topo1.py

```python
from mininet.net import Containernet
from mininet.node import RemoteController, Docker, OVSSwitch
from mininet.cli import CLI
from mininet.log import setLogLevel, info
from mininet.link import TCLink, Link



def topology():

    "Create a network with some docker containers acting as hosts."

    net = Containernet(controller=RemoteController)

    info('*** Adding switch\n')
    r1 = net.addDocker('r1', ip='172.30.1.1/24', dimage="knet/urouter:1.4")
    r2 = net.addDocker('r2', ip='172.30.2.1/24', dimage="knet/urouter:1.4")
    r3 = net.addDocker('r3', ip='172.30.3.1/24', dimage="knet/urouter:1.4")

    h1 = net.addDocker('h1', ip='172.30.1.2/24', defaultRoute='via 172.30.1.1' , dimage="knet/host-ubuntu:1-2")
    h2 = net.addDocker('h2', ip='172.30.2.2/24', defaultRoute='via 172.30.2.1' ,dimage="knet/host-ubuntu:1-2")
    h3 = net.addDocker('h3', ip='172.30.3.2/24', defaultRoute='via 172.30.3.1' ,dimage="knet/host-ubuntu:1-2")



    s3 = net.addSwitch('s3', failMode='standalone')
    s4 = net.addSwitch('s4', failMode='standalone')


    info('*** Creating links\n')

    net.addLink(h1, r1)
    net.addLink(h2, r2)
    net.addLink(h3, r3)

    net.addLink(r1, s3, params1={"ip": "10.10.10.1/24"})
    net.addLink(r2, s3, params1={"ip": "10.10.10.2/24"})
    net.addLink(r2, s4, params1={"ip": "10.20.20.1/24"})
    net.addLink(r3, s4, params1={"ip": "10.20.20.2/24"})
    info('*** Starting network\n')
    net.start()

    #copy the bird config files
    s3.cmd("sudo docker cp r1.conf mn.r1:/etc/bird.conf")
    s3.cmd("sudo docker cp r2.conf mn.r2:/etc/bird.conf")

    s4.cmd("sudo docker cp r2.conf mn.r2:/etc/bird.conf")
    s4.cmd("sudo docker cp r3.conf mn.r3:/etc/bird.conf")
```

```python

    r1.cmd("bird -c /etc/bird.conf")
    r2.cmd("bird -c /etc/bird.conf")
    r3.cmd("bird -c /etc/bird.conf")



    info('*** Running CLI\n')
    CLI(net)
    info('*** Stopping network')
    net.stop()

if __name__ == '__main__':
    setLogLevel('info')
    topology()
```

r1.conf

odlbgp > topo_TEST > r1.conf

```
log "/var/log/bird.log"  all;
debug protocols all

router id 10.10.10.1;
protocol direct {
    interface "*";
}

protocol kernel {
    learn;
    scan time 20;
    export all;
    import all;
}


protocol device {
    scan time 10;
}



#BGP Configuration


protocol bgp R2{
        export all;
        import all;
        local as 64511;
        neighbor 10.10.10.2 as 64512;
}
protocol bgp OD1{
        export all;
        import all;
        local as 64511;
        neighbor 172.17.0.1 as 64513;
}

```

r2.conf

odlbgp > topo_TEST > r2.conf

```
log "/var/log/bird.log"  all;
debug protocols all

router id 10.20.20.1;

protocol direct {
    interface "*";
}


protocol kernel {
    learn;
    scan time 20;
    export all;
    import all;
}


protocol device {
    scan time 10;
}



#BGP Configuration

protocol bgp R1{
        export all;
        import all;
        local as 64512;
        neighbor 10.10.10.1 as 64511;
}
protocol bgp R3{
        export all;
        import all;
        local as 64512;
        neighbor 10.20.20.2 as 64514;
}

```

r3.conf

```
log "/var/log/bird.log"  all;
debug protocols all

router id 10.20.20.2;

protocol direct {
    interface "*";
}


protocol kernel {
    learn;
    scan time 20;
    export all;
    import all;
}


protocol device {
    scan time 10;
}



#BGP Configuration

protocol bgp R2{
        export all;
        import all;
        local as 64514;
        neighbor 10.20.20.1 as 64512;
}

```

Run topology

sudo python3 topo1.py

```
test@test:~/Desktop/SDN_ODL/odlbgp/topo_TEST$ sudo python3 topo1.py
```

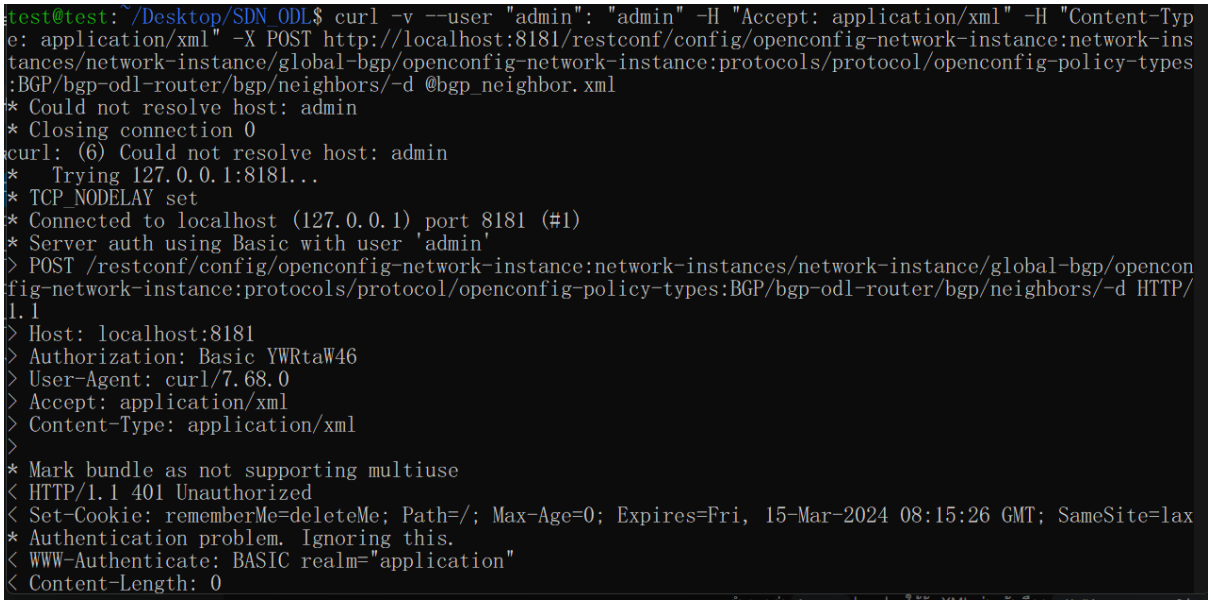
Create the ODL BGL Instance

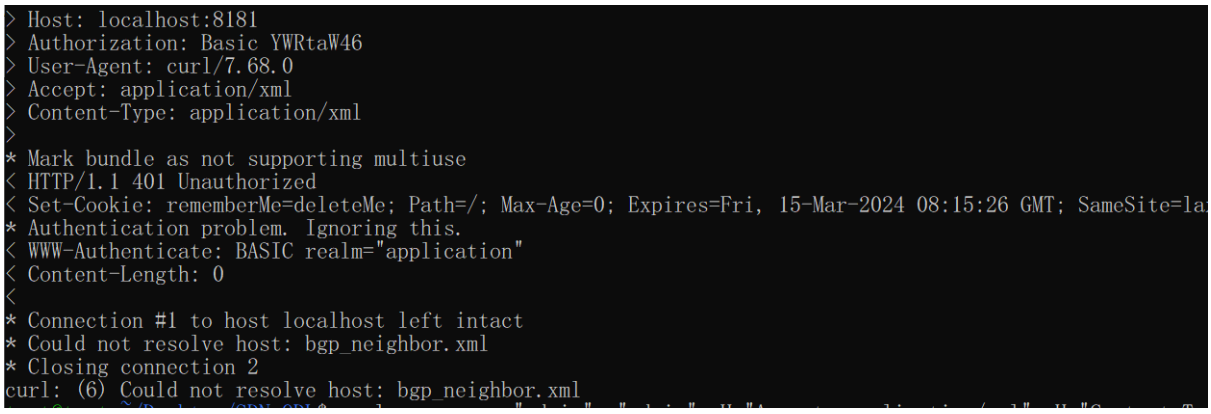
curl -v --user "admin": "admin" -H "Accept: application/xml" -H "Content-Type: application/xml" -X POST http://localhost:8181/restconf/config/openconfig-network-instance:network-instances/network-instance/global-bgp/openconfig-network-instance:protocols/-d @bgp_router.xml

```
test@test:~/Desktop/SDN_ODL$ curl -v --user "admin": "admin" -H "Accept: application/xml" -H "Content-Typ
e: application/xml" -X POST http://localhost:8181/restconf/config/openconfig-network-instance:network-ins
tances/network-instance/global-bgp/openconfig-network-instance:protocols/-d @bgp_router.xml
* Could not resolve host: admin
* Closing connection 0
curl: (6) Could not resolve host: admin
*   Trying 127.0.0.1:8181...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 8181 (#1)
* Server auth using Basic with user 'admin'
> POST /restconf/config/openconfig-network-instance:network-instances/network-instance/global-bgp/opencon
fig-network-instance:protocols/-d HTTP/1.1
> Host: localhost:8181
> Authorization: Basic YWRtaW46
> User-Agent: curl/7.68.0
> Accept: application/xml
> Content-Type: application/xml
>
* Mark bundle as not supporting multiuse
< HTTP/1.1 401 Unauthorized
< Set-Cookie: rememberMe=deleteMe; Path=/; Max-Age=0; Expires=Fri, 15-Mar-2024 08:11:07 GMT; SameSite=lax
* Authentication problem. Ignoring this.
< WWW-Authenticate: BASIC realm="application"
< Content-Length: 0
```

Create bgp neighbor

curl -v --user "admin": "admin" -H "Accept: application/xml" -H "Content-Type: application/xml" -X POST http://localhost:8181/restconf/config/openconfig-network-instance:network-instances/network-instance/global-bgp/openconfig-network-instance:protocols/protocol/openconfig-policy-types:BGP/bgp-odl-router/bgp/neighbors/-d @bgp_neighbor.xml





Verify bgp neighbor / route details

```
test@test:~/Desktop/SDN_ODL$ curl -v --user "admin": "admin" -H "Accept: application/xml" -H "Content-Typ
e: application/xml" -X PUT http://localhost:8181/restconf/config/openconfig-network-instance:network-inst
ances/network-instance/global-bgp/openconfig-network-instance:protocols/protocol/openconfig-policy-types:
BGP/bgp-odl-router/bgp/neighbors/192.168.1.10 -d @bgp_neighbor.xml
Warning: Couldn't read data from file "bgp_neighbor.xml", this makes an empty
Warning: POST.
* Could not resolve host: admin
* Closing connection 0
curl: (6) Could not resolve host: admin
*   Trying 127.0.0.1:8181...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 8181 (#1)
* Server auth using Basic with user 'admin'
> PUT /restconf/config/openconfig-network-instance:network-instances/network-instance/global-bgp/openconf
ig-network-instance:protocols/protocol/openconfig-policy-types:BGP/bgp-odl-router/bgp/neighbors/192.168.1
.10 HTTP/1.1
> Host: localhost:8181
> Authorization: Basic YWRtaW46
> User-Agent: curl/7.68.0
> Accept: application/xml
> Content-Type: application/xml
> Content-Length: 0
>
* Mark bundle as not supporting multiuse
```

```
* Server auth using Basic with user 'admin'
> PUT /restconf/config/openconfig-network-instance:network-instances/network-instance/global-bgp/openconf
ig-network-instance:protocols/protocol/openconfig-policy-types:BGP/bgp-odl-router/bgp/neighbors/192.168.1
.10 HTTP/1.1
> Host: localhost:8181
> Authorization: Basic YWRtaW46
> User-Agent: curl/7.68.0
> Accept: application/xml
> Content-Type: application/xml
> Content-Length: 0
>
* Mark bundle as not supporting multiuse
< HTTP/1.1 401 Unauthorized
< Set-Cookie: rememberMe=deleteMe; Path=/; Max-Age=0; Expires=Fri, 15-Mar-2024 08:17:21 GMT; SameSite=lax
* Authentication problem. Ignoring this.
< WWW-Authenticate: BASIC realm="application"
< Content-Length: 0
* HTTP error before end of send, stop sending
<
* Closing connection 1
test@test:~/Desktop/SDN_ODL$
```

Verify

```
containernet> links
h1-eth0<->r1-eth0 (OK OK)
h2-eth0<->r2-eth0 (OK OK)
h3-eth0<->r3-eth0 (OK OK)
r1-eth1<->s3-eth1 (OK OK)
r2-eth1<->s3-eth2 (OK OK)
r2-eth2<->s4-eth1 (OK OK)
r3-eth1<->s4-eth2 (OK OK)
```

```
containernet> nodes
available nodes are:
h1 h2 h3 r1 r2 r3 s3 s4
```

Ping Test

```
containernet> h1 ping h3
PING 172.30.3.2 (172.30.3.2) 56(84) bytes of data.
64 bytes from 172.30.3.2: icmp_seq=1 ttl=61 time=0.141 ms
64 bytes from 172.30.3.2: icmp_seq=2 ttl=61 time=0.099 ms
^C
--- 172.30.3.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1014ms
```

```
containernet> h3 ping 172.17.0.1
PING 172.17.0.1 (172.17.0.1) 56(84) bytes of data.
64 bytes from 172.17.0.1: icmp_seq=1 ttl=64 time=0.132 ms
64 bytes from 172.17.0.1: icmp_seq=2 ttl=64 time=0.085 ms
^C
--- 172.17.0.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1028ms
rtt min/avg/max/mdev = 0.085/0.108/0.132/0.025 ms
```

```
containernet> h1 traceroute h3
traceroute to 172.30.3.2 (172.30.3.2), 64 hops max
  1   172.30.1.1  0.004ms  0.054ms  0.002ms
  2   10.10.10.2  0.184ms  0.002ms  0.001ms
  3   10.20.20.2  0.001ms  0.001ms  0.001ms
  4   172.30.3.2  0.001ms  0.001ms  0.001ms
containernet>
```

```
containernet> h2 traceroute h3
traceroute to 172.30.3.2 (172.30.3.2), 64 hops max
  1   172.30.2.1  0.004ms  0.001ms  0.001ms
  2   10.20.20.2  0.190ms  0.002ms  0.001ms
  3   172.30.3.2  0.001ms  0.001ms  0.001ms
```