



SONiC Onboarding Exercise

Arista Networks

AGENDA

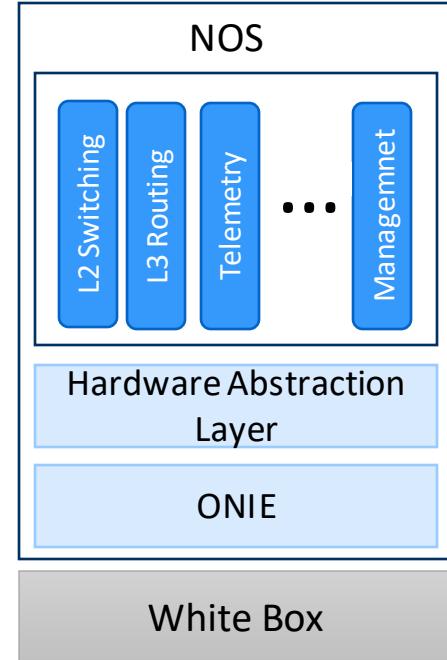
- ❑ Gaining familiarity with key parts of the SONiC network stack
 - NOS & SONiC Overview
 - SONiC Architecture
 - Roles of the SONiC Key Services
 - SONiC Inter Service Communication - BGP
 - Exercise – Static Route Configuration and Packet Flow Analysis
 - Exercise – BGP Configuration and Packet Flow Analysis
- ❑ SONiC build workflow
 - SONiC Repositories
 - SONiC Build Workflow
 - Exercise – Build & Deploy SONiC
 - CI/CD Flow for SONiC Build
- ❑ Gaining familiarity with sonic-mgmt test infrastructure
 - SONiC Test Management Overview
 - Exercise – Test Run on sonic-mgmt and analysis

Gaining familiarity with key parts of the SONiC network stack

- NOS & SONiC Overview
- SONiC Architecture
- Roles of the SONiC Key Services
- SONiC Inter Service Communication – BGP
- Exercise – Static Route Configuration and Packet Flow Analysis
- Exercise – BGP Configuration and Packet Flow Analysis

Disaggregated NOS

- A network operating system (NOS) is a specialized operating system for a network device such as a router, switch or firewall.
- Traditional NOS has OS embedded in a hardware switch or router that operates the functions in the network layer
- Disaggregated NOS provides separation of routing software and hardware components
- Advantages of Disaggregated NOS:
 - Reduced Vendor Lock-In
 - More choice to Service Providers
 - Best Fit Scalability
 - Accelerated Network Innovation
- Leading NOS solutions:
 - Open Source – SONiC, DANOS, OpenSwitch
 - Commercial – Arista EOS, IPInfusion OcNOS, Arrcus ArcOS



SONiC Overview

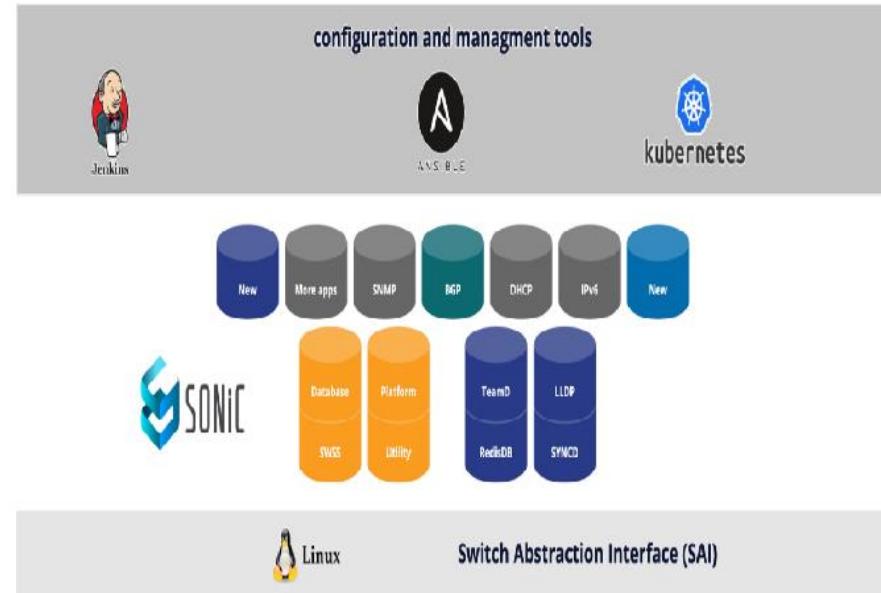
SONiC is an Open Networking in the Cloud (Open API) and distributed network operating system based on Linux. This provides a flexible and scalable platform for managing data center switches with support for various hardware platforms. SONiC decouple underlying data center hardware and cloud computing environment with programmable interface inviting developer's contribution.

SONiC is generally installed in level 3 switch.

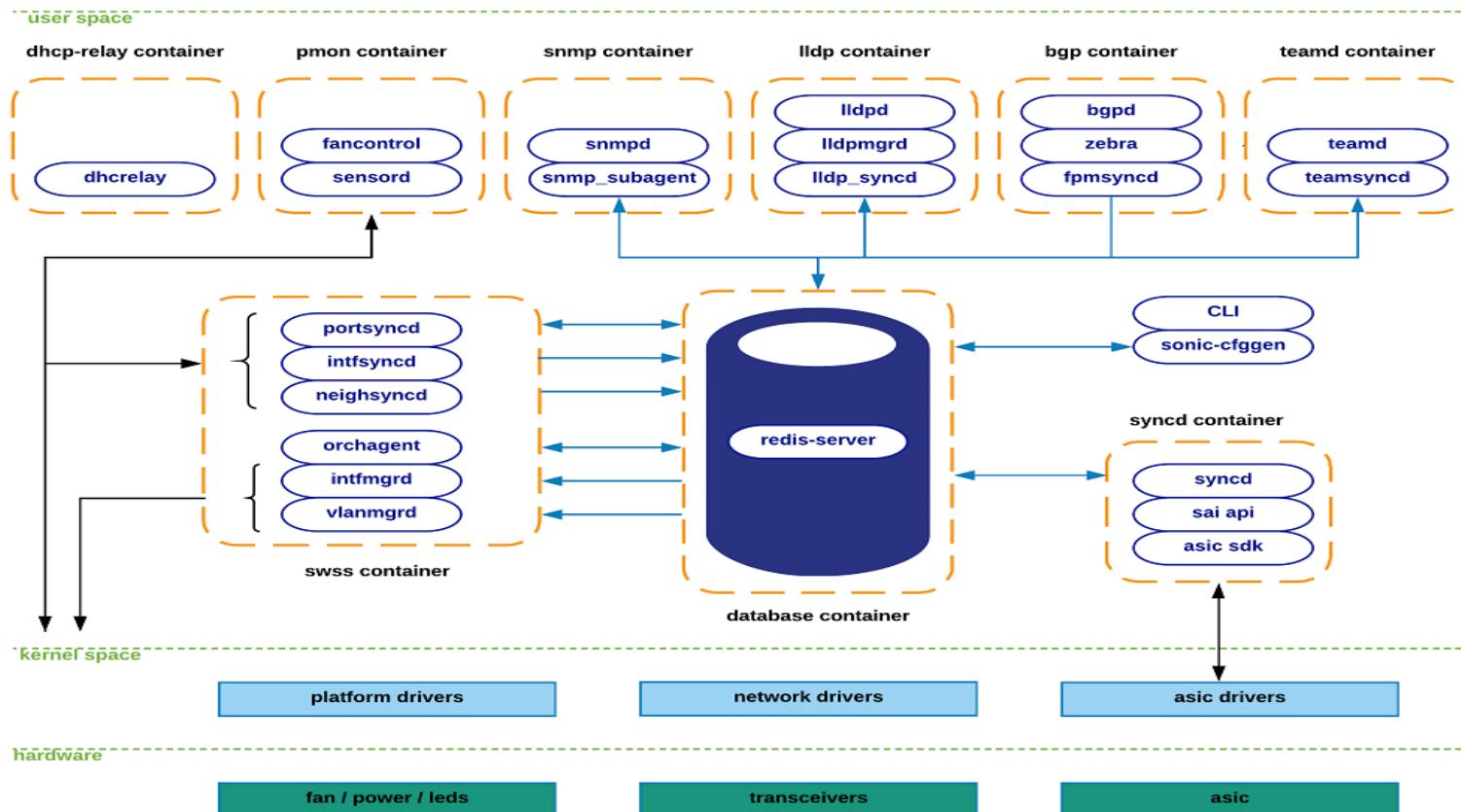
Key features:

- Open Source
- Vendor-Agnostic
- Protocol Support
- Automation and Programmability
- Telemetry and Analytics
- Active Community
- Scalability
- Stability and Reliability

SONiC Software for Open Networking in the Cloud



SONiC Architecture

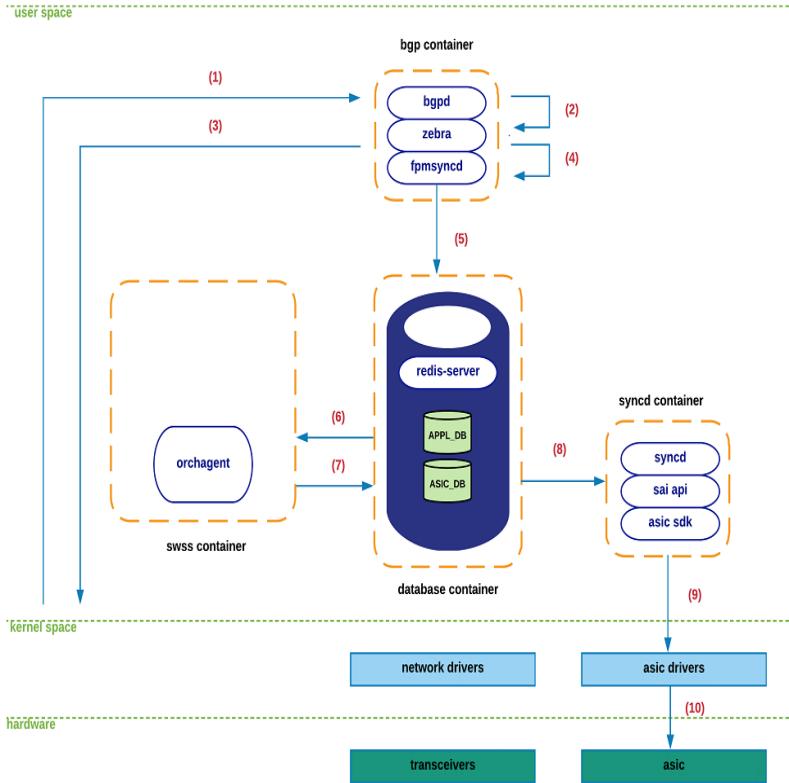


SONiC Role of Container Services

Swss container	Database container	BGP Container	Syncd Container	LLDP container
<input type="checkbox"/> PortsSyncd	<input type="checkbox"/> APPL_DB	<input type="checkbox"/> bgpd	<input type="checkbox"/> Syncd	<input type="checkbox"/> LLdp
<input type="checkbox"/> Intfsyncd	<input type="checkbox"/> CONFIG_DB	<input type="checkbox"/> zebra	<input type="checkbox"/> SAI API	<input type="checkbox"/> LLdp_syncd
<input type="checkbox"/> Neighsyncd	<input type="checkbox"/> STATE_DB	<input type="checkbox"/> fpmsyncd	<input type="checkbox"/> ASICSDK	<input type="checkbox"/> LLdpmgr
<input type="checkbox"/> Orchagent	<input type="checkbox"/> ASIC_DB			
<input type="checkbox"/> IntfMgrd	<input type="checkbox"/> COUNTERS_DB			
<input type="checkbox"/> VlanMngrd				

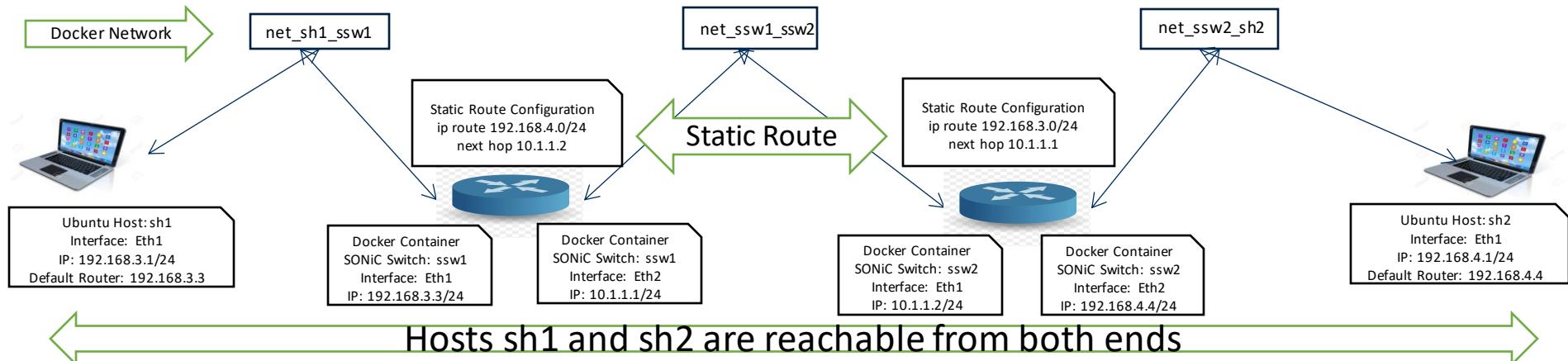
SNMP Container	DHCP-relay Container	TeAMD Container	Pmon Container
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> snmpd	<input type="checkbox"/> DHCP Relay Agent	<input type="checkbox"/> teamd	<input type="checkbox"/> sensord
<input type="checkbox"/> Snmp-agent	<input type="checkbox"/> DHCP Configuration Management	<input type="checkbox"/> teamsyncd	<input type="checkbox"/> fancontrol

SONiC Inter Service Communication – BGP



- A bgp-update arrives at bgp's socket in kernel and eventually to `bgpd` process.
- `bgpd` processes the msg and notifies `zebra` of the existence of a new prefix and associated next-hop.
- Upon determination by `zebra` of the feasibility/reachability of this prefix, it generates a route-netlink message to inject new state in kernel.
- `zebra` makes use of the FPM interface to deliver this netlinkroute message to `fpmsyncd`.
- `fpmsyncd` pushes this state into APPL_DB.
- `orchagentd` receives the content of the information previously pushed to APPL_DB.
- `orchagentd` processes the received information and invoke sairedis APIs to inject the new state into ASIC_DB.
- `syncd` receives the new state generated by `orchagentd`.
- `syncd` invoke SAI APIs to inject this state into the corresponding asic-driver.
- New route is finally pushed to hardware.

Exercise – Packet Flow For IP Packet through Static Route



Router 1(ssw1) Config

```
interface Ethernet1
  no switchport
  ip address 192.168.3.3/24
!
interface Ethernet2
  no switchport
  ip address 10.1.1.1/24
!
ip routing
!
ip route 192.168.4.0/24 10.1.1.2
!
end
dfffa82eb1142(config)#
```

Router 2(ssw2) Config

```
interface Ethernet1
  no switchport
  ip address 10.1.1.2/24
!
interface Ethernet2
  no switchport
  ip address 192.168.4.4/24
!
ip routing
!
ip route 192.168.3.0/24 10.1.1.1
!
end
```

Exercise – Packet Flow For IP Packet through Static Route – Test Results

Ping Host1 to Host2

```
sonic@sonicpc:~/deba/EOS-test$ docker exec -it sh1 bash
root@62daa2dffac0:/# ping 192.168.4.1
PING 192.168.4.1 (192.168.4.1) 56(84) bytes of data.
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=0.493 ms
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=1.10 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=1.13 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=1.62 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=1.71 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=2.10 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=2.24 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=2.56 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=2.77 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=3.04 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=3.66 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=4.14 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=7.64 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=8.42 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=9.23 ms (DUP!)
64 bytes from 192.168.4.1: icmp_seq=1 ttl=62 time=9.95 ms (DUP!)
^C
--- 192.168.4.1 ping statistics ---
1 packets transmitted, 1 received, +15 duplicates, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.493/3.866/9.955/3.026 ms
```

Ping Host2 to Host1

```
sonic@sonicpc:~/deba/EOS-test$ docker exec -it sh2 bash
root@047367732c29:/# ping 192.168.3.1
PING 192.168.3.1 (192.168.3.1) 56(84) bytes of data.
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=0.522 ms
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=1.32 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=1.66 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=1.96 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=2.64 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=2.96 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=3.29 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=3.57 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=3.86 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=4.17 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=4.50 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=4.78 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=5.08 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=5.34 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=5.60 ms (DUP!)
64 bytes from 192.168.3.1: icmp_seq=1 ttl=62 time=5.87 ms (DUP!)
^C
--- 192.168.3.1 ping statistics ---
1 packets transmitted, 1 received, +15 duplicates, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.522/3.574/5.874/1.574 ms
```

Traceroute Host1 to Host2

```
root@62daa2dffac0:/# traceroute -m 4 -I 192.168.4.1
traceroute to 192.168.4.1 (192.168.4.1), 4 hops max, 60 byte packets
 1  192.168.3.3 (192.168.3.3)  0.353 ms  0.074 ms  0.060 ms
 2  10.1.1.2 (10.1.1.2)  3.004 ms  3.877 ms  4.693 ms
 3  192.168.4.1 (192.168.4.1)  15.230 ms  15.670 ms  16.076 ms
root@62daa2dffac0:/#
```

Exercise – Packet Flow For IP Packet through Static Route – Test Results

Ping Host1 to Host2 – tcpdump Logs in Wireshark

sh1_eth1.pcap@sonicpc

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

ip.src_host == 192.168.3.3 or ip.src_host == 10.1.1.2 or ip.src_host == 192.168.4.1 or ip.dst_host == 192.168.3.1 or ip.dst_host == 192.168.4.1 or ip.proto == ICMP

No.	Source	Destination	Time	Protocol	Length	Info
1	192.168.3.1	192.168.4.1	0.000000	ICMP	98	Echo (ping) request id=0x129d, seq=1/256, ttl=64 (reply in 2)
2	192.168.4.1	192.168.3.1	0.004185	ICMP	98	Echo (ping) reply id=0x129d, seq=1/256, ttl=62 (request in 1)
3	192.168.3.1	192.168.4.1	0.997399	ICMP	98	Echo (ping) request id=0x129d, seq=2/512, ttl=64 (reply in 4)
4	192.168.4.1	192.168.3.1	0.002791	ICMP	98	Echo (ping) reply id=0x129d, seq=2/512, ttl=62 (request in 3)
5	192.168.3.1	192.168.4.1	0.998415	ICMP	98	Echo (ping) request id=0x129d, seq=3/768, ttl=64 (reply in 6)
6	192.168.4.1	192.168.3.1	0.003228	ICMP	98	Echo (ping) reply id=0x129d, seq=3/768, ttl=62 (request in 5)
7	192.168.3.1	192.168.4.1	0.998306	ICMP	98	Echo (ping) request id=0x129d, seq=4/1024, ttl=64 (reply in 8)
8	192.168.4.1	192.168.3.1	0.003676	ICMP	98	Echo (ping) reply id=0x129d, seq=4/1024, ttl=62 (request in 7)
9	192.168.3.1	192.168.4.1	0.998426	ICMP	98	Echo (ping) request id=0x129d, seq=5/1280, ttl=64 (reply in 10)
10	192.168.4.1	192.168.3.1	0.003378	ICMP	98	Echo (ping) reply id=0x129d, seq=5/1280, ttl=62 (request in 9)

Exercise – Packet Flow For IP Packet through Static Route – Test Results

Traceroute Host1 to Host2 – tcpdump Logs in Wireshark

sh1_eth1.pcap@soricpc

No.	Source	Destination	Time	Protocol	Length	Info
1	192.168.3.1	192.168.4.1	0.000000	ICMP	74	Echo (ping) request id=0x24b3, seq=1/256, ttl=1 (no response found!)
2	192.168.3.3	192.168.3.1	0.000294	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
3	192.168.3.1	192.168.4.1	0.000449	ICMP	74	Echo (ping) request id=0x24b3, seq=2/512, ttl=1 (no response found!)
4	192.168.3.3	192.168.3.1	0.000600	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
5	192.168.3.1	192.168.4.1	0.000722	ICMP	74	Echo (ping) request id=0x24b3, seq=3/768, ttl=1 (no response found!)
6	192.168.3.3	192.168.3.1	0.000850	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
7	192.168.3.1	192.168.4.1	0.000822	ICMP	74	Echo (ping) request id=0x24b3, seq=4/1024, ttl=2 (no response found!)
8	192.168.3.1	192.168.4.1	0.000930	ICMP	74	Echo (ping) request id=0x24b3, seq=5/1280, ttl=2 (no response found!)
9	192.168.3.1	192.168.4.1	0.000935	ICMP	74	Echo (ping) request id=0x24b3, seq=6/1536, ttl=2 (no response found!)
10	192.168.3.1	192.168.4.1	0.000936	ICMP	74	Echo (ping) request id=0x24b3, seq=7/1792, ttl=3 (reply in 20)
11	192.168.3.1	192.168.4.1	0.000934	ICMP	74	Echo (ping) request id=0x24b3, seq=8/2048, ttl=3 (reply in 21)
12	192.168.3.1	192.168.4.1	0.000933	ICMP	74	Echo (ping) request id=0x24b3, seq=9/2304, ttl=3 (reply in 22)
13	192.168.3.1	192.168.4.1	0.000935	ICMP	74	Echo (ping) request id=0x24b3, seq=10/2560, ttl=4 (reply in 23)
14	192.168.3.1	192.168.4.1	0.000934	ICMP	74	Echo (ping) request id=0x24b3, seq=11/2816, ttl=4 (reply in 24)
15	192.168.3.1	192.168.4.1	0.000933	ICMP	74	Echo (ping) request id=0x24b3, seq=12/3072, ttl=4 (reply in 25)
17	10.1.1.2	192.168.3.1	0.002717	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
18	10.1.1.2	192.168.3.1	0.000912	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
19	10.1.1.2	192.168.3.1	0.000850	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
20	192.168.4.1	192.168.3.1	0.010574	ICMP	74	Echo (ping) reply id=0x24b3, seq=7/1792, ttl=62 (request in 10)
21	192.168.4.1	192.168.3.1	0.000473	ICMP	74	Echo (ping) reply id=0x24b3, seq=8/2048, ttl=62 (request in 11)
22	192.168.4.1	192.168.3.1	0.000449	ICMP	74	Echo (ping) reply id=0x24b3, seq=9/2304, ttl=62 (request in 12)
23	192.168.4.1	192.168.3.1	0.000474	ICMP	74	Echo (ping) reply id=0x24b3, seq=10/2560, ttl=62 (request in 13)
24	192.168.4.1	192.168.3.1	0.000477	ICMP	74	Echo (ping) reply id=0x24b3, seq=11/2816, ttl=62 (request in 14)
25	192.168.4.1	192.168.3.1	0.000594	ICMP	74	Echo (ping) reply id=0x24b3, seq=12/3072, ttl=62 (request in 15)

End to end ping request from 192.168.3.1 (host1) to 192.168.4.1(host2) with TTL=1, means 1 hop... with no response! Because TTL exceed occurs in transit gateway 192.168.3.3. The request is repeated three times for each time-to-live count.

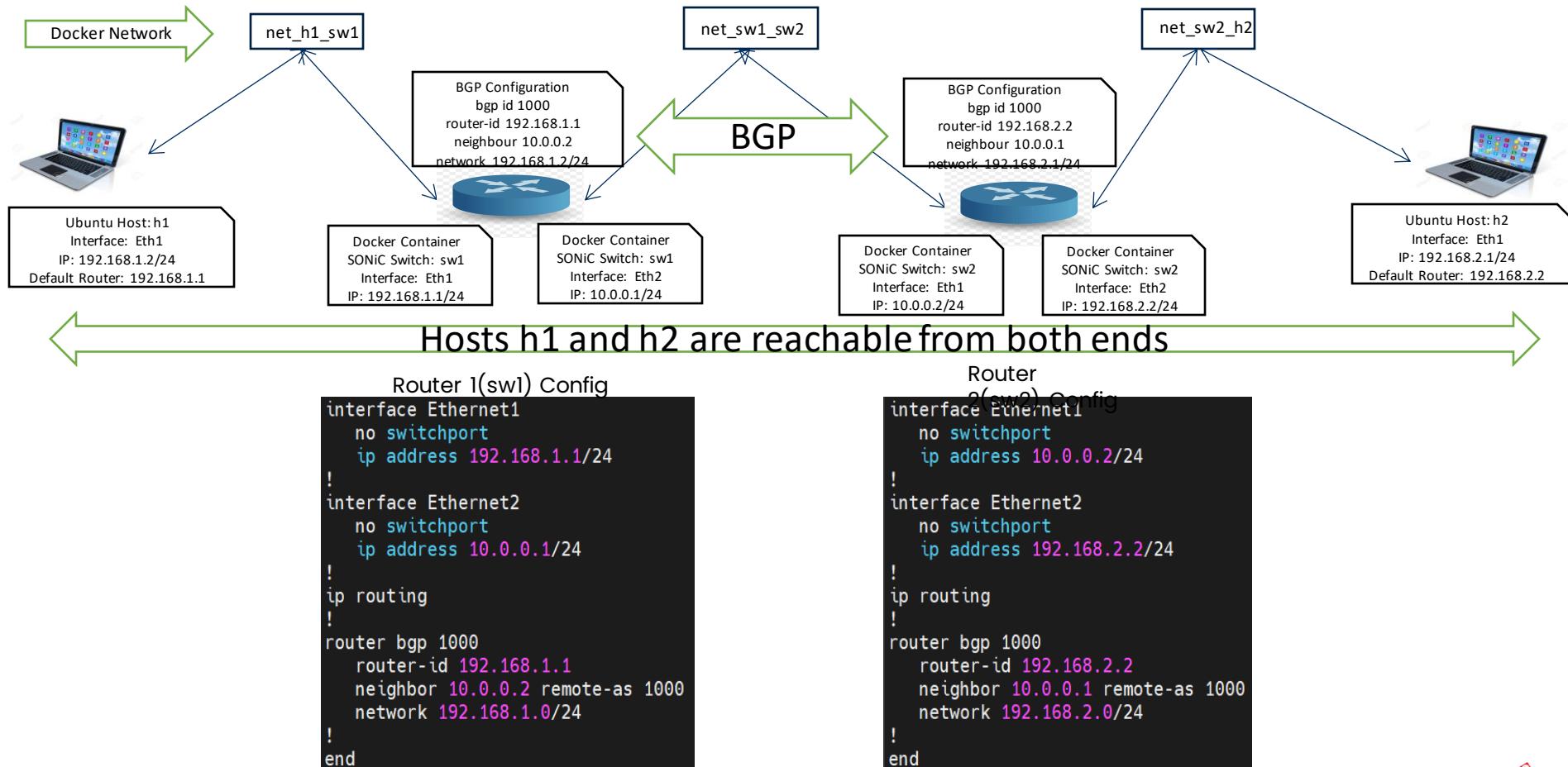
End to end ping request from 192.168.3.1 (host1) to 192.168.4.1(host2) with TTL=2, means 2 hops... with no response!

End to end ping request from 192.168.3.1 (host1) to 192.168.4.1(host2) with TTL>=3, means 3 or more hops.

Here TTL exceed occurs now in 10.1.1.2, that is located in switch 2. The request is repeated three times for each time-to-live count.

At this time with 3 or more hops (TTL >= 3), destination host 192.168.4.1 is reached from source 192.168.3.1 and that's why getting reply with successful route tracing!

Exercise – Packet Flow For IP Packet through BGP



Exercise – Packet Flow For IP Packet through BGP – Test Results

Ping Host1 to Host2

```
sonic@sonicpc:~/deba/EOS-test$ docker exec -it h1 bash
root@e9568723352a:/# ping 192.168.2.1
PING 192.168.2.1 (192.168.2.1) 56(84) bytes of data.
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=0.880 ms
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=1.61 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=1.71 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=2.36 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=2.45 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=3.00 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=3.18 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=3.54 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=3.87 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=4.14 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=4.57 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=5.09 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=5.47 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=6.16 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=6.84 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=7.53 ms (DUP!)
^C
--- 192.168.2.1 ping statistics ---
1 packets transmitted, 1 received, +15 duplicates, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.880/3.905/7.537/1.878 ms
```

Ping Host2 to Host1

```
sonic@sonicpc:~/deba/EOS-test$ docker exec -it h2 bash
root@66b9de101a75:/# ping 192.168.2.1
PING 192.168.2.1 (192.168.2.1) 56(84) bytes of data.
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=0.682 ms
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=1.24 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=1.39 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=1.87 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=2.24 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=2.41 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=3.04 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=3.11 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=3.78 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=3.95 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=4.52 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=4.78 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=5.23 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=5.97 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=6.83 ms (DUP!)
64 bytes from 192.168.2.1: icmp_seq=1 ttl=62 time=7.60 ms (DUP!)
^C
--- 192.168.2.1 ping statistics ---
1 packets transmitted, 1 received, +15 duplicates, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.682/3.668/7.602/1.983 ms
```

Traceroute Host1 to Host2

```
sonic@sonicpc:~/deba$ docker exec -it h1 bash
root@e9568723352a:/# traceroute -m 4 -I 192.168.2.1
traceroute to 192.168.2.1 (192.168.2.1), 4 hops max, 60 byte packets
 1  192.168.1.1 (192.168.1.1)  0.387 ms  0.069 ms  0.054 ms
 2  10.0.0.2 (10.0.0.2)  2.848 ms  3.803 ms  4.678 ms
 3  192.168.2.1 (192.168.2.1)  7.373 ms  8.084 ms  9.042 ms
root@e9568723352a:/#
```

Exercise – Packet Flow For IP Packet through BGP – Test Results

Ping Host1 to Host2 – tcpdump Logs in Wireshark

h1_eth1.pcap@sonicpc

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help



ip.src_host == 192.168.1.1 or ip.src_host == 10.0.0.2 or ip.src_host == 192.168.2.1 or ip.dst_host == 192.168.1.2 or ip.dst_host == 192.168.2.1 or ip.proto == ICMP

No.	Source	Destination	Time	Protocol	Length	Info
1	192.168.1.2	192.168.2.1	0.000000	ICMP	98	Echo (ping) request id=0x1290, seq=1/256, ttl=64 (reply in 2)
2	192.168.2.1	192.168.1.2	0.004261	ICMP	98	Echo (ping) reply id=0x1290, seq=1/256, ttl=62 (request in 1)
3	192.168.1.2	192.168.2.1	0.997325	ICMP	98	Echo (ping) request id=0x1290, seq=2/512, ttl=64 (reply in 4)
4	192.168.2.1	192.168.1.2	0.003618	ICMP	98	Echo (ping) reply id=0x1290, seq=2/512, ttl=62 (request in 3)
5	192.168.1.2	192.168.2.1	0.998390	ICMP	98	Echo (ping) request id=0x1290, seq=3/768, ttl=64 (reply in 6)
6	192.168.2.1	192.168.1.2	0.002883	ICMP	98	Echo (ping) reply id=0x1290, seq=3/768, ttl=62 (request in 5)
7	192.168.1.2	192.168.2.1	0.998282	ICMP	98	Echo (ping) request id=0x1290, seq=4/1024, ttl=64 (reply in 8)
8	192.168.2.1	192.168.1.2	0.002920	ICMP	98	Echo (ping) reply id=0x1290, seq=4/1024, ttl=62 (request in 7)
9	192.168.1.2	192.168.2.1	0.998332	ICMP	98	Echo (ping) request id=0x1290, seq=5/1280, ttl=64 (reply in 10)
10	192.168.2.1	192.168.1.2	0.002889	ICMP	98	Echo (ping) reply id=0x1290, seq=5/1280, ttl=62 (request in 9)
11	192.168.1.2	192.168.2.1	0.998302	ICMP	98	Echo (ping) request id=0x1290, seq=6/1536, ttl=64 (reply in 12)
12	192.168.2.1	192.168.1.2	0.002941	ICMP	98	Echo (ping) reply id=0x1290, seq=6/1536, ttl=62 (request in 11)
15	192.168.1.2	192.168.2.1	0.998291	ICMP	98	Echo (ping) request id=0x1290, seq=7/1792, ttl=64 (reply in 16)
16	192.168.2.1	192.168.1.2	0.003028	ICMP	98	Echo (ping) reply id=0x1290, seq=7/1792, ttl=62 (request in 15)

Exercise – Packet Flow For IP Packet through BGP – Test Results

Traceroute Host1 to Host2 – tcpdump Logs in Wireshark

h1_eth1_N.pcap@sonicpc

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

ip.src_host == 192.168.1.1 or ip.src_host == 10.0.0.2 or ip.src_host == 192.168.2.1 or ip.dst_host == 192.168.1.2 or ip.dst_host == 192.168.2.1 or ip.proto == ICMP

No.	Source	Destination	Time	Protocol	Length	Info
1	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.237971	ICMP	74	Echo (ping) request id=0x0218, seq=1/256, ttl=1 (no response found!)
2	192.168.1.1	192.168.1.2	2023-08-04 04:52:21.238233	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
3	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.238267	ICMP	74	Echo (ping) request id=0x0218, seq=2/256, ttl=1 (no response found!)
4	192.168.1.1	192.168.1.2	2023-08-04 04:52:21.238386	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
5	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.238425	ICMP	74	Echo (ping) request id=0x0218, seq=3/256, ttl=1 (no response found!)
6	192.168.1.1	192.168.1.2	2023-08-04 04:52:21.238511	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
7	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.238558	ICMP	74	Echo (ping) request id=0x0218, seq=4/1024, ttl=2 (no response found!)
8	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.238600	ICMP	74	Echo (ping) request id=0x0218, seq=5/1024, ttl=2 (no response found!)
9	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.238762	ICMP	74	Echo (ping) request id=0x0218, seq=6/1536, ttl=2 (no response found!)
10	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.238827	ICMP	74	Echo (ping) request id=0x0218, seq=7/1792, ttl=3 (reply in 20)
11	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.238886	ICMP	74	Echo (ping) request id=0x0218, seq=8/2048, ttl=3 (reply in 21)
12	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.238941	ICMP	74	Echo (ping) request id=0x0218, seq=9/2304, ttl=3 (reply in 22)
13	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.239002	ICMP	74	Echo (ping) request id=0x0218, seq=10/2560, ttl=4 (reply in 23)
14	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.239061	ICMP	74	Echo (ping) request id=0x0218, seq=11/2816, ttl=4 (reply in 24)
15	192.168.1.2	192.168.2.1	2023-08-04 04:52:21.239117	ICMP	74	Echo (ping) request id=0x0218, seq=12/3072, ttl=4 (reply in 25)
17	10.0.0.2	192.168.1.2	2023-08-04 04:52:21.241322	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
18	10.0.0.2	192.168.1.2	2023-08-04 04:52:21.241325	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
19	10.0.0.2	192.168.1.2	2023-08-04 04:52:21.243271	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
20	192.168.2.1	192.168.1.2	2023-08-04 04:52:21.245024	ICMP	74	Echo (ping) reply id=0x0218, seq=7/1792, ttl=62 (request in 10)
21	192.168.2.1	192.168.1.2	2023-08-04 04:52:21.246418	ICMP	74	Echo (ping) reply id=0x0218, seq=8/2048, ttl=62 (request in 11)
22	192.168.2.1	192.168.1.2	2023-08-04 04:52:21.247170	ICMP	74	Echo (ping) reply id=0x0218, seq=9/2304, ttl=62 (request in 12)
23	192.168.2.1	192.168.1.2	2023-08-04 04:52:21.247847	ICMP	74	Echo (ping) reply id=0x0218, seq=10/2560, ttl=62 (request in 13)
24	192.168.2.1	192.168.1.2	2023-08-04 04:52:21.249138	ICMP	74	Echo (ping) reply id=0x0218, seq=11/2816, ttl=62 (request in 14)
			2023-08-04 04:52:21.249680	ICMP	74	Echo (ping) reply id=0x0218, seq=12/3072, ttl=62 (request in 15)

End to end ping request from 192.168.1.2 (host 1) to 192.168.2.1(host 2) with TTL=1, means 1 hop... with no response! Because TTL exceed occurs in transit gateway 192.168.1.1. The request is repeated three times for each time-to-live count.

End to end ping request from 192.168.1.2 (host 1) to 192.168.2.1(host 2) with TTL=2, means 2 hops... with no response!

End to end ping request from 192.168.1.2 (host 1) to 192.168.2.1(host 2) with TTL>=3, means 3 or more hops.

Here TTL exceed occurs now in 10.0.0.2, that is located in switch 2. The request is repeated three times for each time-to-live count.

At this time with 3 or more hops (TTL >= 3), destination host 192.168.2.1 is reached from source 192.168.1.2 and that's why getting reply with successful route tracing.

Open/Pending points:

- Analysis of packet flow within sonic internal containers and processes.**

SONiC build workflow

- SONiC Repositories
- SONiC Build Workflow
- Exercise – Build & Deploy SONiC

SONiC Repositories – Root Repos

Sonic

- Contains the documentation, wiki, project management and website for SONiC
- Also, documentation covers faq, general requirements , developer's guide, architecture etc.

Sonic-buildimage

- Contains the instructions on how to build NOS installer image for network switches, SONiC code, links to all sub-repos, build related files, platform specific files, how to build docker images running inside the NOS.

Sonic-swss

- Collection of software that provides a database interface for communication and state representation of network applications and switch hardware.

Sonic-mgmt

- Management and automation code used for SONiC testbed deployment test and reporting.

Sonic-pins

- Contains infrastructure and libraries that assist in testing P4 integrated Network stack switches

Sonic-gnmi

- Contains implementation for the sonic system telemetry services.

SONiC Repositories – Repo Walkthrough

Repo Structure

```
sonic-buildimage
|
|_ Makefile
|_ slave.mk
|_ sonic-slave/
|   |_ dockerfile
|_ rules/
|   |_ config
|   |_
|   |_
|_ dockers/
|   |_ docker-database
|       |_ dockerfile.j2
|   |_
|_ src/
|   |_ sonic-swss
|   |_ sonic-sairedis
|   |_ redis
|   |_ sonic-utilities
|   |_ sonic-telemetry
|   |_ sonic-frr/quagga
|_ platform/
|   |_ barefoot
|   |_ vs
|   |_
|_ target/
|   |_ python-wheels
|   |_ deb/
|   |_ docker-xxx.gz
|   |_ sonic-vs.img
|   |_
|_ ...
```

- Makefile
- slave.mk
- sonic-slave

Build Backend



- collection of recipes (small makefiles)
- config file
- configuration parameters for sonic build

Rules



- dockerfiles for generic docker images
- Details about Processes needs to run inside docker

Dockers



- source code for generic packages
- Contains Directories for all features with its make files

Src



- Vendor specific code
- Kernel drivers
- Sensor scripts

Platform



- Build Output Directory
- SONiC Images

Target



SONiC Repositories – Sonic Management

Sonic-mgmt Repo Structure

```
sonic-mgmt
|
|_ansible [deploy SONiC, setup SONiC testbed, run SONiC test, test report processing]
|_docs
|_spystest [test automation framework designed to validate SONiC]
|_test_reporting
|_test
| |_all_scripts
| |_run_scripts
| |_logs
```

Pytest Repo Structure

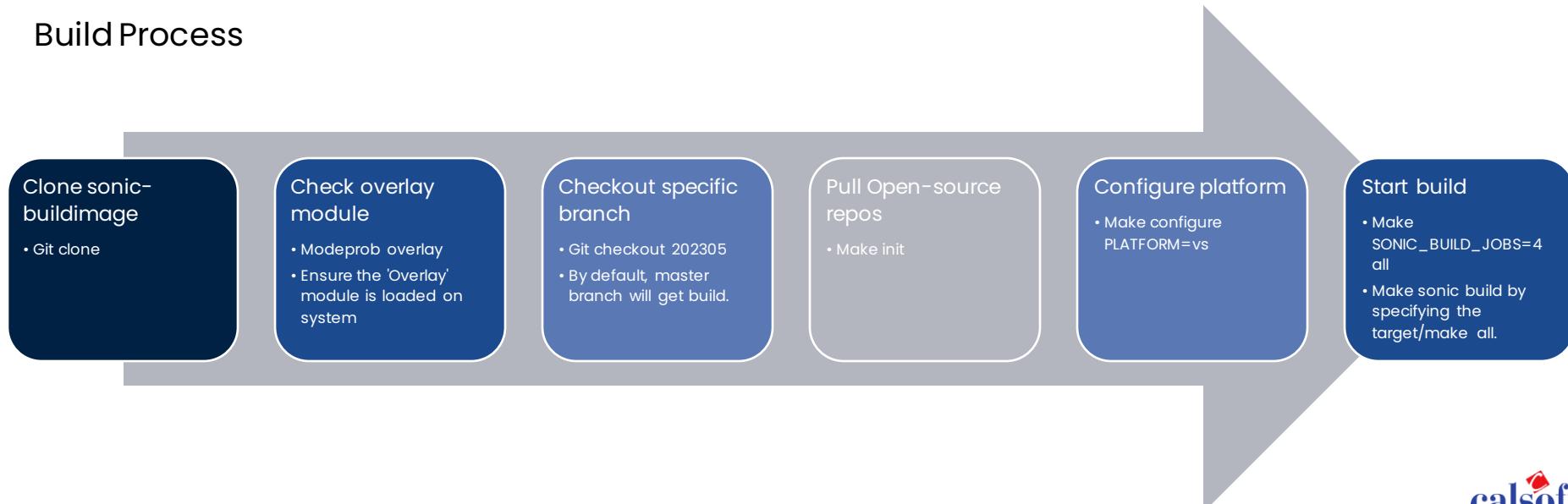
```
tests
|
|_common
|_platform
|_ptftests
|_nat
| |_test_nat_bindings.py
| |_files
|   |_all helpers for the nat feature
|_acl
```

SONiC Build Workflow

Prerequisites

- Choose Right candidate
 - Based on platform and branch you need; you can clone particular sonic-buildimage from azure pipeline.
- Hardware requirements
 - 12 core cpu, 16 Gib RAM, 300 Gib free disk.
 - KVM nested virtualization support.
 - Ubuntu 20.04 is good choice for building SONiC
- Validation checks
 - Docker installation
 - Add your user account to docker group

Build Process



Exercise – Build SONiC

Clone repository

```
sonic@sonicpc:~$ ls
debi p4 prakash snap sonic sonic.img veos-vm wget-log wget-log.1
sonic@sonicpc:~$ cd prakash/
sonic@sonicpc:~/prakash$ ls
202205 docker-sonic-vs_202012.gz sonic-build.txt sonic-vs-experiment sonic_p4_switch
docker-sonic-vs.gz images-sonic sonic-buildimage sonic-vs.img
sonic@sonicpc:~/prakash$ mkdir bf_202305
sonic@sonicpc:~/prakash$ cd bf_202305
sonic@sonicpc:~/prakash$ git clone --recurse-submodules https://github.com/sonic-net/sonic-buildimage.git
Cloning into 'sonic-buildimage'...
remote: Enumerating objects: 127193, done.
remote: Counting objects: 100% (704/704), done.
remote: Compressing objects: 100% (458/458), done.
remote: Total 127193 (delta 353), reused 458 (delta 220), pack-reused 126489
Receiving objects: 100% (127193/127193), 51.04 MiB | 9.46 MiB/s, done.
Resolving deltas: 100% (87905/87905), done.
Updating files: 100% (11522/11522), done.
```

make init

```
sonic@sonicpc:~/prakash/bf_202305/sonic-buildimage$ make init
++ Making init ++
make -f Makefile.work init
make[1]: Entering directory '/home/sonic/prakash/bf_202305/sonic-buildimage'
聯合镜像和 image 'debian:jessie' locally
Digest: sha256:32ad5050caff2c7e969d8c873bce2370015c2256ff984b70c1c08b3a2816a0
Status: Downloaded newer image for debian:jessie
"SECURE_UPGRADE_PROD SIGNING TOOL": ""
~/prakash/bf_202305/sonic-buildimage/src/sonic-build-hooks ~/prakash/bf_202305/sonic-buildimage
make[2]: Entering directory '/home/sonic/prakash/bf_202305/sonic-buildimage/src/sonic-build-hooks'
dpkg-deb: building package 'sonic-build-hooks' in 'buildinfo/sonic-build-hooks_1.0_all.deb'.
make[2]: Leaving directory '/home/sonic/prakash/bf_202305/sonic-buildimage/src/sonic-build-hooks'
~/prakash/bf_202305/sonic-buildimage/src/sonic-platform-barefoot
submodule path 'platform/mellanox/mlnx-sai/SAI-Implementation' (https://github.com/Mellanox/SAI-Implementation) registered for path 'platform/mlnx-sai/SAT-Implementation'
cloning into '/home/sonic/prakash/bf_202305/sonic-buildimage/platform/mellanox/mlnx-sai/SAI-Implementation'...
Submodule path 'platform/barefoot/sonic-platform-modules-arista': checked out '1c03612774da0512a36ac0fc489a619fe87280ba'
Submodule path 'platform/broadcom/sonic-platform-modules-arista': checked out '1c03612774da0512a36ac0fc489a619fe87280ba'
Submodule path 'platform/mellanox/mlnx-sai/SAI-Implementation': checked out 'ec7f674f143809602a5b66ef5d279ade8b77d2'
Submodule path 'src/dhcpclient': checked out '3c16c84ded9c1936950acc76339cad3dfcb'
Submodule path 'src/dhcprelay': checked out '91cfe9639b3c386213ebd9e2d8a52a7fb73'
Submodule path 'src/ethtool': checked out '1d467d5a6636d53cc11665aae27e5'
Submodule path 'src/sonic-common': checked out 'd1467d5a6636d53cc11665aae27e5'
Submodule path 'src/sonic-host-services': checked out '317236e765515488c30198170773591c719720'
Submodule path 'src/sonic-linux-kernel': checked out 'e7c93a542272b952a1082326e097e763f88b1'
Submodule path 'src/sonic-mgmt-common': checked out 'b64a80e9253eaef49315aabfd7fd4243f848ae80'
Submodule path 'src/sonic-mgmt-framework': checked out '1ad8949657073c2c022551a3c19a301c8b1530'
Submodule path 'src/sonic-platform-common': checked out '411d5b28f910e1e30b6cd32914dc6d2333d0f4'
Submodule path 'src/sonic-platform-daemons': checked out '4e4f3ccb6c5e2ed087904a31afe1e6d824fe5'
```

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Switch Branch

```
sonic@sonicpc:~/prakash/bf_202305/sonic-buildimage$ build_docker.sh
sonic@sonicpc:~/prakash/bf_202305/sonic-buildimage$ cd ..
sonic@sonicpc:~/prakash$ sudo modprobe overlay
sonic@sonicpc:~/prakash$ password for sonic
sonic@sonicpc:~/prakash/bf_202305/sonic-buildimage$ git checkout 202305
warning: unable to rmdir 'src/sonic-dash-api/sonic-dash-api': Directory not empty
M platform/barefoot/sonic-platform-modules-arista
M src/dhcprelay
M src/ethtool
M src/sonic-gnmi
M src/sonic-host-services
M src/sonic-linux-kernel
M src/sonic-mgmt-common
M src/sonic-platform-common
M src/sonic-platform-daemons
M src/sonic-platform-pde
M src/sonic-satredis
M src/sonic-snmpagent
M src/sonic-svss
M src/sonic-vswitch-common
M src/sonic-utilities
M src/wpasupplicant/sonic-wpa-suppliant
Branch '202305' set up to track remote branch '202305' from 'origin'.
Switched to a new branch '202305'
sonic@sonicpc:~/prakash/bf_202305/sonic-buildimage$ git branch
* 202305
  master
sonic@sonicpc:~/prakash/bf_202305/sonic-buildimage$
```

configure platform

```
sonic@sonicpc:~/prakash/bf_202305/sonic-buildimage$ make configure PLATFORM=barefoot
++ Checking platform/barefoot ++
++ Making configure ++
LDENV=buster make -f Makefile.work configure
make[1]: Entering directory '/home/sonic/prakash/bf_202305/sonic-buildimage'
"SECURE_UPGRADE_PROD SIGNING TOOL": 
~/prakash/bf_202305/sonic-buildimage/src/sonic-build-hooks ~/prakash/bf_202305/sonic-buildimage
make[2]: Entering directory '/home/sonic/prakash/bf_202305/sonic-buildimage/src/sonic-build-hooks'
ipkg-deb: building package 'sonic-build-hooks' in 'buildinfo/sonic-build-hooks_1.0_all.deb'
make[2]: Leaving directory '/home/sonic/prakash/bf_202305/sonic-buildimage/src/sonic-build-hooks'
~/prakash/bf_202305/sonic-buildimage
checking sonic-slave-base image: sonic-slave-buster:6182dd650b9
image sonic-slave-base:6182dd650b9 not found.
#0 building with "default" instance using docker driver
#1 [internal] load build definition from Dockerfile
#1 transferring dockerfile: 13.62kB done
#1 DONE 0.3s

#2 [internal] load .dockignore
#2 transferring context: 2B done
#2 DONE 0.3s

#3 [internal] load metadata for docker.io/library/debian:buster
#3 DONE 0.0s

#4 [internal] load build context
#4 ...

#5 [1/73] FROM docker.io/library/debian:buster
#5 DONE 0.3s

#4 [internal] load build context
#4 ...

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```

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Deployment Approaches

Deploy as QEMU Process

- Qemu is Open source soft.
Used for creating vms.
- Mainly used for server virtualization.

Deploy as Docker Container

- Docker-sonic-vs.gz
- Load sonic docker image
- Run sonic image as docker

Deploy as Linux VM

- Boot qemu from customized SONiC image
- Using virtual hard disk image to boot SONiC

Exercise – Deploy SONiC – QEMU Process

Qemu command

```
sonic@sonicpc:~/prakash/images-sonic/202305$ ls
docker-sonic-vs.gz sonic-vs.img
sonic@sonicpc:~/prakash/images-sonic/202305$ sudo qemu-system-x86_64 -machine ubuntu -m 2048 -smp 4 -hda sonic-vs.img -nographic -netdev user,id=sonic0,hostfwd=tcp::5555-:22 -device e1000,netdev=sonic0
```

SONiC home page

```
[ 76.50393] rc.local[431]: + [-z 115200]
[ 76.803908] rc.local[431]: + [CONSOLE_SPEED=115200
[ 76.846789] rc.local[506]: + grep agetty /lib/systemd/system/serial-getty@.service
[ 76.891476] rc.local[507]: + grep keep-baud
[FAILED] Failed to start OpenBSD Secure Shell server.
[ 76.977903] rc.local[431]: + [ 1 = 0 ]
[ 76.983628] rc.local[431]: + sed -i $'u ..* %!u' 115200 %!g /lib/systemd/system/serial-getty@.service
[ 77.638039] rc.local[431]: + systemctl daemon-reload
[ 77.638039] rc.local[431]: + [ -f /host/image-202305.323289-9da145cdc/platform/firsttime ]
[FAILED] Failed to start OpenBSD Secure Shell server.
[ 87.875161] rc.local[431]: + [ -f /var/log/fsck.log.gz ]
[ 87.946915] rc.local[585]: + gunzip -d -c /var/log/fsck.log.gz
[ 87.995961] rc.local[586]: + logger -t FSCK
[ 88.411545] rc.local[431]: + rm -f /var/log/fsck.log.gz
[ 88.513608] rc.local[431]: + exit 0
[FAILED] Failed to start OpenBSD Secure Shell server.
[FAILED] Failed to start OpenBSD Secure Shell server.

Debian GNU/Linux 11 sonic ttyS0

sonic login: admin
Password:
Linux sonic 5.10.0-18-2-amd64 #1 SMP Debian 5.10.140-1 (2022-09-02) 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: https://sonic-net.github.io/SONiC/

Last Login: Fri Jul 28 09:29:36 UTC 2023 on ttyS0
admin@sonic:~$ watch docker ps -a
Every 2.0s: docker ps -a
```

Containers running on SONiC

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
a0373002a3c	docker-sonic-telemetry:latest	"/usr/local/bin/supe..."	27 hours ago	Exited (255) 16 minutes ago		telemetry
c653fb326a8	docker-sonic-mgmt-framework:latest	"/usr/local/bin/supe..."	27 hours ago	Exited (255) 16 minutes ago		mgmt-framework
73409c4ed25b	docker-lldp:latest	"#/usr/bin/docker-lld..."	27 hours ago	Exited (255) 16 minutes ago		lldp
a400ab2e63bf	docker-teamd:latest	"/usr/local/bin/supe..."	27 hours ago	Up 8 minutes		teamd
56817f3979f8	docker-syncd-vs:latest	"/usr/local/bin/supe..."	27 hours ago	Up 8 minutes		syncd
7f47e6527e25	docker-orchagent:latest	"#/usr/bin/docker-ini..."	27 hours ago	Created		swss
0fccf0107ead	docker-router-advertiser:latest	"#/usr/bin/docker-ini..."	28 hours ago	Up 2 minutes		radv
68a5ac38d91f	docker-platform-monitor:latest	"#/usr/bin/docker_in..."	28 hours ago	Exited (255) 16 minutes ago		pmon
975e627a5021	docker-gbsyncd-vs:latest	"/usr/local/bin/supe..."	28 hours ago	Up 3 minutes		gbsyncd
949660d4080f	docker-eventd:latest	"/usr/local/bin/supe..."	28 hours ago	Up 8 minutes		eventd
85b93a77e9ac	docker-fpm-frr:latest	"/usr/bin/docker_in..."	28 hours ago	Up 4 minutes		bgp
14196548e590	docker-database:latest	"/usr/local/bin/dock..."	28 hours ago	Up 14 minutes		database

```
admin@sonic:~$
```

Exercise –Deploy SONiC – Docker Container

Load Image

```
sonic@sonicpc:~/prakash/sonic-buildimage/target/test$ docker load < docker-sonic-vs.gz
2aa1a9393a3f: Loading layer [=====] 124.2MB/124.2MB
f7eadae0d01c: Loading layer [=====] 54.28MB/54.28MB
4d76a2005e63: Loading layer [=====] 469.9MB/469.9MB
The image docker-sonic-vs:latest already exists, renaming the old one with ID sha256:8c94f02a48b9118763e395d313dbf691b272a3f4965b905f9c8da4eae1181e7d to empty string
Loaded image: docker-sonic-vs:latest
sonic@sonicpc:~/prakash/sonic-buildimage/target/test$
```

docker image

```
sonic@sonicpc:~/prakash/sonic-buildimage/target$ ls
cache                               docker-database.gz      docker-nat.gz          docker-sonic-telemetry.gz
debs                                docker-database.gz.log   docker-nat.gz.log      docker-sonic-telemetry.gz.log
docker-base-bullseye.gz               docker-dhcp-relay.gz    docker-orchagent.gz    docker-sonic-vs.gz
docker-base-bullseye.gz-load.log     docker-dhcp-relay.gz.log  docker-orchagent.gz.log
docker-base-bullseye.gz.log          docker-fpm-frr.gz      docker-platform-monitor.gz
docker-base-buster.gz                docker-fpm-frr.gz.log   docker-platform-monitor.gz.log
docker-base-buster.gz-load.log       docker-gbsyncd-vs.gz    docker-router-advertiser.gz
docker-base-buster.gz.log            docker-gbsyncd-vs.gz.log  docker-router-advertiser.gz.log
docker-config-engine-bullseye.gz     docker-lldp.gz        docker-sflow.gz        docker-swss-layer-bullseye.gz
docker-config-engine-bullseye.gz-load.log  docker-lldp.gz.log   docker-sflow.gz.log    docker-swss-layer-bullseye.gz.log
docker-config-engine-bullseye.gz.log  docker-macsec.gz      docker-snmp.gz        docker-swss-layer-buster.gz
docker-config-engine-buster.gz       docker-macsec.gz.log   docker-snmp.gz.log    docker-swss-layer-buster.gz.log
docker-config-engine-buster.gz-load.log  docker-mux.gz        docker-sonic-mgmt-framework.gz
docker-config-engine-buster.gz.log    docker-mux.gz.log    docker-sonic-mgmt-framework.gz.log
sonic@sonicpc:~/prakash/sonic-buildimage/target$ cp docker-sonic-vs.gz test/
sonic@sonicpc:~/prakash/sonic-buildimage/target$ cd test/
files
python-debs
python-wheels
sonic-vs1.bin
sonic-vs_bkp.bin
sonic-vs_bkp.img
sonic-vs_bkp.img.gz.log
sonic-vs_img.gz
sonic-vs.img.gz.log
test
versions
```

Challenges

Build Step	Error	Resolution
Make SONIC_BUILD_JOBS=4 all	Could not access KVM kernel module: kvm: failed to initialize kvm	Enable nested virtualization
Make SONIC_BUILD_JOBS=4 all	No swap limits support	Add swap limit capabilities by modifying grub : GRUB_CMDLINE_LINUX="cgroup_enable=memory swapaccount=1"
Make SONIC_BUILD_JOBS=4 all	No rule to make target/sonic-vs.img	Specify the target by mentioning target instead of make all. make SONIC_BUILD_JOBS=4 target/sonic-vs.img.gz
Sonic deployment	Observation : While deploying SONiC using sonic-vs.bin on QEMU with GRUB bootloader support. Used prebuild sonic-vs.bin to extract the files. This extracted file copied onto a virtual hard disk image to boot SONiC. - Missing linux kernel files and grub-pc-bin_xxxx.deb file - Unable to proceed with this approach	
Sonic deployment as docker	Observation: - Docker command is not working inside sonic docker container.	

Open/Pending points:

- **Deploy sonic as VM.**
- **SONiC CI/CD pipeline.**

Gaining familiarity with sonic-mgmt test infrastructure

- SONiC Test Management Overview
- Exercise – Test Run on sonic-mgmt and analysis

SONiC Test Management Overview

'sonic-mgmt' repository contains code for SONiC testbed deployment and setup, SONiC testing, test report processing.

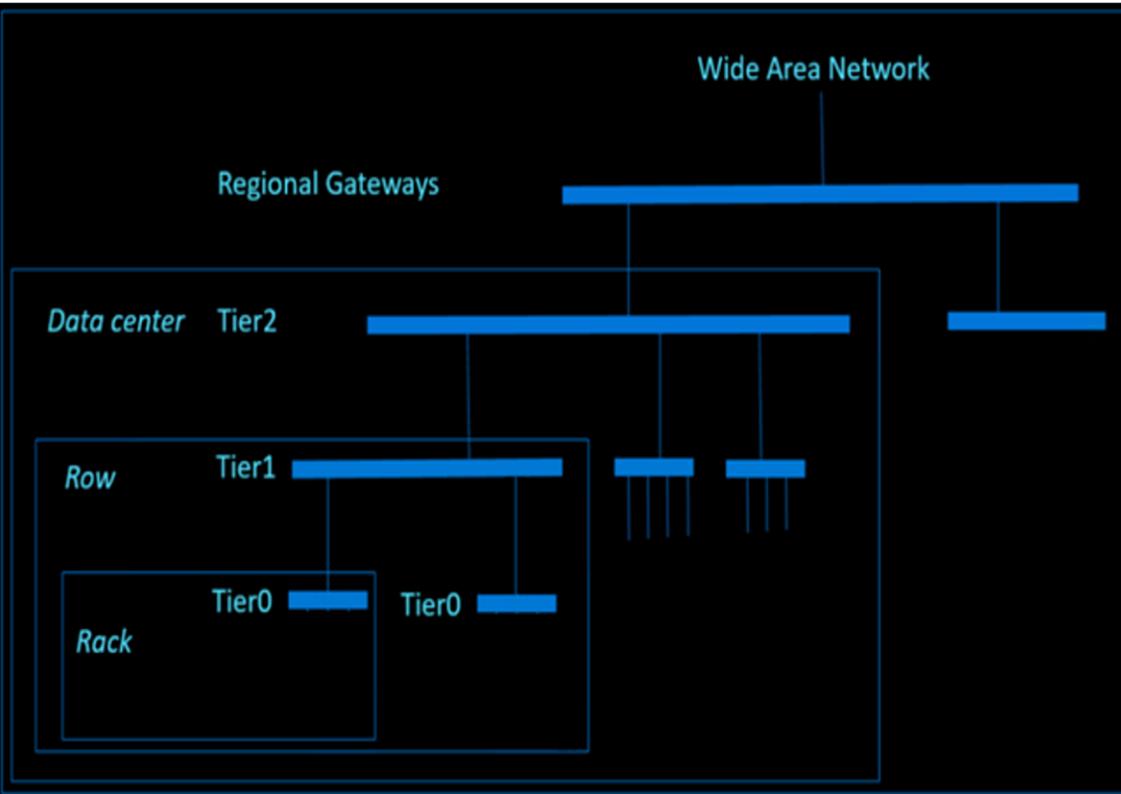
- ❖ Test-bed Setup with multiple topologies, T0, T1, M0, MX etc.
- ❖ Configurable Test Cases
- ❖ SONiC Testing with different network scenarios and traffic generation
- ❖ Test Report Generation
- ❖ Key Tools:
 - Ansible
 - Pytest

SONIC MGMT Repo
sonic-mgmt
|
|_ ansible
|_ docs
|_ spytest
|_ test_reporting
|_ test
|_ all_scripts
|_ run_script
|_ logs

Pytest Repo
tests
|_ common
|_ platform
|_ ptftests
|_ nat
|_ test_nat_bindings.py
|_ files
|_ all helpers for the nat feature
|_ acl

SONiC Test Management – Data Center Topology

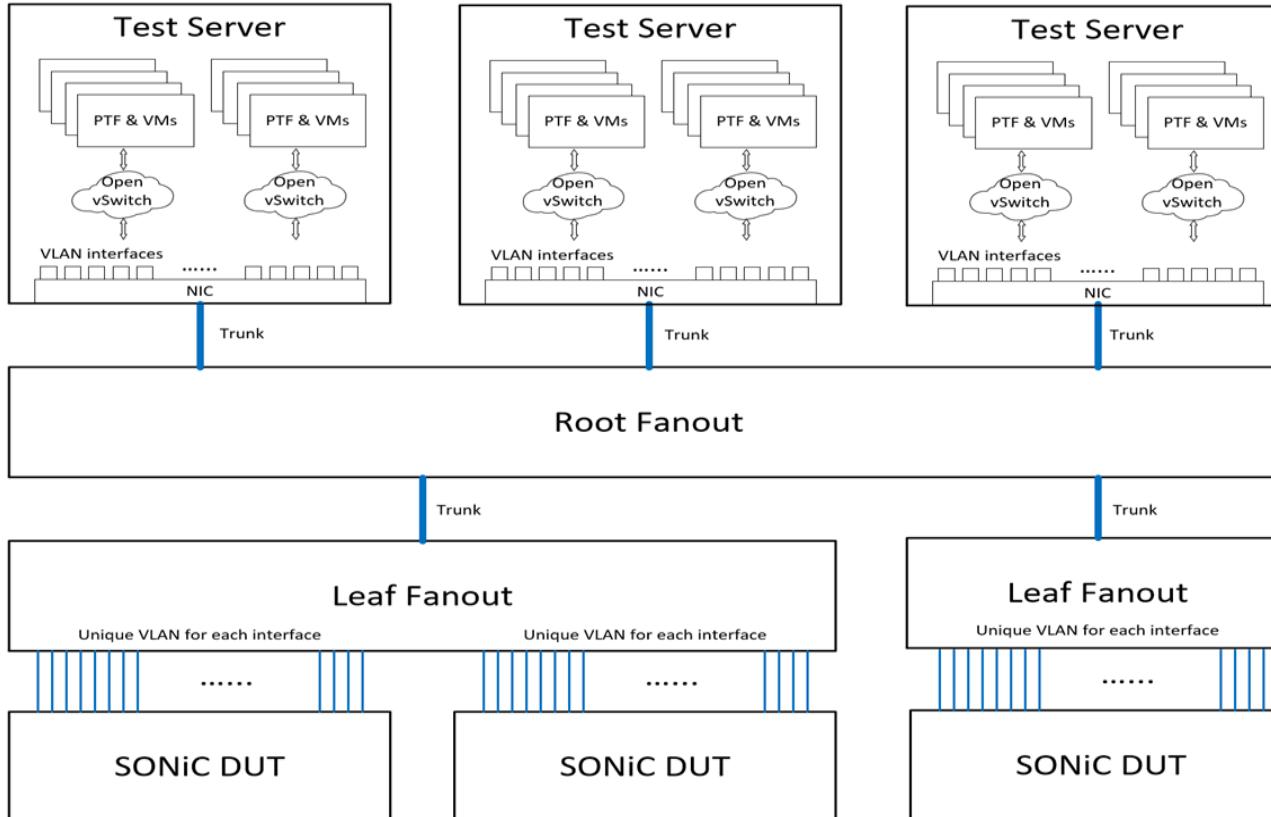
Topology



Tiers

Tiers	Downstream Devices	Upstream Devices
T0	Servers	T1 devices
T1	T0 devices	T2 devices
T2	T1 devices	Regional Gateways (T3 devices)

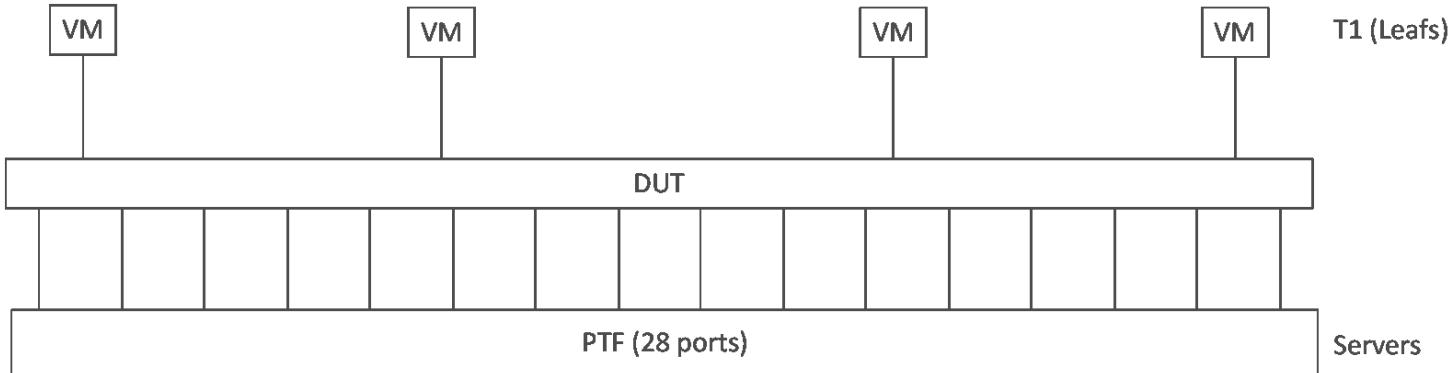
SONiC Test Management – Topology Implementation



Key Components:

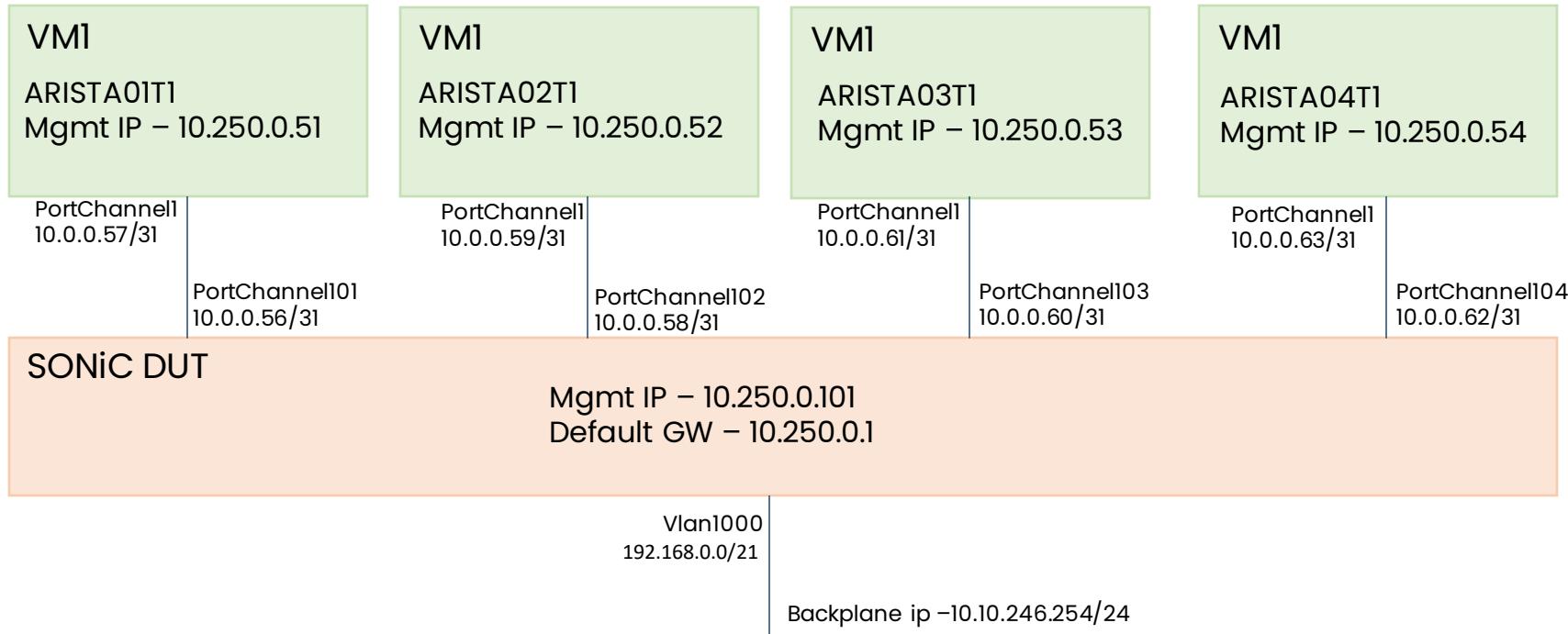
- Test servers
 - PTF
 - VMs
 - Open vSwitch
- Fanout switches
 - Root fanout switch (optional)
 - Leaf fanout switch
- SONiC DUT

SONiC Test Management – T0 Topology



- The DUT has 32 ports.
- Requires 4 VMs.
- The first 28 ports are connected to PTF docker simulating servers.
- The last 4 ports are connected to 4 VMs simulating T1 devices.
- The connection to each of the upstream T1 is configured as a port-channel with single link.

Exercise – Test Run on sonic-mgmt and analysis – Topology Setup



Exercise – Test Run on sonic-mgmt and analysis – Packetflow

VM1 – ARISTA01T1

Last login: Wed Aug 2 11:03:08 2023 from 10.250.0.1					
admin@ARISTA01T1:~\$ show ip interface					
Interface	Master	IPv4 address/mask	Admin/Oper	BGP Neighbor	Neighbor IP
Ethernet5		10.10.246.29/24	up/up	exabgp_v4	10.10.246.254
Loopback0		100.1.0.29/32	up/up	N/A	N/A
PortChannel1		10.0.0.57/31	up/up	vlab-01	10.0.0.56
docker0		240.127.1.1/24	up/down	N/A	N/A
eth0		10.250.0.51/24	up/up	N/A	N/A
lo		127.0.0.1/16	up/up	N/A	N/A

VM3-ARISTA03T1

Last login: Wed Aug 2 07:12:02 2023 from 10.250.0.1					
admin@ARISTA03T1:~\$ show ip interface					
Interface	Master	IPv4 address/mask	Admin/Oper	BGP Neighbor	Neighbor IP
Ethernet5		10.10.246.31/24	up/up	exabgp_v4	10.10.246.254
Loopback0		100.1.0.31/32	up/up	N/A	N/A
PortChannel1		10.0.0.61/31	up/up	vlab-01	10.0.0.60
docker0		240.127.1.1/24	up/down	N/A	N/A
eth0		10.250.0.53/24	up/up	N/A	N/A
lo		127.0.0.1/16	up/up	N/A	N/A

VM4-ARISTA04T1

Last login: Wed Aug 2 07:12:43 2023 from 10.250.0.1					
admin@ARISTA04T1:~\$ show ip interface					
Interface	Master	IPv4 address/mask	Admin/Oper	BGP Neighbor	Neighbor IP
Ethernet5		10.10.246.32/24	up/up	exabgp_v4	10.10.246.254
Loopback0		100.1.0.32/32	up/up	N/A	N/A
PortChannel1		10.0.0.63/31	up/up	vlab-01	10.0.0.62
docker0		240.127.1.1/24	up/down	N/A	N/A
eth0		10.250.0.54/24	up/up	N/A	N/A
lo		127.0.0.1/16	up/up	N/A	N/A

VM2 – ARISTA02T1

Last login: Wed Aug 2 07:11:06 2023 from 10.250.0.1					
admin@ARISTA02T1:~\$ show ip interface					
Interface	Master	IPv4 address/mask	Admin/Oper	BGP Neighbor	Neighbor IP
Ethernet5		10.10.246.30/24	up/up	exabgp_v4	10.10.246.254
Loopback0		100.1.0.30/32	up/up	N/A	N/A
PortChannel1		10.0.0.59/31	up/up	vlab-01	10.0.0.58
docker0		240.127.1.1/24	up/down	N/A	N/A
eth0		10.250.0.52/24	up/up	N/A	N/A
lo		127.0.0.1/16	up/up	N/A	N/A

DUT

Last login: Wed Aug 2 10:42:53 2023 from 10.250.0.1					
admin@vlab-01:~\$ show ip interface					
Interface	Master	IPv4 address/mask	Admin/Oper	BGP Neighbor	Neighbor IP
Loopback0		10.1.0.32/32	up/up	N/A	N/A
PortChannel101		10.0.0.56/31	up/up	ARISTA01T1	10.0.0.57
PortChannel102		10.0.0.58/31	up/up	ARISTA02T1	10.0.0.59
PortChannel103		10.0.0.60/31	up/up	ARISTA03T1	10.0.0.61
PortChannel104		10.0.0.62/31	up/up	ARISTA04T1	10.0.0.63
Vlan1000		192.168.0.1/21	up/up	N/A	N/A
docker0		240.127.1.1/24	up/down	N/A	N/A
eth0		10.250.0.101/24	up/up	N/A	N/A
lo		127.0.0.1/16	up/up	N/A	N/A

Exercise – Test Run on sonic-mgmt and analysis – Packetflow

VM1-IPRoute

```
admin@ARISTA01T1:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, D - SHARP,
       F - PBR, f - OpenFabric,
       > - selected route, * - FIB route, q - queued route, r - rejected route

C>*10.0.0.56/31 is directly connected, PortChannel1, 18:15:16
B>*10.1.0.32/32 [20/0] via 10.0.0.56, PortChannel1, 18:15:14
C>*10.10.246.0/24 is directly connected, Ethernet5, 02w2d14h
C>*10.250.0.0/24 is directly connected, eth0, 02w2d14h
C>*100.1.0.29/32 is directly connected, Loopback0, 02w2d14h
B>*192.168.0.0/21 [20/0] via 10.0.0.56, PortChannel1, 18:15:14
```

VM3-IP Route

Last login: Thu Aug 3 05:11:52 2023 from 10.250.0.1

```
admin@ARISTA03T1:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, D - SHARP,
       F - PBR, f - OpenFabric,
       > - selected route, * - FIB route, q - queued route, r - rejected route

C>*10.0.0.60/31 is directly connected, PortChannel1, 2d23h00m
B>*10.1.0.32/32 [20/0] via 10.0.0.60, PortChannel1, 2d23h00m
C>*10.10.246.0/24 is directly connected, Ethernet5, 02w2d14h
C>*10.250.0.0/24 is directly connected, eth0, 02w2d14h
C>*100.1.0.31/32 is directly connected, Loopback0, 02w2d14h
B>*192.168.0.0/21 [20/0] via 10.0.0.60, PortChannel1, 2d23h00m
```

VM4-IPRoute

```
admin@ARISTA04T1:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, D - SHARP,
       F - PBR, f - OpenFabric,
       > - selected route, * - FIB route, q - queued route, r - rejected route

C>*10.0.0.62/31 is directly connected, PortChannel1, 2d23h01m
B>*10.1.0.32/32 [20/0] via 10.0.0.62, PortChannel1, 2d23h01m
C>*10.10.246.0/24 is directly connected, Ethernet5, 02w2d14h
C>*10.250.0.0/24 is directly connected, eth0, 02w2d14h
C>*100.1.0.32/32 is directly connected, Loopback0, 02w2d14h
B>*192.168.0.0/21 [20/0] via 10.0.0.62, PortChannel1, 2d23h01m
```

VM2- IP Route

```
admin@ARISTA02T1:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, D - SHARP,
       F - PBR, f - OpenFabric,
       > - selected route, * - FIB route, q - queued route, r - rejected route

C>*10.0.0.58/31 is directly connected, PortChannel1, 1d11h27m
B>*10.1.0.32/32 [20/0] via 10.0.0.58, PortChannel1, 1d11h26m
C>*10.10.246.0/24 is directly connected, Ethernet5, 02w2d14h
C>*10.250.0.0/24 is directly connected, eth0, 02w2d14h
C>*100.1.0.30/32 is directly connected, Loopback0, 02w2d14h
B>*192.168.0.0/21 [20/0] via 10.0.0.58, PortChannel1, 1d11h26m
```

DUT-IP Route

```
admin@vlab-01:~$ show ip interface
Interface      Master    IPv4 address/mask   Admin/Oper   BGP Neighbor   Neighbor IP
-----+-----+-----+-----+-----+-----+
Loopback0          -        10.1.0.32/32     up/up       N/A           N/A
PortChannel101      -        10.0.0.56/31     up/up       ARISTA01T1  10.0.0.57
PortChannel102      -        10.0.0.58/31     up/up       ARISTA02T1  10.0.0.59
PortChannel103      -        10.0.0.60/31     up/up       ARISTA03T1  10.0.0.61
PortChannel104      -        10.0.0.62/31     up/up       ARISTA04T1  10.0.0.63
Vlan1000          -        192.168.0.1/21   up/up       N/A           N/A
docker0            -        240.127.1.1/24   up/down     N/A           N/A
eth0               -        10.250.0.101/24  up/up       N/A           N/A
lo                -        127.0.0.1/16    up/up       N/A           N/A
```

```
admin@vlab-01:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, D - SHARP,
       F - PBR, f - OpenFabric,
       > - selected route, * - FIB route, q - queued route, r - rejected route
```

```
C>*10.0.0.56/31 is directly connected, PortChannel101, 18:13:50
C>*10.0.0.58/31 is directly connected, PortChannel102, 1d11h24m
C>*10.0.0.60/31 is directly connected, PortChannel103, 2d22h56m
C>*10.0.0.62/31 is directly connected, PortChannel104, 2d22h56m
C>*10.1.0.32/32 is directly connected, Loopback0, 2d22h56m
C>*10.250.0.0/24 is directly connected, eth0, 2d22h56m
B>*100.1.0.29/32 [20/0] via 10.0.0.57, PortChannel101, 18:13:47
B>*100.1.0.30/32 [20/0] via 10.0.0.59, PortChannel102, 1d11h24m
B>*100.1.0.31/32 [20/0] via 10.0.0.61, PortChannel103, 2d22h55m
B>*100.1.0.32/32 [20/0] via 10.0.0.63, PortChannel104, 2d22h55m
C>*192.168.0.0/21 is directly connected, Vlan1000, 2d22h56m
```

Open/Pending Points:

- End to end packet analysis through tcpdump and wireshark on each node of the topology.

Storage

Networking

Virtualization

Cloud

IoT/AI/ML



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