Quick-and-Easy Deployment of a Ceph Storage Cluster with SLES

With a look at SUSE Studio, Manager and Build Service

Jan Kalcic
Sales Engineer
jkalcic@suse.com

Flavio Castelli
Senior Software Engineer
fcastelli@suse.com

Agenda

Ceph Introduction

System Provisioning with SLES

System Provisioning with SUMa

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SUSE Studio

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Ceph Introduction

What is Ceph

- Open-source software-defined storage
  - It delivers object, block, and file storage in one unified system
- It runs on commodity hardware
  - To provide an infinitely scalable Ceph Storage Cluster
  - Where nodes communicate with each other to replicate and redistribute data dynamically
- It is based upon RADOS
  - Reliable, Autonomic, Distributed Object Store
  - Self-healing, self-managing, intelligent storage nodes

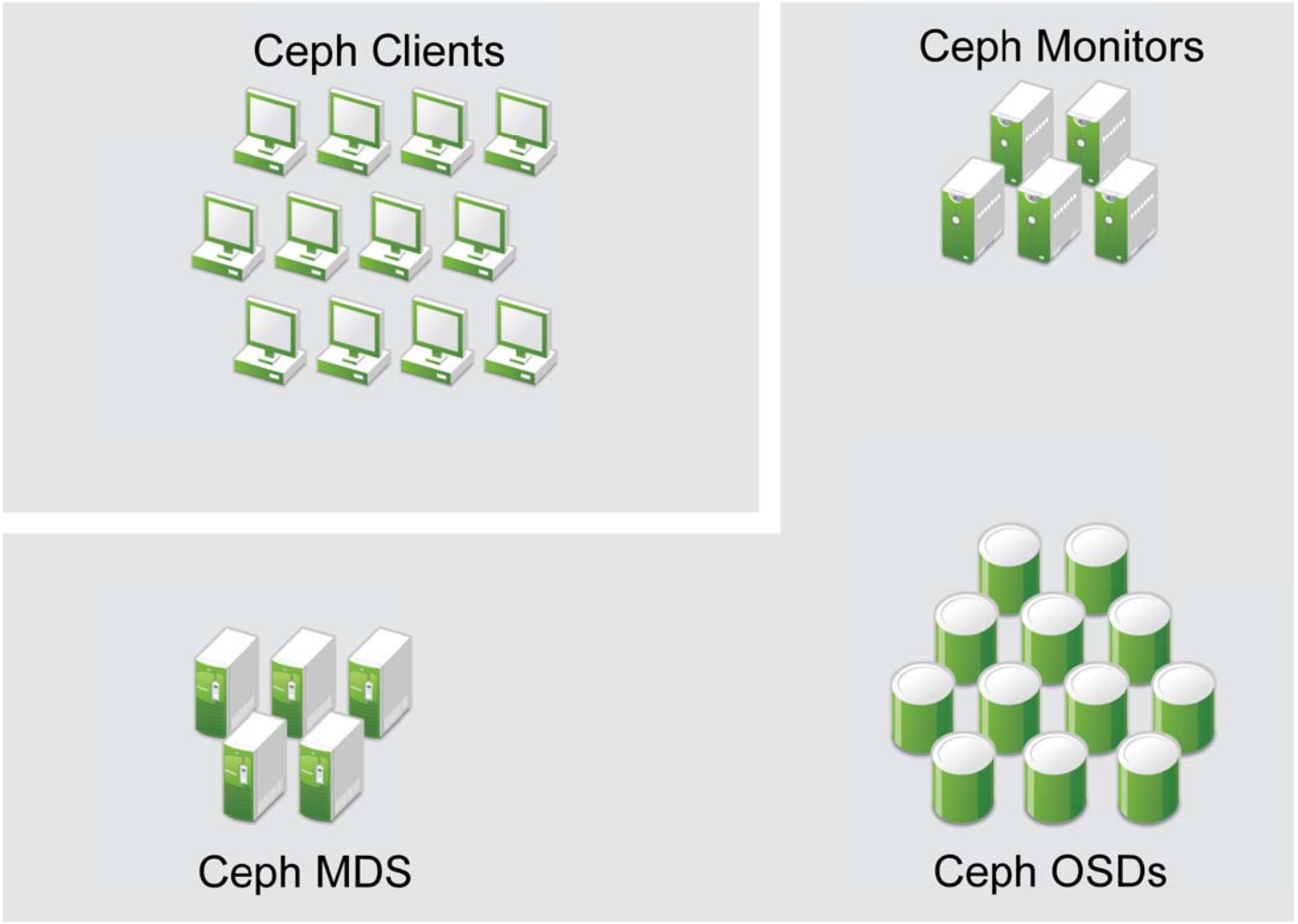
Ceph Components

Ceph Storage Cluster	Monitor Object Storage Device (OSD) Ceph Metadata Server (MDS)
Ceph Clients	Ceph Block Device (RBD) Ceph Object Storage (RGW) Ceph Filesystem Custom implementation

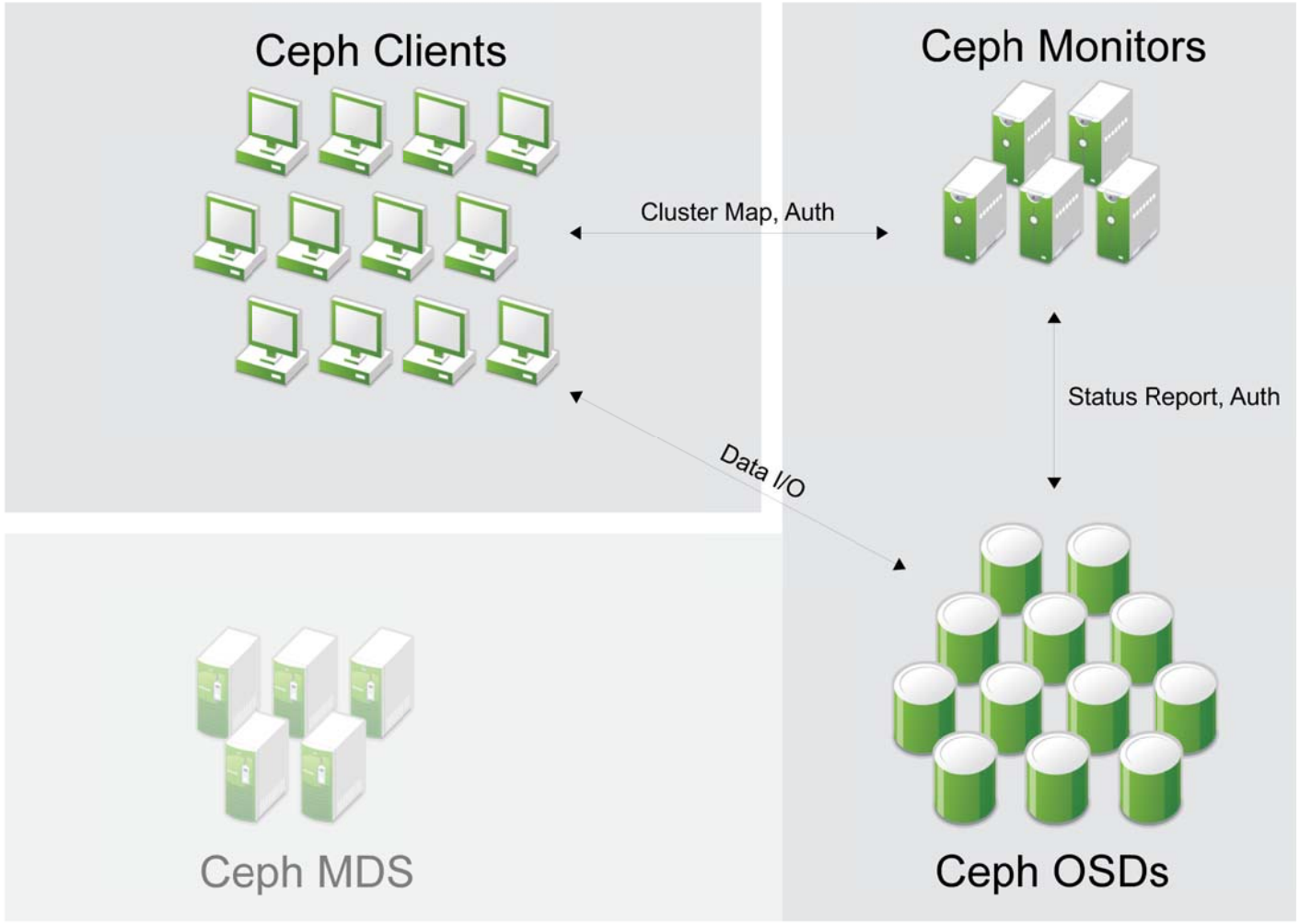
Ceph Storage Cluster

- Ceph Monitor
  - It maintains a master copy of the cluster map (i.e. cluster members, state, changes, and overall health of the cluster)
- Ceph Object Storage Device (OSD)
  - It interacts with a logical disk (e.g. LUN) to store data (i.e. handle the read/write operations on the storage disks).
- Ceph Metadata Server (MDS)
  - It provides the Ceph Filesystem service. Purpose is to store filesystem metadata (directories, file ownership, access modes, etc) in high-availability Ceph Metadata Servers

Architectural Overview



Architectural Overview



Deployment Overview

- All Ceph clusters require:
  - at least one monitor
  - at least as many OSDs as copies of an object stored on the cluster
- Bootstrapping the initial monitor is the first step
  - This also sets important criteria for the cluster, (i.e. number of replicas for pools, number of placement groups per OSD, heartbeat intervals, etc.)
- Add further Monitors and OSDs to expand the cluster

Monitor Bootstrapping

- On mon node, create “/etc/ceph/ceph.conf”

```
[global]
    fsid = a7f64266-0894-4f1e-a635-d0aeaca0e993
    mon initial members = node1
    mon host = 192.168.0.1
    public network = 192.168.0.0/24
    auth cluster required = cephx
    auth service required = cephx
    auth client required = cephx
    osd journal size = 1024
    filestore xattr use omap = true
    osd pool default size = 2
    osd pool default min size = 1
    osd pool default pg num = 333
    osd pool default pgp num = 333
    osd crush chooseleaf type = 1
```

Add UUID: `uuidgen`

Add mon

Add IP

...

- Create a keyring for your cluster and generate a monitor secret key.

  ceph-authtool --create-keyring /tmp/ceph.mon.keyring --gen-key -n mon. --cap mon 'allow *'

Monitor Bootstrapping (cont)

- Generate an administrator keyring, generate a client.admin user and add the user to the keyring

  ceph-authtool --create-keyring /etc/ceph/ceph.client.admin.keyring --gen-key -n client.admin --set-uid=0 --cap mon 'allow *' --cap osd 'allow *' --cap mds 'allow'

- Add the client.admin key to the ceph.mon.keyring.

  ceph-authtool /tmp/ceph.mon.keyring --import-keyring /etc/ceph/ceph.client.admin.keyring

- Generate a monitor map using the hostname(s), host IP address(es) and the FSID. Save it as /tmp/monmap:
  - monmaptool --create --add node1 192.168.0.1 --fsid a7f64266-0894-4f1e-a635-d0aeaca0e993 /tmp/monmap

Monitor Bootstrapping (cont)

- Create a default data directory (or directories) on the monitor host(s).

  ```
  sudo mkdir /var/lib/ceph/mon/ceph-node1
  ```

- Populate the monitor daemon(s) with the monitor map and keyring.

  ```
  ceph-mon --mkfs -i node1 --monmap /tmp/monmap --keyring
  /tmp/ceph.mon.keyring
  ```

- Start the monitor(s).

  ```
  sudo /etc/init.d/ceph start mon.node1
  ```

- Verify that the monitor is running:

  ```
  ceph -s
  ```

Adding OSDs

- Once you have your initial monitor(s) running, you should add OSDs
  - Your cluster cannot reach an active + clean state until you have enough OSDs to handle the number of copies of an object (e.g., osd pool default size = 2 requires at least two OSDs).
- Ceph provides the ceph-disk utility, which can prepare a disk, partition or directory for use with Ceph
  - The ceph-disk utility creates the OSD ID by incrementing the index.
  - ceph-disk will add the new OSD to the CRUSH map under the host for you.

Adding OSDs (cont)

- Prepare the OSD.

  sudo ceph-disk prepare --cluster ceph --cluster-uuid a7f64266-0894-4f1e-a635-d0aeaca0e993 --fs-type ext4 /dev/hdd1

- Activate the OSD:

  sudo ceph-disk activate /dev/hdd1

- To watch the placement groups peer:

  ceph -w

- To view the tree, execute the following:

  ceph osd tree

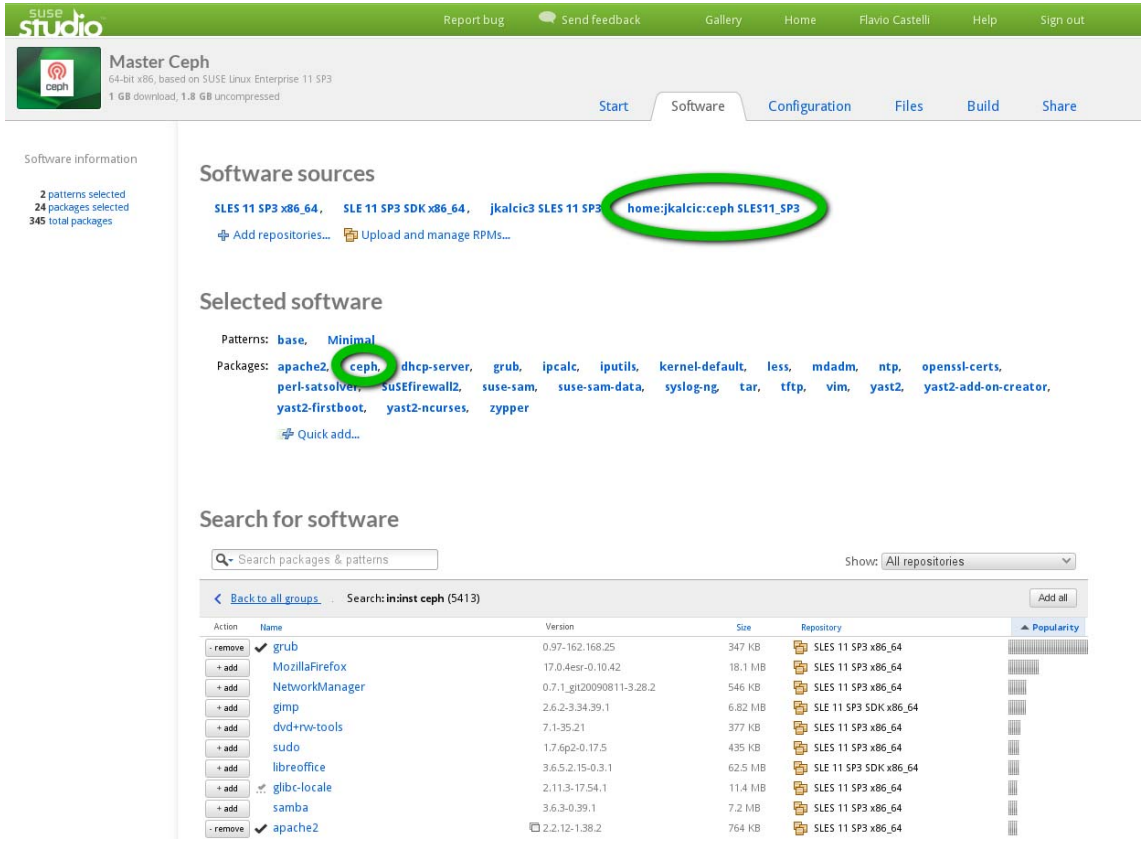
Lab

SUSE Studio

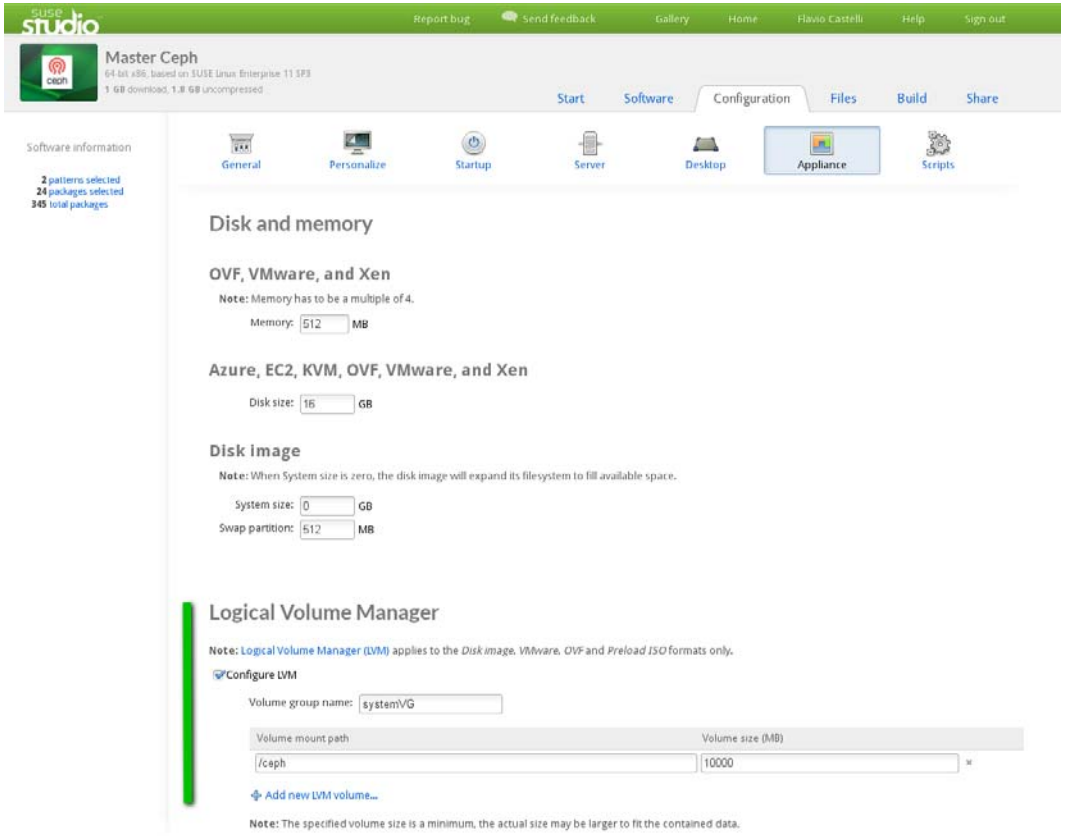
SUSE Studio

- Web application
- Makes it easy to create appliances
- Targets different versions of openSUSE and SLE
- Supports different output formats:
  - ISO, Preload ISO
  - USB disk/ hard disk image
  - Virtual machines (VMware, Xen, KVM, Hyper-V)
  - Cloud (AWS, OpenStack, SUSE Cloud, Azure)

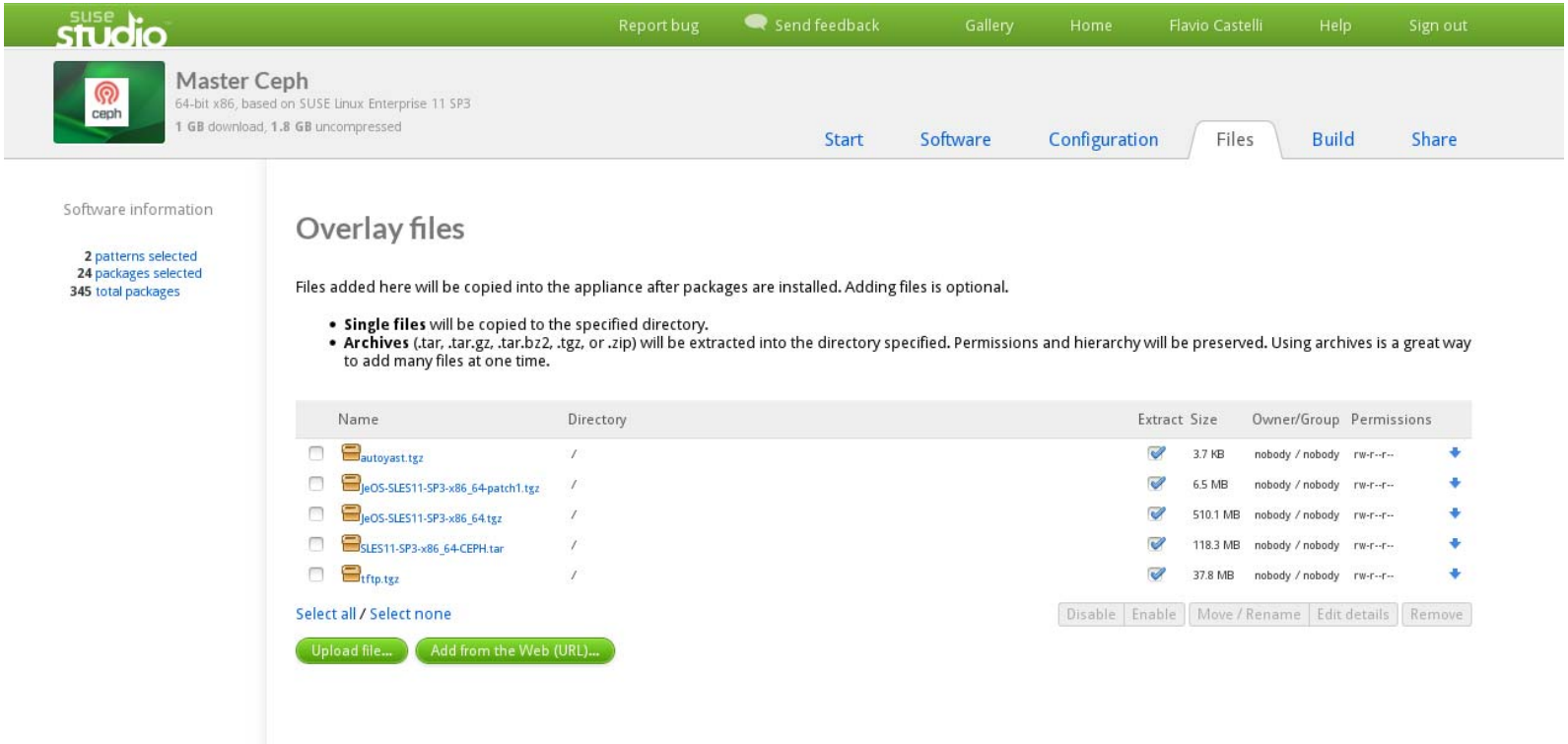
Add packages from OBS project



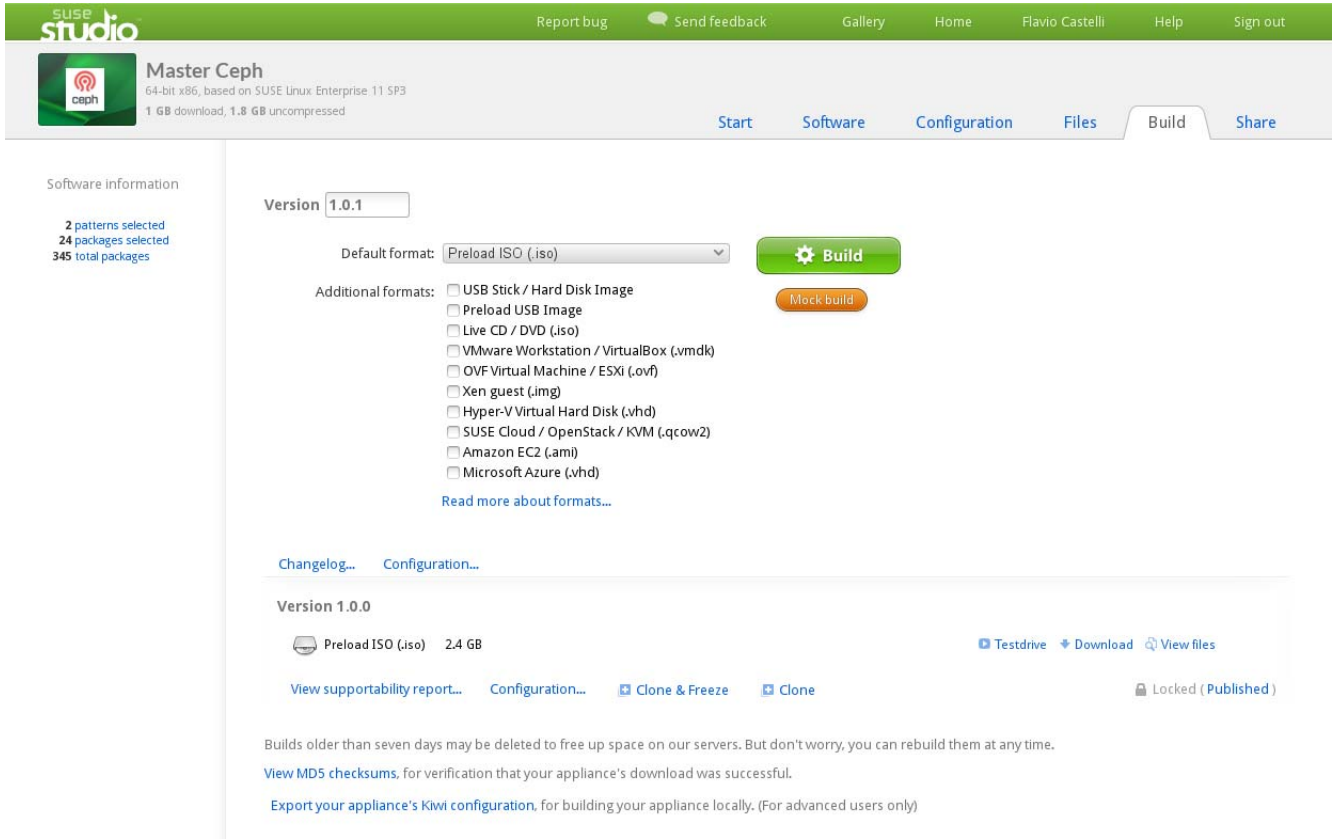
Use LVM


suse studio
Report bug
Send feedback
Gallery
Home
Flavio Castelli
Help
Sign out
Master Ceph
64-bit x86, based on SUSE Linux Enterprise 11 SP3
1 GB download, 1.8 GB uncompressed
Start
Software
Configuration
Files
Build
Share
Software information
2 patterns selected
24 packages selected
345 total packages
General
Personalize
Startup
Server
Desktop
Appliance
Scripts
Disk and memory
OVF, VMware, and Xen
Note: Memory has to be a multiple of 4.
Memory: 512 MB
Azure, EC2, KVM, OVF, VMware, and Xen
Disk size: 16 GB
Disk image
Note: When System size is zero, the disk image will expand its filesystem to fill available space.
System size: 0 GB
Swap partition: 512 MB
Logical Volume Manager
Note: Logical Volume Manager (LVM) applies to the Disk image, VMware, OVF and Preload ISO formats only.
Configure LVM
Volume group name: systemVG
Volume mount path
Volume size (MB)
/ceph
10000
Add new LVM volume...
Note: The specified volume size is a minimum, the actual size may be larger to fit the contained data.

Add custom files to the appliance



Build a preload ISO



What is a “preload ISO”

Bootable ISO which:

1)Asks user permission to wipe the disk.

2)Erase the contents of the disk.

3)Partitions the disk (using LVM in our case).

4)Dumps the contents of the appliance to the disk.

SLES as PXE Boot Server

Introduction

- A PXE boot server allows you to boot up a system over the network instead of a DVD.
- A key requirement of system provisioning.
- When used in conjunction with AutoYaST you can have a fully automated installation of SUSE Linux Enterprise.
- Components needed:
  - DHCP server
  - TFTP server
  - PXE boot server (syslinux)
  - Software repositories

DHCP Server

- Install, configure and enable the DHCP Server as usual.
- /etc/dhcpd.conf

```
subnet 192.168.43.0 netmask 255.255.255.0 {
       range 192.168.43.1 192.168.43.254;
       filename "pxelinux.0";
       next-server 192.168.43.100;
}
```

- Two parameters:
  - next-server - used to specify the host address of the server from which the initial boot file is to be loaded.
  - filename: used to specify the name of the initial boot file which is to be loaded by a client.

TFTP Server

- Install and enable tftp server.
- /etc/xinetd.d/tftpd

```
service tftp
{
        socket_type             = dgram
        protocol                = udp
        wait                    = yes
        flags                   = IPv6 IPv4
        user                    = root
        server                  = /usr/sbin/in.tftpd
        server_args             = -v -s /srv/tftp
        disable                 = no
}
```

PXE Boot Server

- Install “syslinux” and configure the PXE boot server

```
/srv/tftp/pxelinux.cfg/default
/srv/tftp/f1
/srv/tftp/initrd
/srv/tftp/linux
/srv/tftp/pxelinux.0
```

- /srv/tftp/pxelinux.cfg/default

```
# hard disk
label harddisk
  kernel linux
  append SLX=0x202

# ceph installation
label cephosd
  kernel linux
  append initrd=initrd splash=silent showopts \
  install=http://192.168.43.100/repo/JeOS-SLES11-SP3-x86_64/CD1 \
  autoyast=http://192.168.43.100/autoyast/osd.xml

implicit        0
display         f1
prompt          1
timeout         0
```

PXE Boot Server (cont)

- /srv/tftp/f1

```
harddisk        - Boot from Harddisk
cephosd         - Add a new Ceph OSD to the existing Ceph Storage Cluster
cephmon         - TODO Add a new Ceph Mon to the existing Ceph Storage Cluster
cephmds         - TODO Add a new Ceph MDS to the existing Ceph Storage Cluster
```

- Copy files “initrd” and “linux” from SLES DVD

```
# cp /media/cdrom/boot/i386/loader/initrd /srv/tftpboot/
# cp /media/cdrom/boot/i386/loader/linux /srv/tftpboot/
```

- man syslinux

PXE Boot Server (cont)

- Example for more complex scenarios

```
/srv/tftp/pxelinux.cfg/default
/srv/tftp/f1
/srv/tftp/initrd-SLES11SP2
/srv/tftp/linux-SLES11SP2
/srv/tftp/initrd-SLES11SP3
/srv/tftp/linux-SLES11SP3
/srv/tftp/initrd-SLES12
/srv/tftp/linux-SLES12
/srv/tftp/pxelinux.0
```

Copy “initrd” and “linux” from more distributions. Unique names are needed!

```
# ceph on SLES11 SP2
label cephosd-sles11sp2
  kernel linux
  append initrd=initrd splash=silent showopts \
  install=http://192.168.43.100/repo/SLES11-SP2-x86_64/CD1 \
  autoyast=http://192.168.43.100/autoyast/osd.xml

# ceph on SLES11 SP3
label cephosd-sles11sp3
  kernel linux
  append initrd=initrd splash=silent showopts \
  install=http://192.168.43.100/repo/SLES11-SP3-x86_64/CD1 \
  autoyast=http://192.168.43.100/autoyast/osd.xml

# ceph on SLES12
label cephosd-sles12
  kernel linux
  append initrd=initrd splash=silent showopts \
  install=http://192.168.43.100/repo/SLES12-x86_64/CD1 \
  autoyast=http://192.168.43.100/autoyast/osd.xml
```

Create entries in “/srv/tftp/pxelinux.cfg/default” and then update file “f1” accordingly.

Installation Server

- It used to create and manage the repositories hosted on the system and used by clients for network installation.
- It is basically about:
  - Configure initial server options (i.e. directory, protocol, alias)
  - Import DVD content (or ISO) for each distribution
- YaST is your friend
  - yast2 insserver

LAB

AutoYaST

Introduction

- AutoYaST is a system for installing one or more SUSE Linux systems automatically
  - without user intervention
  - or when customization is required
- Installations are performed using an AutoYaST profile (XML) with installation and configuration data.
- Use cases:
  - Massive deployment
  - Deployment on demand
  - Custom installation
  - Changing hardware or a wide variety of hardware

Add-on and Partitions

```
<add-on>
  <add_on_products config:type="list">
    <listentry>
      <media_url><![CDATA[http://@MASTER_IP@/repo/SLES11-SP3-x86_64-CEPH]]></media_url>
      <product>SLES11-SP3-x86_64-CEPH</product>
      <product_dir>/</product_dir>
      <ask_on_error config:type="boolean">true</ask_on_error>
    </listentry>
  </add_on_products>
</add-on>

<partitioning config:type="list">
  <drive>
    <initialize config:type="boolean">true</initialize>
    <partitions config:type="list">
      <partition>
        <create config:type="boolean">true</create>
        <crypt_fs config:type="boolean">false</crypt_fs>
        <filesystem config:type="symbol">xfs</filesystem>
        <format config:type="boolean">true</format>
        <fstopt>defaults</fstopt>
        <loop_fs config:type="boolean">false</loop_fs>
        <lv_name>LVceph</lv_name>
        <mount>/ceph</mount>
        <mountby config:type="symbol">device</mountby>
        <partition_id config:type="integer">131</partition_id>
        <resize config:type="boolean">false</resize>
        <size>max</size>
      </partition>
```

Networking

```
<networking>
  <dhcp_options>
    <dhclient_client_id></dhclient_client_id>
    <dhclient_hostname_option>AUTO</dhclient_hostname_option>
  </dhcp_options>
  <dns>
    <dhcp_hostname config:type="boolean">true</dhcp_hostname>
    <hostname>@HOSTNAME@</hostname>
    <domain>@DOMAIN@</domain>
    <resolv_conf_policy></resolv_conf_policy>
    <write_hostname config:type="boolean">true</write_hostname>
  </dns>
  <interfaces config:type="list">
    <interface>
      <bootproto>static</bootproto>
      <device>eth0</device>
      <ipaddr>@IPADDRESS@</ipaddr>
      <netmask>@NETMASK@</netmask>
      <startmode>auto</startmode>
      <usercontrol>no</usercontrol>
    </interface>
  </interfaces>
  <managed config:type="boolean">false</managed>
</networking>
```

Ask # 1

```
  <ask-list config:type="list">
    <ask>
      <title>Basic Host Configuration</title>
      <dialog config:type="integer">0</dialog>
      <element config:type="integer">1</element>
      <pathlist config:type="list">
        <path>networking,dns,hostname</path>
      </pathlist>
      <question>Full hostname (i.g. linux.site)</question>
      <stage>initial</stage>
      <script>
        <filename>hostname.sh</filename>
        <rerun_on_error config:type="boolean">false</rerun_on_error>
        <environment config:type="boolean">true</environment>
        <source><![CDATA[#!/bin/bash
echo $VAL > /tmp/answer_hostname
]]>
        </source>
        <debug config:type="boolean">false</debug>
        <feedback config:type="boolean">true</feedback>
      </script>
    </ask>
[...]
```

Ask # 2

```
    <ask>
      <title>Basic Host Configuration</title>
        <dialog config:type="integer">0</dialog>
        <element config:type="integer">2</element>
        <pathlist config:type="list">
          <path>networking,interfaces,0,ipaddr</path>
        </pathlist>
        <question>IP Address and CIDR prefix (i.g. 192.168.1.1/24)</question>
        <stage>initial</stage>
        <script>
          <filename>ip.sh</filename>
          <rerun_on_error config:type="boolean">true</rerun_on_error>
          <environment config:type="boolean">true</environment>
          <source><![CDATA[#!/bin/bash
function check_host() {
      local host=$1
      [ -z "$host" ] && echo "You must provide a valid hostname!" && exit 1
      [ -z "${host//[A-Za-z0-9]/}" ] && echo -e "Is this a valid full hostname? (i.g. linux.site)\nCould not find the domain name in \"$
{host}\"" && exit 1
      tmp="$(echo "$host" | awk -F "." '{print $2}')"
      [ -z "$tmp" ] && echo -e "Is this a valid full hostname? (i.g. linux.site)\nCould not find the domain name in \"${host}\"" && exit 1
      tmp="${host//[A-Za-z0-9]/}"
      [ "${#tmp}" -ne 1 ] && echo -e "Is this a valid full hostname? (i.g. linux.site)\nA full hostname can contain only one dot" && exit 1

      return 0
}

cidr2mask ()
{
  # Number of args to shift, 255..255, first non-255 byte, zeroes
  set -- $(( 5 - ($1 / 8) )) 255 255 255 255 $(( (255 << (8 - ($1 % 8))) & 255 )) 0 0 0
  [ $1 -gt 1 ] && shift $1 || shift
  echo ${1-0}.${2-0}.${3-0}.${4-0}
}
[...]
```

Ask # 2 (cont)

```
function check_ip() {
        local ip=$1 tmp

        [ -z "$ip" ] && echo "You must provide a valid IP address plus CIDR prefix!" && exit 1
        [ "${#ip}" -lt 9 ] && echo -e "Is this a valid IP address plus CIDR prefix?\nYou entered only '${#ip}' chars." && exit 1
        [ -n "${ip//[0-9.\/]/}" ] && echo -e "Is this a valid IP address plus CIDR prefix?\nFound unvalid character: '${ip//[0-9.]/}'." && exit 1
        tmp="$(echo "$ip" | awk -F "/" '{print $2}')"
        [ -z "$tmp" ] && echo -e "The CIDR prefix must be provided too!\n(i.g. 192.168.1.1/24)\n" && exit 1

        return 0
}

HOSTNAME="$(cat /tmp/answer_hostname)"
check_host "$HOSTNAME"
check_ip "$VAL"

DOMAIN=$(echo "$HOSTNAME" | awk -F "." '{print $2}')
HOSTNAME=$(echo "$HOSTNAME" | awk -F "." '{print $1}')
IPADDRESS=$(echo "$VAL" | cut -d "/" -f1)
CIDR=$(echo "$VAL" | awk -F "/" '{print $2}')
NETMASK=$(cidr2mask "$CIDR")

sed -e "s/@HOSTNAME@/$HOSTNAME/g"    \
   -e "s/@DOMAIN@/$DOMAIN/g"  \
   -e "s/@IPADDRESS@/$IPADDRESS/g"  \
   -e "s/@NETMASK@/$NETMASK/g"      \
   -e "/^\s*<ask-list/,/ask-list>$/d" \
   /tmp/profile/autoinst.xml > /tmp/profile/modified.xml
]]>
          </source>
          <debug config:type="boolean">false</debug>
          <feedback config:type="boolean">true</feedback>
        </script>
     </ask>
   </ask-list>
```

Post-script

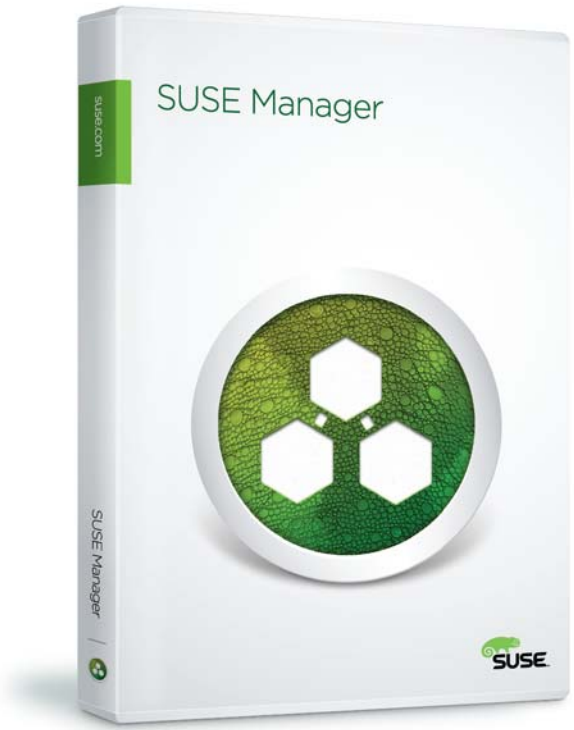
```
<post-scripts config:type="list">
  <script>
    <debug config:type="boolean">true</debug>
    <feedback config:type="boolean">false</feedback>
    <filename>initialize</filename>
    <interpreter>shell</interpreter>
    <location><![CDATA[]]></location>
    <network_needed config:type="boolean">false</network_needed>
    <notification></notification>
    <source><![CDATA[#!/bin/bash

cd /etc/ceph
wget http://@MASTER_IP@/ceph/ceph.conf
wget http://@MASTER_IP@/ceph/ceph.mon.keyring
wget http://@MASTER_IP@/ceph/ceph.client.admin.keyring

# Create a new OSD
osdid=$(ceph osd create)

# If the OSD is for a drive other than the OS drive, prepare it for use with Ceph, and mount it to the directory
you just created:
ln -s /ceph /var/lib/ceph/osd/ceph-${osdid}

# Initialize the OSD data directory.
ceph-osd -i $osdid --mkfs –mkkey
[...]
```

Post-script (cont)

```
# Register the OSD authentication key. The value of ceph for ceph-{osd-num} in the path is the $cluster-$id. If
your cluster name differs from ceph, use your cluster name instead.:
ceph auth add osd.${osdid} osd 'allow *' mon 'allow rwx' -i /var/lib/ceph/osd/ceph-${osdid}/keyring

# WORKAROUND issue "Error EINVAL: entity osd.1 exists but key does not match"
ceph auth del osd.${osdid}
ceph auth add osd.${osdid} osd 'allow *' mon 'allow rwx' -i /var/lib/ceph/osd/ceph-${osdid}/keyring

# Add the OSD to the CRUSH map so that the OSD can begin receiving data.
ceph osd crush add osd.${osdid} 1 root=default

# WORKAROUND issue with mon not found:
touch /var/lib/ceph/osd/ceph-${osdid}/sysvinit

# Starting the OSD
/etc/init.d/ceph start osd.${osdid}

# Enabling Ceph at boot
/sbin/insserv ceph

# Other
echo "@MASTER_HOSTS@" >> /etc/hosts
/usr/bin/zypper ar http://@MASTER_HOSTNAME@/repo/SLES11-SP3-x86_64-CEPH/ SLES11-SP3-x86_64-
CEPH

]]></source>
      </script>
    </post-scripts>
  </scripts>
```

SUSE Manager

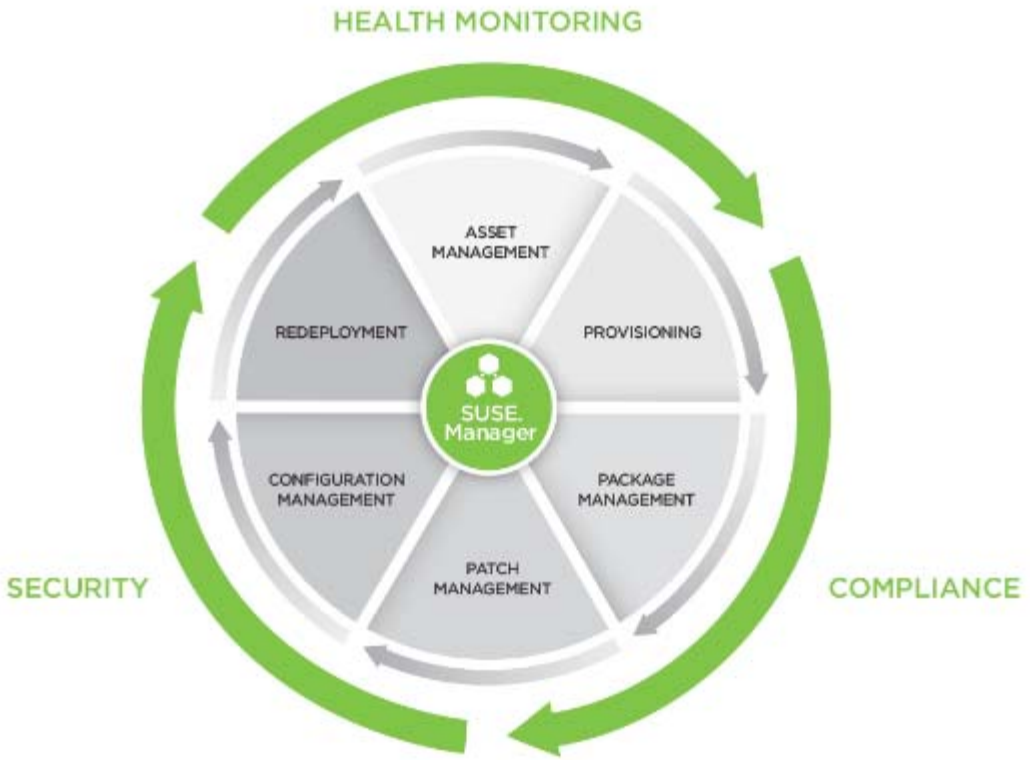
SUSE Manager



Automated Linux systems management that enables you to comprehensively manage SUSE Linux Enterprise and Red Hat Enterprise Linux systems with a single, centralized solution across physical, virtual and cloud environments.

- Reduce complexity with automation.
- Control, standardize and optimize converged, virtualized and cloud data centers.
- Reduce risk and avoidable downtime through better change control, discovery and compliance tracking.

Manage the Full Life-Cycle



- ✓ Gain control
- ✓ Optimize
- ✓ Make room for innovation

System Provisioning with SUMa

PXE - steps

- SUMa does not provide the dhcpd server
  - Either use the one available in your network
  - Or install and configure it on SUMa
    - zypper in dhcp-server
    - Edit /etc/sysconfig/dhcpd
    - Edit /etc/dhcpd.conf
- Enable Bare-metal system management in SUMa
  - Admin > SUSE Manager Configuration > Bare-metal systems > Enable adding to this organization

Channel - Steps

- Add SLES11 SP3 as SUSE Product
  - Admin > Setup Wizard > SUSE Products > *add product*
- Add Ceph Channel from OBS
  - Channels > Manage Software Channels > *create new channel*
- Add Ceph Repository
  - Channels > Manage Software Channels > Manage Repositories > *create new repository*
- Assign Ceph Repository to Channel
  - Channels > Manage Software Channels > *select channel* > Repositories > *assign repo to channel* > *trigger sync for repo*

Distribution - Steps

- Copy SLES DVD on SUMa
  - scp SLES-11-SP3-DVD-x86_64-GM-DVD1.iso root@192.168.43.150:
- Mount it via a loop device
  - mount -o /root/SLES-11-SP3-DVD-x86_64-GM-DVD1.iso /media/sles11sp3-x86_64
- Add the entry in /etc/fstab
  - /root/SLES-11-SP3-DVD-x86_64-GM-DVD1.iso /media/sles11sp3-x86_64 iso9660 loop 0 0
- Create new Autoinstallable Distribution
  - Systems > Autoinstallation > Distributions > *create new distribution*

Profile – Steps

- Create new Autoinstallation profile
  - Systems > Autoinstallation > Profiles > *upload new autoyast profile*
  - Use *Autoinstallation snippets* to store common blocks of code that can be shared across multiple autoinstallation profiles
- Add variables for registration
  - Systems > Autoinstallation > Profiles > *select profile* > Variables
  - For example:
    - registration_key=1-sles11sp3-x86_64

Profile – Steps (cont)

- Create profile:
  - Systems > Autoinstallation > Profiles > *select profile* > Details > File Contents
    - Enclose scripts within “#raw” and “#end raw”
    - Add needed snippets

```
$SNIPPET('spacewalk/sles_no_signature_checks')

$SNIPPET('spacewalk/sles_register_script')
```

    - Add add-on for child channels:

```
<add-on>
    <add_on_products config:type="list">
      <listentry>
        <ask_on_error config:type="boolean">true</ask_on_error>
        <media_url>http://$redhat_management_server/ks/dist/child/sles11-sp3-updates-x86_64/sles11sp3-x86_64</media_url>
        <name>SLES11-SP3-updates</name>
        <product>SLES11 SP3 updates</product>
        <product_dir>/</product_dir>
      </listentry>
      <listentry>
        <ask_on_error config:type="boolean">true</ask_on_error>
        <media_url>http://$redhat_management_server/ks/dist/child/ceph-sles11sp3-x86_64/sles11sp3-x86_64</media_url>
        <name>Ceph-SLES11-SP3</name>
        <product>Ceph SLES11 SP3</product>
        <product_dir>/</product_dir>
      </listentry>
    </add_on_products>
  </add-on>
```

Client Registration – Steps

- Create Group for Ceph Nodes
  - Systems > System Groups > *create new group*
- Create Activation Key
  - Systems > Activation Keys
- Add group to the Activation Key
  - Systems > Activation Keys > Groups > join to the *group*
- Generate generic Bootstrap Script
  - Admin > SUSE Manager Configuration > Bootstrap Script > *update*

Client Registration – Steps (cont)

- Generate Bootstrap Script
  - /srv/www/htdocs/pub/bootstrap
- Create Bootstrap Repositories
  - mgr-create-bootstrap-repo
- Make sure the installation source is available
  - YaST > Software > Software Repositories > Add > *select DVD*
- Execute Bootstrap Script
  - `cat bootstrap-EDITED-NAME.sh | ssh root@CLIENT_MACHINE1 /bin/bash`

Lab

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Corporate Headquarters
Maxfeldstrasse 5
90409 Nuremberg
Germany

+49 911 740 53 0 (Worldwide)
www.suse.com

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