

Zero Touch Deployment of Open Dell Switches with SONiC

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White Paper

Abstract

This white paper helps implement a zero touch deployment with a turnkey network staging experience. Digital transformations require a fast time to market with little room for error using streamlined processes with a high degree of automation.

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Introduction

Executive summary

IT workforces are under great pressure in our digital era. They must deliver their services in a short time, and high quality is expected. Infrastructure deployment and life cycle management should be fast and feasible on a large scale. Cloud application development, deployment, and change management has shifted from manual control to an Infrastructure as Code (IaC) way of working. This change demands optimizations in the underlying infrastructure components, specifically life cycle management of network switches.

Zero touch provisioning (ZTP) allows for the secure deployment of network switching infrastructure from a central management point using a fully automated workflow, eliminating human error, and reducing manual labor. The following are examples of use cases that ZTP supports:

- Turnkey infrastructure deployment and configuration without user intervention
- Upgrade your SONiC infrastructure with a simple ZTP run task
- Replace a broken switch
- Upgrade switches from another third-party NOS to SONiC
- Reinstall an unresponsive SONiC switch
- Reinstall a SONiC switch with lost configuration
- Reset a SONiC switch to clean fabric default status
- Run compliance and quality tasks before letting a switch become operational

This whitepaper guides network staff on how to set up zero touch deployment (ZTD) for a Dell switch with Software for Open Networking in the Cloud (SONiC) step by step. ZTP examples, diagnostics, and monitoring screenshots are all inclusive. After finishing this guide, you will understand ZTD on SONiC and can decide whether this is a valuable addition to your network infrastructure.

Audience

This document is intended for the following Dell-related companies:

- Customers
- Partner
- Internal

This document is intended for the following IT staff roles of the company:

- Network architects
- Network engineers
- Security engineers
- NetOps engineers
- DevOps engineers
- Solution architects

- System engineers
- IT managers
- COO
- CIO
- CISO
- CTO

Solution overview

SONiC has become a standard for open-source networking, similar to how Linux has become an operating system of choice for application serving. SONiC has all the ingredients to fit in a NetDevOps culture. Cloud native architecture, open-sourced, unmodified Debian Linux, purpose build for commodity hardware, and a broad set of API control elements give SONiC the ideal networking operating system to use as a foundation in your infrastructure. All you need is to unlock the Zero touch deployment (ZTD) capabilities of the network switch and the operating system to optimize network staging and life-cycle management.

Dell Technologies has embraced open-source networking on their network switches by delivering an enterprise-grade version of SONiC. With this initiative, customers can benefit from an open-source network operating system with enterprise-grade quality and support.

This whitepaper explains how to install a Dell network switch with the SONiC operating system by using ZTD functionality. You will learn how to get a factory default switch up and running with SONiC in a matter of minutes. You will also be able to equip your environment with SONiC-based network switches and establish an operational environment at scale with central management. Firmware installation, firmware upgrades and downgrades, and base configuration installation is all available with ZTD.

This whitepaper includes zero touch provisioning (ZTP) examples, diagnostics, and monitoring screenshots. After finishing this guide, you will feel confident in your understanding of ZTD on SONiC, and you can decide for yourself that this is a valuable addition to your network infrastructure.

Note: Zero touch deployment (ZTD) and zero touch provisioning (ZTP) are used interchangeably. Both have the same meaning.

Terminology

Acronym	Definition
DHCP	Dynamic host configuration protocol
DNS	Domain name system
HTTP	Hypertext Transfer Protocol
IP	Internet protocol
ONIE	Open network install environment
NOS	Network operating system
OS	Operating system

Acronym	Definition
SONiC	Software for Open Networking in the Cloud
URL	Uniform resource locator
ZTD	Zero touch deployment
ZTP	Zero touch provisioning

Zero Touch Deployment of SONiC

Figure 1 explains the ZTP staging flow of a Dell switch. ZTP capability is a function of the operating system involved, which in this whitepaper is SONiC. However, Dell switches are called open network switches. The switches are factory default equipped with a tiny operating system (OS) called Open Network Install Environment (ONIE). ONIE is installed on the switch and is the first OS that is booted when you turn on the switch. ONIE gives the switch the openness to install a third-party NOS. This whitepaper concentrates on installing SONiC.

Take a closer look into what happens when you power on a factory default switch which has ONIE installed. The following numbers correspond to the numbers in figure 1.

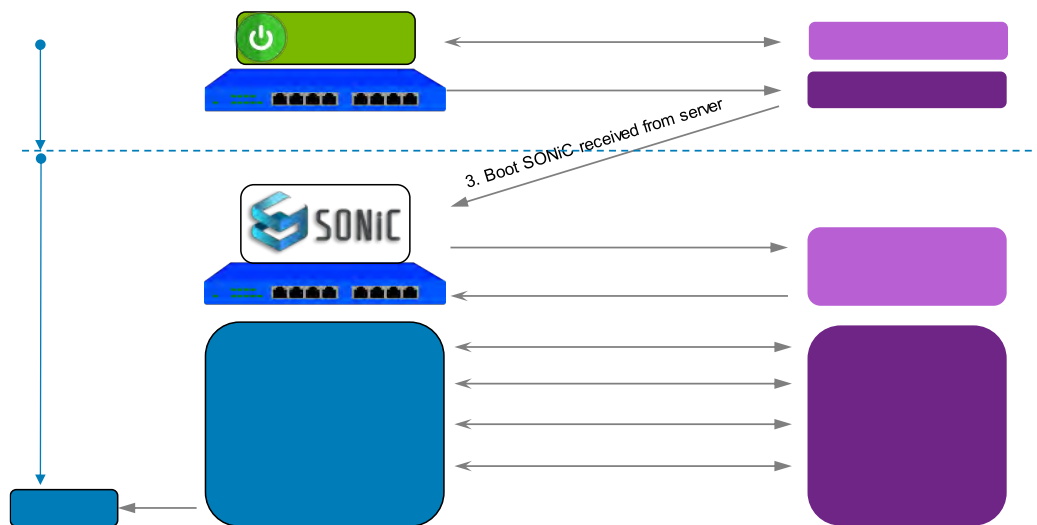


Figure 1. Zero Touch Deployment flow explained

Staging flow overview

1. ONIE loads and requests an IP address using DHCP.
2. Based on the platform details ONIE discovers, it tries to fetch a NOS based on various URL names. If a NOS image is offered by the web server, it proceeds to step 3. When all URL names ONIE tries do not find a match on the webserver, the discovery process starts over.
3. ONIE downloads the NOS (in this case SONiC) offered by the webserver.
4. The switch reboots, loads SONiC, and requests an IP address using DHCP.

5. The DHCP server offers an IP address and option 67, which contains a ZTP URL pointing to a json file for SONiC.
6. SONiC requests the ZTP json file, which contains details for subsequent optional ZTP tasks.
7. If firmware install is defined in the json file, ONIE requests an upgrade/downgrade of the SONiC firmware image, install, and reboot.
8. If config-db is defined in the json file, ONIE requests the SONiC configfile and configures SONiC.
9. If provisioning-script is defined in json file, ONIE requests and runs the script.
10. When the provisioning is completed, the ZTP flow is also completed. The switch is now operational with SONiC.

Note: When ZTP has finished, the ZTP mode is disabled, and normal startup occurs if switch is restarted.

ONIE-based discovery only occurs if no NOS is found on the switch.

M	Z	y	'	&&	'
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Compatible Dell switches

ZTD with SONiC is applicable to all Dell switches that are used with an ONIE bootloader and support the SONiC operating system.

At the time of writing this document, the following are qualified SONiC capable switches:

- 400G — Z9432F-ON, Z9332F-ON, Z9664F-ON (support from SONiC 4.1)
- 100G — Z9100F-ON, Z9264F-ON, S5232F-ON, S5448F-ON (support from SONiC 4.1)
- 25G — S5296F-ON, S5248F-ON, S5224F-ON, S5212F-ON
- 10G — E3248PXE-ON
- 1G — E3248P-ON, N3248TE-ON

ZTP requirements

To build a ZTP environment, the following devices and workloads were used in the lab:

- Linux VM on VMware vSphere
 - VMware vSphere 6.7.0.50000
 - Ubuntu 20.04.4 LTS
 - Docker 20.10.16
 - Docker Compose 1.25.0
 - Docker Hub images
 - HTTPD service: enonicio/apache2
 - DHCP service: rackhd/isc-dhcp-server
- Dell SONiC Enterprise image
 - 'Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin'
- Dell Z9100 switch (or another Z- or S- type switch)

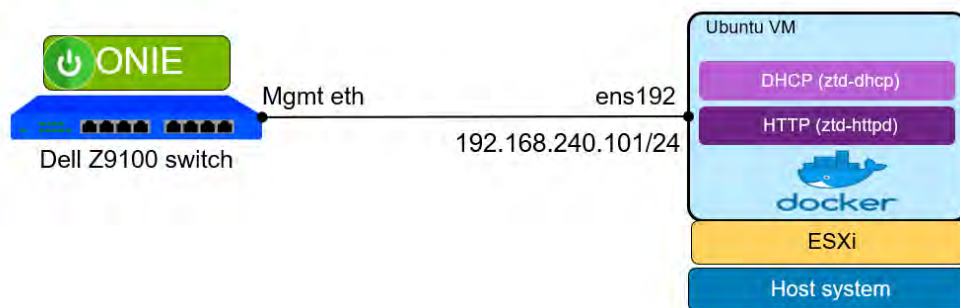


Figure 2. ZTD setup for SONiC

Note: It is the reader's responsibility to use other resources or equipment than those described in this whitepaper. Other than Ubuntu, there are numerous Linux distributions.

While a VM was used on VMware, it could also be used on KVM or bare metal.

Container setup for the web and DHCP service is not mandatory but was used in this environment. The webserver and DHCP servers could also be used as: Bare metal servers, VM-based, or bundled on one host or dedicated per service.

Following the exact steps with same resources and versioning will yield correct end results.

ZTP is also successfully tested on a GNS3 environment; however, firmware upgrade is not available on a GNS3 image. Config install and provisioning script execution will work as expected.

Assumptions

Before starting the setup of the ZTP environment, it is assumed you have set up a fresh Ubuntu Linux server, including:

- Configured IP address 192.168.240.101/24 on the Ethernet interface
- Internet connectivity
- Layer3 link between the server and the Dell switch

Set up essential Linux packages

If Docker and Docker Compose are already available on the Linux VM, proceed to the next chapter; otherwise, perform the following steps to put the Linux VM in the correct state:

```
sudo apt update
sudo apt install net-tools -y
sudo apt install -y apt-transport-https ca-certificates curl
software-properties-common
sudo add-apt-repository "deb [arch=amd64]
https://download.docker.com/linux/ubuntu focal stable"
sudo apt update
sudo apt-cache policy docker-ce
sudo apt install -y docker-ce docker-compose systemctl status
docker -n0
sudo usermod -aG docker ${USER}
```

Create /tftpboot root folder for webserver

Perform the following steps to create /tftpboot folder structure:

```
sudo mkdir /tftpboot && cd tftpboot
sudo mkdir sonic && cd sonic
sudo mkdir config firmware postscript ztp
sudo chown -R www-data.www-data /tftpboot
```

DHCP server configfile setup

Create a /etc/dhcpd.conf file and ensure the following items are included:

```
default-lease-time 600;
    max-lease-time 1800;
    ddns-update-style none;
    authoritative;
    option domain-name-servers 8.8.8.8; #Put in the name-servers
you would like
    option ztp_json_url code 67 = text; #SONiC option for ztp
offering
```

```

        #This is the subnet where the switch management interfaces
        connect to
        subnet 192.168.240.0 netmask 255.255.255.0 {
            option routers 192.168.240.254;
        }

        group {
            host ztd-SONiC-Z9100 {
                hardware ethernet 4c:76:25:e8:29:c0; #<<< PUT mac
                addresss of your switch mgmt eth
                fixed-address 192.168.240.111;
                option ztp_json_url
                "http://192.168.240.101/tftpboot/sonic/ztp/ztp_data_with_firmware.
                json ";
            }
        }

```

Docker-compose configfile setup

To smoothly create and destroy the containers for the webserver and the DHCP server, a docker-compose.yml file is required. Create this file in your preferred location. For example, you could use your /home folder. In this case, we have placed the file in /home/ztd/ztdserver/.

```

version: '3'
services:
    ztd-httpd:
        restart: always
        image: "enonicio/apache2"
        ports:
            - "80:80"
            - "443:443"
        volumes:
            - /etc/dhcp:/etc/dhcp
            - /tftpboot:/var/www/html
    ztd-dhcpd:
        restart: always
        image: rackhd/isc-dhcp-server
        volumes:
            - /var/lib/dhcp:/var/lib/dhcp
            - /etc/dhcp:/etc/dhcp
        network_mode: "host"

```

The command used to start services (from where docker-compose.yml file resides):

```
cd /home/ztd/ztdserver/ && docker-compose up &
```

The command used to stop services (from where docker-compose.yml file resides):

```
cd /home/ztd/ztdserver/ && docker-compose down &
```

Note: Use spaces instead of tabs when you create a YAML file; otherwise, you will get errors when the file is used by docker-compose.

Always start the services from within the location where the docker-compose.yml file resides.

The first time you start docker-compose, the images are pulled from dockerhub. Subsequent starts will use a local copy of the image to create a container.

Store SONiC images in web root

The Dell Enterprise SONiC image needs to be uploaded to the /tftpboot folder. Dell uses two images in this lab:

- The default image for the factory default installs and when all NOS have been removed:
- Enterprise_SONiC_OS_3.5.2_Enterprise_Premium.bin
- Desired upgrade image for the production network:
- Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin

Upload these files into the web server firmware directory. You can do this with SCP from command line:

```
scp ./Enterprise_SONiC_OS_3.5.2_Enterprise_Premium.bin
ztd@192.168.240.101:
mv /home/ztd/Enterprise_SONiC_OS_3.5.2_Enterprise_Premium.bin
/tftpboot/sonic/firmware/
```

```
scp ./Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin
ztd@192.168.240.101:
mv /home/ztd/Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin
/tftpboot/sonic/firmware/
```

When ONIE does the factory default start it will search for discovery image names. You need to have a default image that can be used when ONIE requests such a discovery image. Create a symbolic link for this pointing to the SONiC 3.5.2 image. This can be the default image which is picked for factory new switches that do not have a NOS yet.

In our example setup, we named the link onie-installer-x86_64.

```
cd /tftpboot
ln -s
sonic/firmware/Enterprise_SONiC_OS_3.5.2_Enterprise_Premium.bin
onie-installer-x86_64
```

When ONIE does a discovery and execution, it will fetch `http://192.168.204.101/onie-installer-x86_64`

SONiC ZTP json file

The SONiC ZTP json datafile is consumed by SONiC to perform desired tasks during ZTP staging. For this setup, create the file `/tftpboot/sonic/ztp/ztp_data_with_firmware.json`.

ZTP staging involves the following tasks:

- Firmware upgrade if needed
- Install the basic config file `first_boot_config.json`
- Run a provisioning script that will hint to the server that the ZTP staging has finished
- Configure a hostname.

```
{
  "ztp": {
    "firmware": {
      "install": {
        "url":
"http://192.168.240.101/tftpboot/sonic/firmware/Enterprise_SONiC_O
S_4.0.0_Enterprise_Premium.bin",
        "set-default": true
      },
      "reboot-on-success": true,
    },
    "configdb-json": {
      "url": {
        "source":
"http://192.168.240.101/tftpboot/sonic/config/first_boot_config.js
on",
        "destination": "/etc/sonic/config_db.json",
        "secure": false
      },
      "clear-config" : false
    },
    "provisioning-script": {
      "plugin": {
        "url": "http://192.168.240.101/tftpboot/sonic/postscript/postscript
_simple.sh"
      },
      "reboot-on-success": false
    }
  }
}
```

Note: The firmware stanza should be used when you have SONiC already in production and you would like to upgrade your fleet of switches to another SONiC version. You activate the ZTP process with the `sudo ztp enable && sudo ztp run -y` command line. If the requested

version equals the running version, it will only download the image and silently discard the firmware.

SONiC config_db

SONiC stores its configuration default in `/etc/sonic/config_db.json`. You can merge your settings into the configuration, or you can overwrite the file completely. The settings of this file are in json. The settings in the following example were prepared to be merged into the default configuration. Keys that are already defined in the on-box configuration are replaced by the ones in the ZTP prepared config file. Store this file as: `/tftboot/sonic/config/first_boot_config.json`.

Note: Keep in mind that the initial config is only a staging config. Normally, the use case is to have a secure minimum configuration loaded, which ensures that the switch can be managed remotely. You could set specific usernames or passwords, setup or specific access-lists, or protocol activation as a minimum. Then, finish the final configuration with a configuration controller like Ansible or a REST API client.

```
{
  "MGMT_PORT": {
    "eth0": {
      "admin_status": "up",
      "autoneg": "true",
      "description": "dhcp managed interface",
      "mtu": "1500",
      "speed": "1000"
    }
  },
  "DEVICE_METADATA": {
    "localhost": {
      "hostname": "ztp-config-db-staged"
    }
  },
  "COREDUMP": {
    "config": {
      "enabled": "true"
    }
  },
  "VRF": {
    "default": {
      "enabled": "true"
    }
  },
  "MGMT_VRF_CONFIG": {
    "vrf_global": {
      "mgmtVrfEnabled": "false"
    }
  },
  "SSH_SERVER_VRF": {
    "default": {
      "port": "22"
    }
  }
}
```

```
    }
}
```

Provisioning script

Save the provisioning in
/tftpboot/sonic/postscript/postscript_simple.sh.

This is the last script executed in the ZTP cycle. In this lab, the script will perform the following:

- Find the DHCP IP address received.
- Try to run a cgi script on the webserver. Do not be concerned if it is not available; it is optional. (See the Starting Zero Touch Deployment chapter to learn what the script does and whether you would like to attempt it.)
- Fetch the desired hostname for the switch from the webserver.
- Configure the desired hostname using a localhost REST API call on the switch.
- Save the config.

Copy the following contents into the postscript_simple.sh

```
#!/bin/bash

ZTD_SERVER_IP="192.168.240.101"
ZTD_PATH=/tftpboot
CALLBACK=/callback
CGI=/cgi-bin/callback.sh
HOSTS=/etc/hosts
USER_NAME=admin
PASSWORD=YourPaSsWoRd
MGMT_IP=localhost
APP=http://
APLOCAL=https://

## Extract the ip-address that was received from dhcp server
DHCP_IP=`hostname -I | awk '{printf $1}'`

# Request callback script at http server (cgi-script)
# This creates a file with name <ip-address> and hostname in it on
the server end
/usr/bin/curl -s ${APP}${ZTD_SERVER_IP}${CGI}

sleep 2

# Fetch switch hostname
SWITCHNAME=`/usr/bin/curl
${APP}${ZTD_SERVER_IP}${ZTD_PATH}${CALLBACK}/${DHCP_IP}`

sleep 2

# Check if switchname was found on webserver and received
```

```

if [ -z "${SWITCHNAME}" ]
then
    SWITCHNAME="ztp-staged-done" #Callback script
malfunctioning
else
    SWITCHNAME=${SWITCHNAME}
fi

echo "Found desired hostname: $SWITCHNAME"

# current hostname of switch
CURRENTHOSTNAME=`hostname`
echo "current hostname: ${CURRENTHOSTNAME}"

# set hostname via localhost REST call
curl -s -k -X PATCH "https://localhost/restconf/data/openconfig-
system:system/config/hostname" -H "accept: */*" -H "Content-Type:
application/yang-data+json" -u ${USER_NAME}:${PASSWORD} -d
"{\"openconfig-system:hostname\":\"$SWITCHNAME\"}"

# Save config permanent
config save -y

Set executable attribute:

chmod a+x /tftpboot/sonic/postscript/postscript_simple.sh

```

Create callback cgi-script for webserver

This step is optional.

Note: The use of this script is optional. If you do not want this functionality, omit this step, and the hostname on the switch will not be configured in the same way as the hostname in the dhcpd.conf file.

The following script is used on the webserver to create a file when the script is requested. The output file receives its name from the DHCP IP address that is offered to the switch. Within this file, the desired hostname is written. The desired hostname is extracted from the dhcpd.conf file. The SONiC switch will request the callback file and use the desired hostname to configure it on the switch as a final step. After this step, the ZTP staging has finished. The following figure shows the flow of this functionality.

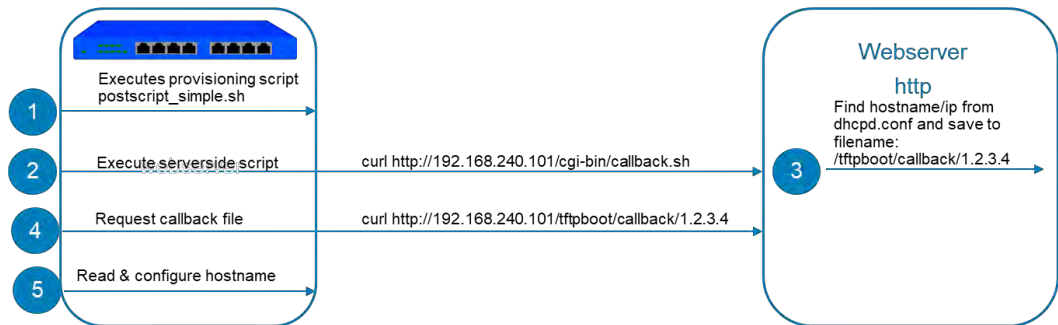


Figure 3. Server side cgi-script to create callback hostname/ip file

As an example, for switch IP address 1.2.3.4 with host entry `my-dell-switch` in the `dhcpd.conf` file, the callback output file written on the server would be:

```
peter@pp-ztd:/tftpboot/sonic$ cat /tftpboot/callback/1.2.3.4
my-dell-switch
peter@pp-ztd:/tftpboot/sonic$
```

The corresponding entry in `/etc/dhcp/dhcpd.conf` would be:

```
group {
    host my-dell-switch {
        hardware ethernet 4c:76:25:e8:29:c0; #mac of mgmt
eth interface
        fixed-address 1.2.3.4;
        option ztp_json_url
        "http://192.168.240.101/tftpboot/sonic/ztp/ztp_data_with_firmware.
        json";
    }
}
```

The cgi-script needs to be created and pushed into the HTTPD docker container. First, you create the script. You can store it to your home directory for convenience. After you store it in your container, you do not have to keep it in your home folder. Create the script and set the execute attribute:

```
touch callback.sh && chmod a+x callback.sh
```

Copy and paste the following into the file:

```
#!/bin/bash

DHCPD_CONF=/etc/dhcp/dhcpd.conf
TFTPBOOT=/var/www/html/tftpboot
CALLBACK=callback
SED=`type -p sed`
GREP=`type -tP grep`

## Silent run of SED
## Find lines matching host & start with leading spaces
```



```
## Remove these leading characters & Store what is left in the
hold space
## Find fixed-address with the requesting IP address of the device
## x: Swap pattern and hold space
## p: Print pattern space
## q: Stop processing
## Second SED line is to strip {
$SED -n '/^ *host /{s///;h};/^ *fixed-address
'"$REMOTE_ADDR"'/{x;p}' $DHCPD_CONF >
$TFTPBOOT/$CALLBACK/$REMOTE_ADDR
$SED -i 's/ {/g' $TFTPBOOT/$CALLBACK/$REMOTE_ADDR

## These lines are needed to echo back to apache server and avoid
errors
echo Content-type: text/html
echo
```

Copy the `callback.sh` into the container. Note the container id:

```
docker ps | grep "enonicio/apache2"
<snip>
8b860abfb41f
```

Upload the `callback.sh` script to the webserver `cgi-bin` folder:

```
docker cp callback.sh 8b860abfb41f:/usr/lib/cgi-bin/
```

Be sure to make the script permanent to your webserver image. It is beyond the scope of this whitepaper to cover specific details. See documentation about Docker images and container management.

If the switch requests `http://192.168.240.101/cgi-bin/callback.sh` from the `provisioningsscript` `postscript_simple.sh`, the webserver runs the `callback.sh` script and saves the desired hostname into the file with the IP address as filename.

Starting zero touch deployment installations

Method 1 - ONIE discovery install (factory default install)

Provided that the following requirements have been set up, powering on a factory default Dell switch starts ONIE OS discovery automatically. Afterward, SONiC ZTP starts automatically.

If you have not met the following requirements, follow the detailed setup steps from the Compatible Dell switches chapter:

- DHCP server has been set up.
- DHCP server configfile has been prepared.
- Web server has been set up.
- Valid default SONiC image has been uploaded to the webroot folder.

- Valid SONiC data json file has been prepared.
- Switch out of band management (OOBM) interface has DHCP broadcast reachability to the DHCP server (udp/67).

When you power on your switch, the ZTP process starts. The following screenshots show a successful ZTP staging with firmware install, basic SONiC config file, and provisioning script that sets the desired hostname.

First, ONIE will install the SONiC 3.5.2 version by discovery and execution method to automatically find the discovery image. When the switch has rebooted with this version, the SONiC ZTP starts and follows the intended SONiC 4.0 version according to the ZTP json file. It loads a default config and performs the hostname task from the final provisioning script.

```
ONIE: OS Install Mode ...
Version : 3.23.1.0-8

Info: Mounting kernel filesystems... done.
Info: Mounting ONIE-BOOT on /mnt/onie-boot ...
EXT4-fs (sda2): mounting with "discard" option, but the device does not support discard
Installing for i386-pc platform.
Installation finrandom: mktemp urandom read with 14 bits of entropy available
ished. No error reported.
Info: Using eth0 MAC address: 4c:76:25:e8:29:c0
Info: eth0: Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 192.168.240.111 / 255.255.255.0
Starting: dropbear ssh daemon... done.
Starting: telnetd... done.
discover: installer mode detected. Running installer.
Starting: discover... done.

Please press Enter to activate this console. Info: eth0: Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 192.168.240.111 / 255.255.255.0
ONIE: Starting ONIE Service Discovery
Info: Fetching http://192.168.240.101/onie-installer-x86_64-dell_z9100_c2538-r0 ...
Info: Fetching http://192.168.240.101/onie-installer-x86_64-dell_z9100_c2538 ...
Info: Fetching http://192.168.240.101/onie-installer-dell_z9100_c2538 ...
Info: Fetching http://192.168.240.101/onie-installer-x86_64-bcm ...
Info: Fetching http://192.168.240.101/onie-installer-x86_64 ...
random: nonblocking pool is initialized
ONIE: Executing installer: http://192.168.240.101/onie-installer-x86_64
Verifying image checksum ... OK.
Preparing image archive ... OK.
Installing SONiC in ONIE
ONIE Installer: platform: x86_64-broadcom-r0
onie_platform: x86_64-dell_z9100_c2538-r0
Installing for i386-pc platform.
Installation finished: No error reported.
Partition #1 is in use.
Partition #2 is in use.
Partition #3 is in use.
Partition #4 is available
Creating new SONiC-OS partition: /dev/sda# ...
Could not create partition 4 from 265440 to 60474303
Unable to set partition 4's name to 'SONIC-OS'!
Error encountered; not saving changes.
Warning: The first trial of creating partition failed, trying the largest aligned available block of sectors on the disk
Warning: The kernel is still using the old partition table.
The new table will be used at the next reboot.
The operation has completed successfully.
mke2fs 1.42.13 (17-May-2015)
Creating filesystem with 3613969 4k blocks and 903984 inodes
filesystem UUID: 4b542741-2f1a-4f46-bf6a-16a2a0d7e296
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208

Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done

Installing SONiC to /tmp/tmp.smSUFy/image-3.5.2-Enterprise_Advanced
```

Figure 4. ONIE locates an initial image requested from webserver and installs it

Method 2 - SONiC initiated ZTP install

When the switch is already running with a SONiC version, you can reboot the switch in ZTP mode. If the ZTP mode requires another SONiC version, SONiC creates a multiboot.

SONiC deletes the current SONiC config, reboots, and follows the settings in the ZTP data json file. Before you start the ZTP staging process, be sure that your environment meets the following requirements:

- DHCP server has been set up.
- DHCP server configfile has been prepared.
- Web server has been set up.

- Valid SONiC image has been uploaded to the webserver firmware folder.
- Valid SONiC data jsonfile has been prepared.
- Switch OOBM has IP reachability to the webserver and layer2 DHCP broadcast reachability to the DHCP server (udp port 67).

When the above requirements have been met, log in to the Linux shell of your SONiC switch and run the following commands sequentially (as root):

- `sudo ztp enable`
- `sudo ztp run -y`

Note: You could also send the ZTP commands using Ansible or a REST API call to your switch if you have these remote facilities set up. This paper does not cover setting up Ansible or REST API syntax to your SONiC switch.

The switch deletes the SONiC configuration and start ZTP staging flow. The ZTP cycles start with DHCP and request the option67 URL which DHCP offers.

The following screenshot shows the starting screen when ZTP is started from SONiC. It may take 10 minutes for the entire cycle to complete.

```
admin@ztd-Z9100:~$
admin@ztd-Z9100:~$ sudo ztp enable
admin@ztd-Z9100:~$ sudo ztp run
ZTP will be restarted. You may lose switch data and connectivity, continue?[yes/NO] yes
admin@ztd-Z9100:~$ Jun 07 15:03:30.021333 2022 ztd-Z9100 INFO sonic-ztp[22939]: Installing ZTP configuration profile to initiate ZTP discovery.
Jun 07 15:03:36.632975 2022 ztd-Z9100 INFO sonic-ztp[22939]: Platform and HWSKU Valid - /usr/share/sonic/device/x86_64-dell_z9100_c2538-r0/Force10-Z9100-C32
Jun 07 15:03:36.633249 2022 ztd-Z9100 INFO sonic-ztp[22939]: Running command: /usr/bin/db_migrator.py -o check_version -f /tmp/ztp_config_db.json

Zero Touch Provisioning discovery in progress. Please disable ZTP or logout.

Jun 07 15:03:41.003877 2022 ztd-Z9100 INFO sonic-ztp[22939]: FRR Retain Cleared ...
Jun 07 15:03:41.003926 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service uddid ...
Jun 07 15:03:43.004118 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service dhcp_relay ...

Zero Touch Provisioning discovery in progress. Please disable ZTP or logout.

admin@ztd-Z9100:~$ exit
logout

Jun 07 15:03:52.953397 System is not ready - Core services are down

Jun 07 15:03:53.005210 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service swss ...

Debian GNU/Linux 9 ztd-Z9100 ttyS1

ztd-Z9100 login: Jun 07 15:04:39.012664 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service mgmt-framework ...
Jun 07 15:04:39.012711 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service wrp ...
Jun 07 15:04:39.012749 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service hostcfgd ...
Jun 07 15:04:39.012785 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service nat ...
Jun 07 15:04:40.013587 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service telemetry ...
Jun 07 15:04:40.013631 2022 ztd-Z9100 INFO sonic-ztp[22939]: Stopping service resrcmgrd ...
Jun 07 15:04:40.013674 2022 ztd-Z9100 INFO sonic-ztp[22939]: Running command: queuestat -D
Jun 07 15:04:40.013711 2022 ztd-Z9100 INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/copp_config.json --write-to-db
Jun 07 15:04:40.013746 2022 ztd-Z9100 INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/init_cfg.json --write-to-db
Jun 07 15:04:41.013720 2022 ztd-Z9100 INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /tmp/ztp_config_db.json --write-to-db
Jun 07 15:04:43.014126 2022 ztd-Z9100 INFO sonic-ztp[22939]: Resetting failed status for service bgp ...
Jun 07 15:04:43.014171 2022 ztd-Z9100 INFO sonic-ztp[22939]: Resetting failed status for service dhcp_relay
```

Figure 5. ZTP install initiated from a SONiC switch

Monitoring and diagnostics

Screenshots of an ONIE discovery install

The following figures are screenshots captured during the factory default ZTP staging that occurs when a factory default Dell switch is powered on. The same flow also occurs when you delete all NOSes from the switch, and you reboot the switch.



Figure 6. ONIE starts discovery and execution process for ZTP install and seeks an image

```

Version: 3.23.1.0-8
Info: Mounting kernel filesystems... done.
Info: Mounting ONIE-BOOT on /mnt/onie-boot ...
EXT4-fs (sda2): mounting with "discard" option, but the device does not support discard
Installing for i386-pc platform.
Installation finished. No error reported.
Info: Using eth0 MAC address: 4c:76:25:e8:29:c0
Info: eth0: Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 192.168.240.111 / 255.255.255.0
Starting: dropbear ssh daemon... done.
Starting: telnetd... done.
discover: installer mode detected. Running installer.
Starting: discover... done.

Please press Enter to activate this console. Info: eth0: Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 192.168.240.111 / 255.255.255.0
ONIE: Starting ONIE Service Discovery
Info: Fetching http://192.168.240.101/onie-installer-x86_64-dell_r9100_c2538-r0 ...
Info: Fetching http://192.168.240.101/onie-installer-x86_64-dell_r9100_c2538 ...
Info: Fetching http://192.168.240.101/onie-installer-dell_r9100_c2538 ...
Info: Fetching http://192.168.240.101/onie-installer-x86_64-bcm ...
Info: Fetching http://192.168.240.101/onie-installer-x86_64 ...
random: nonblocking pool is initialized
ONIE: Executing installer: http://192.168.240.101/onie-installer-x86_64
Verifying image checksum ... OK.
Preparing image archive ... OK.
Installing SONiC in ONIE
ONIE Installer: platform: x86_64-broadcom-r0
onie_platform: x86_64-dell_r9100_c2538-r0
Installing for i386-pc platform.
Installation finished. No error reported.
Partition #1 is in use.
Partition #2 is in use.
Partition #3 is in use.
Partition #4 is available
Creating new SONiC-OS partition: /dev/sda#4 ...
Could not create partition 4 from 2365440 to 69474303
Unable to set partition 4's name to "SONiC-OS"!
Error encountered; not saving changes.
Warning: The first trial of creating partition failed, trying the largest aligned available block of sectors on the disk
Warning: The kernel is still using the old partition table.
The new table will be used at the next reboot.
The operation has completed successfully.
mke2fs 1.42.13 (17-May-2015)
Creating filesystem with 3613969 4k blocks and 903984 inodes
Filesystem UUID: 1bc54274-2cf1-4f46-bf6a-16a2a0d7e296
Superblock backups stored on blocks:
    32768, 90304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208

Allocating group tables: done

```

Figure 7. ONIE locates an initial image requested from webserver and installs it

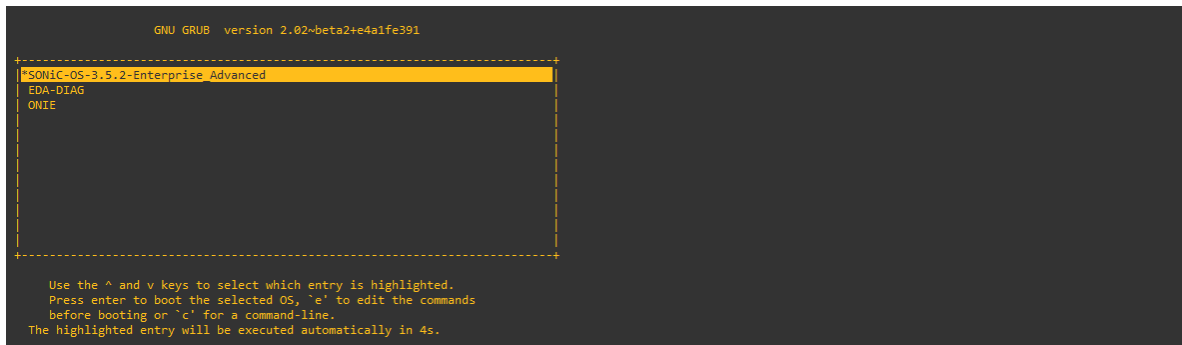


Figure 8. ONIE reboots switch and Grub loads SONiC 3.5.2

```

sonic login:
Debian GNU/Linux 9 sonic ttyS1

sonic login: Jun 07 13:53:25.995333 2022 sonic INFO sonic-ztp[3291]: ZTP service started.
Jun 07 13:53:25.995405 2022 sonic INFO sonic-ztp[3291]: Checking running configuration to load ZTP configuration profile.
Jun 07 13:53:31.738605 2022 sonic INFO sonic-ztp[3284]: Waiting for system online status before continuing ZTP. (This may take 30-120 seconds).

Jun 07 13:54:39.243299 System is ready

Jun 07 13:54:43.209572 2022 sonic INFO sonic-ztp[3284]: System is ready to respond.
Jun 07 13:54:43.251271 2022 sonic INFO sonic-ztp[3291]: Link up detected for interface eth0
Jun 07 13:54:43.251686 2022 sonic INFO sonic-ztp[3291]: Restarting network discovery after link scan.
Jun 07 13:54:54.654044 2022 sonic INFO sonic-ztp[3291]: Restarted network discovery after link scan.
Jun 07 13:54:54.691898 2022 sonic INFO sonic-ztp[3291]: Port breakout configurations for port Ethernet0 ['1x100G', '1x40G', '4x25G', '4x10G'].
Jun 07 13:54:54.692528 2022 sonic INFO sonic-ztp[3291]: SFP not present in the port Ethernet0
Jun 07 13:54:54.692606 2022 sonic INFO sonic-ztp[3291]: Port breakout configurations for port Ethernet4 ['1x100G', '1x40G', '4x25G', '4x10G'].
Jun 07 13:54:54.693026 2022 sonic INFO sonic-ztp[3291]: SFP not present in the port Ethernet4
Jun 07 13:54:54.693026 2022 sonic INFO sonic-ztp[3291]: Port breakout configurations for port Ethernet8 ['1x100G', '1x40G', '4x25G', '4x10G'].

```

Figure 9. SONiC loads its first run while still in ZTP mode

```

Jun 07 13:54:54.710084 2022 sonic INFO sonic-ztp[3291]: Port breakout configurations for port Ethernet120 ['1x100G', '1x40G', '4x25G', '4x10G'].
Jun 07 13:54:54.710435 2022 sonic INFO sonic-ztp[3291]: SFP not present in the port Ethernet120
Jun 07 13:54:54.710556 2022 sonic INFO sonic-ztp[3291]: Port breakout configurations for port Ethernet124 ['1x100G', '1x40G', '4x25G', '4x10G'].
Jun 07 13:54:54.710899 2022 sonic INFO sonic-ztp[3291]: SFP not present in the port Ethernet124
Jun 07 13:55:04.911252 2022 sonic INFO sonic-ztp[3291]: Downloading provisioning data from http://192.168.240.101/tftpboot/sonic/ztp/ztp_data_with_firmware.json to /var/run/ztp/ztp_data_opt67.json
Jun 07 13:55:05.512735 2022 sonic INFO sonic-ztp[3291]: Starting ZTP using JSON file /var/run/ztp/ztp_data_opt67.json at 2022-06-07 13:55:05 UTC.
Jun 07 13:55:05.512872 2022 sonic INFO sonic-ztp[3291]: Verifying and downloading plugin used by the configuration section configdb-json.
Jun 07 13:55:05.514073 2022 sonic INFO sonic-ztp[3291]: Verifying and downloading plugin used by the configuration section firmware.
Jun 07 13:55:05.514488 2022 sonic INFO sonic-ztp[3291]: Verifying and downloading plugin used by the configuration section provisioning-script.
Jun 07 13:55:06.049298 2022 sonic INFO sonic-ztp[3291]: Processing configuration section configdb-json at 2022-06-07 13:55:06 UTC.
Jun 07 13:55:11.323901 2022 sonic INFO sonic-ztp[9634]: configdb-json: Downloading config_db.json file from 'http://192.168.240.101/tftpboot/sonic/config/first_boot_config.json'.
Jun 07 13:55:11.351854 2022 sonic INFO sonic-ztp[9634]: configdb-json: Loading factory default configuration.
Jun 07 13:55:14.697603 2022 sonic INFO sonic-ztp[9634]: configdb-json: Appending input configuration to factory default configuration.
Jun 07 13:55:15.355725 2022 sonic INFO sonic-ztp[3284]: Platform and HWSKU Valid - /usr/share/sonic/device/x86_64-dell_z9100_c2538-r0/Force10-Z9100-C32
Jun 07 13:55:15.360615 2022 sonic INFO sonic-ztp[3284]: Platform and HWSKU Valid - /usr/share/sonic/device/x86_64-dell_z9100_c2538-r0/Force10-Z9100-C32
Jun 07 13:55:15.360615 2022 sonic INFO sonic-ztp[3284]: Running command: /usr/bin/db_migrator.py -o check_version -f /tmp/config_d1.json
Jun 07 13:55:10.728877 2022 sonic INFO sonic-ztp[3284]: FRR Retain Cleared ...
Jun 07 13:55:10.728922 2022 sonic INFO sonic-ztp[3284]: Stopping service uddl ...
Jun 07 13:55:21.730143 2022 sonic INFO sonic-ztp[3284]: Stopping service dhcp_relay ...

Jun 07 13:55:31.704604 System is not ready - Core services are down

Jun 07 13:55:31.731274 2022 sonic INFO sonic-ztp[3284]: Stopping service swss ...
Jun 07 13:56:18.736958 2022 sonic INFO sonic-ztp[3284]: Stopping service mgmt-framework ...
Jun 07 13:56:18.737004 2022 sonic INFO sonic-ztp[3284]: Stopping service vrrp ...
Jun 07 13:56:18.737039 2022 sonic INFO sonic-ztp[3284]: Stopping service hostcfgd ...
Jun 07 13:56:18.737074 2022 sonic INFO sonic-ztp[3284]: Stopping service nat ...
Jun 07 13:56:18.737108 2022 sonic INFO sonic-ztp[3284]: Stopping service telemetry ...
Jun 07 13:56:18.737150 2022 sonic INFO sonic-ztp[3284]: Stopping service resrcmgrd ...
Jun 07 13:56:18.737191 2022 sonic INFO sonic-ztp[3284]: Running command: queuestat -D
Jun 07 13:56:19.737128 2022 sonic INFO sonic-ztp[3284]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/copp_config.json --write-to-db
Jun 07 13:56:19.737173 2022 sonic INFO sonic-ztp[3284]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/init_cfg.json --write-to-db
Jun 07 13:56:19.737225 2022 sonic INFO sonic-ztp[3284]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/config_db.json --write-to-db
Jun 07 13:56:20.737198 2022 sonic INFO sonic-ztp[3284]: Running command: /usr/local/bin/sonic-cfggen -j /tmp/config_d1.json --write-to-db
Jun 07 13:56:21.737600 2022 sonic INFO sonic-ztp[3284]: Resetting failed status for service bgp ...
Jun 07 13:56:21.737650 2022 sonic INFO sonic-ztp[3284]: Resetting failed status for service dhcp_relay ...
Jun 07 13:56:21.737688 2022 sonic INFO sonic-ztp[3284]: Resetting failed status for service hostcfgd ...

```

Figure 10. SONiC comes online in ZTP mode and requests ZTP data json file

```

Jun 07 13:56:39.761445 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Starting service resrcmgrd ...
Jun 07 13:56:39.761497 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Starting service resrcmgrd ...
Jun 07 13:56:39.761533 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Verifying if all services have started

Jun 07 13:57:58.258600 System is ready

Jun 07 13:57:58.882192 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Services are started
Jun 07 13:57:58.882252 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Reload complete!
Jun 07 13:57:58.955694 2022 ztp-config-db-staged INFO sonic-ztp[9634]: configdb-json: Saving Config DB contents to startup configuration.
Jun 07 13:57:59.594137 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Running command: /usr/local/bin/sonic-cfggen -d --print-data > /run/tmp2SerY9
Jun 07 13:58:00.257538 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Running command: mv -f /run/tmp2SerY9 /etc/sonic/config_db.json
Jun 07 13:58:00.279411 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Running command: sync;sync;sync
Jun 07 13:58:00.371492 2022 ztp-config-db-staged INFO sonic-ztp[3284]: 17109 Bytes written
Jun 07 13:58:00.488960 2022 ztp-config-db-staged INFO sonic-ztp[3291]: Processed Configuration section configdb-json with result SUCCESS, exit code (0) at 2022-06-07 13:58:00 UTC.
Jun 07 13:58:00.493592 2022 ztp-config-db-staged INFO sonic-ztp[3291]: Processing configuration section firmware at 2022-06-07 13:58:00 UTC.
Jun 07 13:58:06.025431 2022 ztp-config-db-staged INFO sonic-ztp[19303]: firmware: Downloading file 'http://192.168.240.101/tftpboot/sonic/firmware/Enterprise_SoNIC_OS_4.0.0_Enterprise_Premium.bin'.
Jun 07 13:58:29.268475 2022 ztp-config-db-staged INFO sonic-ztp[19303]: firmware: Installing firmware image located at '/var/lib/ztp/tmp/Enterprise_SoNIC_OS_4.0.0_Enterprise_Premium.bin'.
Jun 07 13:58:43.135749 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Command: /var/lib/ztp/tmp/Enterprise_SoNIC_OS_4.0.0_Enterprise_Premium.bin
Jun 07 13:59:39.849278 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Verifying image checksum ... OK.
Jun 07 13:59:39.849326 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Preparing image archive ... OK.
Jun 07 13:59:39.849361 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Installing SoNIC in SoNIC
Jun 07 13:59:39.849396 2022 ztp-config-db-staged INFO sonic-ztp[3284]: ONIE Installer: platform: x86_64-broadcom-r0
Jun 07 13:59:39.849430 2022 ztp-config-db-staged INFO sonic-ztp[3284]: onie_platform: x86_64-dell_z9100_c2538-r0
Jun 07 13:59:39.849466 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Installing SoNIC to /host/image-4.0.0-Enterprise_Advanced
Jun 07 13:59:39.849501 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Archive: fs.zip
Jun 07 13:59:39.849541 2022 ztp-config-db-staged INFO sonic-ztp[3284]: creating: /host/image-4.0.0-Enterprise_Advanced/boot/
Jun 07 13:59:39.849577 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/initrd.img-4.19.0-9-2-amd64
Jun 07 13:59:39.849612 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/grubx64.efi
Jun 07 13:59:39.849647 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/shimx64.efi
Jun 07 13:59:39.849682 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/mmx64.efi
Jun 07 13:59:39.849717 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/vmlinuz-4.19.0-9-2-amd64
Jun 07 13:59:39.849752 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/config-4.19.0-9-2-amd64

```

Figure 11. SONiC ZTP downloads all relevant files according to ZTP data JSON file and installs desired firmware

```

Jun 07 13:59:39.857484 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/01-dir-preservation
Jun 07 13:59:39.857520 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/sonic_version.yml
Jun 07 13:59:39.857555 2022 ztp-config-db-staged INFO sonic-ztp[3284]: inflating: /host/image-4.0.0-Enterprise_Advanced/db_migrator.py
Jun 07 13:59:39.857589 2022 ztp-config-db-staged INFO sonic-ztp[3284]: /host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks' -> '/var/run/config-setup/installer-migration-hooks'
Jun 07 13:59:39.857626 2022 ztp-config-db-staged INFO sonic-ztp[3284]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/08-config-profile-backup' -> '/var/run/config-setup/installer-migration-hooks/08-config-profile-backup'
Jun 07 13:59:39.857707 2022 ztp-config-db-staged INFO sonic-ztp[3284]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/02-kernel-bootarg-pre' -> '/var/run/config-setup/installer-migration-hooks/02-kernel-bootarg-pre'
Jun 07 13:59:39.857743 2022 ztp-config-db-staged INFO sonic-ztp[3284]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/01-local-users-pre' -> '/var/run/config-setup/installer-migration-hooks/01-local-users-pre'
Jun 07 13:59:39.857779 2022 ztp-config-db-staged INFO sonic-ztp[3284]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/01-kdump-pre' -> '/var/run/config-setup/installer-migration-hooks/01-kdump-pre'
Jun 07 13:59:39.857819 2022 ztp-config-db-staged INFO sonic-ztp[3284]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/01-dir-preservation' -> '/var/run/config-setup/installer-migration-hooks/01-dir-preservation'
Jun 07 13:59:39.857856 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Switch CPU vendor is: GenuineIntel
Jun 07 13:59:39.857911 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Installed SoNIC base image SoNIC-OS successfully
Jun 07 13:59:39.857946 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Command: grub-set-default --boot-directory=/host 0
Jun 07 13:59:46.988479 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Command: config-setup backup
Jun 07 13:59:50.604747 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Taking backup of current configuration
Jun 07 13:59:50.604793 2022 ztp-config-db-staged INFO sonic-ztp[3284]: /var/run/config-setup/installer-migration-hooks/01-dir-preservation returned non-zero exit status 2
Jun 07 13:59:50.604829 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Kdump configuration has been updated in the startup configuration
Jun 07 13:59:50.604865 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Kdump configuration changes will be applied after the system reboots
Jun 07 13:59:50.604942 2022 ztp-config-db-staged INFO sonic-ztp[3284]: [ TPCM ] Taking backup of running TPC dockers into new image for migration
Jun 07 13:59:50.625169 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Command: sync;sync;sync
Jun 07 13:59:53.998052 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Command: sleep 3
Jun 07 13:59:57.005677 2022 ztp-config-db-staged INFO sonic-ztp[3284]: Done
Jun 07 13:59:57.643370 2022 ztp-config-db-staged INFO sonic-ztp[19303]: firmware: Version SoNIC-OS-4.0.0-Enterprise_Advanced successfully installed.
Jun 07 13:59:57.916637 2022 ztp-config-db-staged INFO sonic-ztp[19303]: firmware: Post image installation device reboot.
Jun 07 13:59:57.916708 2022 ztp-config-db-staged INFO sonic-ztp[19303]: firmware: Initiating device reboot.

Jun 07 14:00:14.351145 System is not ready - Core services are down

[ 527.535231] kdump-tools[23734]: Stopping kdump-tools: unloaded kdump kernel.

BIOS Boot Selector for Z9100
Primary BIOS Version 3.23.0.0-7

SMF Version: MSS 2.1, FPGA 2.1
Last POR=0x11, Reset Cause=0x44

POST Configuration
CPU Signature 460B8
CPU FamilyID=6, Model=40, SteppingID=8, Processor=0
Microcode Revision 125
Platform ID: 0x10041A48
PCH_CST_CFG_CTL: 0x40006
BBU_CR_CTL: 0x7E2801FF
Misc EN: 0x840001
Gen PM Con1: 0x3008
Therm Status: 0x88400000
POST Control=0xEA000303, Status=0xE6009F00

BIOS initializations...

```

Figure 12. Switch reboots with SONiC 4.0


```

***** GNU GRUB  version 2.02~beta2+e4a11e391 *****
*SONiC-OS-4.0.0-Enterprise_Advanced
|*SONiC-OS-4.0.0-Enterprise_Advanced
* SONiC-OS-3.5.2-Enterprise_Advanced
*
*
*
*
*
*
*
*
*
*
*
*****

Use the * and * keys to select which entry is highlighted.
Press enter to boot the selected OS, `e' to edit the commands
before booting or `c' for a command-line.

```

Figure 13. Updated Grub menu with both SONiC versions; 4.0 is default selected

```

Debian GNU/Linux 10 sonic ttyS1
sonic login:
sonic login:
sonic login:
sonic login:
sonic login:
sonic login: [ 170.245516] sonic-ztp[2687]: % Total % Received % Xferd Average Speed Time Time Time Current
[ 170.245802] sonic-ztp[2687]: Dload Upload Total Spent Left Speed
100 10 100 10 0 0 10000 0 --:--:-- --:--:-- --:--:-- 10000

Jun 07 14:04:33.863118 System is ready
ztd-Z9100 login:

```

Figure 14. SONiC 4.0 loads and provisioning script finishes

```

ztd-Z9100 login: admin
Password:
You are required to change your password immediately (administrator enforced)
Changing password for admin.
Current password:
New password:
Retype new password:
Linux ztd-Z9100 4.19.0-9-2-amd64 #1 SMP Debian 4.19.118-2+deb10u1 (2020-06-07) x86_64
You are on

SONiC

-- Software for Open Networking in the Cloud --

Unauthorized access and/or use are prohibited.
All access and/or use are subject to monitoring.

Help: http://azure.github.io/SONiC/

admin@ztd-Z9100:~$
admin@ztd-Z9100:~$ show version

SONiC Software Version: SONiC-OS-4.0.0-Enterprise_Advanced
Product: Enterprise SONiC Distribution by Dell Technologies
Distribution: Debian 10.12
Kernel: 4.19.0-9-2-amd64
Config DB Version: version_4_0_1
Build commit: cfcae285b
Build date: Fri Apr 22 23:39:23 UTC 2022
Built by: sonicbld@sonic-lvn-csg-004

Platform: x86_64-dell_z9100_c2538-r0
HwSKU: Force10-Z9100-C32
ASIC: broadcom
ASIC Count: 1

Platform: x86_64-dell_z9100_c2538-r0
Serial Number: CN0VRMPN779316210002
Uptime: 14:07:55 up 6 min, 1 user, load average: 1.87, 3.25, 1.85

```

Figure 15. Hostname is set and version check of correct SONiC version

```

admin@ztd-29100:~$
admin@ztd-29100:~$
admin@ztd-29100:~$ ztp status
ZTP Admin Mode : True
ZTP Service    : Inactive
ZTP Status     : SUCCESS
ZTP Source     : dhcp-opt67 (eth0)
ZTP Runtime    : 10m 57s
ZTP Timestamp  : 2022-06-07 14:04:22 UTC

ZTP Service is not running

configdb-json: SUCCESS
firmware: SUCCESS
provisioning-script: SUCCESS

admin@ztd-29100:~$

```

Figure 16. ZTP status shows all JSON data elements correctly finished and ZTP inactive

```

172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-x86_64-dell_z9100_c2538-r0 HTTP/1.1" 404 498 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-x86_64-dell_z9100_c2538-r0 HTTP/1.1" 404 498 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-x86_64-dell_z9100_c2538 HTTP/1.1" 404 495 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-dell_z9100_c2538 HTTP/1.1" 404 495 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-dell_z9100_c2538 HTTP/1.1" 404 488 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-x86_64-bcm HTTP/1.1" 404 482 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-x86_64-bcm HTTP/1.1" 404 482 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-x86_64 HTTP/1.1" 200 1066877144 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:49:36 +0000] "GET /onie-installer-x86_64 HTTP/1.1" 200 1066877144 "-" "onie/1.0 (Linux-4.1.28-onie+3.23.1.0-8; BusyBox-v1.20.2)"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:55:06 +0000] "GET /ftftboot/sonic/ztp_data_with_firmware.json HTTP/1.1" 200 926 "-" "SONiC-ZTP/0.1"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:55:06 +0000] "GET /ftftboot/sonic/ztp_data_with_firmware.json HTTP/1.1" 200 926 "-" "SONiC-ZTP/0.1"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:55:06 +0000] "GET /ftftboot/sonic/postscript/postscript_simple.sh HTTP/1.1" 200 1509 "-" "SONiC-ZTP/0.1"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:55:06 +0000] "GET /ftftboot/sonic/postscript/postscript_simple.sh HTTP/1.1" 200 1509 "-" "SONiC-ZTP/0.1"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:55:12 +0000] "GET /ftftboot/sonic/config/first_boot_config.json HTTP/1.1" 200 1024 "-" "SONiC-ZTP/0.1"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:55:12 +0000] "GET /ftftboot/sonic/config/first_boot_config.json HTTP/1.1" 200 1024 "-" "SONiC-ZTP/0.1"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:58:07 +0000] "GET /ftftboot/sonic/firmware/Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin HTTP/1.1" 200 1070502125 "-" "SONiC-ZTP/0.1"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:13:58:07 +0000] "GET /ftftboot/sonic/firmware/Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin HTTP/1.1" 200 1070502125 "-" "SONiC-ZTP/0.1"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:14:04:12 +0000] "GET /ftftboot/sonic/postscript/postscript_simple.sh HTTP/1.1" 200 1509 "-" "SONiC-ZTP/0.1"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:14:04:12 +0000] "GET /ftftboot/sonic/postscript/postscript_simple.sh HTTP/1.1" 200 1509 "-" "SONiC-ZTP/0.1"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:14:04:16 +0000] "GET /cgi-bin/callback.sh HTTP/1.1" 200 131 "-" "curl/7.64.0"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:14:04:16 +0000] "GET /cgi-bin/callback.sh HTTP/1.1" 200 131 "-" "curl/7.64.0"
172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:14:04:18 +0000] "GET /ftftboot/callback/192.168.240.111 HTTP/1.1" 200 210 "-" "curl/7.64.0"
cfd-httpd_1 | 172.22.0.2:80 192.168.240.111 - - [07/Jun/2022:14:04:18 +0000] "GET /ftftboot/callback/192.168.240.111 HTTP/1.1" 200 210 "-" "curl/7.64.0"

```

Figure 17. Logging of http container shows all requested files during this factory default ZTP staging flow

Screenshots of a SONiC initiated ZTP install

The following figures are screenshots of a successful ZTP staging with firmware install, basic SONiC config file, and provisionings script.

```

admin@ztd-29100:~$
admin@ztd-29100:~$ sudo ztp enable
admin@ztd-29100:~$ sudo ztp run
ZTP will be restarted. You may lose switch data and connectivity, continue?[yes/NO] yes
Jun 07 15:03:36.632975 2022 ztd-29100 INFO sonic-ztp[22939]: Platform and HwSKU Valid - /usr/share/sonic/device/x86_64-dell_z9100_c2538-r0/Force10-Z9100-C32
Jun 07 15:03:36.632449 2022 ztd-29100 INFO sonic-ztp[22939]: Running command: /usr/bin/db_migrator.py -o check_version -f /tmp/ztp_config_db.json

Zero Touch Provisioning discovery in progress. Please disable ZTP or logout.

Jun 07 15:03:41.003877 2022 ztd-29100 INFO sonic-ztp[22939]: FR4 Retain Cleared ...
Jun 07 15:03:41.003926 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service udd ...
Jun 07 15:03:43.004110 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service dhcp_relay ...

Zero Touch Provisioning discovery in progress. Please disable ZTP or logout.

admin@ztd-29100:~$ exit
logout

Jun 07 15:03:52.953397 System is not ready - Core services are down

Jun 07 15:03:53.005210 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service swss ...

Debian GNU/Linux 9 ztd-29100 ttyS1

ztd-29100 login: Jun 07 15:04:39.012664 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service mgmt-framework ...
Jun 07 15:04:39.012711 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service vrrp ...
Jun 07 15:04:39.012749 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service hostcfgd ...
Jun 07 15:04:39.012785 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service nat ...
Jun 07 15:04:40.013587 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service telemetry ...
Jun 07 15:04:40.013631 2022 ztd-29100 INFO sonic-ztp[22939]: Stopping service resrcmgrd ...
Jun 07 15:04:40.013674 2022 ztd-29100 INFO sonic-ztp[22939]: Running command: queuestat -D
Jun 07 15:04:40.013711 2022 ztd-29100 INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/copp_config.json --write-to-db
Jun 07 15:04:40.013746 2022 ztd-29100 INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/init_cfg.json --write-to-db
Jun 07 15:04:41.013720 2022 ztd-29100 INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /tmp/ztp_config_db.json --write-to-db
Jun 07 15:04:43.014126 2022 ztd-29100 INFO sonic-ztp[22939]: Resetting failed status for service bgp ...
Jun 07 15:04:43.014173 2022 ztd-29100 INFO sonic-ztp[22939]: Resetting failed status for service dhcp_relay ...

```

Figure 18. ZTP install started from a SONiC switch


```

Jun 07 15:05:01.025840 2022 sonic INFO sonic-ztp[22939]: Verifying if all services have started

Jun 07 15:06:18.886055 System is ready

Jun 07 15:06:19.242408 2022 sonic INFO sonic-ztp[22939]: Services are started
Jun 07 15:06:19.242470 2022 sonic INFO sonic-ztp[22939]: Reload complete!
Jun 07 15:06:19.323690 2022 sonic INFO sonic-ztp[22939]: Waiting for system online status before continuing ZTP. (This may take 30-120 seconds).
Jun 07 15:06:20.637998 2022 sonic INFO sonic-ztp[22939]: System is ready to respond.
Jun 07 15:06:20.682498 2022 sonic INFO sonic-ztp[22941]: Link up detected for interface eth0
Jun 07 15:06:20.682486 2022 sonic INFO sonic-ztp[22941]: Restarting network discovery after link scan.
Jun 07 15:06:31.978861 2022 sonic INFO sonic-ztp[22941]: Restarted network discovery after link scan.
Jun 07 15:06:32.030683 2022 sonic INFO sonic-ztp[22941]: Port breakout configurations for port Ethernet0 ['1x100G', '1x40G', '4x25G', '4x10G'].
Jun 07 15:06:32.031242 2022 sonic INFO sonic-ztp[22941]: SFP not present in the port Ethernet0
Jun 07 15:06:32.031521 2022 sonic INFO sonic-ztp[22941]: Port breakout configurations for port Ethernet4 ['1x100G', '1x40G', '4x25G', '4x10G'].
Jun 07 15:06:32.031818 2022 sonic INFO sonic-ztp[22941]: SFP not present in the port Ethernet4

```

Figure 19. ZTP progress on a SONiC switch

```

Jun 07 15:06:32.046919 2022 sonic INFO sonic-ztp[22941]: SFP not present in the port Ethernet124
Jun 07 15:06:42.383316 2022 sonic INFO sonic-ztp[22941]: Downloading provisioning data from http://192.168.240.101/tftpboot/sonic/ztp/ztp_data_with_firmware.json to /var/run/ztp/ztp_data_opt67.json
Jun 07 15:06:42.910161 2022 sonic INFO sonic-ztp[22941]: Starting ZTP using JSON file /var/run/ztp/ztp_data_opt67.json at 2022-06-07 15:06:42 UTC.
Jun 07 15:06:42.910258 2022 sonic INFO sonic-ztp[22941]: Verifying and downloading plugin used by the configuration section configdb-json.
Jun 07 15:06:42.911275 2022 sonic INFO sonic-ztp[22941]: Verifying and downloading plugin used by the configuration section firmware.
Jun 07 15:06:42.912214 2022 sonic INFO sonic-ztp[22941]: Verifying and downloading plugin used by the configuration section provisioning-script.
Jun 07 15:06:43.438945 2022 sonic INFO sonic-ztp[22941]: Processing configuration section configdb-json at 2022-06-07 15:06:43 UTC.
Jun 07 15:06:48.658708 2022 sonic INFO sonic-ztp[1687]: configdb-json: Downloading config_db.json file from 'http://192.168.240.101/tftpboot/sonic/config/first_boot_config.json'.
Jun 07 15:06:48.683320 2022 sonic INFO sonic-ztp[1687]: configdb-json: Loading factory default configuration.
Jun 07 15:06:52.013147 2022 sonic INFO sonic-ztp[1687]: configdb-json: Appending input configuration to factory default configuration.
Jun 07 15:06:52.652156 2022 sonic INFO sonic-ztp[22939]: Platform and HWSKU Valid - /usr/share/sonic/device/x86_64-dell_z9100_c2538-r0/Force10-Z9100-C32
Jun 07 15:06:52.657508 2022 sonic INFO sonic-ztp[22939]: Platform and HWSKU Valid - /usr/share/sonic/device/x86_64-dell_z9100_c2538-r0/Force10-Z9100-C32
Jun 07 15:06:52.697921 2022 sonic INFO sonic-ztp[22939]: Running command: /usr/bin/dm_migrator.py -o check_version -f /tmp/config_d1.json
Jun 07 15:06:57.037055 2022 sonic INFO sonic-ztp[22939]: FRR Retain Cleared ...
Jun 07 15:06:57.037082 2022 sonic INFO sonic-ztp[22939]: Stopping service udd ...
Jun 07 15:06:59.037361 2022 sonic INFO sonic-ztp[22939]: Stopping service dhcp_relay ...

Jun 07 15:07:08.896059 System is not ready - Core services are down

Jun 07 15:07:09.038580 2022 sonic INFO sonic-ztp[22939]: Stopping service swss ...
Jun 07 15:07:56.047941 2022 sonic INFO sonic-ztp[22939]: Stopping service mgmt-framework ...
Jun 07 15:07:56.047986 2022 sonic INFO sonic-ztp[22939]: Stopping service wrp ...
Jun 07 15:07:56.048024 2022 sonic INFO sonic-ztp[22939]: Stopping service hostcfd ...
Jun 07 15:07:56.048059 2022 sonic INFO sonic-ztp[22939]: Stopping service nat ...
Jun 07 15:07:56.048110 2022 sonic INFO sonic-ztp[22939]: Stopping service telemetry ...
Jun 07 15:07:56.048150 2022 sonic INFO sonic-ztp[22939]: Stopping service resrcmgrd ...
Jun 07 15:07:56.048191 2022 sonic INFO sonic-ztp[22939]: Running command: queuestat -0
Jun 07 15:07:57.048116 2022 sonic INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/copp_config.json --write-to-db
Jun 07 15:07:57.048161 2022 sonic INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/init_cfg.json --write-to-db
Jun 07 15:07:57.048196 2022 sonic INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /etc/sonic/config_db.json --write-to-db
Jun 07 15:07:57.048314 2022 sonic INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -j /tmp/config_d1.json --write-to-db
Jun 07 15:07:59.048479 2022 sonic INFO sonic-ztp[22939]: Resetting failed status for service hw ...

```

Figure 20. ZTP json file processing on a SONiC switch

```

Jun 07 15:08:17.060599 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Starting service (re)image ...
Jun 07 15:08:17.063028 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Verifying if all services have started

Jun 07 15:09:32.502181 System is ready

Jun 07 15:09:34.109598 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Services are started
Jun 07 15:09:34.109649 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Reload complete!
Jun 07 15:09:34.181704 2022 ztp-config-db-staged INFO sonic-ztp[1687]: configdb-json: Saving Config DB contents to startup configuration.
Jun 07 15:09:34.829124 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Running command: /usr/local/bin/sonic-cfggen -d --print-data > /run/tmpRuu8cC
Jun 07 15:09:35.336044 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Running command: mv -f /run/tmpRuu8cC /etc/sonic/config_db.json
Jun 07 15:09:35.351291 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Running command: sync;sync;sync
Jun 07 15:09:35.469503 2022 ztp-config-db-staged INFO sonic-ztp[22939]: 17367 Bytes written
Jun 07 15:09:35.583663 2022 ztp-config-db-staged INFO sonic-ztp[22941]: Processed Configuration section configdb-json with result SUCCESS, exit code (0) at 2022-06-07 15:09:35 UTC.
Jun 07 15:09:35.587888 2022 ztp-config-db-staged INFO sonic-ztp[22941]: Processing configuration section firmware at 2022-06-07 15:09:35 UTC.
Jun 07 15:09:41.796425 2022 ztp-config-db-staged INFO sonic-ztp[11149]: Firmware: Downloading file 'http://192.168.240.101/tftpboot/sonic/firmware/Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin'.
Jun 07 15:10:04.201762 2022 ztp-config-db-staged INFO sonic-ztp[11149]: Firmware: Installing firmware image located at '/var/lib/ztp/tmp/Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin'.
Jun 07 15:10:17.631287 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Command: /var/lib/ztp/tmp/Enterprise_SONiC_OS_4.0.0_Enterprise_Premium.bin
Jun 07 15:11:12.725963 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Verifying image checksum ... OK.
Jun 07 15:11:12.726009 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Preparing image archive ... OK.
Jun 07 15:11:12.726044 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Installing SONiC in SONiC
Jun 07 15:11:12.726078 2022 ztp-config-db-staged INFO sonic-ztp[22939]: ONIE Installer: platform: x86_64-broadcom-r0
Jun 07 15:11:12.726113 2022 ztp-config-db-staged INFO sonic-ztp[22939]: onie platform: x86_64-dell_z9100_c2538-r0
Jun 07 15:11:12.726147 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Installing SONiC to /host/image-4.0.0-Enterprise_Advanced
Jun 07 15:11:12.726182 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Archive: fs.zip
Jun 07 15:11:12.726217 2022 ztp-config-db-staged INFO sonic-ztp[22939]: creating: /host/image-4.0.0-Enterprise_Advanced/boot/
Jun 07 15:11:12.726254 2022 ztp-config-db-staged INFO sonic-ztp[22939]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/initrd.img-4.19.0-9-2-amd64
Jun 07 15:11:12.726289 2022 ztp-config-db-staged INFO sonic-ztp[22939]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/grubx64.efi
Jun 07 15:11:12.726324 2022 ztp-config-db-staged INFO sonic-ztp[22939]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/shimx64.efi
Jun 07 15:11:12.726367 2022 ztp-config-db-staged INFO sonic-ztp[22939]: inflating: /host/image-4.0.0-Enterprise_Advanced/boot/mmx64.efi

```

Figure 21. SONiC firmware installation during a ZTP install

```

Jun 07 15:11:12.732584 2022 ztp-config-db-staged INFO sonic-ztp[22939]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks' -> '/var/run/config-setup/installer-migration-hooks'
Jun 07 15:11:12.732626 2022 ztp-config-db-staged INFO sonic-ztp[22939]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/08-config-profile-backup' -> '/var/run/config-setup/installer-migration-hooks/08-config-profile-backup'
Jun 07 15:11:12.732692 2022 ztp-config-db-staged INFO sonic-ztp[22939]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/02-kernel-bootarg-pre' -> '/var/run/config-setup/installer-migration-hooks/02-kernel-bootarg-pre'
Jun 07 15:11:12.732737 2022 ztp-config-db-staged INFO sonic-ztp[22939]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/01-local-users-pre' -> '/var/run/config-setup/installer-migration-hooks/01-local-users-pre'
Jun 07 15:11:12.732773 2022 ztp-config-db-staged INFO sonic-ztp[22939]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/01-kdump-pre' -> '/var/run/config-setup/installer-migration-hooks/01-kdump-pre'
Jun 07 15:11:12.732812 2022 ztp-config-db-staged INFO sonic-ztp[22939]: '/host/image-4.0.0-Enterprise_Advanced/installer-migration-hooks/01-dir-preservation' -> '/var/run/config-setup/installer-migration-hooks/01-dir-preservation'
Jun 07 15:11:12.732851 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Switch CPU vendor is: GenuineIntel
Jun 07 15:11:12.732888 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Installed SONiC Base image SONiC-OS successfully
Jun 07 15:11:12.732926 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Command: grub-set-default --boot-directory=/host 0
Jun 07 15:11:20.031718 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Command: config-setup backup
Jun 07 15:11:23.630306 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Taking backup of current configuration
Jun 07 15:11:23.630345 2022 ztp-config-db-staged INFO sonic-ztp[22939]: /var/run/config-setup/installer-migration-hooks/01-dir-preservation returned non-zero exit status 2
Jun 07 15:11:23.630388 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Kdump configuration has been updated in the startup configuration
Jun 07 15:11:23.630415 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Kdump configuration changes will be applied after the system reboots
Jun 07 15:11:23.630448 2022 ztp-config-db-staged INFO sonic-ztp[22939]: [ TPCM ] Taking backup of running TPC dockers into new image for migration
Jun 07 15:11:23.649721 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Command: sync;sync;sync
Jun 07 15:11:23.231188 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Command: sleep 3
Jun 07 15:11:32.238527 2022 ztp-config-db-staged INFO sonic-ztp[22939]: Done
Jun 07 15:11:32.867878 2022 ztp-config-db-staged INFO sonic-ztp[11149]: firmware: Version SONiC-OS-4.0.0-Enterprise_Advanced successfully installed.
Jun 07 15:11:33.136469 2022 ztp-config-db-staged INFO sonic-ztp[11149]: firmware: Post image installation device reboot.
Jun 07 15:11:33.136487 2022 ztp-config-db-staged INFO sonic-ztp[11149]: firmware: Initiating device reboot.

Jun 07 15:11:48.308123 System is not ready - Core services are down

Jun 07 15:12:26.065422 2022 ztp-config-db-staged WARNING sonic-ztp[22941]: Received terminate signal. Shutting down.
[ 1032.596738] kdump-tools[15296]: Stopping kdump-tools: unloaded kdump kernel.

BIOS Boot Selector for Z9100
Primary BIOS Version 3.23.0.0-7

SMF Version: MSS 2.1, FPGA 2.1
Last POR=0x11, Reset Cause=0x44

POST Configuration
CPU Signature 406D8
CPU FamilyID=6, Model=4D, SteppingId=B, Processor=0
Microcode Revision 125
Platform ID: 0x10041A08
PWR_LST_CFG_CTL: 0x40006
BDL_CR_CTL3: 0x7E2801FF
Misc EN: 0x840001
Gen_PM_Cool: 0x3008

```

Figure 22. Switch reboots after a new SONiC version is installed

```

*****
*SONIC-OS-4.0.0-Enterprise_Advanced
SONIC-OS-3.9.0-Enterprise_Advanced  .2-Enterprise_Advanced
ONIE
*
*
*
*
*
*
*
*
*
*
*
*****

```

Figure 23. Multiboot Grub menu on a Dell SONiC switch after ZTP install

```
admin@ztd-Z9100:~$ show version

SONiC Software Version: SONiC-OS-4.0.0-Enterprise_Advanced
Product: Enterprise SONiC Distribution by Dell Technologies
Distribution: Debian 10.12
Kernel: 4.19.0-9-2-amd64
Config DB Version: version_4_0_1
Build commit: cfcac285b
Build date: Fri Apr 22 23:39:23 UTC 2022
Built by: sonicbld@sonic-lvn-csg-004

Platform: x86_64-dell_z9100_c2538-r0
HwSKU: Force10-Z9100-C32
ASIC: broadcom
ASIC Count: 1

Platform: x86_64-dell_z9100_c2538-r0
```

Figure 24. Verification after a successful ZTP install for SONiC


```

ttd-Z9100 login: admin
Password:
Last login: Tue Jun  7 15:02:25 UTC 2022 on ttyS1
linux ttd-Z9100 4.19.0-9-2-amd64 #1 SMP Debian 4.19.118-2+deb10u1 (2020-06-07) x86_64
You are on

SONiC

-- Software for Open Networking in the Cloud --

Unauthorized access and/or use are prohibited.
All access and/or use are subject to monitoring.

Help:  http://azure.github.io/SONiC/

admin@ttd-Z9100:~$
admin@ttd-Z9100:~$ ztp status
ZTP Admin Mode : True
ZTP Service    : Inactive
ZTP Status     : SUCCESS
ZTP Source     : dhcp-opt67 (eth0)
ZTP Runtime    : 12m 28s
ZTP Timestamp  : 2022-06-07 15:15:55 UTC

ZTP Service is not running

configdb-json: SUCCESS
firmware: SUCCESS
provisioning-script: SUCCESS

admin@ttd-Z9100:~$

```

Figure 25. ZTP status shows a successful ZTP installation for SONiC

```

172.24.0.2:80 192.168.240.111 - - [07/Jun/2022:15:06:43 +0000] "GET /tftpboot/sonic/ztp/ztp_data_with_firmware.json HTTP/1.1" 200 926 "-" "SONiC-ZTP/0.1"
172.24.0.2:80 192.168.240.111 - - [07/Jun/2022:15:06:43 +0000] "GET /tftpboot/sonic/postscript/postscript_simple.sh HTTP/1.1" 200 1509 "-" "SONiC-ZTP/0.1"
172.24.0.2:80 192.168.240.111 - - [07/Jun/2022:15:06:49 +0000] "GET /tftpboot/sonic/config/first_boot_config.json HTTP/1.1" 200 1024 "-" "SONiC-ZTP/0.1"
172.24.0.2:80 192.168.240.111 - - [07/Jun/2022:15:09:42 +0000] "GET /tftpboot/sonic/firmware/Enterprise_SONiC_QS_4.0.0_Enterprise_Premium.bin HTTP/1.1" 200 1070502125 "-" "SONiC-ZTP/0.1"
172.24.0.2:80 192.168.240.111 - - [07/Jun/2022:15:15:45 +0000] "GET /tftpboot/sonic/postscript/postscript_simple.sh HTTP/1.1" 200 1509 "-" "SONiC-ZTP/0.1"
172.24.0.2:80 192.168.240.111 - - [07/Jun/2022:15:15:49 +0000] "GET /cgi-bin/callback.sh HTTP/1.1" 200 131 "-" "curl/7.64.0"
172.24.0.2:80 192.168.240.111 - - [07/Jun/2022:15:15:51 +0000] "GET /tftpboot/callback/192.168.240.111 HTTP/1.1" 200 210 "-" "curl/7.64.0"

```

Figure 26. Logging of the http webserver during a SONiC ZTP install which requests required files

Diagnostic commands

The following tables provide an overview of some useful commands to monitor or diagnose status. Some commands are related to the SONiC Click CLI, and others are related to the Dell management CLI (mf-cli or sonic-cli). The click-cli is available after you log in to SONiC. If you type `sonic-cli`, you enter the management framework CLI. This CLI resembles such as the Cisco, Dell OS10 or Arista CLIs. In the SONiC Click shell, you need to run some commands as root, that is, prefix them with `sudo`.

Table 1. Diagnostic commands on SONiC switch

COMMAND	SHELL	PURPOSE
<code>ztp status</code>	SONiC click	Show the status of ztp staging
<code>sudo ztp</code>	SONiC click	Show available ztp options
<code>sudo ztp run -y</code>	SONiC click	Start a ztp install
<code>sudo config save -y</code>	SONiC click	Write configuration to config-db.json file
<code>sudo cat /var/log/ztp.log</code>	SONiC click	Show SONiC ztp logfile
<code>sonic-cli</code>	SONiC click	Log in to management-cli (sonic-cli)
<code>sudo cat /etc/sonic/config_db.json</code>	SONiC click	Show SONiC saved configuration file (startup config)
<code>show interface Management</code>	Sonic-cli	Show management interface details
<code>show version</code>	Sonic-cli	Show version details of SONiC
<code>onie_mode_set --help</code>	SONiC click	Show available ONIE options that can be set from SONiC

COMMAND	SHELL	PURPOSE
<code>sudo onie_mode_set -o uninstall</code>	SONiC click	Set ONIE to delete all NOSes and start factory default discovery and execution method of ztp installation (reboot needed after command)

Table 2. Diagnostic commands on Linux server host system

COMMAND	SHELL	PURPOSE
<code>docker-compose ps</code>	Linux	Show started containers
<code>docker-compose ps -a</code>	Linux	Show all containers (started and not started)
<code>docker ps</code>	Linux	Show started containers with container ids
<code>docker ps -a</code>	Linux	Show all containers with container ids (started and not started)
<code>docker logs <container id></code>	Linux	Show log of container
<code>docker logs <container id> -f</code>	Linux	Follow log of container

Problem solving and troubleshooting

Dell highly recommends having a serial console connection available on the switch. This will ensure the best possible monitoring capabilities during all ZTP stages. The following information explains how to connect the console to the RS232 port and how to connect to the microUSB port

RS-232 console port access

The RS-232 console port is on the I/O side of the Z9100-ON switch.

Figure 1. Z9100-ON RS-232 console ports



1. RS-232 Console Port-top; RJ-45 Ethernet management port-bottom

- CAUTION:** Ensure that any equipment attached to the serial port can support the required 115200 baud rate.
- NOTE:** When connecting the RJ45 console to the patch panel or terminal server using Cat5e or Cat5 Ethernet cables, the maximum cable length is 100m. However, if the Ethernet cable is disconnected from the patch panel or terminal server but connected to the RJ45 console, the maximum cable length is 6m. If the cable is longer than 6m when disconnected from the panel or server, your switch may not boot.
- NOTE:** Before starting, be sure that your PC has a 9-pin serial port and that you have a terminal emulation program already installed and running on the PC.
- NOTE:** If your PC's serial port cannot accept a female DB-9 connector, use a DB-9 male-to-female adaptor.

1. Install the provided RJ-45 connector-side of the provided cable into the Z9100-ON console port.
2. Install the DB-9 female-side of the provided copper cable into your PC's serial port or into other data terminal equipment (DTE) server hardware.
3. Keep the default terminal settings on the console as follows:
 - 115200 baud rate
 - No parity
 - 8 data bits
 - 1 stop bit
 - No flow control

MicroUSB-B console port access

The MicroUSB type B console port is on the I/O side of the switch.

- NOTE:** The Z9100-ON switch uses the Silicon Labs CP2102 USB-B chip. To find the correct USB-B universal asynchronous receiver-transmitter (UART) driver, see <https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>.

The terminal settings are the same for the serial console port and the RS-232/RJ-45 console port:

- 115200 baud rate
- No parity
- 8 data bits
- 1 stop bit
- No flow control

When you connect the MicroUSB-B port, it becomes the primary connection and, while connected, all messages are sent to the microUSB-B port.

- NOTE:** Before starting this procedure, be sure that you have a terminal emulation program already installed on your PC. Install the appropriate drivers to support the microUSB-B port. For assistance or to download the drivers, contact www.dell.com/support. If your computer requires non-Dell EMC drivers, contact Dell EMC Technical Support for assistance.

1. Power on the PC.
2. Connect the USB-A end of cable into an available USB port on the PC.
3. Connect the microUSB-B end of cable into the microUSB-B console port on the Z9100-ON.
4. Power on the switch.
5. Install the necessary USB device drivers. To download the drivers, go to www.dell.com/support. For assistance, contact Dell EMC Technical Support.
6. Open your terminal software emulation program to access the Z9100-ON.
7. Confirm that the terminal settings on your terminal software emulation program are as follows:
 - 115200 baud rate
 - No parity
 - 8 data bits
 - 1 stop bit
 - No flow control

Figure 27. Console to RS232 connection overview

Table 3. Troubleshooting solutions

Problem	Possible causes	Possible solutions
No space left on switch	Too many operating systems installed.	Remove specific NOS or all NOSes with ONIE Uninstall OS
ONIE keeps on starting its discovery loop and execution loop	Discovery image could not be requested from webserver.	Check if discovery name is on webserver is correct Check if discovery name is reachable in webserver root Check if webserver is up Check if you can fetch image in a web browser
Firmware image timeout	Management VRF is configured in your initial configdb json file, which prevents the curl process on SONiC from reaching the webserver. Curl does not follow IP routing in the management VRF and thus has no IP routing available in the global table.	Disable management vrf global; <pre>"MGMT_VRF_CONFIG": { "vrf_global": { "mgmtVrfEnabled": "false" } },</pre>
Firmware download aborts unexpected	No space left on switch.	U
Failure on requesting ztp json file, firmware, configdb or provisioning script	Availability or reachability of files on webserver.	Check logging of webserver requests Check file rights on webserver Are files available on webserver Start webserver if not started
Errors on processing ztp json file, configdb json or provisioning script	Wrong json syntax or unknown key/values.	Check correctness of files. Use a json lint checker for valid json Use github SONiC ztp repo for key/value options (see Chapter Error! Reference source not found.)
Switch gets wrong IP address	MAC-address specified in dhcpd.conf on DHCP server configured in wrong IP subnet.	Configure correct mgmt eth mac-address on DHCP server config
Switch gets no IP address	DHCP server is down or an incorrect mac-address is specified in dhcpd.conf on DHCP server.	Configure correct mgmt eth mac-address on DHCP server config Start DHCP server if not started
DHCP server will not start	Subnet declaration is incorrectly configured.	Check DHCP server log during start
Switch cannot reach webserver IP	Wrong IP address in ZTP URL provided in dhcpd.conf on DHCP server or no option routers are configured.	Check ZTP URL IP address Check option routers IP address in dhcpd.conf
ZTP unsuccessfully finished	Errors in processing scripts.	k failed and check syntax correctness. Use github SONiC ztp repo for key/value options and syntax (See chapter Error! Reference source not found. for the reference link)
Multiple failures on ZTP json file processing	Syntax error.	Start with one plugin and if successful, add one by one. We recommend starting with the configdb-json plugin.

References

- [Official Zero touch deployment repository for SONiC on Github](#)
- [ONIE Design specification](#)
- [Enterprise SONiC Distribution by Dell Technologies - Lifecycle Management](#)
- [Enterprise SONiC Distribution by Dell Technologies – Zero Touch Provisioning](#)
- [Install Docker Engine on Ubuntu](#)
- [Install Docker Compose](#)