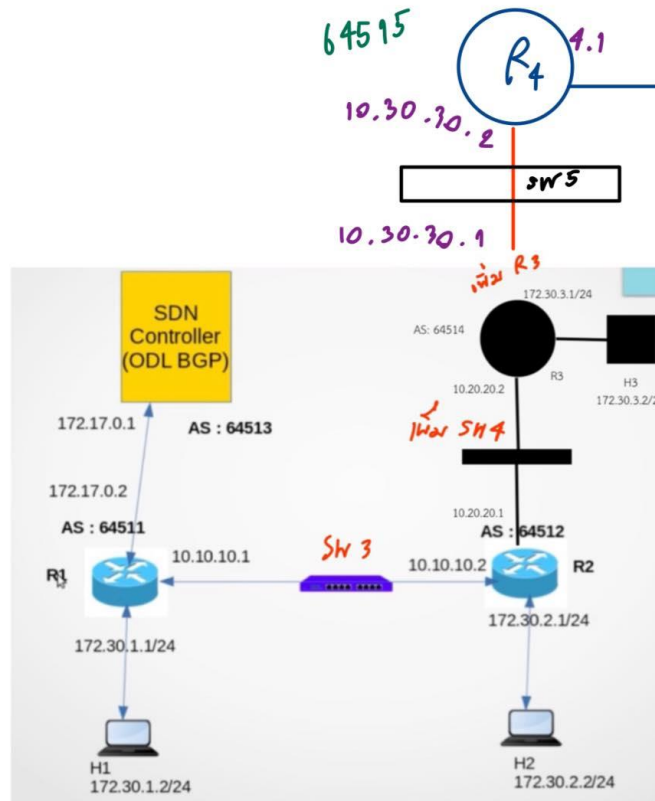


เพิ่ม R4 ต่อ จาก R3 ข้างบน



1. รัน Apache karaf

```
test@test: ~/Downloads/opendaylight-15.3.0
test@test:~/Downloads/opendaylight-15.3.0$ sudo ./bin/karaf
[sudo] password for test:
karaf: JAVA_HOME not set; results may vary
Apache Karaf starting up. Press Enter to open the shell now...
71% [=====] ]WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by com.esotericsoftware.kryo.util.UnsafeUtil (file:/home/test/Downloads/opendaylight-15.3.0/data/cache/org.eclipse.osgi/203/0/bundleFile) to constructor java.nio.DirectByteBuffer(long,int,java.lang.Object)
WARNING: Please consider reporting this to the maintainers of com.esotericsoftware.kryo.util.UnsafeUtil
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operation
WARNING: All illegal access operations will be denied in a future release
100% [=====]
Karaf started in 29s. Bundle stats: 443 active, 444 total

Hit '<tab>' for a list of available commands
and '[cmd] --help' for help on a specific command.
Hit '<ctrl-d>' or type 'system:shutdown' or 'logout' to shutdown OpenDaylight.

opendaylight-user@root>
```

2.Topo1.py

```
test@test: ~/Desktop/ODL_week9/odlbgp/add_R4-R3
test@test:~/Desktop/ODL_week9/odlbgp/add_R4-R3$ sudo python3 topo1.py
[sudo] password for test:
*** Adding switch
r1: kwargs {'ip': '172.30.1.1/24'}
r1: update resources {}
r2: kwargs {'ip': '172.30.2.1/24'}
r2: update resources {}
r3: kwargs {'ip': '172.30.3.1/24'}
r3: update resources {}
r4: kwargs {'ip': '172.30.4.1/24'}
r4: update resources {}
h1: kwargs {'ip': '172.30.1.2/24', 'defaultRoute': 'via 172.30.1.1'}
h1: update resources {}
h2: kwargs {'ip': '172.30.2.2/24', 'defaultRoute': 'via 172.30.2.1'}
h2: update resources {}
h3: kwargs {'ip': '172.30.3.2/24', 'defaultRoute': 'via 172.30.3.1'}
h3: update resources {}
h4: kwargs {'ip': '172.30.4.2/24', 'defaultRoute': 'via 172.30.4.1'}
h4: update resources {}
*** Creating links
*** Starting network
*** Configuring hosts
r1 r2 r3 r4 h1 h2 h3 h4
*** Starting controller

*** Starting 3 switches
s3 s4 s5 ...
*** Running CLI
*** Starting CLI:
containernet>
```

3. Create the ODL BGP Instance

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

```
test@test: ~/Desktop/ODL_week9/odlbgp/add_R4-R3
test@test:~/Desktop/ODL_week9/odlbgp/add_R4-R3$ curl -v --user "admin":"admin" -H "Accept: application/xml" -H "Content-Type: application/xml" -X POST http://localhost:8181/restconf/config/openconfig-network-instance:networkinstances/network-instance/global-bgp/openconfig-network-instance:protocols/ -d @bgp_router.xml
Note: Unnecessary use of -X or --request, POST is already inferred.
* Trying 127.0.0.1:8181...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 8181 (#0)
* Server auth using Basic with user 'admin'
> POST /restconf/config/openconfig-network-instance:networkinstances/network-instance/global-bgp/openconfig-network-instance:protocols/ HTTP/1.1
> Host: localhost:8181
> Authorization: Basic YWRtaW46YWRtaW4=
> User-Agent: curl/7.68.0
> Accept: application/xml
> Content-Type: application/xml
> Content-Length: 819
>
* upload completely sent off: 819 out of 819 bytes
* Mark bundle as not supporting multiuse
< HTTP/1.1 204 No Content
< Set-Cookie: JSESSIONID=node0xt0vacqskn591urw4zdyqnjah0.node0; Path=/; HttpOnly
< Expires: Thu, 01 Jan 1970 00:00:00 GMT
< Set-Cookie: rememberMe=deleteMe; Path=/; Max-Age=0; Expires=Wed, 20-Mar-2024 12:23:11 GMT; SameSite=lax
< Location: http://localhost:8181/restconf/config/openconfig-network-instance:networkinstances/openconfig-netw
```

4. verification

```
ใช้คำสั่ง curl -v -u "admin":"admin" -H "Accept: application/xml" -H "Content-Type: application/xml"
-X GET http://localhost:8181/restconf/operational/bgp-rib:bgp-rib/ | xmllint --format -
```

```
test@test: ~/Desktop/ODL_week9/odlbgp/add_R4-R3
test@test:~/Desktop/ODL_week9/odlbgp/add_R4-R3$ curl -v --user "admin":"admin" -H "Accept: application/xml" -H "Content-Type: application/xml" -X GET http://localhost:8181/restconf/operational/bgp-rib:bgp-rib/ | xmllint -format -
Note: Unnecessary use of -X or --request, GET is already inferred.
% Total    % Received % Xferd  Average Speed   Time    Time     Current
                                 Dload  Upload   Total   Spent    Left     Speed
  0     0    0     0    0     0     0      0      0 --:--:-- --:--:-- --:--:--    0*   Trying 127.0.0.1:8181...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 8181 (#0)
* Server auth using Basic with user 'admin'
> GET /restconf/operational/bgp-rib:bgp-rib/ HTTP/1.1
> Host: localhost:8181
> Authorization: Basic YWRtaW46YWRtaW4=
> User-Agent: curl/7.68.0
> Accept: application/xml
> Content-Type: application/xml
>
* Mark bundle as not supporting multiuse
< HTTP/1.1 200 OK
< Set-Cookie: JSESSIONID=node03dqnrc3z9a8cku7qt3ouf7tr1.node0; Path=/; HttpOnly
< Expires: Thu, 01 Jan 1970 00:00:00 GMT
< Set-Cookie: rememberMe=deleteMe; Path=/; Max-Age=0; Expires=Wed, 20-Mar-2024 12:25:32 GMT; SameSite=lax
< Content-Type: application/xml
< Content-Length: 642
```

5. create bgp neighbor

```
ใช้คำสั่ง curl -v -u "admin":"admin" -H "Accept: application/xml" -H "Content-Type: application/xml"
-X POST http://localhost:8181/restconf/config/openconfig-network-instance:networkinstances/network-
instance/global-bgp/openconfig-network-instance:protocols/protocol/openconfigpolicy-types:BGp/bgp-odl-
router/bgp/neighbors/ -d @bgp_neighbor.xml
```

```
test@test: ~/Desktop/ODL_week9/odlbgp/add_R4-R3
test@test:~/Desktop/ODL_week9/odlbgp/add_R4-R3$
test@test:~/Desktop/ODL_week9/odlbgp/add_R4-R3$ curl -v --user "admin":"admin" -H "Accept: application/xml" -H
"Content-Type: application/xml" -X POST http://localhost:8181/restconf/config/openconfig-network-instance:net
work-instances/network-instance/global-bgp/openconfig-network-instance:protocols/protocol/openconfig-policy-typ
es:BGP/bgp-odl-router/bgp/neighbors/ -d @bgp_neighbor.xml
Note: Unnecessary use of -X or --request, POST is already inferred.
* Trying 127.0.0.1:8181...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 8181 (#0)
* Server auth using Basic with user 'admin'
> POST /restconf/config/openconfig-network-instance:network-instances/network-instance/global-bgp/openconfig-ne
network-instance:protocols/protocol/openconfig-policy-types:BGP/bgp-odl-router/bgp/neighbors/ HTTP/1.1
> Host: localhost:8181
> Authorization: Basic YWRtaW46YWRtaW4=
> User-Agent: curl/7.68.0
> Accept: application/xml
> Content-Type: application/xml
> Content-Length: 851
>
* upload completely sent off: 851 out of 851 bytes
* Mark bundle as not supporting multiuse
< HTTP/1.1 204 No Content
< Set-Cookie: JSESSIONID=node014b7g7l4u7ehg1mvir0n5wsolm2.node0; Path=/; HttpOnly
< Expires: Thu, 01 Jan 1970 00:00:00 GMT
```

6. verify bgp neighbor/route details

ใช้คำสั่ง curl -v -u "admin":"admin" -H "Accept: application/xml" -H "Content-Type: application/xml" -X GET http://localhost:8181/restconf/operational/bgp-rib:bgp-rib/bgp-odl-router/ | xmllint --format -

```
test@test: ~/Desktop/ODL_week9/odlbgp/add_R4-R3
test@test:~/Desktop/ODL_week9/odlbgp/add_R4-R3$
test@test:~/Desktop/ODL_week9/odlbgp/add_R4-R3$ curl -v --user "admin":"admin" -H "Accept: application/xml" -H "Content-Type: application/xml" -X GET http://localhost:8181/restconf/operational/bgp-rib:bgp-rib/bgp-odl-router/ | xmllint --format -
Note: Unnecessary use of -X or --request, GET is already inferred.
% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
           Dload  Upload   Total   Spent    Left   Speed
  0     0    0     0      0     0      0      0  0*   Trying 127.0.0.1:8181...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 8181 (#0)
* Server auth using Basic with user 'admin'
> GET /restconf/operational/bgp-rib:bgp-rib/bgp-odl-router/ HTTP/1.1
> Host: localhost:8181
> Authorization: Basic YWRtaW46YWRTaW4=
> User-Agent: curl/7.68.0
> Accept: application/xml
> Content-Type: application/xml
>
* Mark bundle as not supporting multiuse
< HTTP/1.1 200 OK
< Set-Cookie: JSESSIONID=node0luw769fp93y2l11328pkd2mhmy4.node0; Path=/; HttpOnly
< Expires: Thu, 01 Jan 1970 00:00:00 GMT
< Set-Cookie: rememberMe=deleteMe; Path=/; Max-Age=0; Expires=Wed, 20-Mar-2024 12:28:04 GMT; SameSite=lax
```

7. verify the bgp portss and neighbor establishmen

7.1 r1 birdc show protocol

```
containernet> r1 birdc show protocols
BIRD 1.4.0 ready.
name      proto  table  state  since      info
direct1   Direct master  up     11:57:51
kernel1   Kernel master  up     11:57:51
device1   Device master  up     11:57:51
R2        BGP    master  up     11:57:55   Established
R3        BGP    master  start  11:57:51   Idle
R4        BGP    master  start  11:57:51   Idle
ODL       BGP    master  up     12:26:23   Established
containernet>
```

```

containernet> r2 birdc show protocols
BIRD 1.4.0 ready.
name      proto    table    state    since      info
direct1   Direct   master   up        11:57:51
kernel1   Kernel   master   up        11:57:51
device1    Device   master   up        11:57:51
R1         BGP      master   up        11:57:55   Established
R3         BGP      master   up        11:57:55   Established
R4         BGP      master   start    11:57:51   Idle
containernet>
containernet> r3 birdc show protocols
BIRD 1.4.0 ready.
name      proto    table    state    since      info
direct1   Direct   master   up        11:57:51
kernel1   Kernel   master   up        11:57:51
device1    Device   master   up        11:57:51
R2         BGP      master   up        11:57:55   Established
R1         BGP      master   start    11:57:51   Idle
R4         BGP      master   up        11:57:55   Established
containernet>
containernet> r4 birdc show protocols
BIRD 1.4.0 ready.
name      proto    table    state    since      info
direct1   Direct   master   up        11:57:51
kernel1   Kernel   master   up        11:57:51
device1    Device   master   up        11:57:51
R2         BGP      master   start    11:57:51   Idle
R1         BGP      master   start    11:57:51   Idle
R3         BGP      master   up        11:57:55   Established
containernet>

```

7.2 r1 ip route

```

containernet> r1 ip route
default via 172.17.0.1 dev eth0
10.10.10.0/24 dev r1-eth1 proto kernel scope link src 10.10.10.1
10.20.20.0/24 via 10.10.10.2 dev r1-eth1 proto bird
10.30.30.0/24 via 10.10.10.2 dev r1-eth1 proto bird
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.2
172.30.1.0/24 dev r1-eth0 proto kernel scope link src 172.30.1.1
172.30.2.0/24 via 10.10.10.2 dev r1-eth1 proto bird
172.30.3.0/24 via 10.10.10.2 dev r1-eth1 proto bird
172.30.4.0/24 via 10.10.10.2 dev r1-eth1 proto bird
containernet>

```

```

containernet> r2 ip route
default via 172.17.0.1 dev eth0
10.10.10.0/24 dev r2-eth1 proto kernel scope link src 10.10.10.2
10.20.20.0/24 dev r2-eth2 proto kernel scope link src 10.20.20.1
10.30.30.0/24 via 10.20.20.2 dev r2-eth2 proto bird
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.3
172.30.1.0/24 via 10.10.10.1 dev r2-eth1 proto bird
172.30.2.0/24 dev r2-eth0 proto kernel scope link src 172.30.2.1
172.30.3.0/24 via 10.20.20.2 dev r2-eth2 proto bird
172.30.4.0/24 via 10.20.20.2 dev r2-eth2 proto bird
containernet>

```

```

containernet> r3 ip route
default via 172.17.0.1 dev eth0
10.10.10.0/24 via 10.20.20.1 dev r3-eth1 proto bird
10.20.20.0/24 dev r3-eth1 proto kernel scope link src 10.20.20.2
10.30.30.0/24 dev r3-eth2 proto kernel scope link src 10.30.30.1
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.4
172.30.1.0/24 via 10.20.20.1 dev r3-eth1 proto bird
172.30.2.0/24 via 10.20.20.1 dev r3-eth1 proto bird
172.30.3.0/24 dev r3-eth0 proto kernel scope link src 172.30.3.1
172.30.4.0/24 via 10.30.30.2 dev r3-eth2 proto bird
containernet>

```

```

containernet> r4 ip route
default via 172.17.0.1 dev eth0
10.10.10.0/24 via 10.30.30.1 dev r4-eth1 proto bird
10.20.20.0/24 via 10.30.30.1 dev r4-eth1 proto bird
10.30.30.0/24 dev r4-eth1 proto kernel scope link src 10.30.30.2
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.5
172.30.1.0/24 via 10.30.30.1 dev r4-eth1 proto bird
172.30.2.0/24 via 10.30.30.1 dev r4-eth1 proto bird
172.30.3.0/24 via 10.30.30.1 dev r4-eth1 proto bird
172.30.4.0/24 dev r4-eth0 proto kernel scope link src 172.30.4.1
containernet>

```

8. Check แต่ละ Host ว่า ping หากันเจอ

```

containernet> h1 ping h2
PING 172.30.2.2 (172.30.2.2) 56(84) bytes of data.
64 bytes from 172.30.2.2: icmp_seq=1 ttl=62 time=0.147 ms
64 bytes from 172.30.2.2: icmp_seq=2 ttl=62 time=0.053 ms
^C
--- 172.30.2.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1024ms
rtt min/avg/max/mdev = 0.053/0.100/0.147/0.047 ms
containernet>

```

```

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=0.327 ms
64 bytes from 172.30.3.2: icmp_seq=2 ttl=61 time=0.062 ms
^C
--- 172.30.3.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1015ms
rtt min/avg/max/mdev = 0.062/0.194/0.327/0.133 ms
containernet>

```

```

containernet> h1 ping h4
PING 172.30.4.2 (172.30.4.2) 56(84) bytes of data.
64 bytes from 172.30.4.2: icmp_seq=1 ttl=60 time=0.248 ms
64 bytes from 172.30.4.2: icmp_seq=2 ttl=60 time=0.064 ms
^C
--- 172.30.4.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1019ms
rtt min/avg/max/mdev = 0.064/0.156/0.248/0.092 ms
containernet>

```

สามารถ ping ไปที่ 172.17.0.1

```

containernet>
containernet> h4 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=0.055 ms
64 bytes from 172.17.0.1: icmp_seq=2 ttl=64 time=0.026 ms
^C
--- 172.17.0.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1004ms
rtt min/avg/max/mdev = 0.026/0.040/0.055/0.015 ms
containernet>

```


Check traceroute

```
containernet>
containernet> h1 traceroute h2
traceroute to 172.30.2.2 (172.30.2.2), 64 hops max
 1  172.30.1.1  0.002ms  0.002ms  0.001ms
 2  10.10.10.2  0.516ms  0.001ms  0.000ms
 3  172.30.2.2  0.002ms  0.000ms  0.002ms
containernet>
```

```
containernet>
containernet> h1 traceroute h3
traceroute to 172.30.3.2 (172.30.3.2), 64 hops max
 1  172.30.1.1  0.003ms  0.001ms  0.001ms
 2  10.10.10.2  0.180ms  0.002ms  0.001ms
 3  10.20.20.2  0.002ms  0.001ms  0.001ms
 4  172.30.3.2  0.001ms  0.001ms  0.001ms
containernet>
```

```
containernet>
containernet> h1 traceroute h4
traceroute to 172.30.4.2 (172.30.4.2), 64 hops max
 1  172.30.1.1  0.002ms  0.001ms  0.002ms
 2  10.10.10.2  0.002ms  0.002ms  0.002ms
 3  10.20.20.2  0.002ms  0.000ms  0.002ms
 4  10.30.30.2  0.001ms  0.001ms  0.002ms
 5  172.30.4.2  0.002ms  0.002ms  0.002ms
containernet>
```

```
containernet>
containernet> h1 traceroute 127.17.0.1
traceroute to 127.17.0.1 (127.17.0.1), 64 hops max
 1  127.17.0.1  0.002ms  0.001ms  0.001ms
containernet>
containernet> h2 traceroute 127.17.0.1
traceroute to 127.17.0.1 (127.17.0.1), 64 hops max
 1  127.17.0.1  0.001ms  0.001ms  0.001ms
containernet>
containernet> h3 traceroute 127.17.0.1
traceroute to 127.17.0.1 (127.17.0.1), 64 hops max
 1  127.17.0.1  0.002ms  0.001ms  0.001ms
containernet>
containernet> h4 traceroute 127.17.0.1
traceroute to 127.17.0.1 (127.17.0.1), 64 hops max
 1  127.17.0.1  0.002ms  0.001ms  0.000ms
containernet>
containernet>
```

```
containernet>
containernet> links
h1-eth0<->r1-eth0 (OK OK)
h2-eth0<->r2-eth0 (OK OK)
h3-eth0<->r3-eth0 (OK OK)
h4-eth0<->r4-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)
r3-eth2<->s5-eth1 (OK OK)
r4-eth1<->s5-eth2 (OK OK)
containernet>
```

9. Destop the test (Delete the BGP)

ใช้คำสั่ง `curl -v -u "admin":"admin" -H "Accept: application/xml" -H "Content-Type: application/xml" -X DELETE 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/ODL_week9/odlbgp/add_R4-R3
test@test:~/Desktop/ODL_week9/odlbgp/add_R4-R3$ curl -v --user "admin":"admin" -H "Accept: application/xml" -H "Content-Type: application/xml" -X DELETE http://localhost:8181/restconf/config/openconfig-network-instance:network-instances/network-instance/global-bgp/openconfig-network-instance:protocols/ -d @bgp_router.xml
* Trying 127.0.0.1:8181...
* TCP_NODELAY set
* Connected to localhost (127.0.0.1) port 8181 (#0)
* Server auth using Basic with user 'admin'
> DELETE /restconf/config/openconfig-network-instance:network-instances/network-instance/global-bgp/openconfig-network-instance:protocols/ HTTP/1.1
> Host: localhost:8181
> Authorization: Basic YWRtaW46YWRtaW4=
> User-Agent: curl/7.68.0
> Accept: application/xml
> Content-Type: application/xml
> Content-Length: 819
>
* upload completely sent off: 819 out of 819 bytes
* Mark bundle as not supporting multiuse
< HTTP/1.1 200 OK
< Set-Cookie: JSESSIONID=node0lugid75sj2r45142oip612yyaa5.node0; Path=/; HttpOnly
< Expires: Thu, 01 Jan 1970 00:00:00 GMT
< Set-Cookie: rememberMe=deleteMe; Path=/; Max-Age=0; Expires=Wed, 20-Mar-2024 12:39:24 GMT; SameSite=lax
< Content-Length: 0
```

10. Check หลังลบ BGP ออก

Interrupt มีการขัดจังหวะหรือหยุดลง อาจจะ

H1 ping h1

Code

Topo1.py

```
Open  [icon] topo1.py ~/Desktop/ODL_week9/odlbgp/add_R4-R3 Save [icon]

1 from mininet.net import Containernet
2 from mininet.node import RemoteController, Docker, OVSSwitch
3 from mininet.cli import CLI
4 from mininet.log import setLogLevel, info
5 from mininet.link import TCLink, Link
6
7 # topo diagram
8 # h1---r1---s3---r2-----h2
9
10
11 def topology():
12
13     "Create a network with some docker containers acting as hosts."
14
15     net = Containernet(controller=RemoteController)
16
17     info('*** Adding switch\n')
18
19     #add r
20     r1 = net.addDocker('r1', ip='172.30.1.1/24', dimage="knet/urouter:1.4")
21     r2 = net.addDocker('r2', ip='172.30.2.1/24', dimage="knet/urouter:1.4")
22     r3 = net.addDocker('r3', ip='172.30.3.1/24', dimage="knet/urouter:1.4")
23     r4 = net.addDocker('r4', ip='172.30.4.1/24', dimage="knet/urouter:1.4")
24
25     #add h
26     h1 = net.addDocker('h1', ip='172.30.1.2/24', defaultRoute='via 172.30.1.1', dimage="knet/host-ubuntu:1-2")
27     h2 = net.addDocker('h2', ip='172.30.2.2/24', defaultRoute='via 172.30.2.1', dimage="knet/host-ubuntu:1-2")
28     h3 = net.addDocker('h3', ip='172.30.3.2/24', defaultRoute='via 172.30.3.1', dimage="knet/host-ubuntu:1-2")
29     h4 = net.addDocker('h4', ip='172.30.4.2/24', defaultRoute='via 172.30.4.1', dimage="knet/host-ubuntu:1-2")
30
31
32     #add sw
33     s3 = net.addSwitch('s3', failMode='standalone')
34     s4 = net.addSwitch('s4', failMode='standalone')
35     s5 = net.addSwitch('s5', failMode='standalone')
36
37     info('*** Creating links\n')
```

```
Open  [icon] topo1.py ~/Desktop/ODL_week9/odlbgp
36
37     info('*** Creating links\n')
38
39     #add h - r
40     net.addLink(h1, r1)
41     net.addLink(h2, r2)
42     net.addLink(h3, r3)
43     net.addLink(h4, r4)
44
45     #add r - sw
46     net.addLink(r1, s3, params1={"ip": "10.10.10.1/24"})
47     net.addLink(r2, s3, params1={"ip": "10.10.10.2/24"})
48     net.addLink(r2, s4, params1={"ip": "10.20.20.1/24"})
49     net.addLink(r3, s4, params1={"ip": "10.20.20.2/24"})
50
51     net.addLink(r3, s5, params1={"ip": "10.30.30.1/24"})
52     net.addLink(r4, s5, params1={"ip": "10.30.30.2/24"})
53
54
55
56
57     info('*** Starting network\n')
58     net.start()
59
60     #copy the bird config files
61     s3.cmd("sudo docker cp r1.conf mn.r1:/etc/bird.conf")
62     s3.cmd("sudo docker cp r2.conf mn.r2:/etc/bird.conf")
63     s3.cmd("sudo docker cp r3.conf mn.r3:/etc/bird.conf")
64     s3.cmd("sudo docker cp r4.conf mn.r4:/etc/bird.conf")
65
66     s4.cmd("sudo docker cp r1.conf mn.r1:/etc/bird.conf")
67     s4.cmd("sudo docker cp r2.conf mn.r2:/etc/bird.conf")
68     s4.cmd("sudo docker cp r3.conf mn.r3:/etc/bird.conf")
69     s4.cmd("sudo docker cp r4.conf mn.r4:/etc/bird.conf")
70
```

```

70
71
72     #add r
73     r1.cmd("bird -c /etc/bird.conf")
74     r2.cmd("bird -c /etc/bird.conf")
75     r3.cmd("bird -c /etc/bird.conf")
76     r4.cmd("bird -c /etc/bird.conf")
77
78
79     info('*** Running CLI\n')
80     CLI(net)
81     info('*** Stopping network')
82     net.stop()
83
84 if __name__ == '__main__':
85     setLogLevel('info')
86     topology()

```

R1.conf

```

Open ▼ [+]
```

```

1 log "/var/log/bird.log" all;
2 debug protocols all
3
4 router id 10.10.10.1;
5 protocol direct {
6     interface "*";
7 }
8
9 protocol kernel {
10     learn;
11     scan time 20;
12     export all;
13     import all;
14 }
15
16
17 protocol device {
18     scan time 10;
19 }
20
21
22
23 #BGP Configuration
24
25 protocol bgp R2{
26     export all;
27     import all;
28     local as 64511;
29     neighbor 10.10.10.2 as 64512;
30 }
31
32 protocol bgp R3{
33     export all;
34     import all;
35     local as 64511;
36     neighbor 10.20.20.2 as 64514;
37 }

```

```

37 }
38
39 protocol bgp R4{
40     export all;
41     import all;
42     local as 64511;
43     neighbor 10.30.30.2 as 64515;
44 }
45
46 protocol bgp ODl{
47     export all;
48     import all;
49     local as 64511;
50     neighbor 172.17.0.1 as 64513;
51 }

```

R2.conf

```

Open ▼ [🔍]
1 log "/var/log/bird.log" all;
2 debug protocols all
3
4 router id 10.10.10.2;
5 protocol direct {
6     interface "*";
7 }
8
9
10 protocol kernel {
11     learn;
12     scan time 20;
13     export all;
14     import all;
15 }
16
17
18 protocol device {
19     scan time 10;
20 }
21
22
23
24 #BGP Configuration
25
26 protocol bgp R1{
27     export all;
28     import all;
29     local as 64512;
30     neighbor 10.10.10.1 as 64511;
31 }
32
33 protocol bgp R3{
34     export all;
35     import all;
36     local as 64512;
37     neighbor 10.20.20.2 as 64514;

```

```

37     neighbor 10.20.20.2 as 64514;
38 }
39
40 protocol bgp R4{
41     export all;
42     import all;
43     local as 64512;
44     neighbor 10.30.30.2 as 64515;
45 }
46

```

R3.conf

```

1 log "/var/log/bird.log" all;
2 debug protocols all
3
4 router id 10.20.20.2;
5 protocol direct {
6     interface "*";
7 }
8
9
10 protocol kernel {
11     learn;
12     scan time 20;
13     export all;
14     import all;
15 }
16
17
18 protocol device {
19     scan time 10;
20 }
21
22
23
24 #BGP Configuration
25
26 protocol bgp R2{
27     export all;
28     import all;
29     local as 64514;
30     neighbor 10.20.20.1 as 64512;
31 }
32
33 protocol bgp R1{
34     export all;
35     import all;
36     local as 64514;
37     neighbor 10.10.10.1 as 64511;
38 }
39
40 protocol bgp R4{
41     export all;
42     import all;
43     local as 64514;
44     neighbor 10.30.30.2 as 64515;
45 }

```

R4.conf

```
1 log "/var/log/bird.log" all;
2 debug protocols all
3
4 router id 10.30.30.2;
5 protocol direct {
6     interface "*";
7 }
8
9
10 protocol kernel {
11     learn;
12     scan time 20;
13     export all;
14     import all;
15 }
16
17
18 protocol device {
19     scan time 10;
20 }
21
22
23
24 #BGP Configuration
25
26 protocol bgp R2{
27     export all;
28     import all;
29     local as 64515;
30     neighbor 10.20.20.1 as 64512;
31 }
32
33 protocol bgp R1{
34     export all;
35     import all;
36     local as 64515;
37     neighbor 10.10.10.1 as 64511;
38 }
39
40 protocol bgp R3{
41     export all;
42     import all;
43     local as 64515;
44     neighbor 10.30.30.1 as 64514;
45 }
46
```