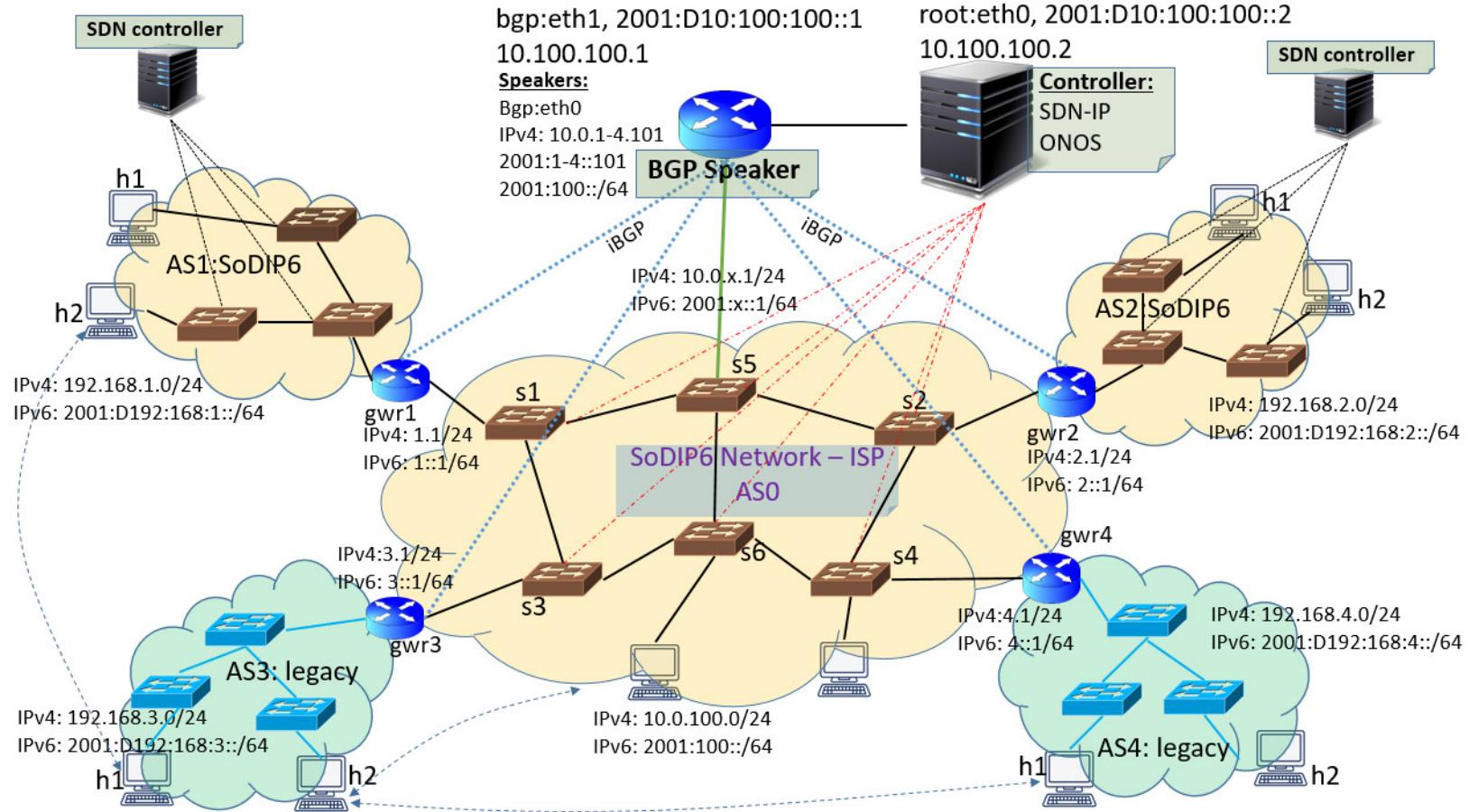
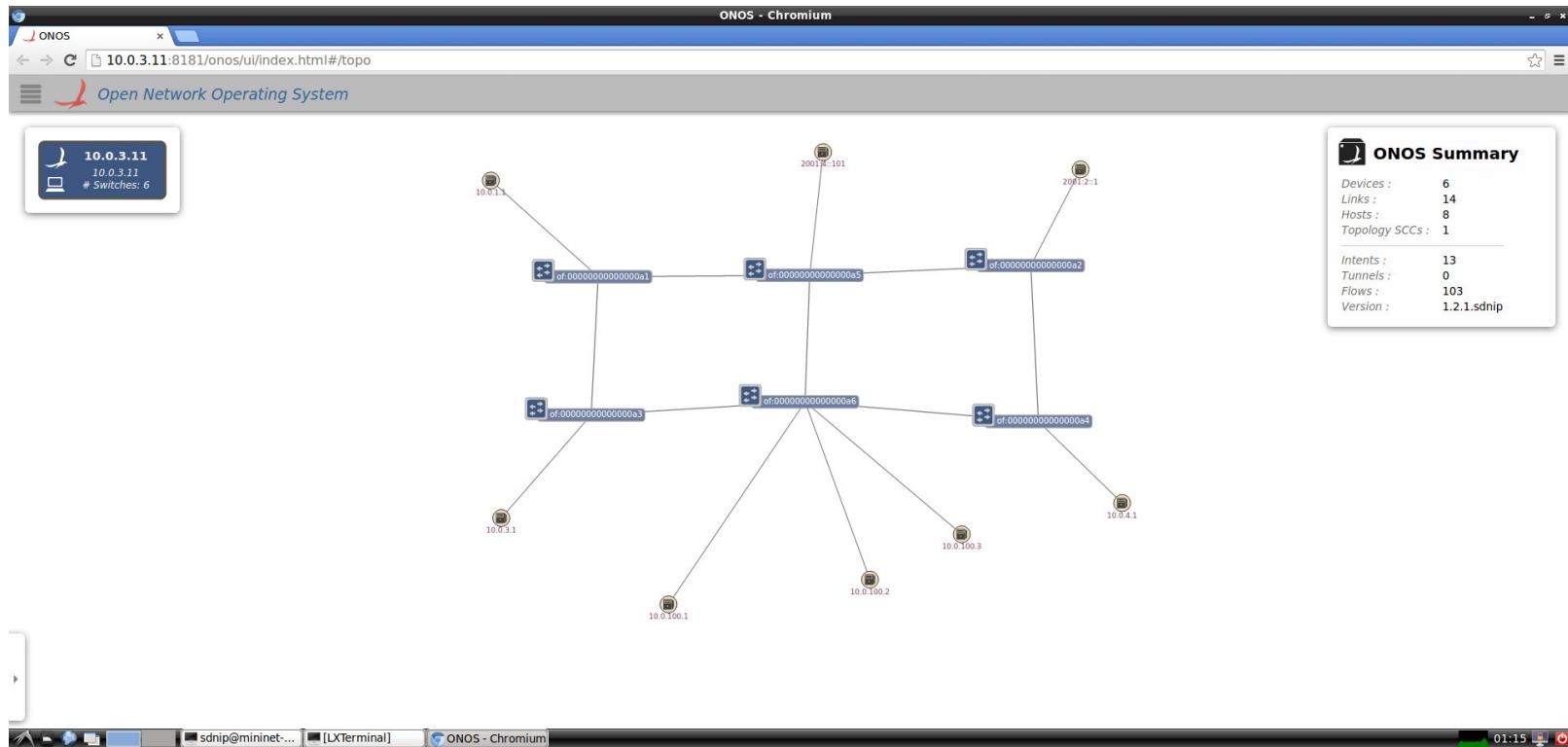
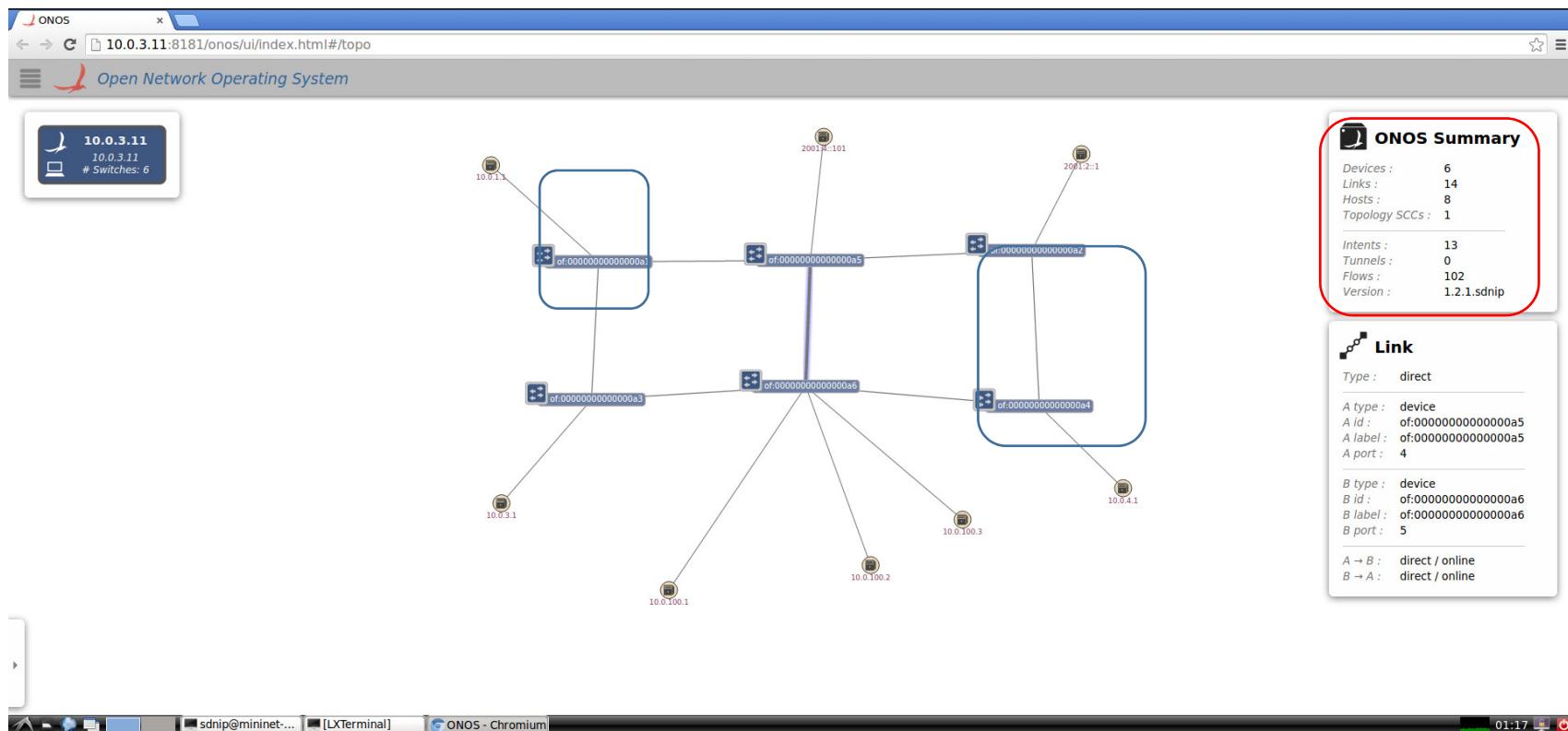


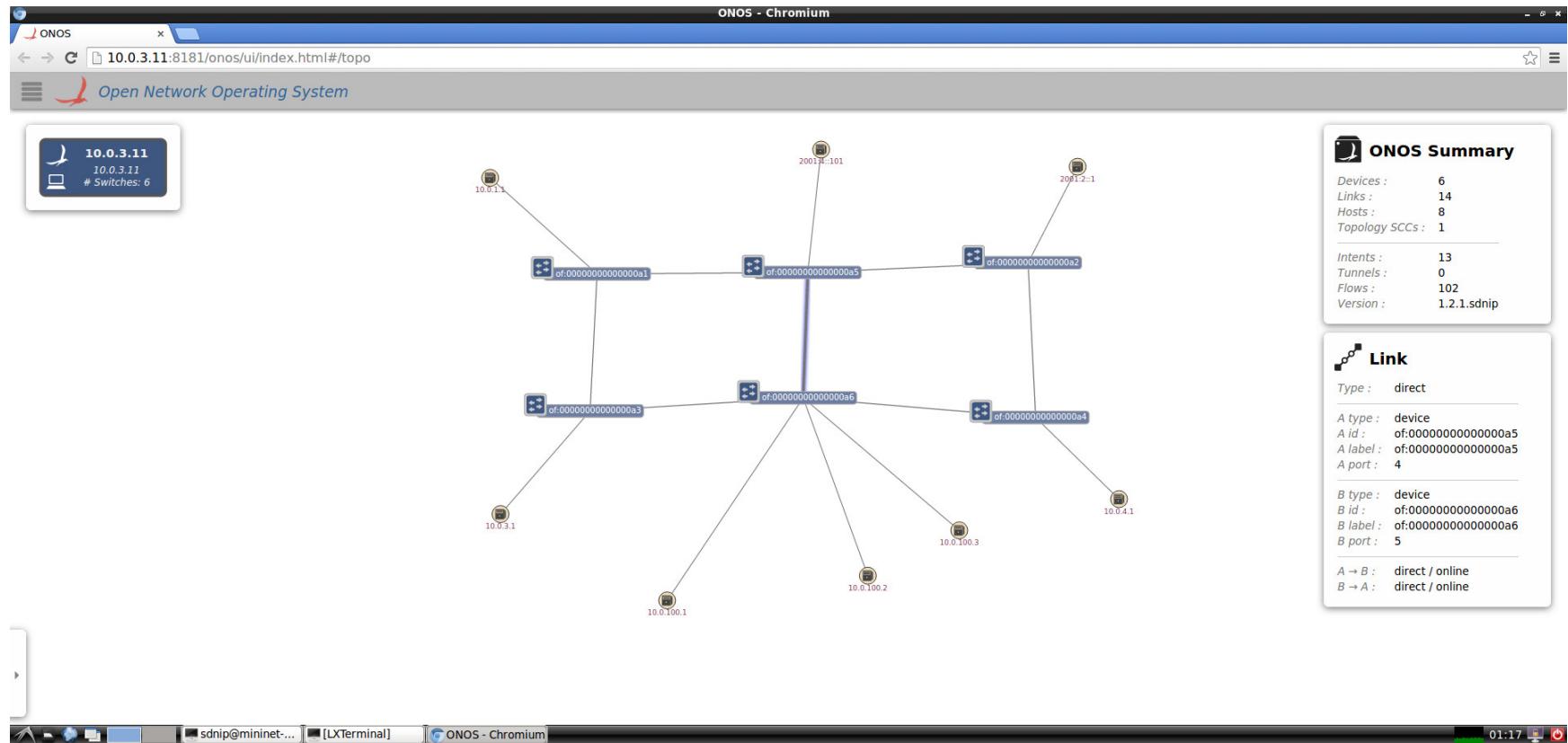
## Some glimpses of ongoing ONOS/SDN-IP tests/implementation for SoDIP6 networks (use-case)

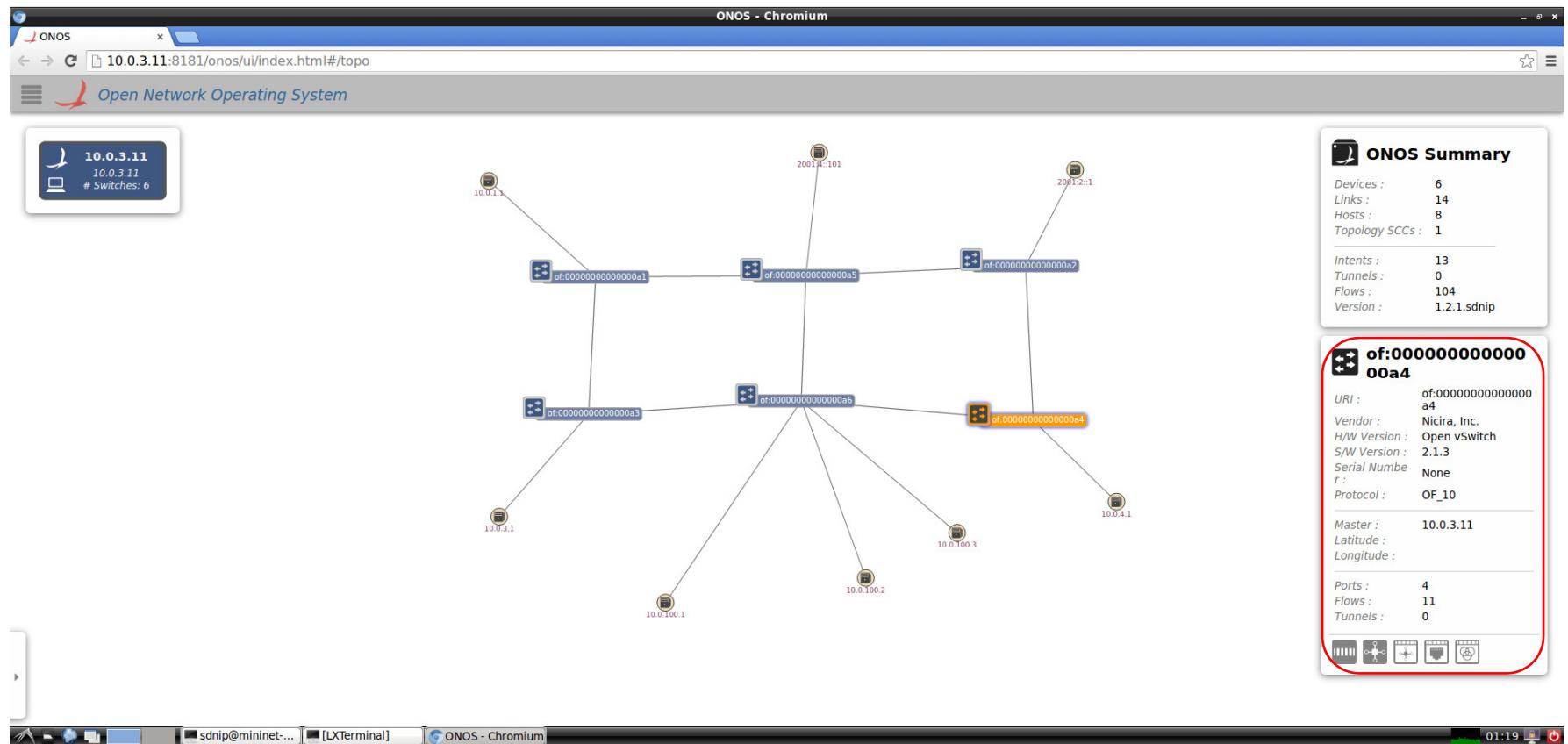
*Authors: Babu R Dawadi, Danda B Rawat, Shashidhar R Joshi, and Pietro Manzoni*

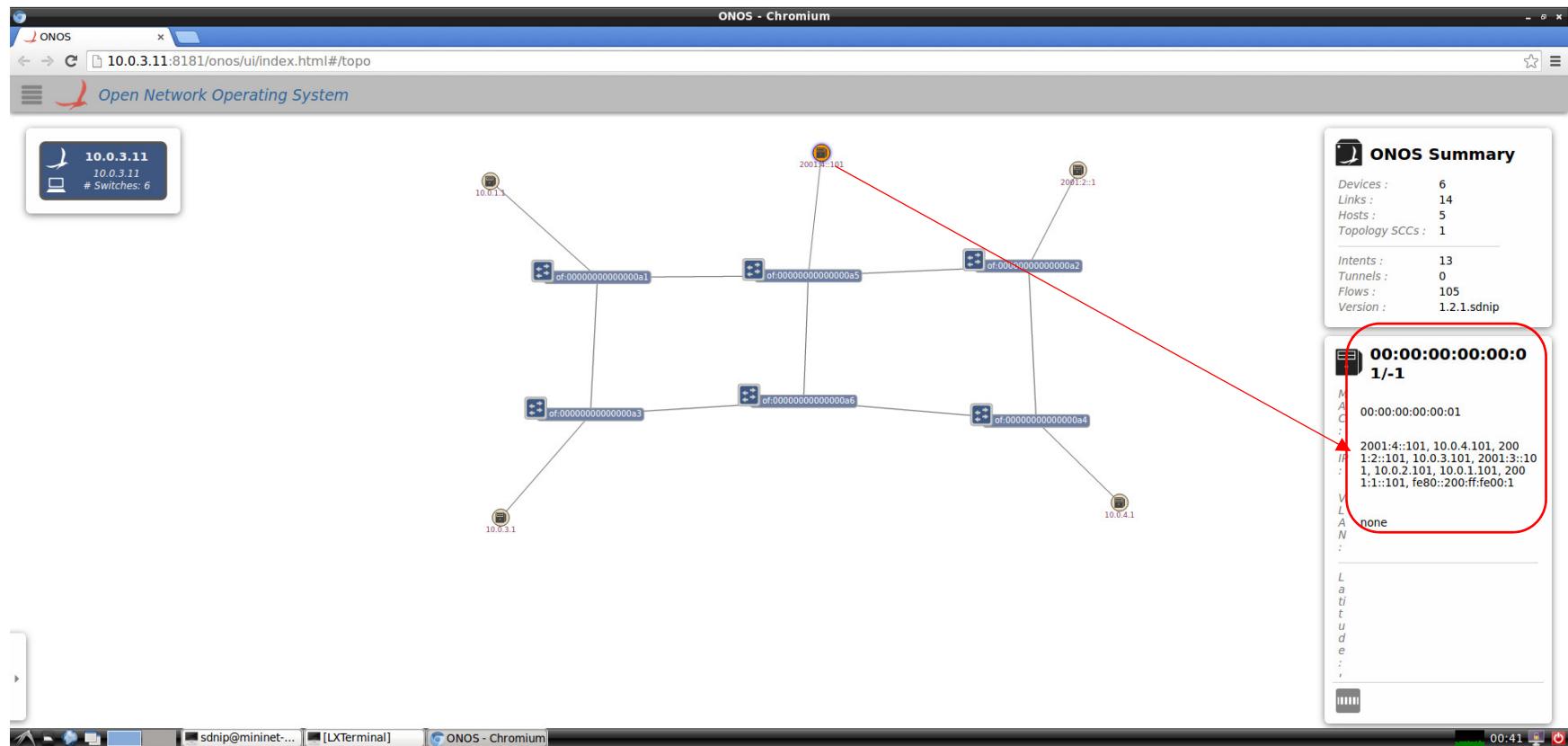


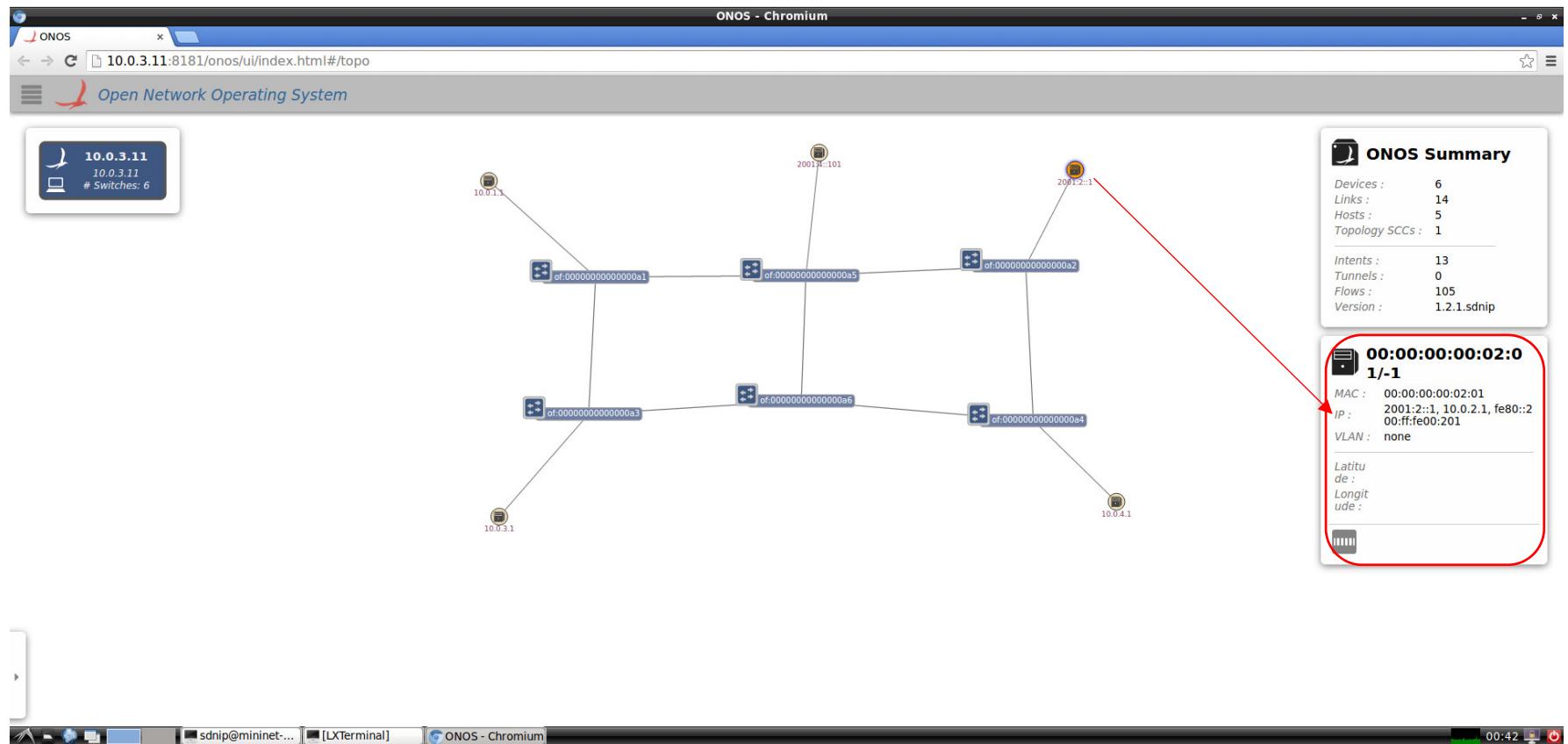


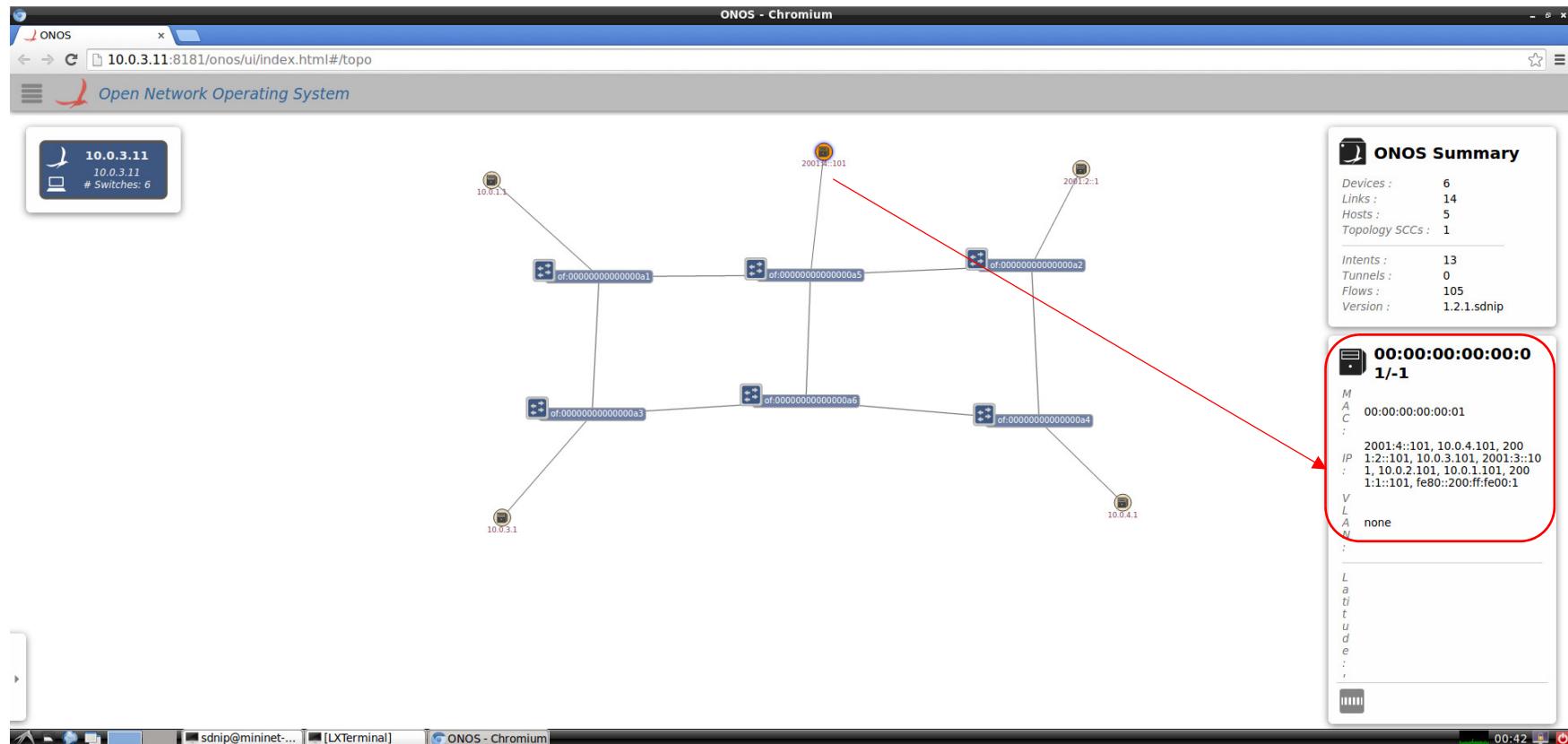












LXTerminal

File Edit Tabs Help

```

192.168.3.0/24      10.0.3.1
192.168.4.0/24      10.0.4.1
Total SDN-IP IPv4 routes = 3

Network          Next Hop
Total SDN-IP IPv6 routes = 0
onos> intents
id=0x2, state=INSTALLED, key=0x2, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=6}, TCP_DST{tcpPort=179}, IPV4_SRC{ip=10.0.2.1/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.2.101/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a2, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}
id=0x8, state=INSTALLED, key=0x8, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=6}, TCP_DST{tcpPort=179}, IPV4_SRC{ip=10.0.1.1/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.1.101/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a1, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}
id=0x0, state=INSTALLED, key=0x0, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=6}, TCP_DST{tcpPort=179}, IPV4_SRC{ip=10.0.2.101/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.2.1/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a2, portNumber=1}
id=0x7, state=INSTALLED, key=0x7, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=6}, IPV4_SRC{ip=10.0.1.101/32}, TCP_SRC{tcpPort=179}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.1.1/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a1, portNumber=1}
id=0x81, state=WITHDRAWN, key=192.168.1.0/24, type=MultiPointToSinglePointIntent, appId=org.onosproject.sdnip
    selector=[ETH_TYPE{ethType=800}, IPV4_DST{ip=192.168.1.0/24}]
    treatment=[ETH_DST{mac=00:00:00:00:00:01}]
    ingress=[ConnectPoint{elementId=of:00000000000000a4, portNumber=1}, ConnectPoint{elementId=of:00000000000000a3, portNumber=1}, ConnectPoint{elementId=of:00000000000000a1, portNumber=1}]
id=0x5, state=INSTALLED, key=0x5, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=1}, IPV4_SRC{ip=10.0.2.1/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.2.101/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a2, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}
id=0x9, state=INSTALLED, key=0x9, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=6}, IPV4_SRC{ip=10.0.1.1/32}, TCP_SRC{tcpPort=179}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.1.101/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a1, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}
id=0xa, state=INSTALLED, key=0xa, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=1}, IPV4_SRC{ip=10.0.1.101/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.1.1/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a1, portNumber=1}
id=0x6, state=INSTALLED, key=0x6, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=6}, TCP_DST{tcpPort=179}, IPV4_SRC{ip=10.0.1.101/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.1.1/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a1, portNumber=1}
id=0x3, state=INSTALLED, key=0x3, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=6}, IPV4_SRC{ip=10.0.2.1/32}, TCP_SRC{tcpPort=179}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.2.101/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a2, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}
id=0x4, state=INSTALLED, key=0x4, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=1}, IPV4_SRC{ip=10.0.2.101/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.2.1/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a2, portNumber=1}
id=0x1, state=INSTALLED, key=0x1, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=6}, IPV4_SRC{ip=10.0.2.101/32}, TCP_SRC{tcpPort=179}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.2.1/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a2, portNumber=1}
id=0xb, state=INSTALLED, key=0xb, type=PointToPointIntent, appId=org.onosproject.sdnip
    selector=[IP_PROTO{protocol=1}, IPV4_SRC{ip=10.0.1.1/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.1.101/32}]
    ingress=ConnectPoint{elementId=of:00000000000000a1, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}
onos>

```

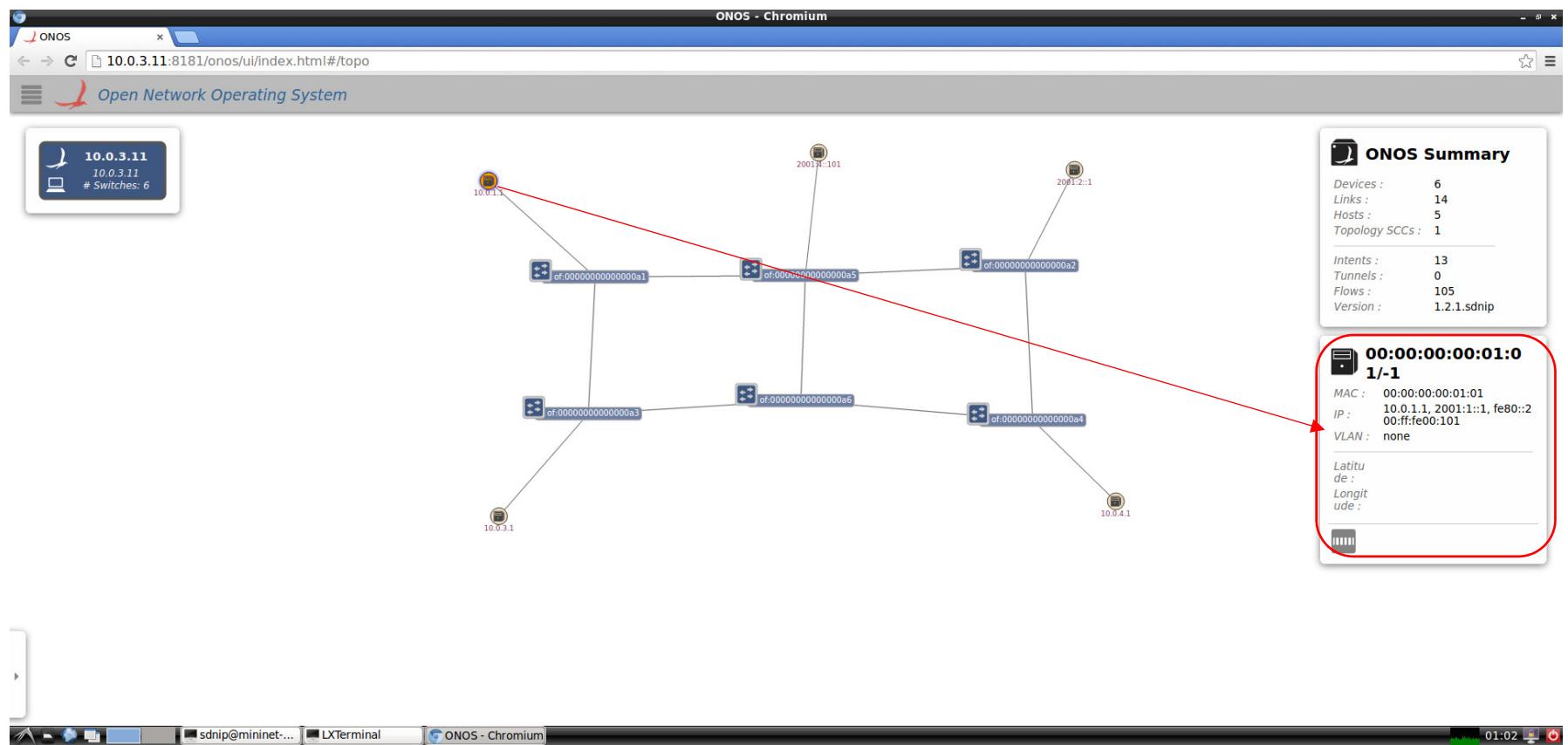
sdnip@mininet... LXTerminal ONOS - Chromium

LXTerminal

```

File Edit Tabs Help
ingress=ConnectPoint{elementId=of:00000000000000a1, portNumber=1}, egress=ConnectPoint{elementId=of:00000000000000a3, portNumber=1}
onos> devices
id=of:00000000000000a1, available=true, role=MASTER, type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.1.3, serial=None, protocol=OF_10, channelId=10.0.3.1:48617
id=of:00000000000000a2, available=true, role=MASTER, type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.1.3, serial=None, protocol=OF_10, channelId=10.0.3.1:48618
id=of:00000000000000a3, available=true, role=MASTER, type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.1.3, serial=None, protocol=OF_10, channelId=10.0.3.1:48619
id=of:00000000000000a4, available=true, role=MASTER, type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.1.3, serial=None, protocol=OF_10, channelId=10.0.3.1:48620
id=of:00000000000000a5, available=true, role=MASTER, type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.1.3, serial=None, protocol=OF_10, channelId=10.0.3.1:48621
id=of:00000000000000a6, available=true, role=MASTER, type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.1.3, serial=None, protocol=OF_10, channelId=10.0.3.1:48622
onos> flows
deviceID=of:00000000000000a1, flowRuleCount=19
    id=100008507e769, state=ADDED, bytes=2442, packets=33, duration=2000, priority=5, tableId=0 appId=org.onosproject.core, payLoad=null
        selector=[ETH_TYPE{ethType=800}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=CONTROLLER}], deferred[], transition=None, cleared=false, metadata=null}
    id=100008507fdef, state=ADDED, bytes=1764, packets=42, duration=2000, priority=40000, tableId=0 appId=org.onosproject.core, payLoad=null
        selector=[ETH_TYPE{ethType=806}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=CONTROLLER}], deferred[], transition=None, cleared=false, metadata=null}
    id=100008507fdef, state=ADDED, bytes=0, packets=0, duration=2000, priority=5, tableId=0 appId=org.onosproject.core, payLoad=null
        selector=[ETH_TYPE{ethType=806}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=CONTROLLER}], deferred[], transition=None, cleared=false, metadata=null}
    id=1000086e42306, state=ADDED, bytes=17560, packets=188, duration=2000, priority=5, tableId=0 appId=org.onosproject.core, payLoad=null
        selector=[ETH_TYPE{ethType=86dd}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=CONTROLLER}], deferred[], transition=None, cleared=false, metadata=null}
    id=1000086eb6535, state=ADDED, bytes=104814, packets=1294, duration=2000, priority=40000, tableId=0 appId=org.onosproject.core, payLoad=null
        selector=[ETH_TYPE{ethType=88cc}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=CONTROLLER}], deferred[], transition=None, cleared=false, metadata=null}
    id=1000086ed202b, state=ADDED, bytes=104814, packets=1294, duration=2000, priority=40000, tableId=0 appId=org.onosproject.core, payLoad=null
        selector=[ETH_TYPE{ethType=8942}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=CONTROLLER}], deferred[], transition=None, cleared=false, metadata=null}
    id=100008714e102, state=FAILED, bytes=0, packets=0, duration=0, priority=40000, tableId=0 appId=org.onosproject.core, payLoad=null
        selector=[IP_PROTO{protocol=58}, ICMPV6_TYPE{icmpv6Type=135}, ETH_TYPE{ethType=86dd}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=CONTROLLER}], deferred[], transition=None, cleared=false, metadata=null}
    id=100008714e4c3, state=FAILED, bytes=0, packets=0, duration=0, priority=40000, tableId=0 appId=org.onosproject.core, payLoad=null
        selector=[IP_PROTO{protocol=58}, ICMPV6_TYPE{icmpv6Type=136}, ETH_TYPE{ethType=86dd}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=CONTROLLER}], deferred[], transition=None, cleared=false, metadata=null}
    id=1d000080b1524d, state=FAILED, bytes=0, packets=0, duration=0, priority=10, tableId=0 appId=org.onosproject.fwd, payLoad=null
        selector=[IPV6_SRC{ip=2001:1::101/128}, IN_PORT{port=3}, ETH_SRC{mac=00:00:00:00:00:01}, IPV6_DST{ip=2001:1::1/128}, ETH_DST{mac=00:00:00:00:01:01}, ETH_TYPE{ethType=86dd}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=1}], deferred[], transition=None, cleared=false, metadata=null}
    id=1d000084fd27cc, state=PENDING_REMOVE, bytes=0, packets=0, duration=0, priority=10, tableId=0 appId=org.onosproject.fwd, payLoad=null
        selector=[IN_PORT{port=3}, ETH_SRC{mac=00:00:00:00:01}, ETH_DST{mac=00:00:00:01:01}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=1}], deferred[], transition=None, cleared=false, metadata=null}
    id=23000019c173c1, state=ADDED, bytes=0, packets=0, duration=2000, priority=1000, tableId=0 appId=org.onosproject.net.intent, payLoad=null
        selector=[IP_PROTO{protocol=1}, IN_PORT{port=2}, IPV4_SRC{ip=10.0.1.101/32}, ETH_TYPE{ethType=800}, IPV4_DST{ip=10.0.1.1/32}]
            treatment=DefaultTrafficTreatment{immediate=[OUTPUT{port=1}], deferred[], transition=None, cleared=false, metadata=null}
    id=23000019cf8781, state=ADDED, bytes=0, packets=0, duration=1000, priority=1000, tableId=0 appId=org.onosproject.net.intent, payLoad=null

```



```
File Edit Tabs Help
id=00:00:00:00:04:01/-1, mac=00:00:00:00:04:01, location=of:00000000000000a4/1, vlan=-1, ip(s)=[10.0.4.1]
id=66:73:8F:C9:DC:41/-1, mac=66:73:8F:C9:DC:41, location=of:00000000000000a6/3, vlan=-1, ip(s)=[10.0.100.3]
id=C6:54:5B:AF:D9:7D/-1, mac=C6:54:5B:AF:D9:7D, location=of:00000000000000a6/2, vlan=-1, ip(s)=[10.0.100.2]
id=DA:08:96:78:6C:3E/-1, mac=DA:08:96:78:6C:3E, location=of:00000000000000a6/1, vlan=-1, ip(s)=[10.0.100.1]
onos> hosts
id=00:00:00:00:00:01/-1, mac=00:00:00:00:00:01, location=of:00000000000000a5/1, vlan=-1, ip(s)=[2001:4::101, 2001:3::101, 2001:1::101, 2001:2::101, 10.0.100.254]
id=00:00:00:00:01:01/-1, mac=00:00:00:00:01:01, location=of:00000000000000a1/1, vlan=-1, ip(s)=[10.0.1.1]
id=00:00:00:00:02:01/-1, mac=00:00:00:00:02:01, location=of:00000000000000a2/1, vlan=-1, ip(s)=[10.0.2.1]
id=00:00:00:00:04:01/-1, mac=00:00:00:00:04:01, location=of:00000000000000a4/1, vlan=-1, ip(s)=[10.0.4.1]
id=66:73:8F:C9:DC:41/-1, mac=66:73:8F:C9:DC:41, location=of:00000000000000a6/3, vlan=-1, ip(s)=[10.0.100.3]
id=C6:54:5B:AF:D9:7D/-1, mac=C6:54:5B:AF:D9:7D, location=of:00000000000000a6/2, vlan=-1, ip(s)=[10.0.100.2]
id=DA:08:96:78:6C:3E/-1, mac=DA:08:96:78:6C:3E, location=of:00000000000000a6/1, vlan=-1, ip(s)=[10.0.100.1]
onos> routes
Network Next Hop
10.0.100.0/24 10.10.10.1
192.168.1.0/24 10.0.1.1
192.168.2.0/24 10.0.2.1
192.168.3.0/24 10.0.3.1
192.168.4.0/24 10.0.4.1
Total SDN-IP IPv4 routes = 5

Network Next Hop
Total SDN-IP IPv6 routes = 0
onos> bgp-
bgp-neighbors bgp-routes
onos> bgp-neighbors
BGP neighbor is 10.10.10.1, remote AS 65000, local AS 65000
  Remote router ID 10.10.10.1, IP /10.10.10.1:60597, BGP version 4, Hold time 9
  Remote AFI/SAFI IPv4 Unicast YES Multicast NO, IPv6 Unicast NO Multicast NO
  Local  router ID 10.0.3.11, IP /10.0.3.11:2000, BGP version 4, Hold time 9
  Local  AFI/SAFI IPv4 Unicast YES Multicast NO, IPv6 Unicast NO Multicast NO
  4 Octet AS Capability: Advertised Received
onos> bgp-routes
Network Next Hop Origin LocalPref MED BGP-ID
192.168.4.0/24 10.0.4.1 IGP 100 0 10.10.10.1
AsPath 65004
192.168.3.0/24 10.0.3.1 IGP 100 0 10.10.10.1
AsPath 65003
10.0.100.0/24 10.10.10.1 IGP 100 0 10.10.10.1
AsPath [none]
192.168.2.0/24 10.0.2.1 IGP 100 0 10.10.10.1
AsPath 65002
192.168.1.0/24 10.0.1.1 IGP 100 0 10.10.10.1
AsPath 65001
Total BGP IPv4 routes = 5

Network Next Hop Origin LocalPref MED BGP-ID
Total BGP IPv6 routes = 0
onos>
```

```
mininet> isp_h1 ping isp_h2
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=61 time=3.40 ms
64 bytes from 192.168.2.1: icmp_seq=2 ttl=61 time=3.51 ms
64 bytes from 192.168.2.1: icmp_seq=3 ttl=61 time=1.07 ms
^CsendInt: writing chr(3)
--- 192.168.2.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 1.071/2.666/3.519/1.128 ms
```

```
mininet> isp_h1 ping isp_h3
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=61 time=1.54 ms
64 bytes from 192.168.3.1: icmp_seq=2 ttl=61 time=2.42 ms
64 bytes from 192.168.3.1: icmp_seq=3 ttl=61 time=1.71 ms
^CsendInt: writing chr(3)
--- 192.168.3.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 1.547/3.064/6.569/2.050 ms
```

```
mininet> isp_h1 ping isp_h4
OPING 192.168.4.1 (192.168.4.1) 56(84) bytes of data.
64 bytes from 192.168.4.1: icmp_seq=1 ttl=61 time=2.12 ms
64 bytes from 192.168.4.1: icmp_seq=2 ttl=61 time=1.06 ms
64 bytes from 192.168.4.1: icmp_seq=3 ttl=61 time=4.41 ms
^CsendInt: writing chr(3)
--- 192.168.4.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 1.064/2.532/4.411/1.397 ms
```

```
mininet> isp_h1 ping sdn_h1
PING 10.0.100.1 (10.0.100.1) 56(84) bytes of data.
64 bytes from 10.0.100.1: icmp_seq=1 ttl=62 time=21.5 ms
64 bytes from 10.0.100.1: icmp_seq=2 ttl=62 time=1.15 ms
^CsendInt: writing chr(3)
--- 10.0.100.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 1.157/11.336/21.515/10.179 ms
```

```
mininet> isp_h2 ping sdn_h1
PING 10.0.100.1 (10.0.100.1) 56(84) bytes of data.
64 bytes from 10.0.100.1: icmp_seq=1 ttl=62 time=17.0 ms
64 bytes from 10.0.100.1: icmp_seq=2 ttl=62 time=0.670 ms
64 bytes from 10.0.100.1: icmp_seq=3 ttl=62 time=0.087 ms
^CsendInt: writing chr(3)
--- 10.0.100.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2023ms
rtt min/avg/max/mdev = 0.087/5.919/17.001/7.839 ms
```

```
mininet> isp_h3 ping sdn_h1
PING 10.0.100.1 (10.0.100.1) 56(84) bytes of data.
64 bytes from 10.0.100.1: icmp_seq=1 ttl=62 time=0.064 ms
64 bytes from 10.0.100.1: icmp_seq=2 ttl=62 time=0.232 ms
^CsendInt: writing chr(3)
--- 10.0.100.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1011ms
rtt min/avg/max/mdev = 0.064/0.148/0.232/0.084 ms
```

```
mininet> isp_h4 ping sdn_h1
PING 10.0.100.1 (10.0.100.1) 56(84) bytes of data.
64 bytes from 10.0.100.1: icmp_seq=1 ttl=62 time=0.076 ms
64 bytes from 10.0.100.1: icmp_seq=2 ttl=62 time=0.241 ms
^CsendInt: writing chr(3)
--- 10.0.100.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1031ms
rtt min/avg/max/mdev = 0.076/0.158/0.241/0.083 ms
```

```
mininet> sdn_h1 ping isp_h1
PING 192.168.1.1 (192.168.1.1) 56(84) bytes of data.
64 bytes from 192.168.1.1: icmp_seq=1 ttl=62 time=1.96 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=62 time=2.42 ms
64 bytes from 192.168.1.1: icmp_seq=3 ttl=62 time=2.37 ms
64 bytes from 192.168.1.1: icmp_seq=4 ttl=62 time=4.93 ms
^CsendInt: writing chr(3)
--- 192.168.1.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3005ms
rtt min/avg/max/mdev = 1.967/2.926/4.939/1.177 ms
```

```
mininet> sdn_h1 ping isp_h4
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=0.058 ms
64 bytes from 192.168.4.1: icmp_seq=2 ttl=62 time=0.273 ms
64 bytes from 192.168.4.1: icmp_seq=3 ttl=62 time=0.137 ms
64 bytes from 192.168.4.1: icmp_seq=4 ttl=62 time=0.210 ms
^CsendInt: writing chr(3)
--- 192.168.4.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3061ms
rtt min/avg/max/mdev = 0.058/0.169/0.273/0.081 ms
```

