HOL-0709-01 Enterprise SONiC - Introduction to Enterprise SONiC

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Introduction

Introduction

This document is intended for technical professionals whom want to learn about the Enterprise SONiC Distribution by Dell Technologies network operating system.

Note: The virtual lab environment is using the virtual Enterprise SONiC switch using version 4.1 operating system. As a virtual lab, it simulates physical hardware, therefore the performance may be slower than labs that have a physical infrastructure. Some elements of the lab may take longer to complete than would normally be the case in a physical environment.

Software for Open Networking in the Cloud (SONiC)

SONiC is an open-source network operating system based on Debian Linux that runs on switches from multiple vendors. SONiC offers a full feature set that has been in use in the data centers of some of the largest cloud service providers. Since it is open-source, SONiC helps users leverage the collective strength and take advantage of the vast ecosystem and community.

Enterprise SONiC Distribution by Dell Technologies

Enterprise SONiC Distribution by Dell Technologies (also known as Enterprise SONiC) is an enhancement of the SONiC community version. Enterprise SONiC is based on the open-source SONiC operating system, which includes feature enhancements, hardening, and support targeted for the demanding data center leaf and spine fabrics while maintaining the open-source spirit.

Enterprise SONiC provides the benefits of our partnering with the SONiC community on a highly scalable open-source network operating system (NOS). SONiC is based on a modern containerized architecture that accelerates software innovation and evolution. The customers will also benefit from Dell Technologies enhancements, including hardening and validation of enterprise-ready data center use cases and support on select Dell EMC's PowerSwitch family of industry-leading open networking switches.

The Enterprise SONiC operating system supports the following system models:

- Dell EMC PowerSwitch N3248TE -ON
- Dell EMC PowerSwitch S5224F-ON
- Dell EMC PowerSwitch S5232F-ON
- Dell EMC PowerSwitch S5248F-ON
- Dell EMC PowerSwitch S5296F-ON
- Dell EMC PowerSwitch Z9264F-ON
- Dell EMC PowerSwitch Z9332F-ON
- Dell EMC PowerSwitch Z9100-ON

Dell Technologies has released a virtual appliance version of the Enterprise SONiC network operating system for the Dell EMC PowerSwitch S5248F-ON. Customers and other interested people can use this virtual switch to simulate and experiment with various network topologies. It enables the provisioning of a robust and proven network operating system across production and development platforms with a uniform Enterprise SONiC distribution and single-image consistency. The Enterprise vSONiC appliance is used to test various network configurations and integration in a simulated environment.

Lab Overview

Lab guidance

Architecture

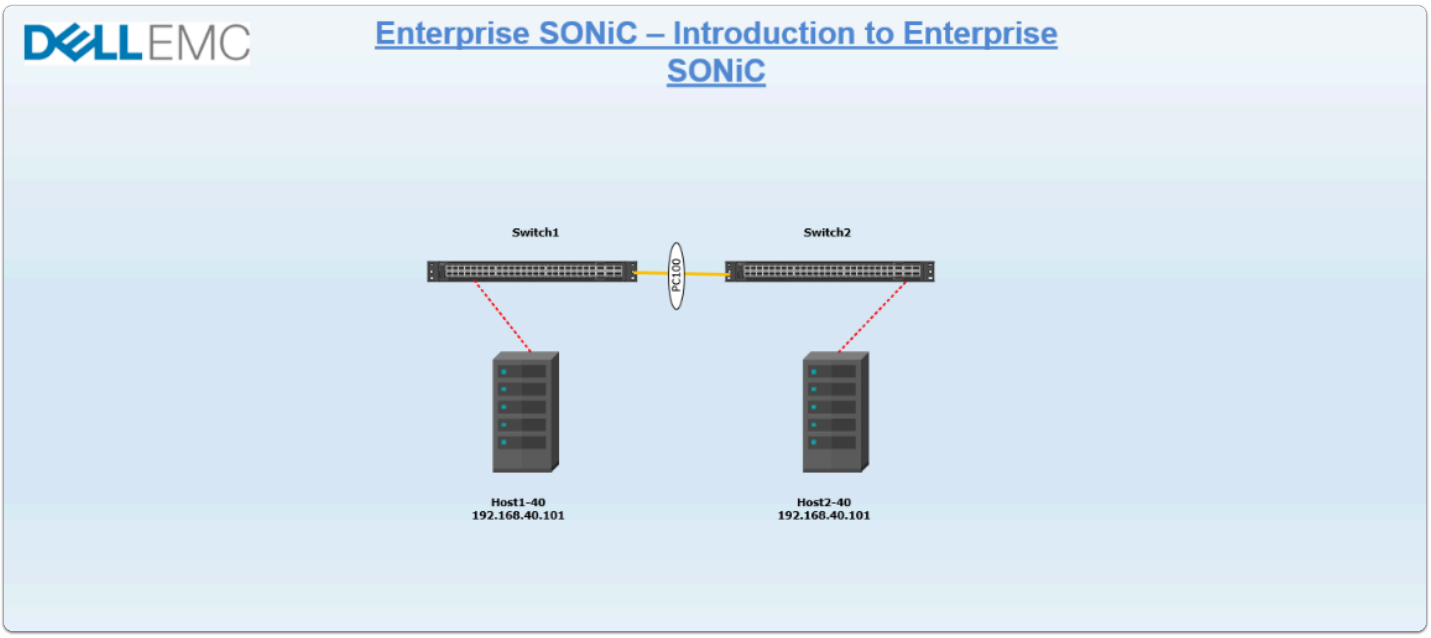
Introduction to the Dell Enterprise SONiC operating system (30 minutes): Basic - This module:

- Introduces the Dell Enterprise SONiC operating system
- How to configure the interfaces and IP addresses.
- How to upgrade the switch's operating system
- How to configure the switch's name

Dell Enterprise SONiC Distribution operating system - Getting Started

The Enterprise SONiC Distribution by Dell Technologies operating system enables dis-aggregation of the operating system from the underlying hardware. You will gain firsthand experience with the configuration of VLANs, assignment of IP addresses, and the basic Enterprise SONiC operating system commands using the Management Framework command-line interface (MF-CLI).

Network Diagram



Lab Details

Switch Hostname	Use	IP Address	Gateway	Credentials	Shutdown Procedure
Switch1	Leaf	192.168.1.11/24	N/A	admin/admin	sudo

Switch Hostname	Use	IP Address	Gateway	Credentials	Shutdown Procedure
					shutdown
Switch2	Leaf	192.168.1.12/24	N/A	admin/admin	sudo shutdown
Host1-40	Server	192.168.40.101/24	192.168.40.254	admin/admin	sudo poweroff
Host2-40	Server	192.168.40.102/24	192.168.40.254	admin/admin	sudo poweroff

Introduction to Enterprise SONiC

Introduction to the Enterprise SONiC operating system - module overview

Enterprise SONiC Distribution by Dell Technologies, also known as Enterprise SONiC, is based on the open-source SONiC OS, which adds feature enhancements, hardening, and support targeted for the demanding data center leaf and spine fabrics while maintaining the open-source spirit. Enterprise SONiC offers a full-suite of network functionality, such as MCLAG, VRRP, PVST, VXLAN and BGP to support large data center environments.

Benefits summary

Enterprise SONiC offers comparable network capabilities in an open-source environment that uses multiple containerized components. Flawed containers can be restarted independently with almost no system downtime. You can add new third-party, proprietary, or open-sourced components to tailor Enterprise SONiC to your needs. Community participation accelerates software development and continually offers new features.

This lab focuses on the configuration of the Enterprise SONiC operating system using the Dell Management Framework-CLI.

In this module, you will complete three lesssons:

Lesson 1

- Get a quick introduction to GNS3

Lesson 2

- Overview of Enterprise SONiC
- Configure a new password for "admin" user
- How to disable Zero Touch Provisioning (ZTP)
- Basic introduction of "Legacy SONiC"
- Configure standard interface naming
- Configure the switch's name
- Configure the Out-of-Band management interface
- Configure Role Based Access (RBAC) to the switch
- Upgrade the switch's operating system

Lesson 3

- Configure VLANs
- Configure interface IP address
- Configure port channels

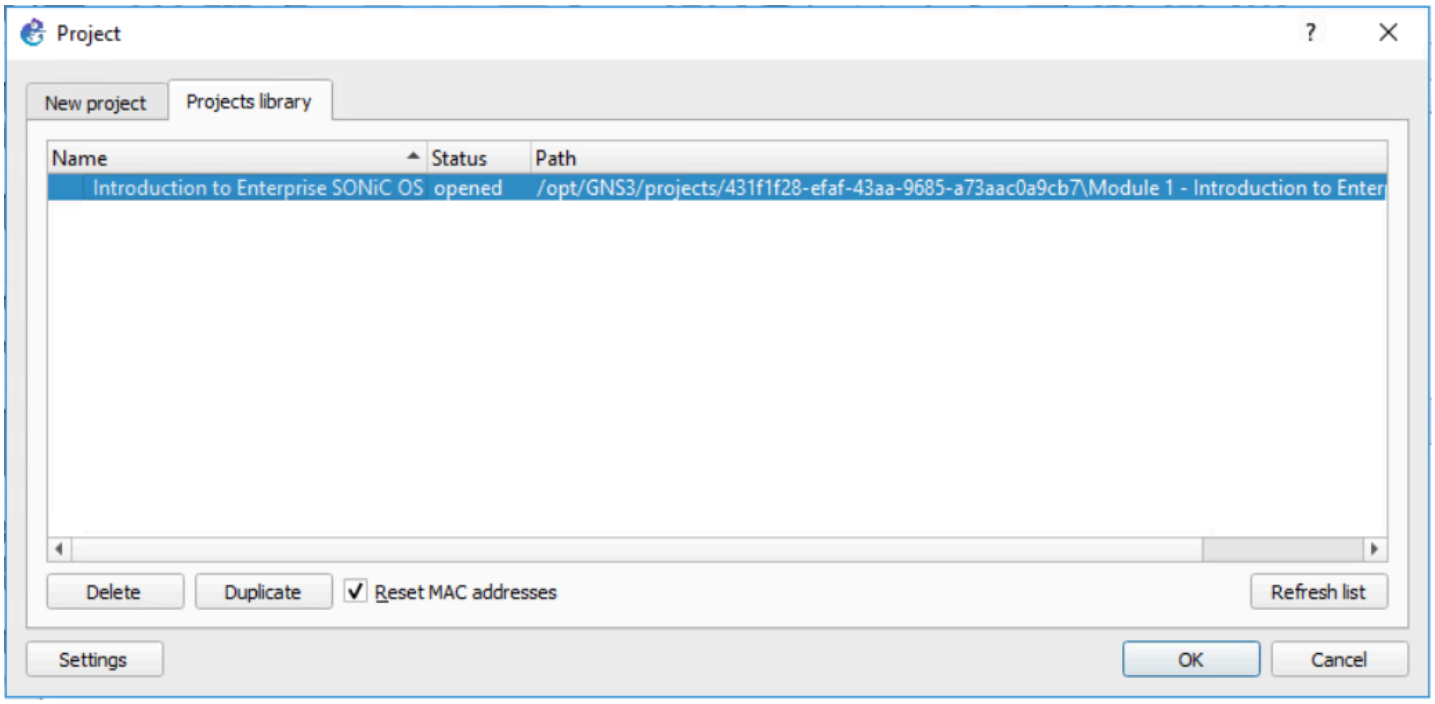
Lesson 1: Accessing the GNS3 virtual environment

The GNS3 software emulates the Enterprise SONiC operating system that runs on the Dell EMC PowerSwitch S5248F-ON. Network engineers use GNS3 to emulate, configure, test, and troubleshoot virtual and real networks. GNS3 enables you to run a small topology that consists of only a few devices on your laptop, to those that have many devices that are hosted on multiple servers or even hosted in the cloud. GNS3 is open-source, free software.

Open GNS3 application

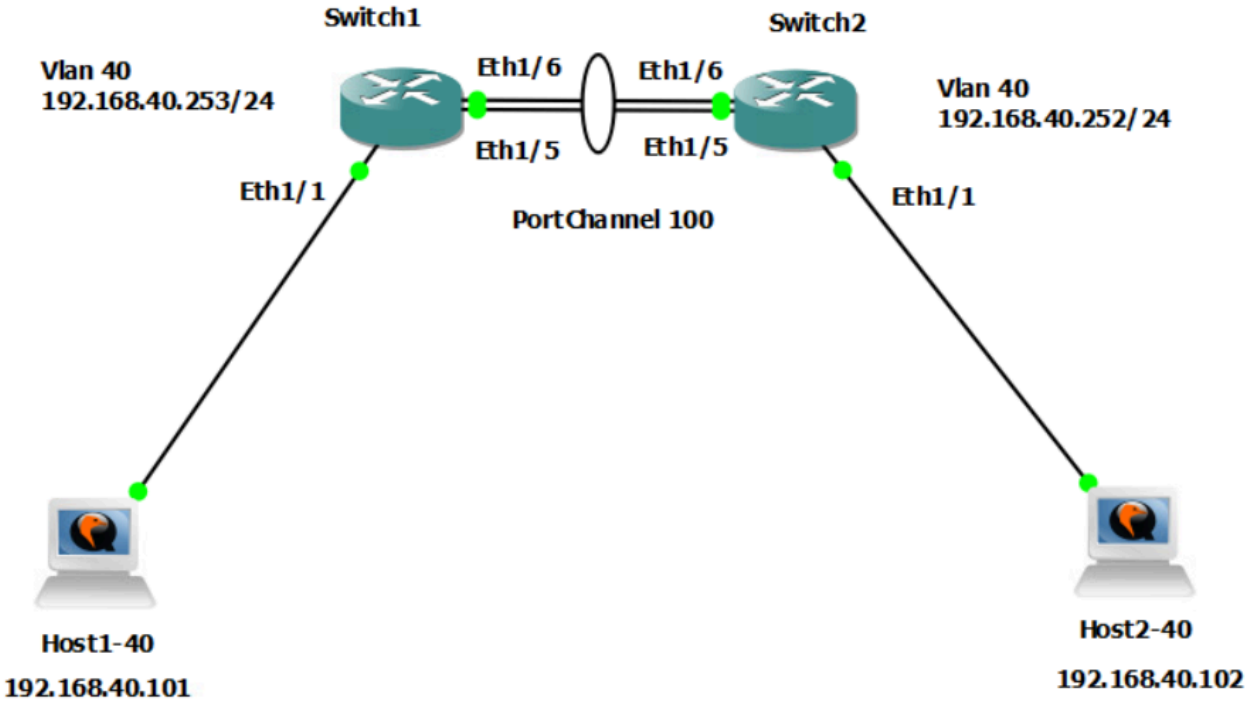
To open the GNS3 application, double click the **GNS3** icon on the desktop.

When the **Project** window opens, select **Project library** tab, click the **Introduction to Enterprise SONiC** entry and click **OK**.



View the topology

The topology should come up with all connections green. If not, please **END** the lab and try again.



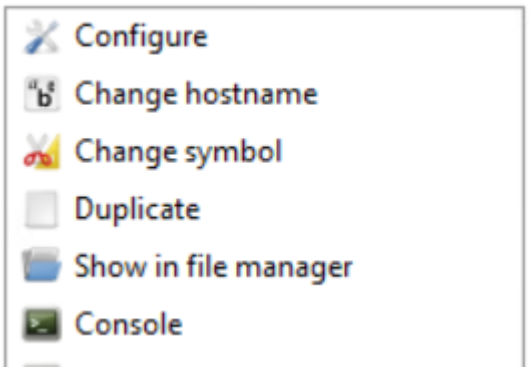
Note: Linux servers will be used as Host interfaces. **Host1-40** represents Host1 VLAN 40.

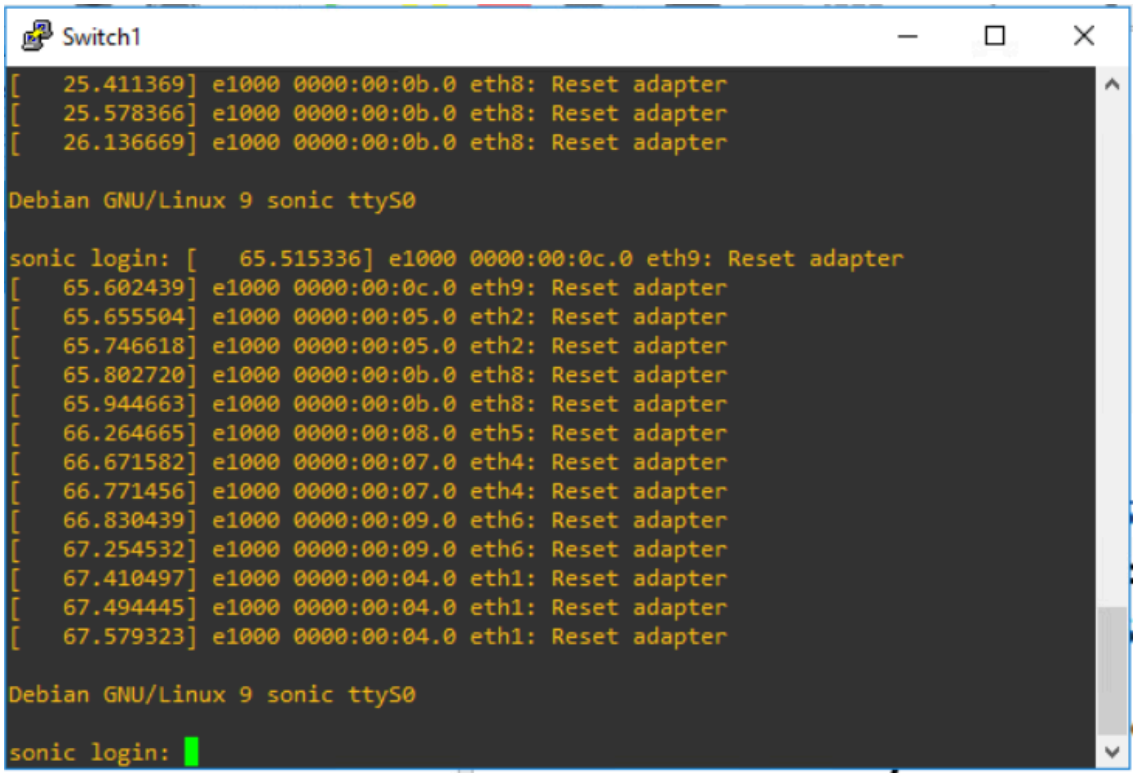
To identify the connected ports between the switches, hover the cursor over the green dot on the link. For a list of ports on the switch and the connection details, hover the cursor over the switch icon.

Only the management interface (eth0) and the first nine front end interfaces (Eth1/1 thru Eth1/9) are available for use in GNS3.

Activate Consoles

To activate the consoles, right-click the device icon and select **Console**. Consoles can also be activated by a double-click on the device icon.





This concludes Lesson 1. Please continue to Lesson 2.

Lesson 2: Dell Enterprise SONiC Quick Start up

Switch1 Login

This lesson provides an overview of the Enterprise SONiC operating system loaded on all of the switches.

Double-click the router icons to open a terminal emulator. To log in to the switches, use the following credentials:

Username: **admin**

Password: **YourPaSsWoRd**

Note: The default SONiC login/password is **admin/YourPaSsWoRd**.

Note: The default SONiC login/password is **admin/YourPaSsWoRd**.

Check the image version

This lab uses the latest Dell Enterprise SONiC code 4.1.0

Enter the following command in **Switch1** to check the version of the code:

```
show version
```

```
admin@sonic:~$ show version

SONiC Software Version: SONiC-OS-4.1.0-Enterprise_Base
Product: Enterprise SONiC Distribution by Dell Technologies
Distribution: Debian 10.13
Kernel: 5.10.0-8-2-amd64
Config DB Version: version_4_1_1
Build commit: 93589a15db
Build date: Tue Apr 18 17:56:48 UTC 2023
Built by: sonicbld@sonic-lvn-csg-001

Platform: x86_64-kvm_x86_64-r0
HwSKU: DellEMC-S5248f-P-25G-DPB
ASIC: vs
ASIC Count: 1
```

Note: This version is the "Enterprise Base" bundle. There are several Enterprise SONiC bundles: Enterprise, Cloud, and Edge.

Disable Zero Touch Provisioning

In this course, we will not be using Zero-Touch Provisioning (ZTP). ZTP is enabled by default after the initial operating system load. All switches in this lab except **Switch1** have ZTP disabled.

Enter the following command in **Switch1** to disable ZTP:

```
sudo ztp disable -y
```

```
admin@sonic:~$

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

sudo ztp disable -y
Dec 17 22:05:53.711300 2020 sonic WARNING sonic-ztp[3140]: Received terminate si
gnal. Shutting down.
Waiting for system online status before stopping ZTP. (This may take 30--120 sec
onds).
Removing ZTP configuration profile. Loading factory default configuration.
Running command: /usr/bin/db_migrator.py -o check_version -f /etc/sonic/config_d
b.json
FRR Retain Cleared ...
Stopping service udld ...
Stopping service dhcp_relay ...
Stopping service swss ...
```

Note: It takes a few minutes after disabling ZTP before System is ready.

The ZTP status can be viewed with the **show ztp** command.

```
admin@sonic:~$ show ztp
ZTP Admin Mode : False
ZTP Service    : Inactive
ZTP Status     : Not Started

ZTP Service is not running


admin@sonic:~$
```

Configure new switch login credentials

The next step is to change the switch login credentials from the default **admin/YourPaSsWoRd** to **admin/admin123**.

Remain logged into the switch console and perform the following steps to change the default switch access credentials.

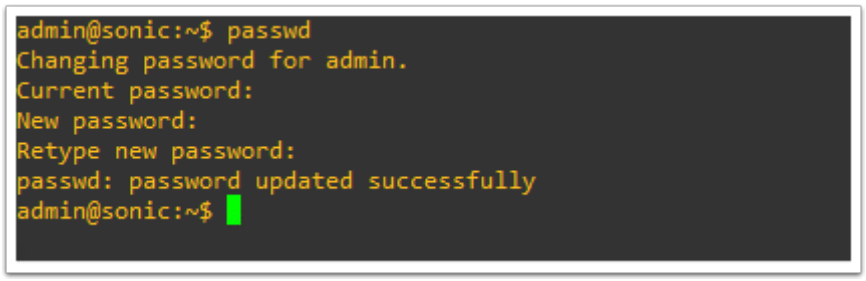
Note: When a switch is accessed for the first time, the user will get a prompt to change the default access credentials. The switches were accessed previously so you will not see this message.

The image below shows the steps on a switch that has been accessed for the **first** time and a new admin password is being configured.

```
You are required to change your password immediately (root enforced)
Changing password for admin.
(current) UNIX password: YourPaSsWoRd
Enter new UNIX password: *********
Retype new UNIX password: ********
Linux sonic 4.9.0-11-2-amd64 #1 SMP Debian 4.9.189-3+deb9u2 (2019-11-11) x86_64
You are on
 ____   ___   _   _ ___ ____
/ ___| / _ \| \ | |_ _/ ___|
\___ \| | | |  \| || | |
 ___) | |_| | |\  || | |___
|____/ \___/|_| \_|___\____|

-- Software for Open Networking in the Cloud --

Unauthorized access and/or use are prohibited.
```

The steps below are NOT to be executed. The steps are being provided to inform.

To configure the new switch login credentials, issue the **passwd** command at the switch prompt and proceed with new login credentials. The current password is **YourPaSsWoRd** and the new password is **admin123.** These credentials will be preconfigured.



Linux shell

The Legacy SONiC CLI uses a prompt with the format *username@hostname*. The default username is **admin** and the default hostname is **sonic**.

The user is greeted with the Linux shell when accessing the Enterprise SONiC networking operating system. The list of Linux shell commands available is invoked by typing **help**.

Legacy SONiC CLI

The Legacy SONiC CLI is built on the implementation of Python Click library. The CLI component provides the administrators with a customizable approach to creating command-line tools.

Note: The Legacy SONIC CLI is only covered to introduce the concept. All exercises will be executed in the Management Framework CLI (MF-CLI) later in this lesson.

Show commands

The **show ?** command lists the available show commands.

```
admin@sonic:~$ show ?
Usage: show [OPTIONS] COMMAND [ARGS]...

  SONiC command line - 'show' command

Options:
  -?, -h, --help  Show this message and exit.

Commands:
  aaa                   Show AAA configuration
  acl                   Show ACL related information
  arp                   Show IP ARP table
  bgp                   Show BGP information
  boot                  Show boot configuration
  buffer_pool           Show details of the buffer pools
  classifier            Show flow based services classifiers related...
  clock                 Show date and time
  config                Show details about configuration profiles...
  copp                  Show COPP
  cores                 Show core dump events encountered
  database              Show Redis database information
  debug                 Collect debugging information from components
  ecn                   Show ECN configuration
  environment           Show environmentals (voltages, fans, temps)
  errdisable            Errdisable information
  error_database        Show ERROR DB entries
  export                show tech-support export configurations
  hardware              Show ASIC related information
  hostname              Show hostname
  hosts                 Show nameserver configuration
  interfaces            Show details of the network interfaces
  ip                    Show IP (IPv4) commands
  ipv6                  Show IPv6 commands
  kdump                 Show kdump configuration, status and...
  ldap                  Show LDAP configuration
  line                  Show all /dev/ttyUSB lines and their info
```

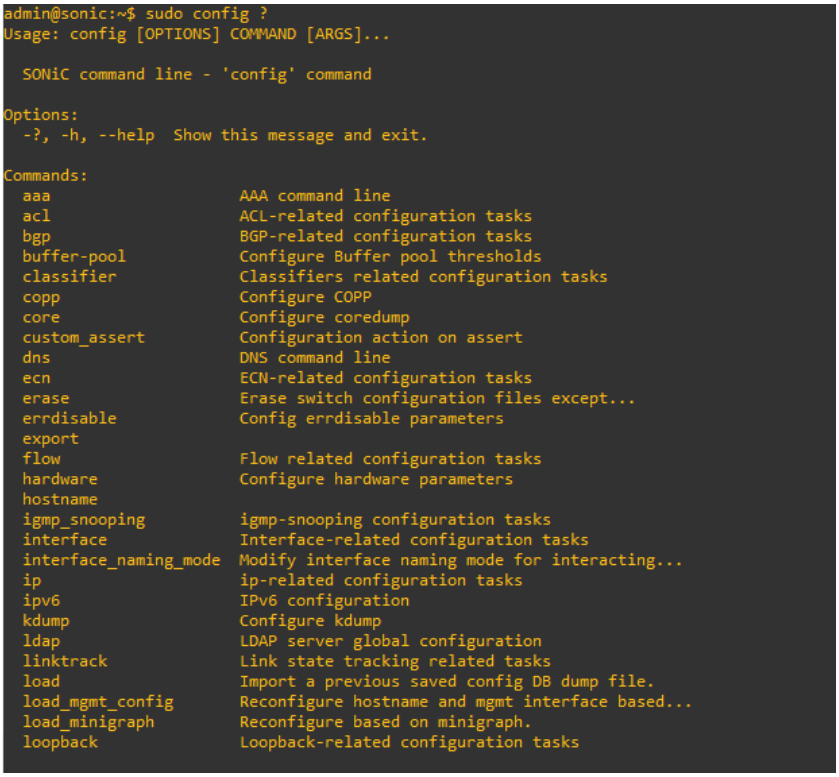
View configuration

Configurations are saved in JSON format in the **/etc/sonic/config_db.json** file. To view the running configuration in JSON format, type **show runningconfiguration all | more.**

```
admin@sonic:~$ show runningconfiguration all | more
{
    "CLASSIFIER_TABLE": {
        "class-oob-arp": {
            "DESCRIPTION": "",
            "ETHER_TYPE": "0x806",
            "MATCH_TYPE": "FIELDS"
        },
        "class-oob-dhcp-client": {
            "DESCRIPTION": "",
            "ETHER_TYPE": "0x800",
            "IP_PROTOCOL": "17",
            "L4_DST_PORT": "68",
            "MATCH_TYPE": "FIELDS"
        },
        "class-oob-dhcp-server": {
            "DESCRIPTION": "",
            "ETHER_TYPE": "0x800",
            "IP_PROTOCOL": "17",
            "L4_DST_PORT": "67",
            "MATCH_TYPE": "FIELDS"
        },
        "class-oob-ip-multicast": {
            "DESCRIPTION": "",
--More--
```

Legacy SONiC configuration commands

Legacy SONiC CLI configuration commands can be listed by typing **sudo config ?**



```
admin@sonic:~$ sudo config ?
Usage: config [OPTIONS] COMMAND [ARGS]...

  SONiC command line - 'config' command

Options:
  -?, -h, --help  Show this message and exit.

Commands:
  aaa                   AAA command line
  acl                   ACL-related configuration tasks
  bgp                   BGP-related configuration tasks
  buffer-pool           Configure Buffer pool thresholds
  classifier            Classifiers related configuration tasks
  copp                  Configure COPP
  core                  Configure coredump
  custom_assert         Configuration action on assert
  dns                   DNS command line
  ecn                   ECN-related configuration tasks
  erase                 Erase switch configuration files except...
  errdisable            Config errdisable parameters
  export
  flow                  Flow related configuration tasks
  hardware              Configure hardware parameters
  hostname
  igmp_snooping         igmp-snooping configuration tasks
  interface             Interface-related configuration tasks
  interface_naming_mode Modify interface naming mode for interacting...
  ip                    ip-related configuration tasks
  ipv6                  IPv6 configuration
  kdump                 Configure kdump
  ldap                  LDAP server global configuration
  linktrack             Link state tracking related tasks
  load                  Import a previous saved config DB dump file.
  load_mgmt_config      Reconfigure hostname and mgmt interface based...
  load_minigraph        Reconfigure based on minigraph.
  loopback              Loopback-related configuration tasks
```

Note: Root privilege is required to run the configuration commands. Root privilege shell can be started by typing **sudo -i** or by prefixing each command with **sudo**.

```
sudo -i
```

To save the configuration in the Legacy SONiC CLI mode, type **config save -y**.

```
config save -y
```

This command copies the running configuration to the **/etc/sonic/config_db.json** file. To view this file, type **cat /etc/sonic/config_db.json**.

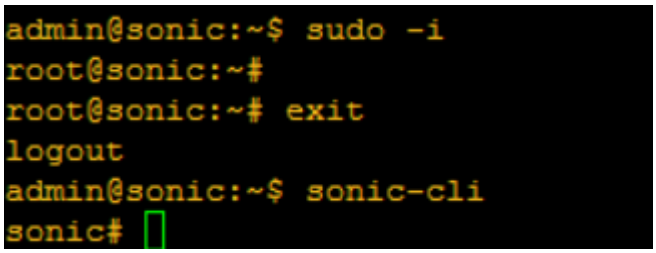
Note: In this guide we will predominately use the Management Framework CLI commands. MF-CLI provides the user with an industry standard look and feel.

Dell Enterprise SONiC Management-Framework CLI

The Management Framework CLI (MF-CLI) is being developed to provide an industry standard CLI format. Many commands are available in MF-CLI now, and most use cases may be configured in MF-CLI. However, there are some commands that may need to be performed in the Linux shell.

On **Switch1**, enter the Management Framework CLI by typing **sonic-cli**. If the **sudo** shell was entered, you must exit before entering MF-CLI.

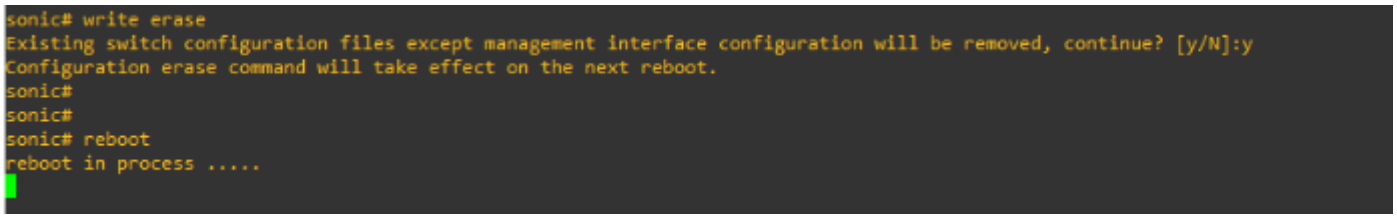
```
sonic-cli
```



Note: The prompt for MF-CLI is *hostname* followed by #. The remaining lessons will use the Management Framework CLI.

Erase configuration

To erase the configuration file except for the management interface configuration, type **write erase** and then **reboot**.



Interface configuration commands - Native SONiC vs. Dell Standard

Interface naming supports SONiC **Native** mode and Dell **Standard** mode naming conventions. In Native mode, interfaces are named Ethernet0 through Ethernet<n>. In standard mode, the interfaces correspond to the switch front panel numbering, Eth 1/1 through Eth 1/n.

Note: In this lab, we will be using the **Standard** naming mode. After changing interface naming mode, you must wait for the naming mode change message.

```
configure terminal
interface-naming standard
end
write memory
```

After the Interface naming mode message, exit the Management Framework CLI session and re-enter to activate.

```
exit
```

```
sonic-cli
```

```
sonic(config)# interface-naming standard

Broadcast message: Interface naming mode has changed. Users running 'sonic-cli' are required to restart your session.

sonic(config)# end
sonic# write memory
sonic# exit
admin@sonic:~$ sonic-cli
sonic#
```

Hostname

Configure the hostname on **Switch1** by entering the following commands:

```
configure terminal
hostname Switch1
end
write memory
```

Note: After changing hostname, you must exit and re-enter MF-CLI to activate the newly configured hostname.

```
exit
sonic-cli
```

```
sonic# configure terminal
sonic(config)# hostname Switch1
sonic(config)#
Broadcast message: Hostname has been changed from 'sonic' to 'Switch1'. Users running 'sonic-cli' are suggested to restart y
our session.


sonic(config)# end
sonic# write memory
sonic# exit
admin@sonic:~$ sonic-cli
Switch1#
```

Configure the Out-of-Band (OOB) Management interface

The eth0 interface denotes the out-of-band (OOB) management interface. It is also identified as interface **Management 0**. The management interface is set by default to obtain the IP address using DHCP and can be changed to a static value.

The following sets a static IP and gateway address to the management interface and saves the configuration. Enter the following in **Switch1**.

```
configure terminal
interface Management 0
 ip address 192.168.153.32/24 gwaddr 192.168.153.254
 exit

end
write memory
!
```

Note: The OOB interface (eth0) will not be used in this lab.

Front panel interfaces

To view the status of the switch interfaces, use the **show interfaces status** command.

Note: The GNS3 SONiC appliances that are used in the lab are configured with only 10 active interfaces per appliance. The first interface is eth0 which is the OOB management interface. The front-panel interfaces available are Eth1/1- Eth1/9.

```
Switch1# show interface status
------------------------------------------------------------------------------------------------------------------------
Name               Description                Admin          Oper           Speed          MTU            Alternate Name
------------------------------------------------------------------------------------------------------------------------
Eth1/1             -                          down           up             25000          9100           Ethernet0
Eth1/2             -                          down           up             25000          9100           Ethernet1
Eth1/3             -                          down           up             25000          9100           Ethernet2
Eth1/4             -                          down           up             25000          9100           Ethernet3
Eth1/5             -                          down           up             25000          9100           Ethernet4
Eth1/6             -                          down           up             25000          9100           Ethernet5
Eth1/7             -                          down           up             25000          9100           Ethernet6
Eth1/8             -                          down           up             25000          9100           Ethernet7
Eth1/9             -                          down           up             25000          9100           Ethernet8
Eth1/10            -                          down           down           25000          9100           Ethernet9
Eth1/11            -                          down           down           25000          9100           Ethernet10
Eth1/12            -                          down           down           25000          9100           Ethernet11
Eth1/13            -                          down           down           25000          9100           Ethernet12
Eth1/14            -                          down           down           25000          9100           Ethernet13
Eth1/15            -                          down           down           25000          9100           Ethernet14
Eth1/16            -                          down           down           25000          9100           Ethernet15
Eth1/17            -                          down           down           25000          9100           Ethernet16
Eth1/18            -                          down           down           25000          9100           Ethernet17
Eth1/19            -                          down           down           25000          9100           Ethernet18
Eth1/20            -                          down           down           25000          9100           Ethernet19
Eth1/21            -                          down           down           25000          9100           Ethernet20
--more--
```

Note: The interfaces are administratively shut down by default when the switch is first brought up. Use the **no shutdown** command to administratively bring the interfaces up. GNS3 interface status will only reliably show the **Admin** status. Please ignore the interface **Oper** status.

Other **show interface** command options.

```
Switch1# show interface
  breakout                  Show port breakout information
  counters                  Counters for physical interfaces
  Eth                       Physical interface ID/range
  Loopback                  Loopback interface
  Management                Management interface
  PortChannel               PortChannel interface
  status                    Physical interfaces status
  transceiver               Transceiver info
  Vlan                      VLAN ID/range
```

On **Switch1**, startup interface **Eth 1/1**.

```
configure terminal
interface Eth 1/1
no shutdown
exit
end
write memory
```

Other interface configuration commands are:

```
Switch1(config)# interface Eth 1/1
Switch1(conf-if-Eth1/1)#
  channel-group          Configure PortChannel parameters
  description            Textual description
  end                    Exit to EXEC mode
  exit                   Exit from current mode
  fec                    Configure FEC (forward error correction)
  flow-group             Attaches specific flow-group to interface
  ip                     Interface Internet Protocol config commands
  ipv6                   Interface Internet Protocol v6 config commands
  link                   Interface link
  lldp                   LLDP interface configuration subcommands
  mac                    Configure MAC parameters
  mtu                    Configure MTU
  nat-zone               NAT Zone
  no                     Negate a command or set its defaults
  priority-flow-control  PFC Configuration
  qos-map                QoS Map Configuration
  queue                  Queue configuration
  scheduler-policy       Scheduler Policy configuration
  service-policy         Apply ingress or egress policy
  sflow                  Interface sFlow settings
  shutdown               Disable the interface
  spanning-tree          Spanning tree configuration
  speed                  Configure speed
  storm-control          Configure storm-control
  switchport             Configure switchport parameters
  threshold              Configure priority-group/queue threshold on an interface.
  udld                   UDLD configuration
  unreliable-los         Configure unreliable LOS mode
  vrrp                   Configures VRRP

Switch1(conf-if-Eth1/1)#
```

Dynamic Port Breakout

Dynamic Port Breakout (DPB) allows converting an interface dynamically to different speeds. For example, with DPB, a 100G interface may be converted from 1x100G to 4x25G.

Unfortunately, we cannot demonstrate DPB with GNS3 as the high speed ports are beyond the 10 port limit. However, here is an example of the breakout modes supported on a Dell EMC PowerSwitch S5232F-ON.

```
sonic# show interface breakout modes
-------------------------------------------------------------------------
Port   Interface    Supported Modes                          Default Mode
-------------------------------------------------------------------------
1/1    Eth1/1       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/2    Eth1/2       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/3    Eth1/3       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/4    Eth1/4       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/5    Eth1/5       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/6    Eth1/6       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/7    Eth1/7       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/8    Eth1/8       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/9    Eth1/9       1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/10   Eth1/10      1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/11   Eth1/11      1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/12   Eth1/12      1x100G, 1x40G, 4x25G, 4x10G              1x100G
1/13   Eth1/13      1x100G, 1x40G, 4x25G, 4x10G              1x100G
```

In order to change a 1x100G interface to a 4x25G interface, the following command would be used:

sonic(config)# **interface breakout port 1/1 mode 4x25G**

Show version

The **show version** command enables you to see the Enterprise SONiC version in use.

```
show version
```

```
sonic# show version

Software Version  : 4.1.0-Enterprise_Base
Product           : Enterprise SONiC Distribution by Dell Technologies
Distribution      : Debian 10.13
Kernel            : 5.10.0-8-2-amd64
Config DB Version : version_4_1_1
Build Commit      : 93589a15db
Build Date        : Tue Apr 18 17:56:48 UTC 2023
Built By          : sonicbld@sonic-lvn-csg-001
Platform          : x86_64-kvm_x86_64-r0
HwSKU             : DellEMC-S5248f-P-25G-DPB
ASIC              : vs
Serial Number     :
Uptime            : 22:06:08 up 58 min, 1 user, load average: 8.43, 5.46, 4.68
```

You have completed Lesson 2. Continue to the next lesson.

Role-based Access Control (RBAC)

RBAC provides control for access and authorization. Enterprise SONiC supports two predefined roles; **admin** and **operator**.

- **admin** - Provides full access to all commands in the system, exclusive access to commands that manipulate the file system, and access to the system shell. A system administrator can create user IDs and user roles.
- **operator** - Provides access to EXEC mode to view the current configuration with limited access. A network operator cannot modify any configuration setting on a switch. Only allowed SSH access to MF-CLI; no Linux access.

```
configure terminal
username User1 password Password1 role admin
username User2 password Password2 role operator
```

```
sonic# configure terminal
sonic(config)# username User1 password Password1 role admin
sonic(config)# username User2 password Password2 role operator
sonic(config)# end
```

Managing (Upgrade/downgrade) the Dell PowerSwitch SONiC system image

To install or upgrade the system image:

- **Copy** - Use the **copy** command to copy an image file from a source location to the local file system or a network server.
- **Install** - Use the **image install** command to install the image on the switch. The installed image is stored as the next-boot image.
- **Verify** - Use the **image status** command to view the image installation status.
- **Reboot** - Use the **reboot** command to activate the new image file.

Note: All commands are executed at the "enable" mode.

```
copy
```

```
sonic# copy
  config:                Copy from configuration directory (config://filename)
  coredump:              Copy from coredump directory (coredump://filename)
  event-profile:         Copy from event-profile directory (event-profile://filename)
  ftp:                   Copy from remote FTP server (ftp://userid:passwd@hostip/filepath)
  home:                  Copy from home directory (home://filename)
  http:                  Copy from remote HTTP server (http://hostip/filepath)
  log:                   Copy from log directory (log://filename)
  running-configuration  Copy running-configuration
  scp:                   Copy from remote SCP server (scp://userid:passwd@hostip/filepath)
  startup-configuration  Copy startup-configuration
  tech-support:          Copy from tech-support directory (tech-support://filename)
  usb:                   Copy from usb media directory (usb://filename)
```

```
image install
```

```
sonic# image install
  cancel  Cancel image installation
  String  Path(file://filepath) or URL(http:// or https://) to image
```

```
show image status
```

```
sonic# show image status
------------------------------------------------------------
Global operation status   : GLOBAL_STATE_IDLE
------------------------------------------------------------
sonic#
```

```
reboot
```

Show running-configuration

To view the current running configuration, type **show running-configuration** .

```
Switch1# show running-configuration
!
ip load-share hash ipv4 ipv4-dst-ip
ip load-share hash ipv4 ipv4-src-ip
ip load-share hash ipv4 ipv4-ip-proto
ip load-share hash ipv4 ipv4-l4-dst-port
ip load-share hash ipv4 ipv4-l4-src-port
ip load-share hash ipv6 ipv6-dst-ip
ip load-share hash ipv6 ipv6-src-ip
ip load-share hash ipv6 ipv6-next-hdr
ip load-share hash ipv6 ipv6-l4-src-port
ip load-share hash ipv6 ipv6-l4-dst-port
username User1 password $6$jH1vtFM3biIHxWZj$056Vvk9oFIjQUU8zdURDIUAkGfE9jMtsTIMGXdOMnIftIPdV3ifCIz6xaVUiZW1LvVG
V7RVK3logIHqdeM/Av. role admin
username User2 password $6$o6iY6HkbO0T8WEtz$HkTn6EB/j2B1Ah8JU1fR/3fcARdOQkCt9DgNwuEpHTiAmPPQurSvwGnvdG5vhoItpSA
DGedk1alBveEMOkhAQ0 role operator
mac address-table aging-time 600
kdump enable
kdump memory 0M-2G:256M,2G-4G:320M,4G-8G:384M,8G-:448M
kdump num-dumps 3
ip vrf default
```

To view specific running configuration options, type **show running-configuration ?**

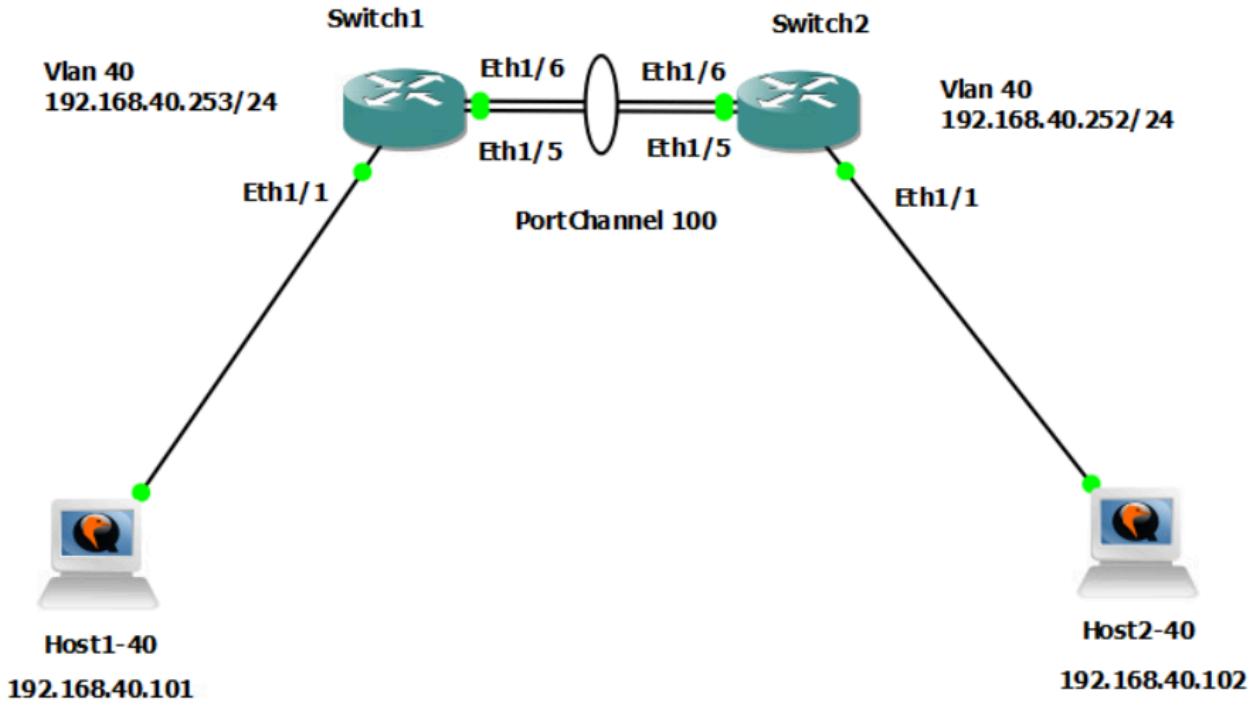
```
Switch1# show running-configuration
  bfd             Show all BFD configurations
  bgp             Display current BGP configurations
  class-map       Shows current class-map configuration
  hardware        Show current hardware configuration
  interface       Show interface info
  ip              Show current IPv4 ACL configuration
  ipv6            Show current IPv6 ACL configuration
  line            Show current session configuration
  link            Show current link state tracking configuration
  mac             Show current MAC ACL configuration
  mirror-session  Show mirror session info
  nat             Displays all NAT configurations
  ospf            Displays all OSPFv2 router configurations
  policy-map      Shows current policy-map configuration
  route-map       Display current route map configuration
  spanning-tree   Show spanning-tree configuration
  tam             Displays all TAM configurations
  |               Pipe through a command
  <cr>

Switch1#
```

Lesson 3: Lab setup configuration

Overview

The Enterprise SONiC operating system has all interfaces in Layer 3 mode by default. To configure an interface for L2, first assign the VLAN interface, then assign the interfaces to the VLAN ID. Optionally, an IP address can be assigned to the VLAN.

Again, here is the topology.



Configure Switch1

Switch1 login

Right-click on node **Switch1.**

Select **Console**.

On switch **Switch1**, please log in with the following credentials:

login: **admin**

password: **admin**

Enter the Management Framework shell.

```
sonic-cli
```

Enable all switch interfaces

Remain logged in and at the switch prompt enter the following commands.

```
configure terminal
interface range ethernet 1/1-1/56
no shut
```

Configure Host1 interface

Switch1 Eth 1/1 is connected to **Host1**. Enter the following commands to create **Vlan 40** with an IP address **192.168.40.253/24. Eth 1/1** is an untagged member of **Vlan 40.**

```
configure terminal

interface vlan 40
ip address 192.168.40.253/24
exit

interface Eth 1/1
description Host1
switchport access vlan 40
exit
```

```
Switch1# configure terminal
Switch1(config)# interface Vlan 40
Switch1(conf-if-Vlan40)# ip address 192.168.40.253/24
Switch1(conf-if-Vlan40)# exit
Switch1(config)# interface Eth 1/1
Switch1(conf-if-Eth1/1)# description Host1
Switch1(conf-if-Eth1/1)# switchport access vlan 40
Switch1(conf-if-Eth1/1)# no shutdown
Switch1(conf-if-Eth1/1)# exit
Switch1(config)#
```

Configure port channel

Create a port channel. By default, the port channel is set to LACP.

Note: The following options must be selected when creating the port channel. If changes need to be made at a later date, the port channel will need to be deleted and re-entered.

- fallback LACP Fallback
- fast_rate LACP Fast Rate Interval
- min-links Minimum links for port-channel to stay up
- mode Port channel mode (active/on). Mode **on** is static LAG.

Now create the static port channel **PortChannel 100** and add as a tagged member of **Vlan 40.** Then add **Eth 1/5** and **Eth 1/6** as members. Then save configuration.

```
interface PortChannel 100 mode on
description Static_LAG_to_Switch2
switchport trunk allowed vlan add 40
exit

interface Eth 1/5
description PortChannel100_Mem
channel-group 100
exit

interface Eth 1/6
description PortChannel100_Mem
channel-group 100
exit

end
write memory
```

Note: SONiC port channels will be configured as static in this lab to reduce GNS3 CPU load. To create dynamic (LACP) port channels in a hardware environment, set to **mode active**.

```
Switch1(config)# interface PortChannel 100 mode on
Switch1(conf-if-po100)# description Static_LAG_to_Switch2
Switch1(conf-if-po100)# switchport trunk allowed Vlan add 40
Switch1(conf-if-po100)# exit
Switch1(config)# interfac
interface         interface-naming
Switch1(config)# interface Eth 1/5
Switch1(conf-if-Eth1/5)# description PortChannel100_Mem
Switch1(conf-if-Eth1/5)# channel-group 100
Switch1(conf-if-Eth1/5)# no shutdown
Switch1(conf-if-Eth1/5)# exit
Switch1(config)# interface Eth 1/6
Switch1(conf-if-Eth1/6)# description PortChannel100_Mem
Switch1(conf-if-Eth1/6)# channel-group 100
Switch1(conf-if-Eth1/6)# no shutdown
Switch1(conf-if-Eth1/6)# exit
Switch1(config)#
```

Verify VLAN

Verify the VLAN configuration with **Eth1/1** and **PortChannel 100** as tagged members.

```
show vlan
```

```
Switch1# show Vlan
Q: A - Access (Untagged), T - Tagged
NUM        Status      Q Ports
40         Active      T  PortChannel100
                       A  Eth1/1
```

Verify port channel

Show the operational status and counters of the port channel with the following commands:

```
show portchannel summary
show interface portchannel
```

```
Switch1# show PortChannel summary
Flags(oper-status):  D - Down U - Up (portchannel) P - Up in portchannel (members)
-------------------------------------------------------------------------------------------------------------
Group              PortChannel                Type              Protocol       Member Ports
-------------------------------------------------------------------------------------------------------------
100                PortChannel100 (U)         Eth               NONE           Eth1/5(P)
                                                                                Eth1/6(P)
Switch1#
```

```
Switch1# show interface PortChannel
PortChannel100 is up, line protocol is up, mode Static
Description: Static_LAG_to_Switch2
Minimum number of links to bring PortChannel up is 1
Mode of IPV4 address assignment: not-set
Mode of IPV6 address assignment: not-set
Graceful shutdown: Disabled
MTU 9100
LineSpeed 50.0GB
Members in this channel: Eth1/5
Members in this channel: Eth1/6
Last clearing of "show interface" counters: 1970-01-01 00:00:00
10 seconds input rate 0 packets/sec, 0 bits/sec, 0 Bytes/sec
10 seconds output rate 0 packets/sec, 0 bits/sec, 0 Bytes/sec
Input statistics:
          0 packets, 0 octets
          0 Multicasts, 0 Broadcasts, 0 Unicasts
          0 error, 0 discarded
Output statistics:
          0 packets, 0 octets
          0 Multicasts, 0 Broadcasts, 0 Unicasts
          0 error, 0 discarded
```

Note: GNS3 objects do not show the true operational interface status. At this point, there are no active interfaces on Switch2.

Configure Switch2

Note: ZTP is already disabled on **Switch2**.

Switch2 login

Right-click on node **Switch2.**

Select **Console**.

On switch **Switch2**, please log in with the following credentials:

login: **admin**

Password: **admin**

Enter the Management Framework CLI shell.

```
sonic-cli
```

Enable Standard interface naming mode and hostname.

```
configure terminal
interface-naming standard
hostname Switch2
end
write memory
```

Wait for **Interface naming mode has changed** message, then exit the Management Framework session and re-enter.

```
admin@sonic:~$ sonic-cli
sonic# configure terminal
sonic(config)# interface-naming standard

Broadcast message: Interface naming mode has changed. Users running 'sonic-cli' are required to restart your session.

sonic(config)# hostname Switch2
sonic(config)#
Broadcast message: Hostname has been changed from 'sonic' to 'Switch2'. Users running 'sonic-cli' are suggested to restart y
our session.

end
sonic# write memory
sonic# exit
admin@sonic:~$ sonic-cli
Switch2#
```

Enable all switch interfaces

Remain logged in and at the switch prompt enter the following commands.

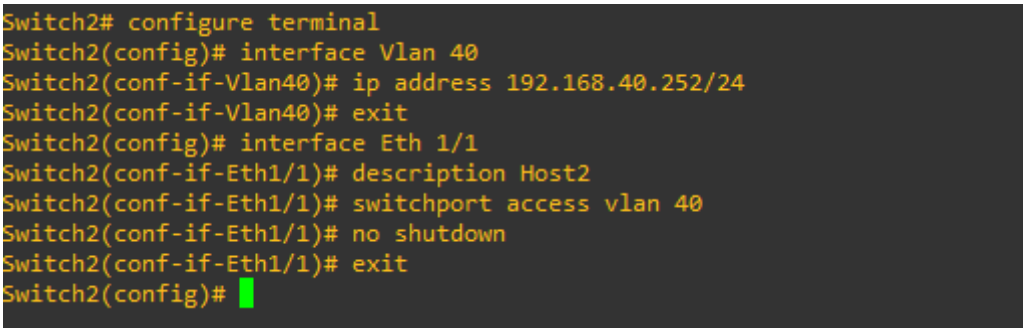
```
configure terminal
interface range ethernet 1/1-1/56
no shut
```

Configure Host2 interface

Switch2 Eth 1/1 is connected to **Host2**. Enter the following commands to create **VLAN 40** with IP address **192.168.40.252/24.** Then assign **Eth 1/1** as an untagged VLAN member.

```
configure terminal
```

```
interface vlan 40
ip address 192.168.40.252/24
exit

interface Eth 1/1
description Host2
switchport access vlan 40
exit
```



Configure port channel

Now create static **PortChannel 100** to **Switch1** as a tagged member of **Vlan 40** and add **Eth 1/5** and **Eth 1/6** as members. Save configuration.

```
interface PortChannel 100 mode on
description Static_LAG_to_Switch1
switchport trunk allowed Vlan add 40
exit

interface Eth 1/5
description PortChannel100_Mem
channel-group 100
exit

interface Eth 1/6
description PortChannel100_Mem
channel-group 100
exit

end
write memory
```

```
Switch2(config)# interface PortChannel 100 mode on
Switch2(conf-if-po100)# description Static_LAG_to_Switch1
Switch2(conf-if-po100)# switchport trunk allowed vlan add 40
Switch2(conf-if-po100)# exit
Switch2(config)# interface Eth 1/5
Switch2(conf-if-Eth1/5)# description PortChannel100_Mem
Switch2(conf-if-Eth1/5)# channel-group 100
Switch2(conf-if-Eth1/5)# no shutdown
Switch2(conf-if-Eth1/5)# exit
Switch2(config)# inte
interface         interface-naming
Switch2(config)# interface Eth 1/6
Switch2(conf-if-Eth1/6)# description PortChannel100_Mem
Switch2(conf-if-Eth1/6)# channel-group 100
Switch2(conf-if-Eth1/6)# no shutdown
Switch2(conf-if-Eth1/6)# exit
Switch2(config)# end
Switch2# write memory
Switch2#
```

Verify port channel

The port channel should now be up between **Switch1** and **Switch2**. From **Switch2**, run the following commands:

```
show portchannel summary
show interface portchannel
```

```
Switch2# show PortChannel summary
Flags(oper-status):  D - Down U - Up (portchannel) P - Up in portchannel (members)
------------------------------------------------------------------------------------------------------------------------
Group               PortChannel                 Type               Protocol       Member Ports
------------------------------------------------------------------------------------------------------------------------
100                 PortChannel100 (U)          Eth                NONE           Eth1/5(P)
                                                                                   Eth1/6(P)
Switch2#
Switch2#
Switch2# show interface PortChannel
PortChannel100 is up, line protocol is up, mode Static
Description: Static_LAG_to_Switch1
Minimum number of links to bring PortChannel up is 1
Mode of IPV4 address assignment: not-set
Mode of IPV6 address assignment: not-set
Graceful shutdown: Disabled
MTU 9100
LineSpeed 50.0GB
Members in this channel: Eth1/5
Members in this channel: Eth1/6
Last clearing of "show interface" counters: 1970-01-01 00:00:00
10 seconds input rate 0 packets/sec, 0 bits/sec, 0 Bytes/sec
10 seconds output rate 0 packets/sec, 0 bits/sec, 0 Bytes/sec
Input statistics:
          0 packets, 0 octets
          0 Multicasts, 0 Broadcasts, 0 Unicasts
          0 error, 0 discarded
Output statistics:
          0 packets, 0 octets
          0 Multicasts, 0 Broadcasts, 0 Unicasts
          0 error, 0 discarded

Switch2#
```

View configurations

To view the interface configurations, enter the following commands:

```
show running-configuration interface PortChannel
show running-configuration interface Eth 1/1
show show running-configuration interface Vlan
```

```
Switch2# show running-configuration interface PortChannel
!
interface PortChannel 100 mode on
 description Static_LAG_to_Switch1
 switchport trunk allowed Vlan add 40
 no shutdown
Switch2#
Switch2# show running-configuration interface Eth 1/1
!
interface Eth1/1
 description Host2
 mtu 9100
 speed 25000
 fec none
 no shutdown
 switchport access Vlan 40
Switch2#
Switch2# show running-configuration interface Vlan
!
interface Vlan40
 ip address 192.168.40.252/24
Switch2#
```

The configuration can also be shown in any configuration level using the **show configuration** command.

```
Switch2(config)# interface Eth 1/1
Switch2(conf-if-Eth1/1)# show configuration
!
interface Eth1/1
 description Host2
 mtu 9100
 speed 25000
 fec none
 no shutdown
 switchport access Vlan 40
Switch2(conf-if-Eth1/1)#
```

Ping network

On switch **Host1-40**, please log in with the following credentials:

login: **admin**

Password: **admin**

From Host1-40, ping **Switch1 (192.168.40.253)**, **Switch2 (192.168.40.252)**, and **Host2-40 (192.168.40.102)**. All should be successful.

```
ping 192.168.40.253 -c 3
ping 192.168.40.252 -c 3
ping 192.168.40.102 -c 3
```

```
gns3@gns3:~$ ping 192.168.40.253 -c 3
PING 192.168.40.253 (192.168.40.253) 56(84) bytes of data.
64 bytes from 192.168.40.253: icmp_seq=1 ttl=64 time=1.91 ms
64 bytes from 192.168.40.253: icmp_seq=2 ttl=64 time=2.01 ms
64 bytes from 192.168.40.253: icmp_seq=3 ttl=64 time=5.59 ms

--- 192.168.40.253 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 1.911/3.174/5.592/1.710 ms
gns3@gns3:~$ ping 192.168.40.252 -c 3
PING 192.168.40.252 (192.168.40.252) 56(84) bytes of data.
64 bytes from 192.168.40.252: icmp_seq=1 ttl=64 time=112 ms
64 bytes from 192.168.40.252: icmp_seq=2 ttl=64 time=7.86 ms
64 bytes from 192.168.40.252: icmp_seq=3 ttl=64 time=4.05 ms

--- 192.168.40.252 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 4.055/41.474/112.503/50.249 ms
gns3@gns3:~$ ping 192.168.40.102
PING 192.168.40.102 (192.168.40.102) 56(84) bytes of data.
64 bytes from 192.168.40.102: icmp_seq=1 ttl=64 time=6.21 ms
64 bytes from 192.168.40.102: icmp_seq=2 ttl=64 time=6.58 ms
64 bytes from 192.168.40.102: icmp_seq=3 ttl=64 time=12.9 ms
64 bytes from 192.168.40.102: icmp_seq=4 ttl=64 time=7.99 ms
64 bytes from 192.168.40.102: icmp_seq=5 ttl=64 time=6.02 ms
64 bytes from 192.168.40.102: icmp_seq=6 ttl=64 time=8.51 ms
64 bytes from 192.168.40.102: icmp_seq=7 ttl=64 time=25.4 ms
```

Monitoring the network

While pinging **Host2-40** from **Host1-40**, monitor packets on **Switch2 Eth 1/1** using tcpdump. To run tcpdump on **Switch2**, first find the **Alternate Name** for **Eth 1/1** with the **show interface status** command, then exit run the following commands on **Switch2**.

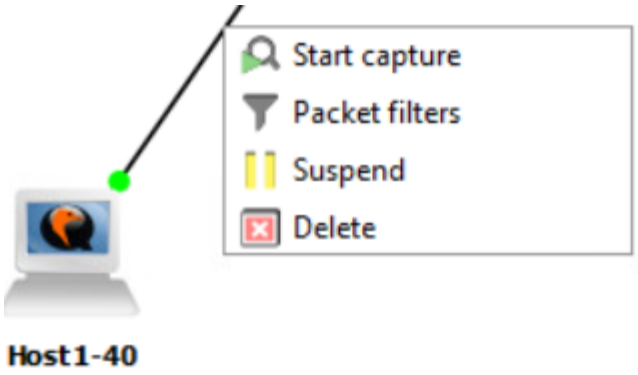
```
show interface status
exit
sudo tcpdump -i Ethernet0 -v
```

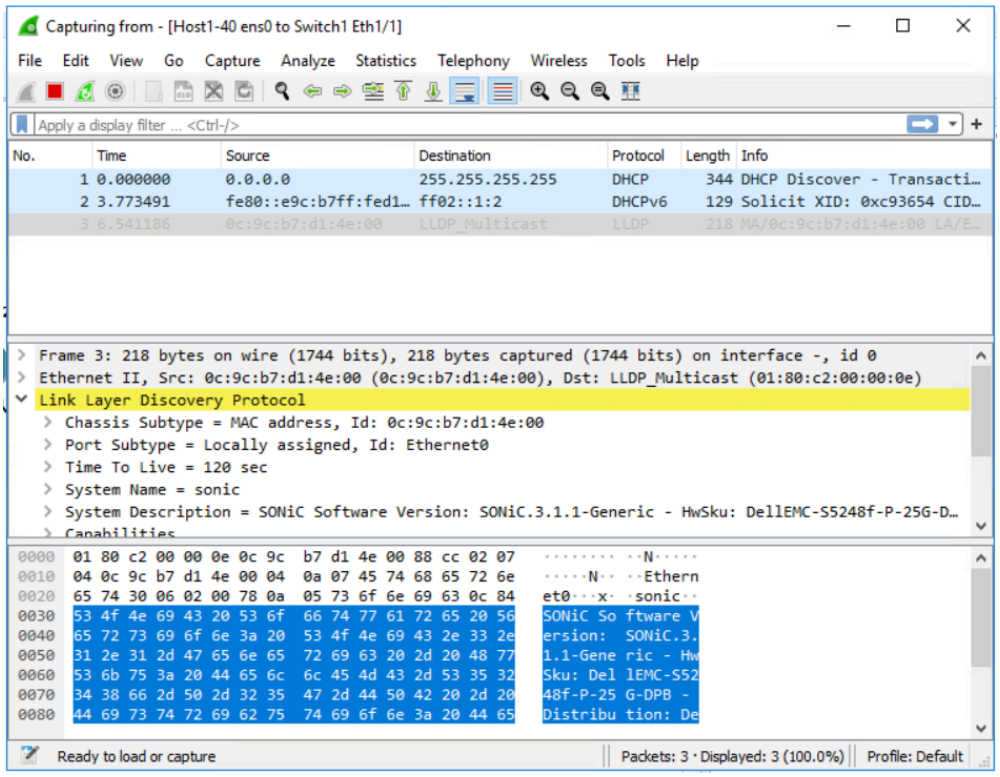
Note: Linux will refer to the interfaces as the **Alternate Name** (EthernetXX).

```
Switch2# show interface status
------------------------------------------------------------------------------------------------
Name          Description          Admin    Oper    Speed    MTU     Alternate Name
------------------------------------------------------------------------------------------------
Eth1/1        Host2                up       up      25000    9100    Ethernet0
Eth1/2        -                    down     down    25000    9100    Ethernet1
Eth1/3        -                    down     down    25000    9100    Ethernet2
Eth1/4        -                    down     down    25000    9100    Ethernet3
Eth1/5        PortChannel100_Mem   up       up      25000    9100    Ethernet4
Eth1/6        PortChannel100_Mem   up       up      25000    9100    Ethernet5
Eth1/7        -                    down     down    25000    9100    Ethernet6
Eth1/8        -                    down     down    25000    9100    Ethernet7
Eth1/9        -                    down     down    25000    9100    Ethernet8
```

```
Switch2# exit
admin@sonic:~$ sudo tcpdump -i Ethernet0 -v
tcpdump: listening on Ethernet0, link-type EN10MB (Ethernet), capture size 262144 bytes
15:15:51.310374 IP (tos 0x0, ttl 64, id 42028, offset 0, flags [DF], proto ICMP (1), length 84)
    192.168.40.101 > 192.168.40.102: ICMP echo request, id 2373, seq 397, length 64
15:15:51.314456 IP (tos 0x0, ttl 64, id 21217, offset 0, flags [none], proto ICMP (1), length 84)
    192.168.40.102 > 192.168.40.101: ICMP echo reply, id 2373, seq 397, length 64
15:15:52.310049 IP (tos 0x0, ttl 64, id 42081, offset 0, flags [DF], proto ICMP (1), length 84)
    192.168.40.101 > 192.168.40.102: ICMP echo request, id 2373, seq 398, length 64
15:15:52.312892 IP (tos 0x0, ttl 64, id 21424, offset 0, flags [none], proto ICMP (1), length 84)
    192.168.40.102 > 192.168.40.101: ICMP echo reply, id 2373, seq 398, length 64
^C
4 packets captured
4 packets received by filter
0 packets dropped by kernel
admin@sonic:~$
```

Wireshark may be used to monitor traffic between devices. This is done by hovering over a link and right-click. Then click **Start Capture** and press **OK**.





To stop Wireshark, hover over the connection and click **Stop Capture** and close the Wireshark window.

Type control 'C' to stop tcpdump and **Host1-40** pings.

This concludes Lesson 3.

Conclusion

Congratulations! You have completed the Dell Enterprise SONiC Introduction Hands on Lab.

This lab introduced you to the Native SONiC CLI and the Dell Enterprise SONiC Management Framework CLI and provided you with steps to:

- Show system information
- Change the default switch hostname
- Configure a VLAN
- Add tagged and untagged members to a VLAN
- Assign IP address to the interfaces
- Create port channels
- Add members to the port channel
- Run validation commands

If you wish to learn more about Enterprise SONiC you can explore the following Hands On Labs

- HOL-0709-02 Enterprise SONiC - Building a Layer-3 Fabric with BGP
- HOL-0709-03 Enterprise SONiC - Building a L2 VXLAN BGP EVPN fabric
- HOL-0709-04 Enterprise SONiC - Building a L3 VXLAN BGP EVP fabric