot and current system
- ○ Show the difference between second snapshot and current system

File content was modified.

```
--- /snapshots/2/snapshot/etc/passwd 2011-03-30 14:41:45.943000001 +0200
+++ /snapshots/3/snapshot/etc/passwd 2011-03-30 14:57:33.916000003 +0200
@@ -22,3 +22,4 @@
uucp:x:10:14:Unix-to-Unix CoPy system:/etc/uucp:/bin/bash
wwwrun:x:30:8:WWW daemon apache:/var/lib/wwwrun:/bin/false
linux:x:1000:100:linux:/home/linux:/bin/bash
+tux:x:1001:100:tux:/home/tux:/bin/bash
```

Example how Btrfs is useful

Session Evaluation

12876 – Using LXC and Btfs with SLES11 SP2 on System z

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