Deploying SUSE Linux Micro using Raw Disk Images on IBM Z DASD Disks

WHAT?

SUSE Linux Micro provides raw images (also referred to as pre-built images) that can be deployed directly to your device storage.

WHY?

This article provides you with step-by-step instructions on deploying SUSE Linux Micro on an IBM Z machine.

EFFORT

It takes approximately 20 minutes to read the article.

GOAL

SUSE Linux Micro is successfully deployed on your system.

REQUIREMENTS

- A disk with running Linux.
- A disk where you deploy the raw image and where SUSE Linux Micro will run.
- A disk that serves as a configuration medium.

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Contents

1 About pre-built images

Pre-built images are ready-to-use representations of a running operating system. They are not installed in a traditional way using an installer, but copied to the hard disk of the target host. The topic covers basic information about these pre-built images.

The pre-built images are intended to be configured on the first boot by using tools delivered in the images. The boot loader detects the first boot as described in *Section 1.2, "First boot detection"*. Each image comes with default mounted subvolumes, which may be changed during the first boot configuration. For details about the subvolumes, refer to *Section 1.1, "Default partitioning"*.

1.1 Default partitioning

The pre-built images are delivered with a default partitioning scheme. You can change it during the first boot by using *Ignition* or *Combustion*.

Important: Btrfs is mandatory for the root file system

If you intend to perform any changes to the default partitioning scheme, the root file system must be Btrfs.

Each image has the following subvolumes:

```
/home
/root
/opt
/srv
/usr/local
/var
```

The `/etc` directory is mounted as overlayFS, where the upper directory is mounted to `/var/lib/overlay/1/etc/`.

You can recognize the subvolumes mounted by default by the option `x-initrd.mount` in `/etc/fstab`. Other subvolumes or partitions must be configured either by Ignition or Combustion.

1.2 First boot detection

The deployment configuration runs on the first boot only. To distinguish between the first and subsequent boots, the flag file `/boot/writable/firstboot_happened` is created after the first boot finishes. If the file is not present in the file system, the attribute `ignition.firstboot` is passed to the kernel command line and thus both Ignition and Combustion are triggered to run (in the initrd). After completing the first boot, the `/boot/writable/firstboot_happened` flag file is created.

Note: The flag file is always created

Even though the configuration may not be successful because of improper or missing configuration files, the `/boot/writable/firstboot_happened` flag file is created.

1.2.1 Force system reconfiguration on a subsequent boot

If you need to reconfigure your system after the first boot happened, you can force the reconfiguration on the subsequent boot. Here you have two options.

- You can pass the `ignition.firstboot=1` attribute to the kernel command line.
- You can delete the flag file `/boot/writable/firstboot_happened`.

2 Deployment of SUSE Linux Micro

The deployment procedure of SUSE Linux Micro comprises three phases. Do not skip any of the phases and follow the order as stated below.

1. DASD disks activation—before you start the deployment, you need to ensure that all disks to be used are available and active. For details, refer to *Section 3, "Preparing the machine"*.
2. Preparing a configuration device—to configure the network, add users and register the system, prepare the configuration according to the instructions provided in *Section 4, "Preparing the configuration disk"*.
3. Downloading the SUSE Linux Micro image and deploying it on the disk. For details, refer to *Section 5, "Deploying the raw disk image on the DASD disk"*.

3 Preparing the machine

Before you start deploying SUSE Linux Micro, you need to check if all the three needed DASD disks are active. To check the disks' state, run the command:

```
# lsdasd

Bus-ID    Status    Name      Device  Type         BlkSz  Size      Blocks
==============================================================================
0.0.0100  active    dasda     94:0    ECKD         4096   30720MB   7864380
0.0.0101  active    dasdc     94:8    ECKD         4096   20480MB   5243040
0.0.0102  active    dasdb     94:4    ECKD         4096   5120MB    1310760
```

The 5 GB disk will be used as a configuration device, and the 20 GB disk is the disk where SUSE Linux Micro will be deployed.

If you do not see the disks in the command output, you need to activate the disks. To do so, proceed as follows:

1. Run the **`lszdev dasd`** to display a full list of devices:

   ```
   # lszdev dasd

   TYPE       ID        ON   PERS  NAMES
   dasd-eckd  0.0.0100  yes  no    dasda
   dasd-eckd  0.0.0101  no   no
   dasd-eckd  0.0.0102  no   no
   dasd-eckd  0.0.0190  no   no
   dasd-eckd  0.0.019d  no   no
   dasd-eckd  0.0.019e  no   no
   dasd-eckd  0.0.0592  no   no
   ```

2. Activate the disks by using the command:

   ```
   # chzdev -e DISK_ID
   ```

   For example, to activate the disk `0.0.0101`:

   ```
   # chzdev -e 0.0.0101
   ```

3. Verify that the disks are active in the output of the **`lsdasd`** command.

4 Preparing the configuration disk

Tip: Virtual versus physical disk

A virtual disk may be more suitable for production deployments, while a physical disk is better suited for development.

During the installation process, you can pass a complex configuration to define users, directories, or to provide SSH keys. To do so, create a configuration device that stores a complete configuration. The following example procedure describes how to create such a device:

1. Identify the 5 GB disk:

```
# lsdasd

Bus-ID    Status    Name      Device  Type         BlkSz  Size      Blocks
==============================================================================
0.0.0100  active    dasda     94:0    ECKD         4096   30720MB   7864380
0.0.0101  active    dasdc     94:8    ECKD         4096   20480MB   5243040
0.0.0102  active    dasdb     94:4    ECKD         4096   5120MB    1310760
```

   In the output above, the `Bus-ID` value of the disk to be used as a configuration device is *0.0.0102*. Use the value of `Bus-ID` or the disk size to identify the disk, as the device name (`/dev/dasdX`) can change after each reboot.

2. Format the disk. Keep in mind that formatting removes all data on that disk.

```
# dasdfmt -b 4096 -y -p /dev/dasdb
```

3. Create a partition:

```
# parted /dev/dasdb mkpart ext2 0% 100%
```

4. Format the partition:

```
# mkfs.ext4 /dev/dasdb1
```

5. Label the partition as `ignition`:

```
# e2label /dev/dasdb1 ignition
```

6. Verify the file system:

```
# blkid
```

7. Mount the partition:

```
# mount /dev/dasdb1 /mnt
```

8. Prepare the directory structure for Ignition and/or Combustion. For Ignition:

```
# mkdir -p  /mnt/ignition
```

   For Combustion:

```
# mkdir -p /mnt/combustion
```

9. Copy your public SSH key to `/mnt/combustion` as `ssh_key.pub`.
10. Prepare the configuration as described further.

4.1 Configuring SUSE Linux Micro deployment with Combustion

Combustion is a dracut module that enables you to configure your system on the first boot. You can use Combustion, for example, to change the default partitions, set user passwords, create files, or install packages.

4.1.1 How does Combustion work?

Combustion is invoked after the `ignition.firstboot` argument is passed to the kernel command line. Combustion reads a provided file named `script`, executes included commands, and thus performs changes to the file system. If `script` includes the network flag, Combustion tries to configure the network. After `/sysroot` is mounted, Combustion tries to activate all mount points in `/etc/fstab` and then calls **`transactional-update`** to apply other changes, for example, setting `root` password or installing packages.

The configuration file `script` must reside in the `combustion` subdirectory on the configuration media labeled `combustion`. The directory structure must look as follows:

```
<root directory>
└── combustion
    └── script
```

```
    └── other files
```

Tip: Using Combustion together with Ignition

Combustion can be used along with Ignition. If you intend to do so, label your configuration medium `ignition` and include the `ignition` directory with the `config.ign` to your directory structure as shown below:

```
<root directory>
└── combustion
    └── script
    └── other files
└── ignition
    └── config.ign
```

In this scenario, Ignition runs before Combustion.

4.1.2 Combustion configuration examples

4.1.2.1 The `script` configuration file

The `script` configuration file is a set of commands that are parsed and executed by Combustion in a **`transactional-update`** shell. This article provides examples of configuration tasks performed by Combustion.

Important: Include interpreter declaration

As the `script` file is interpreted by the shell, always start the file with the interpreter declaration on its first line. For example, in case of Bash:

```
#!/bin/bash
```

To log in to your system, include at least the `root` password. However, it is recommended to establish the authentication using SSH keys. If you need to use a `root` password, make sure to configure a secure password. For a randomly generated password, use at least 10 characters. If you create your password manually, use even more than 10 characters and combine uppercase and lowercase letters and numbers.

4.1.2.1.1 Network configuration

To configure and use the network connection during the first boot, add the following statement to `script`:

```
# combustion: network
```

Using this statement passes the `rd.neednet=1` argument to dracut. The network configuration defaults to using DHCP. If a different network configuration is needed, proceed as described in *Section 4.1.2.1.2, "Performing modifications in the initramfs"*.

If you do not use the statement, the system remains configured without any network connection.

4.1.2.1.2 Performing modifications in the initramfs

You may need to perform changes to the initramfs environment, for example, to write a custom network configuration for NetworkManager into `/etc/NetworkManager/system-connections/`. To do so, use the `prepare` statement.

For example, to create a connection with a static IP address and configure DNS:

```
#!/bin/bash
# combustion: network prepare
set -euxo pipefail

nm_config() {
  umask 077 # Required for NM config
  mkdir -p /etc/NetworkManager/system-connections/
  cat >/etc/NetworkManager/system-connections/static.nmconnection <<-EOF
  [connection]
  id=static
  type=ethernet
  autoconnect=true

  [ipv4]
  method=manual
  dns=192.168.100.1
  address1=192.168.100.42/24,192.168.100.1
EOF
}

if [ "${1-}" = "--prepare" ]; then
  nm_config # Configure NM in the initrd
  exit 0
fi
```

```
# Redirect output to the console
exec > >(exec tee -a /dev/tty0) 2>&1

  nm_config # Configure NM in the system
  curl example.com
# Leave a marker
echo "Configured with combustion" > /etc/issue.d/combustion
```

4.1.2.1.3 Partitioning

SUSE Linux Micro raw images are delivered with a default partitioning scheme as described in *Section 1.1, "Default partitioning"*. You might want to use a different partitioning. The following set of example snippets moves the `/home` to a different partition.

Note: Performing changes outside of directories included in snapshots

The following script performs changes that are not included in snapshots. If the script fails and the snapshot is discarded, certain changes remain visible and cannot be reverted, for example, the changes to the `/dev/vdb` device.

The following snippet creates a GPT partitioning schema with a single partition on the `/dev/vdb` device:

```
sfdisk /dev/vdb <<EOF
label: gpt
type=linux
EOF

partition=/dev/vdb1
```

The partition is formatted to Btrfs:

```
wipefs --all ${partition}
mkfs.btrfs ${partition}
```

Possible content of `/home` is moved to the new `/home` folder location by the following snippet:

```
mount /home
mount ${partition} /mnt
rsync -aAXP /home/ /mnt/
umount /home /mnt
```

The snippet below removes an old entry in `/etc/fstab` and creates a new entry:

```
awk -i inplace '$2 != "/home"' /etc/fstab
echo "$(blkid -o export ${partition} | grep ^UUID=) /home btrfs defaults 0 0" >>/etc/
fstab
```

4.1.2.1.4 Creating new users

As some services, such as Cockpit, require login using a non-root user, define at least one unprivileged user here. Alternatively, you can create such a user from a running system as described in *Section 6.2, "Adding users"*.

To add a new user account, first create a hash string that represents the user's password. Use the **`openssl passwd -6`** command.

After you obtain the password hash, add the following lines to the `script`:

```
mount /home
useradd -m EXAMPLE_USER
echo 'EXAMPLE_USER:PASSWORD_HASH' | chpasswd -e
```

4.1.2.1.5 Setting a password for `root`

Before you set the `root` password, generate a hash of the password, for example, by using the **`openssl passwd -6`**. To set the password, add the following line to the `script`:

```
echo 'root:PASSWORD_HASH' | chpasswd -e
```

4.1.2.1.6 Adding SSH keys

The following snippet creates a directory to store the `root`'s SSH key and then copies the public SSH key located on the configuration device to the `authorized_keys` file.

```
mkdir -pm700 /root/.ssh/
cat id_rsa_new.pub >> /root/.ssh/authorized_keys
```

Note

The SSH service must be enabled in case you need to use remote login via SSH. For details, refer to *Section 4.1.2.1.7, "Enabling services"*.

4.1.2.1.7 Enabling services

To enable system services, for example, the SSH service, add the following line to `script`:

```
systemctl enable sshd.service
```

4.1.2.1.8 Installing packages

Important: Network connection and registering your system may be necessary

As certain packages may require additional subscription, you may need to register your system beforehand. An available network connection may also be needed to install additional packages.

During the first boot configuration, you can install additional packages to your system. For example, you can install the `vim` editor by adding:

```
zypper --non-interactive install vim-small
```

Note

Bear in mind that you will not be able to use **`zypper`** after the configuration is complete and you boot to the configured system. To perform changes later, you must use the **`transactional-update`** command to create a changed snapshot.

4.1.2.2 A complete example of the `script` file

The following `script` provides complete settings that may serve you as a guide on how to write your own Combustion configuration. The example does not require any further Ignition configuration.

```
    #!/bin/bash
    # combustion: network prepare


    set -euxo pipefail

    ## The OSA subchannels to enable
```

```
   ZNET_SUBCHANNELS=0.0.1000,0.0.1001,0.0.1002

   ## Network information to configure
   IPADDRESS="10.144.64.155/24" ## Formet is ipaddress/cidr
   GATEWAY="10.144.64.254"
   NAMESERVERS="10.144.53.53;10.144.53.54" ## A semicolon-separated list of name servers

   ## Hostname information
   NODE_HOSTNAME="micro6"

   ## Add password for root user
   ## Use either 'openssl passwd -6' or 'mkpasswd --method=sha-512' to encrypt the
password.
   ROOT_USER_PASSWORD='PASSWORD_HASH'
   SSH_ROOT_PUBLIC_KEY=ssh_key.pub

   ## Add a regular user, because root login may be disallowed in some services.
   CREATE_NORMAL_USER=user ## Replace the "user" with a desired username here.
   NORMAL_USER_PASSWORD='PASSWORD_HASH'
   SSH_USER_PUBLIC_KEY=ssh_key.pub

   ## Register to SUSE Customer Center and install additional packages
   REG_EMAIL='tux@suse.com' ## Email address for product registration
   SLMICRO_REGCODE='REGISTRATIONCODE' ## A registration code required to install
additional packages
   ADDITIONAL_PACKAGES='' ## A space separated list of additional packages to install


   nm_config() {
     umask 077 # Required for Network Manager configuration
     mkdir -p /etc/NetworkManager/system-connections/
     cat >'/etc/NetworkManager/system-connections/Wired connection 1.nmconnection' <<EOF
     [connection]
     id=static
     type=ethernet
     autoconnect=true

     [ipv4]
     method=manual
     address1=$IPADDRESS
     gateway=$GATEWAY
     dns=$NAMESERVERS
   EOF
   }

   if [ "${1-}" = "--prepare" ]; then
     # Configure Network Manager in the initrd
```

```
    nm_config
    # Enable OSA network devices
    chzdev qeth $ZNET_SUBCHANNELS -ep
    chzdev qeth $ZNET_SUBCHANNELS -e
    exit 0
  fi



  ## Post output on stdout
  exec > >(exec tee -a /dev/ttyS0) 2>&1

  ## Set hostname
  echo $NODE_HOSTNAME > /etc/hostname

  ## Set root password
  echo root:$ROOT_USER_PASSWORD | chpasswd -e
  ## Add ssh public key as authorized key for the root user
  mkdir -pm700 /root/.ssh/
  cat $SSH_ROOT_PUBLIC_KEY >> /root/.ssh/authorized_keys

  ## Mount /var and /home so user can be created smoothly
  if [ "$CREATE_NORMAL_USER" ]
  then
    mount /var && mount /home
  fi
  ## User creation
  if [ "$CREATE_NORMAL_USER" ]
  then
    echo "User creation is requested, creating user."
    useradd -m $CREATE_NORMAL_USER -s /bin/bash -g users
    echo $CREATE_NORMAL_USER:$NORMAL_USER_PASSWORD | chpasswd -e
    echo $CREATE_NORMAL_USER "ALL=(ALL) NOPASSWD: ALL" >> /etc/sudoers.d/adminusers
    mkdir -pm700 /home/$CREATE_NORMAL_USER/.ssh/
    chown -R $CREATE_NORMAL_USER:users /home/$CREATE_NORMAL_USER/.ssh/
    cat $SSH_USER_PUBLIC_KEY >> /home/$CREATE_NORMAL_USER/.ssh/authorized_keys
    echo "Requested user has been created, requested password has been set."
  else
    echo "No user will be created"
  fi

  # Configure NM in the system
  nm_config
  # Enable OSA network device
  chzdev qeth $ZNET_SUBCHANNELS -ep
  chzdev qeth $ZNET_SUBCHANNELS -e
```

```
## Enable services
echo "Enabling services."
systemctl enable cockpit.socket
systemctl enable sshd

## Unmount var and home
if [ "$CREATE_NORMAL_USER" ]
then
  umount /var && umount /home
fi


echo "Configured with Combustion at $(date)" > /etc/issue.d/combustion
```

4.2 Configuring SUSE Linux Micro deployment with Ignition

Ignition (https://coreos.github.io/ignition/) is a provisioning tool that enables you to configure a system according to your specification on the first boot.

4.2.1 How does Ignition work?

When the system is booted for the first time, Ignition is loaded as part of an `initramfs` and searches for a configuration file within a specific directory (on a USB flash disk, or you can provide a URL). All changes are performed before the kernel switches from the temporary file system to the real root file system (before the `switch_root` command is issued).

Ignition uses a configuration file in the JSON format named `config.ign`. You can either write the configuration manually or use the Fuel Ignition Web application at https://ignite.opensuse.org to generate it.

Important

Fuel Ignition does not cover the complete Ignition vocabulary yet, and the resulting JSON file may need additional manual tweaking.

4.2.1.1 `config.ign`

The configuration file `config.ign` must reside in the `ignition` subdirectory on the configuration media, for example, a USB stick labeled `ignition`. The directory structure must look as follows:

```
<root directory>
└── ignition
    └── config.ign
```

Tip

To create a disk image with the Ignition configuration, you can use the Fuel Ignition Web application at https://ignite.opensuse.org.

The `config.ign` contains multiple data types: objects, strings, integers, booleans and lists of objects. For a complete specification, refer to Ignition specification v3.3.0 (https://coreos.github.io/ignition/configuration-v3_3/).

The `version` attribute is mandatory and in case of SUSE Linux Micro, its value must be set either to `3.3.0` or to any lower version. Otherwise, Ignition will fail.

To log in to your system as `root`, you must at least include a password for `root`. However, it is recommended to establish access via SSH keys. To configure a password, make sure to use a secure one. If you use a randomly generated password, use at least 10 characters. If you create your password manually, use even more than 10 characters and combine uppercase and lowercase letters and numbers.

4.2.2 Ignition configuration examples

4.2.2.1 Configuration examples

This section provides several examples of the Ignition configuration in the built-in JSON format.

Important

Section 1.1, "Default partitioning" lists subvolumes that are mounted by default when running the pre-built image. If you want to add a new user or modify any of the files on a subvolume that is not mounted by default, you need to declare such subvolume first so that it is mounted as well. Find more details about mounting file systems in *Section 4.2.2.1.1.3, "The `filesystems` attribute"*.

Note: The `version` attribute is mandatory

Each `config.fcc` must include version 1.4.0 or lower that is then converted to the corresponding Ignition specification.

4.2.2.1.1 Storage configuration

The `storage` attribute is used to configure partitions, RAID, define file systems, create files, etc. To define partitions, use the `disks` attribute. The `filesystems` attribute is used to format partitions and define mount points of particular partitions. The `files` attribute can be used to create files in the file system. Each of the mentioned attributes is described in the following sections.

4.2.2.1.1.1 The `disks` attribute

The `disks` attribute is a list of devices that enables you to define partitions on these devices. The `disks` attribute must contain at least one `device`, other attributes are optional. The following example uses a single virtual device and divides the disk into four partitions:

```
{
  "ignition": {
    "version": "3.0.0"
  },
  "storage": {
    "disks": [
      {
        "device": "/dev/vda",
        "partitions": [
          {
            "label": "root",
            "number": 1,
```

```
            "typeGuid": "4F68BCE3-E8CD-4DB1-96E7-FBCAF984B709"
          },
          {
            "label": "boot",
            "number": 2,
            "typeGuid": "BC13C2FF-59E6-4262-A352-B275FD6F7172"
          },
          {
            "label": "swap",
            "number": 3,
            "typeGuid": "0657FD6D-A4AB-43C4-84E5-0933C84B4F4F"
          },
          {
            "label": "home",
            "number": 4,
            "typeGuid": "933AC7E1-2EB4-4F13-B844-0E14E2AEF915"
          }
        ],
        "wipeTable": true
      }
    ]
  }
}
```

4.2.2.1.1.2 The `raid` attribute

The `raid` is a list of RAID arrays. The following attributes of `raid` are mandatory:

level
: a level of the particular RAID array (linear, raid0, raid1, raid2, raid3, raid4, raid5, raid6)

devices
: a list of devices in the array referenced by their absolute paths

name
: a name that will be used for the md device

For example:

```
{
  "ignition": {
    "version": "3.0.0"
  },
  "storage": {
```

```
    "raid": [
      {
        "devices": [
          "/dev/sda",
          "/dev/sdb"
        ],
        "level": "raid1",
        "name": "system"
      }
    ]
  }
}
```

4.2.2.1.1.3 The `filesystems` attribute

`filesystems` must contain the following attributes:

device

the absolute path to the device, typically `/dev/sda` in case of physical disk

format

the file system format (Btrfs, Ext4, xfs, vfat or swap)

Note

In case of SUSE Linux Micro, the `root` file system must be formatted to Btrfs.

The following example demonstrates using the `filesystems` attribute. The `/opt` directory will be mounted to the `/dev/sda1` partition, which is formatted to Btrfs. The device will not be erased.

For example:

```
{
  "ignition": {
    "version": "3.0.0"
  },
  "storage": {
    "filesystems": [
      {
        "device": "/dev/sda1",
        "format": "btrfs",
        "path": "/opt",
```

```
        "wipeFilesystem": false
      }
    ]
  }
}
```

Normally, a regular user's home directory is located in the `/home/USER_NAME` directory. Since `/home` is not mounted by default in the initrd, the mount has to be explicitly defined for the user creation to succeed:

```
{
  "ignition": {
    "version": "3.1.0"
  },
  "passwd": {
    "users": [
      {
        "name": "root",
        "passwordHash": "PASSWORD_HASH",
        "sshAuthorizedKeys": [
          "ssh-rsa SSH_KEY_HASH"
        ]
      }
    ]
  },
  "storage": {
    "filesystems": [
      {
        "device": "/dev/sda3",
        "format": "btrfs",
        "mountOptions": [
          "subvol=/@/home"
        ],
        "path": "/home",
        "wipeFilesystem": false
      }
    ]
  }
}
```

4.2.2.1.1.4 The `files` attribute

You can use the `files` attribute to create any files on your machine. Bear in mind that to create files outside the default partitioning schema, you need to define the directories by using the `filesystems` attribute.

In the following example, a host name is created by using the `files` attribute. The file `/etc/hostname` will be created with the *sl-micro1* host name:

Important

Keep in mind that JSON accepts file modes in decimal numbers, for example, `420`.

JSON:

```
{
  "ignition": {
    "version": "3.0.0"
  },
  "storage": {
    "files": [
      {
        "overwrite": true,
        "path": "/etc/hostname",
        "contents": {
          "source": "data:,sl-micro1"
        },
        "mode": 420
      }
    ]
  }
}
```

4.2.2.1.1.5 The `directories` attribute

The `directories` attribute is a list of directories that will be created in the file system. The `directories` attribute must contain at least one `path` attribute.

For example:

```
{
  "ignition": {
    "version": "3.0.0"
  },
  "storage": {
    "directories": [
      {
        "path": "/home/tux",
        "user": {
          "name": "tux"
```

```
        }
      }
    ]
  }
}
```

4.2.2.1.2 Users administration

The `passwd` attribute is used to add users. As some services, such as Cockpit, require login using a non-root user, define at least one unprivileged user here. Alternatively, you can create such a user from a running system as described in *Section 6.2, "Adding users"*.

To log in to your system, create `root` and a regular user and set their passwords. You need to hash the passwords, for example, by using the **`openssl`** command:

```
openssl passwd -6
```

The command creates a hash of the password you chose. Use this hash as the value of the `password_hash` attribute.

For example:

```
{
  "ignition": {
    "version": "3.0.0"
  },
  "passwd": {
    "users": [
      {
        "name": "root",
        "passwordHash": "PASSWORD_HASH",
        "sshAuthorizedKeys": [
          "ssh-rsa SSH_KEY_HASH USER@HOST"
        ]
      }
    ]
  }
}
```

The `users` attribute must contain at least one `name` attribute. `ssh_authorized_keys` is a list of ssh keys for the user.

4.2.2.1.3 Enabling `systemd` services

You can enable `systemd` services by specifying them in the `systemd` attribute.

For example:

```
{
  "ignition": {
    "version": "3.0.0"
  },
  "systemd": {
    "units": [
      {
        "enabled": true,
        "name": "sshd.service"
      }
    ]
  }
}
```

4.2.2.2 Converting YAML formatted files into JSON

JSON is a universal file format for storing structured data. Applications, for example, Ignition, use it to store and retrieve their configuration. Because JSON's syntax is complex and hard to read for human beings, you can write the configuration in a more friendly format called YAML and then convert it into JSON.

4.2.2.2.1 Converting YAML files into JSON format

The tool that converts Ignition-specific vocabularies in YAML files into JSON format is `butane`. It also verifies the syntax of the YAML file to catch potential errors in the structure. For the latest version of `butane`, add the following repository:

```
> sudo  zypper ar -f \
  https://download.opensuse.org/repositories/devel:/kubic:/ignition/openSUSE_Tumbleweed/
 \
  devel_kubic_ignition
```

Replace `openSUSE_Tumbleweed` with one of the following (depending on your distribution):

- `'openSUSE_Leap_$releasever'`
- `15.5`

Now you can install the `butane` tool:

```
> sudo  zypper ref && zypper in butane
```

After the installation is complete, you can invoke `butane` by running:

```
>  butane -p -o config.ign config.fcc
```

- `config.fcc` is the path to the YAML configuration file.
- `config.ign` is the path to the output JSON configuration file.
- The `-p` command option adds line breaks to the output file and thus makes it more readable.

5 Deploying the raw disk image on the DASD disk

To deploy the SUSE Linux Micro to the 20 GB DASD disk, proceed as follows:

1. Download the raw disk image using **`wget`** or **`curl`**. For example:

   ```
   > curl -L0kO
   ```

2. Extract the image:

   ```
   > unpack xz -d BUILD_IDENTIFICATION.raw.xz
   ```

3. Export a variable that finds and stores the 20 GB device name.

   ```
   # export SMDASD=$(lsdasd -s | grep 20480MB | tr -s [:blank:] | cut -d' ' -f3)
   ```

4. Format the disk:

   - If the disk is formatted for the first time:

     ```
     # dasdfmt -b 4096 -y -p /dev/$SMDASD
     ```

   - If the disk was previously formatted:

     ```
     # dasdfmt -b 4096 -M quick -y -p /dev/$SMDASD
     ```

5. Copy the raw disk image to the disk (the device name is /dev/dasdc in our case):

   ```
   dd if=IMAGE_NAME.raw status=progress  of=/dev/dasdc bs=4k
   ```

6. Shut down the running Linux:

```
# init 0
```

7. Start SUSE Linux Micro by booting the second DASD minidisk in an x3270 terminal:

```
# ipl 101
```

6 Post-deployment steps

6.1 Registering SUSE Linux Micro from CLI

If your system was not registered during the deployment process by using the Combustion `script`, you can register from the running system.

To register SUSE Linux Micro with SUSE Customer Center, proceed as follows:

1. Run **`transactional-update register`** as follows:

```
# transactional-update register -r REGISTRATION_CODE -e EMAIL_ADDRESS
```

   To register with a local registration server, additionally provide the URL to the server:

```
# transactional-update register -r REGISTRATION_CODE -e EMAIL_ADDRESS \
 --url "https://suse_register.example.com/"
```

   Replace *`REGISTRATION_CODE`* with the registration code you received with your copy of SUSE Linux Micro. Replace *`EMAIL_ADDRESS`* with the e-mail address associated with the SUSE account you or your organization uses to manage subscriptions.

2. Reboot your system to switch to the latest snapshot.

3. SUSE Linux Micro is now registered.

Note: Other registration options

For information that goes beyond the scope of this section, refer to the inline documentation with **`SUSEConnect --help`**.

6.2 Adding users

As SUSE Linux Micro requires having a non-privileged user to log in via SSH or to access Cockpit, you need to create such an account.

This step is optional if you have defined an unprivileged user in the Combustion.

1. Run the `useradd` command as follows:

```
#
useradd -m USER_NAME
```

2. Set a password for that account:

```
# passwd USER_NAME
```

3. If needed, add the user to the `wheel` group:

```
# usermod -aG wheel USER_NAME
```

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