OSPF and ECMP

```
==========================================================
```
Need of Routing
```
==========================================================
```

Need of Routing
+++++++++++++++++++++

10 to 30 pc can be handled by switch
Switch occurs MAC address table
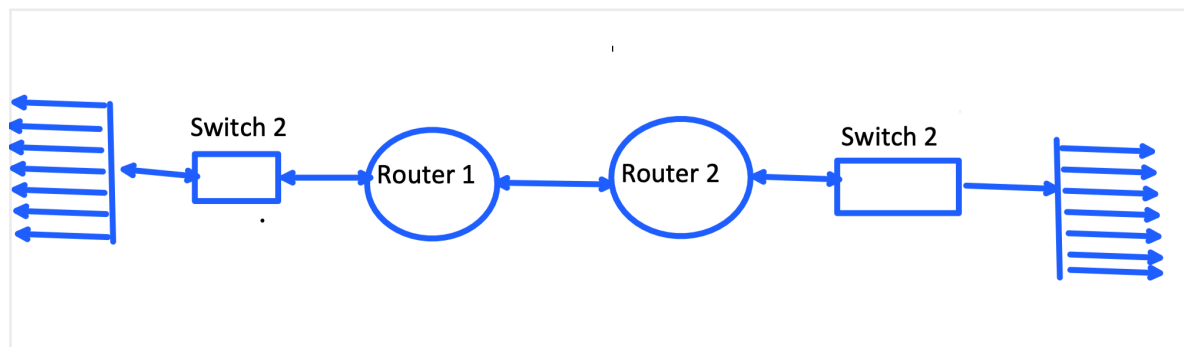Switch occurs broadcast problem, and all network down .
Switch takes time to process, MAC address lookup

So
We introduce router
But if more than 50 , 100 , 10000, need router
Like MAC address table , router have MAC address table


```
==========================================================
```
Static vs Dynamic Routing
```
==========================================================
```

Static vs Dynamic Routing
+++++++++++++++++++++

LAB 1——— STATIC ROUTING and default route
——————————————

1. Configure IP address on R1 and R2 as shown in figure
2. Ping from R1 to R2 , do u have replay ? Then ping from destination network , you have a replay? Why not?
3. Configure a static route from R1 to the network on R2
4. Ping from R1 to the network of R2. Do u have a replay? Why not?
5. Make a default static route from R2 to the network of R1.
6. Ping from R1 to the network of R2. Do u have a replay and why?
7. LAN2 must reachable LAN1 vice versa.
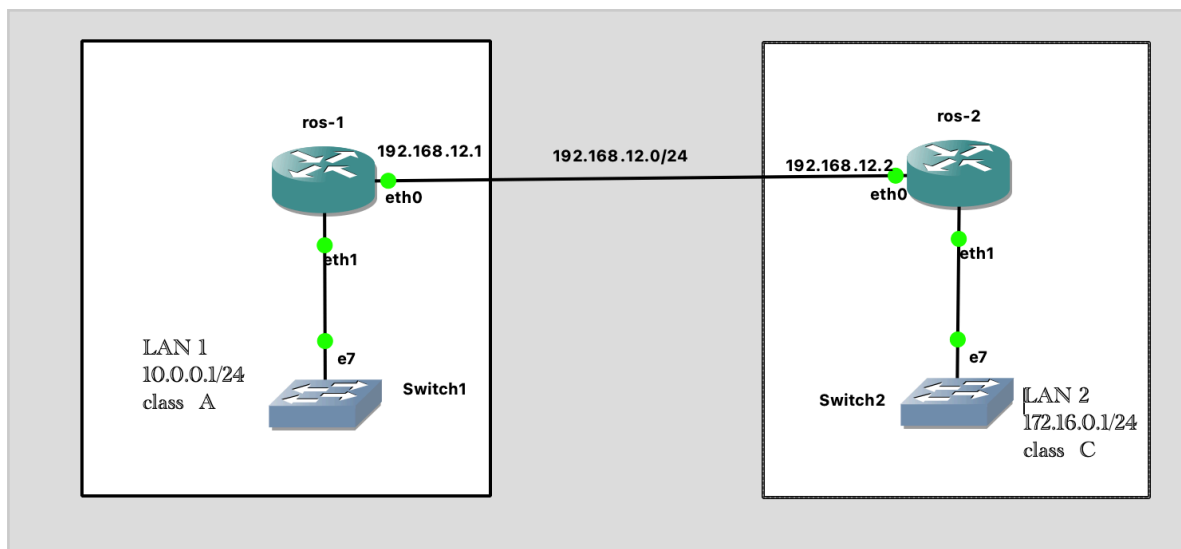
Configure IP address on R1 and R2 as shown in figure
****

```
[admin@MikroTik] > system identity set name=ROS1
[admin@ROS1] >
```

```
[admin@MikroTik] > system identity set name=ROS2
[admin@ROS2] >
```

```
[admin@ROS1] > ip dhcp-client print
[admin@ROS1] > ip dhcp-client remove numbers=0
```

/ip address
add **address**=192.168.12.1/24 **interface**=ether1 network=192.168.12.0
      //WAN1
add **address**=10.0.0.1/24 **interface**=ether2 network=10.0.0.0
      //LAN1

/ip address
add **address**=192.168.12.2/24 **interface**=ether1 network=192.168.12.0
      /WAN2
add **address**=172.16.0.1/24 **interface**=ether2 network=172.16.0.0
      /LAN2

Ping from R1 to R2 , do u have replay ? Then ping from destination network ,
you have a replay? Why not?
****

[admin@ROS1] > ping 192.168.12.1   //ROS1
ping gateway
  SEQ HOST   **SIZE TTL TIME STATUS**
   0 192.168.12.1   56 64 5ms
   1 192.168.12.1   56 64 3ms
   2 192.168.12.1   56 64 1ms

[admin@ROS1] > ping 192.168.12.2   //
ROS2 ping   another ROS2
  SEQ HOST   **SIZE TTL TIME STATUS**
   0 192.168.12.2   56 64 1ms
   1 192.168.12.2   56 64 2ms
   2 192.168.12.2   56 64 2ms

[admin@ROS1] > ping 10.0.0.1   //
ROS1 ping same LAN1

```
 SEQ HOST                      SIZE TTL TIME  STATUS
   0 10.0.0.1                    56  64 7ms
   1 10.0.0.1                    56  64 2ms
   sent=2 received=2 packet-loss=0% min-rtt=2ms avg-rtt=4ms max-rtt=7ms
```

[admin@ROS1] > ping 172.16.0.1   ////
ROS1 ping ROS2 LAN2
```
 SEQ HOST                      SIZE TTL TIME  STATUS
   0                                     no route to host
   1                                     no route to host
   sent=2 received=0 packet-loss=100%
```

[admin@ROS2] > ping 192.168.12.2
```
 SEQ HOST                      SIZE TTL TIME  STATUS
   0 192.168.12.2                56  64 3ms
   1 192.168.12.2                56  64 1ms
   sent=2 received=2 packet-loss=0% min-rtt=1ms avg-rtt=2ms max-rtt=3ms
```

[admin@ROS2] > ping 192.168.12.1
```
 SEQ HOST                      SIZE TTL TIME  STATUS
   0 192.168.12.1                56  64 3ms
   1 192.168.12.1                56  64 2ms
   2 192.168.12.1                56  64 3ms
   sent=3 received=3 packet-loss=0% min-rtt=2ms avg-rtt=2ms max-rtt=3ms
```

[admin@ROS2] > ping 172.16.0.1
```
 SEQ HOST                      SIZE TTL TIME  STATUS
   0 172.16.0.1                  56  64 9ms
   1 172.16.0.1                  56  64 2ms
   sent=2 received=2 packet-loss=0% min-rtt=2ms avg-rtt=5ms max-rtt=9ms
```

```
[admin@ROS1] > ip route print
Flags: X – disabled, A – active, D – dynamic,
C – connect, S – static, r – rip, b – bgp, o – ospf, m – mme,
B – blackhole, U – unreachable, P – prohibit
 #   DST-ADDRESS      PREF-SRC      GATEWAY        DISTANCE
 0 A S  0.0.0.0/0                    192.168.12.2         1
 1 ADC  10.0.0.0/24      10.0.0.1     ether2            0
 2 A S  172.16.0.0/24                192.168.12.2         1
 3 ADC  192.168.12.0/24   192.168.12.1   ether1          0
```

```
[admin@ROS2] > ip route print
Flags: X – disabled, A – active, D – dynamic,
C – connect, S – static, r – rip, b – bgp, o – ospf, m – mme,
B – blackhole, U – unreachable, P – prohibit
 #   DST-ADDRESS      PREF-SRC      GATEWAY        DISTANCE
 0 A S  0.0.0.0/0                    192.168.12.1         1
 1 A S  10.0.0.0/24                 192.168.12.1         1
 2 ADC  172.16.0.0/24    172.16.0.1    ether2            0
 3 ADC  192.168.12.0/24   192.168.12.2   ether1          0
```

Configure a static route from R1 to the network on R2
****

[admin@ROS1] > ip route add dst-address=172.16.0.0/24
gateway=192.168.12.2   //LAN2 is in R1

[admin@ROS1] > ping 172.16.0.1
```
  SEQ HOST                       SIZE TTL TIME  STATUS
    0 172.16.0.1                   56  64 2ms
    1 172.16.0.1                   56  64 1ms
    2 172.16.0.1                   56  64 0ms
    sent=3 received=3 packet-loss=0% min-rtt=0ms avg-rtt=1ms max-rtt=2ms
```


[admin@ROS1] > ping 172.16.0.1 src-
address=10.0.0.1   //not resolved
```
  SEQ HOST                       SIZE TTL TIME  STATUS
    0 172.16.0.1                              timeout
    1 172.16.0.1                              timeout
    sent=2 received=0 packet-loss=100%
```


Configure a static route from R2to the network on R1
****
[admin@ROS2] > ip route add dst-address=10.0.0.0/24 gateway=192.168.12.1
     //LAN1is in R2

[admin@ROS1] > ping 172.16.0.1 src-address=10.0.0.1
     //resolved
```
  SEQ HOST                       SIZE TTL TIME  STATUS
    0 172.16.0.1                   56  64 1ms
    1 172.16.0.1                   56  64 1ms
    2 172.16.0.1                   56  64 1ms
    sent=3 received=3 packet-loss=0% min-rtt=1ms avg-rtt=1ms max-rtt=1ms
```


[admin@ROS2] > ping 10.0.0.1 src-address=172.16.0.1
```
  SEQ HOST                       SIZE TTL TIME  STATUS
    0 10.0.0.1                     56  64 2ms
    1 10.0.0.1                     56  64 1ms
    2 10.0.0.1                     56  64 1ms
    sent=3 received=3 packet-loss=0% min-rtt=1ms avg-rtt=1ms max-rtt=2ms
```

Make a default static route from R2 to the network of R1. A and vice versa.........
Internet reachable
****

[admin@ROS2] > ip route add dst-address=0.0.0.0/0 gateway=192.168.12.1

[admin@ROS1] > ip route add dst-address=0.0.0.0/0 gateway=192.168.12.2

Export
***
/ip address
add **address**=192.168.12.1/24 **interface**=ether1 network=192.168.12.0
add **address**=10.0.0.1/24 **interface**=ether2 network=10.0.0.0
/ip dhcp-client
add disabled=no **interface**=ether1
/ip route
add distance=1 gateway=192.168.12.2
add distance=1 dst-address=172.16.0.0/24 gateway=192.168.12.2
/system identity
set name=ROS1

interface wireless security-profiles
set [find **default**=yes] supplicant-identity=MikroTik
/ip address
add **address**=192.168.12.2/24 **interface**=ether1 network=192.168.12.0

add **address**=172.16.0.1/24 **interface**=ether2 network=172.16.0.0
/ip dhcp-client
add disabled=no **interface**=ether1
/ip route
add distance=1 dst-address=10.0.0.0/24 gateway=192.168.12.1
/system identity
set name=ROS2
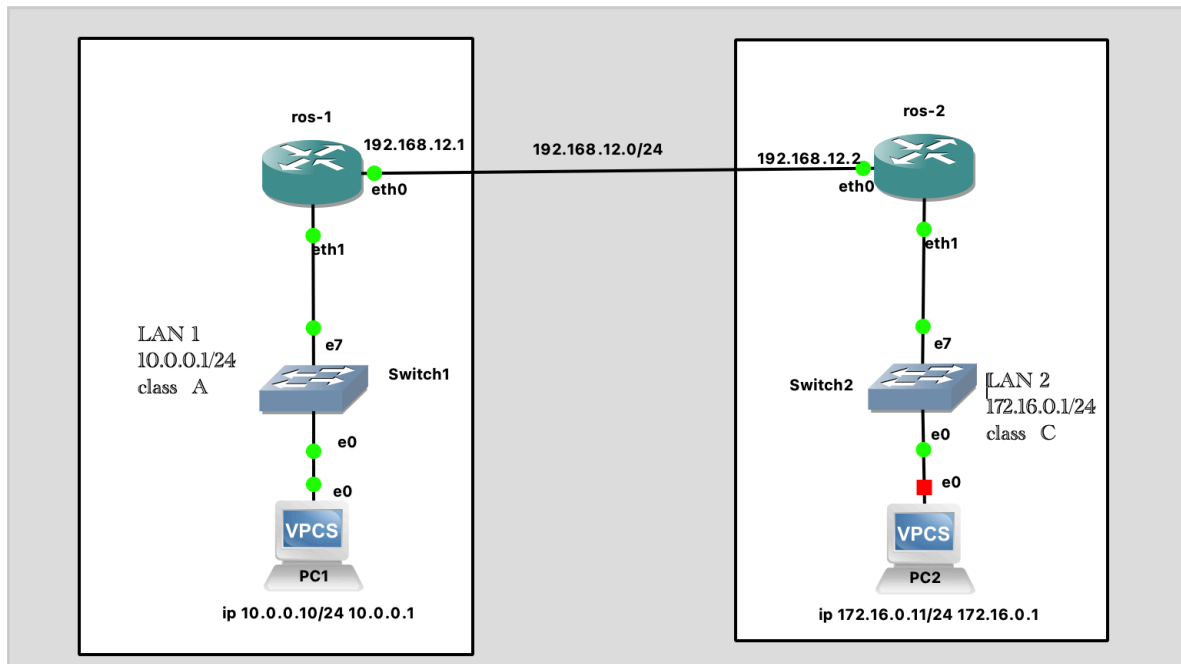
[admin@ROS2] > ping 10.0.0.10

SEQ HOST	SIZE	TTL	TIME	STATUS
0 10.0.0.10	56	63	850ms	
1 10.0.0.10	56	63	1ms	
2 10.0.0.10	56	63	1ms	

[admin@ROS1] > ping 172.16.0.11

SEQ HOST	SIZE	TTL	TIME	STATUS
0 172.16.0.11	56	63	1ms	

```
1 172.16.0.11                    56  63 3ms
2 172.16.0.11                    56  63 1ms
```

****
*
LAB2: working with 3 routes in different lan
****
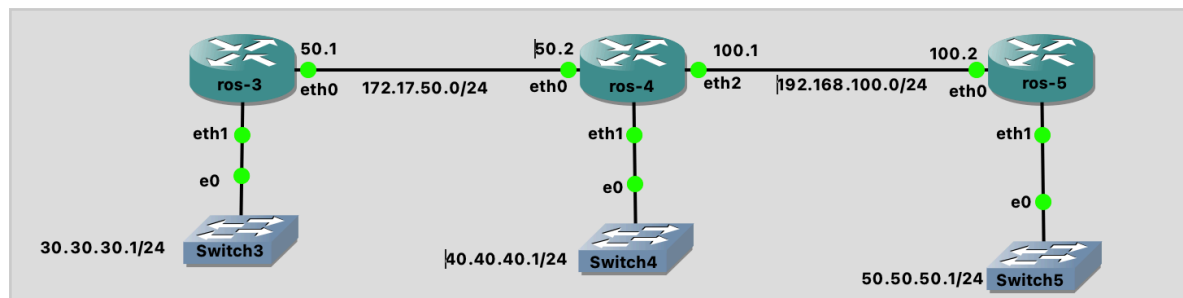
/ip address
add **address**=172.17.50.1/24 **interface**=ether1 network=172.17.50.0
add **address**=30.30.30.1/24 **interface**=ether2 network=30.30.30.0
/ip dhcp-client
add disabled=no **interface**=ether1
/ip route
add distance=1 dst-address=40.40.40.0/24 gateway=172.17.50.2
/system identity
set name=ROS3

/interface wireless security-profiles
set [find **default**=yes] supplicant-identity=MikroTik
/ip address
add **address**=172.17.50.2/24 **interface**=ether1 network=172.17.50.0

```
add address=40.40.40.1/24 interface=ether2 network=40.40.40.0
add address=192.168.100.1/24 interface=ether3 network=192.168.100.0
/ip dhcp-client
add disabled=no interface=ether1
/ip route
add distance=1 dst-address=30.30.30.0/24 gateway=172.17.50.1
add distance=1 dst-address=50.50.50.0/24 gateway=192.168.100.2
/system identity
set name=ROS4
```

```
/interface wireless security-profiles
set [ find default=yes ] supplicant-identity=MikroTik
/ip address
add address=192.168.100.2/24 interface=ether1 network=192.168.100.0
add address=50.50.50.1/24 interface=ether2 network=50.50.50.0
/ip dhcp-client
add disabled=no interface=ether1
/ip route
add distance=1 dst-address=40.40.40.0/24 gateway=192.168.100.1
/system identity
set name=ROS5
```

Now ping from ROS 3 and 5 , ass well as theirs LAN
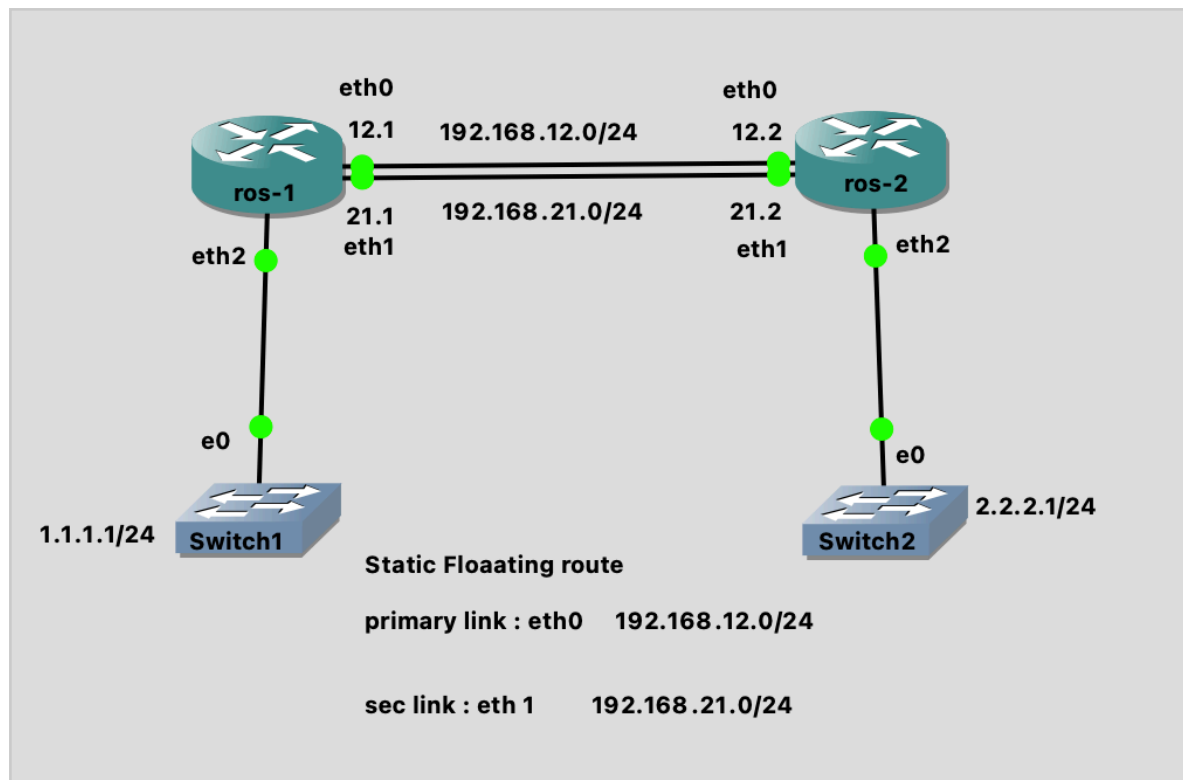BOOM — NO

==
Static Floating Route
==

[admin@MikroTik] > system identity set name=ROS2
[admin@ROS2] >

[admin@MikroTik] > system identity set name=ROS1
[admin@ROS1] >

[admin@ROS1] > ip address add **interface**=ether1 **address**=192.168.12.1/24
[admin@ROS1] > ip address add **interface**=ether2 **address**=192.168.21.1/24

eth0
12.1   **192.168.12.0/24**

eth0
12.2

ros-1

ros-2

21.1   **192.168.21.0/24**

21.2

eth2

eth1

eth1

eth2

e0

e0

1.1.1.1/24   Switch1

2.2.2.1/24

Switch2

Static Floaating route

primary link : eth0   192.168.12.0/24

sec link : eth 1   192.168.21.0/24

[admin@ROS2] > ip address add **interface**=ether1 **address**=192.168.12.2/24
[admin@ROS2] > ip address add **interface**=ether2 **address**=192.168.21.2/24

[admin@ROS1] > ip address add **interface**=ether3 **address**=1.1.1.1/24
[admin@ROS2] > ip address add **address**=2.2.2.1/24 **interface**=ether3

[admin@ROS2] > ip route add dst-address=1.1.1.0/24 gateway=192.168.12.1
[admin@ROS2] > ip route add dst-address=1.1.1.0/24 gateway=192.168.21.1

[admin@ROS2] > ip route print
Flags: **X** – disabled, **A** – active, **D** – dynamic,
C – connect, **S** – static, **r** – rip, **b** – bgp, **o** – ospf, **m** – mme,
B – blackhole, **U** – unreachable, **P** – prohibit

```
#    DST-ADDRESS        PREF-SRC       GATEWAY        DISTANCE
0 A S  1.1.1.0/24                192.168.21.1         1
1   S  1.1.1.0/24                192.168.12.1
1                               //ECMP, one link down backup
2 ADC  192.168.12.0/24  192.168.12.2   ether1            0
3 ADC  192.168.21.0/24  192.168.21.2   ether2            0
```

[admin@ROS1] > ip route add dst-address=2.2.2.0/24 gateway=192.168.12.2
[admin@ROS1] > ip route add dst-address=2.2.2.0/24 gateway=192.168.21.2
[admin@ROS1] > ip route print
Flags: **X** – disabled, **A** – active, **D** – dynamic,
C – connect, **S** – static, **r** – rip, **b** – bgp, **o** – ospf, **m** – mme,
B – blackhole, **U** – unreachable, **P** – prohibit

```
#    DST-ADDRESS       PREF-SRC       GATEWAY        DISTANCE
0 A S  2.2.2.0/24               192.168.12.2         1
1   S  2.2.2.0/24               192.168.21.2         1                    //
ECMP, one link down backup
2 ADC  192.168.12.0/24  192.168.12.1   ether1            0
3 ADC  192.168.21.0/24  192.168.21.1   ether2            0
```

[admin@ROS1] > ping 2.2.2.1 src-address=1.1.1.1
```
 SEQ HOST                  SIZE TTL TIME  STATUS
  0 2.2.2.1                 56  64 16ms
  1 2.2.2.1                 56  64 4ms
  2 2.2.2.1                 56  64 4ms
```

[admin@ROS2] > ping 1.1.1.1 src-address=2.2.2.1
```
 SEQ HOST                  SIZE TTL TIME  STATUS
  0 1.1.1.1                 56  64 6ms
  1 1.1.1.1                 56  64 13ms
  2 1.1.1.1                 56  64 2ms
```

Now check administrative distance

Route <0.0.0.0/0>

General | Attributes

Dst. Address: 0.0.0.0/0

Gateway: 192.168.1.1

Check Gateway:

Type: unicast

Distance: 1

Scope: 30
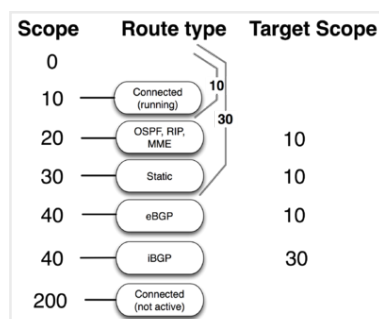
Target Scope: 10

Routing Mark:

Pref. Source:

Route List

Routes | Nexthops | Rules | VRF

Find | all

	Dst. Address	Gateway	Distance
DAC	▶ 1.1.1.1	bridge1 reachable	0
DAo	▶ 2.2.2.2	12.12.12.2 reachable ether2	110
DAo	▶ 3.3.3.3	12.12.12.2 reachable ether2	110
AS	▶ 10.10.10.0/24	192.168.0.2 reachable ether1	1
DAC	▶ 11.11.11.0/24	ether5 reachable	0
DAC	▶ 12.12.12.0/24	ether2 reachable	0
DAr	▶ 14.0.0.0/8	11.11.11.2 reachable ether5	120
DAr	▶ 14.14.14.0/24	11.11.11.2 reachable ether5	120
DAo	▶ 23.23.23.0/24	12.12.12.2 reachable ether2	110
DAC	▶ 192.168.0.0/24	ether1 reachable	0
DAo	▶ 192.168.2.0/24	12.12.12.2 reachable ether2	110
DAo	▶ 192.168.3.0/24	12.12.12.2 reachable ether2	110

Route Source	Default Distance Values
Connected interface	0
Static route	1
Enhanced Interior Gateway Routing Protocol (EIGRP) summary route	5
External Border Gateway Protocol (BGP)	20
Internal EIGRP	90
IGRP	100
OSPF	110
Intermediate System-to-Intermediate System (IS-IS)	115
Routing Information Protocol (RIP)	120
Exterior Gateway Protocol (EGP)	140
On Demand Routing (ODR)	160
External EIGRP	170
Internal BGP	200
Unknown*	255

Scope	Route type	Target Scope
0		
10	Connected (running)	10
20	OSPF, RIP, MME	30 10
30	Static	10
40	eBGP	10
40	iBGP	30
200	Connected (not active)	

[admin@ROS1] > ip route print

#	DST-ADDRESS	PREF-SRC	GATEWAY	DISTANCE	
0 **ADC**	1.1.1.0/24	1.1.1.1	ether3	0	
1 **A S**	2.2.2.0/24		192.168.12.2	1	//admin distance 1

```
 2   S  2.2.2.0/24                    192.168.21.2           1                    // same as
1, now making to 2


[admin@ROS2] > ip route print
 #    DST-ADDRESS      PREF-SRC      GATEWAY          DISTANCE
 0 A S  1.1.1.0/24                    192.168.21.1           1                    //admin
distance 1
 1   S  1.1.1.0/24                    192.168.12.1           1                    // same as
1, now making to 2
```

Making primary route
Instead of 2 , router will choose admin distance 1

```
[admin@ROS1] > ip route set distance=2 numbers=2

[admin@ROS1] > ip route print
 #    DST-ADDRESS      PREF-SRC      GATEWAY          DISTANCE
 1 A S  2.2.2.0/24                    192.168.12.2           1                    //
main link , 1 is static distance
 2   S  2.2.2.0/24                    192.168.21.2           2
```

```
[admin@ROS1] > ip route set check-gateway=ping  numbers=1              //
ping response check primary
```

And secondary route

```
[admin@ROS1] > ip route print
 #    DST-ADDRESS      PREF-SRC      GATEWAY          DISTANCE
 1 A S  2.2.2.0/24                    192.168.12.2           1
 2   S  2.2.2.0/24                    192.168.21.2
2                        //backup link , 2 is static distance
```

Same ass router2
————————

```
[admin@ROS2] > ip route set distance=2 numbers=1

[admin@ROS2] > ip route print
 #    DST-ADDRESS      PREF-SRC      GATEWAY          DISTANCE
```

```
 0 A S  1.1.1.0/24              192.168.12.1        1
 1   S  1.1.1.0/24              192.168.21.1        2
```

[admin@ROS2] > ip route set check-gateway=ping **numbers**=0   //
enable ping, not necessary

Checking Output
———————————

From ROS1 disable ethernet1 and check the route table and ping , after 10 sec
back link ll be active

[admin@ROS1] > ping 2.2.2.1 src-address=1.1.1.1

[admin@ROS2] > ping 1.1.1.1 src-address=2.2.2.1

```
 SEQ HOST                      SIZE TTL TIME  STATUS
  0 1.1.1.1                     56  64 1ms
  1 1.1.1.1                     56  64 2ms
```
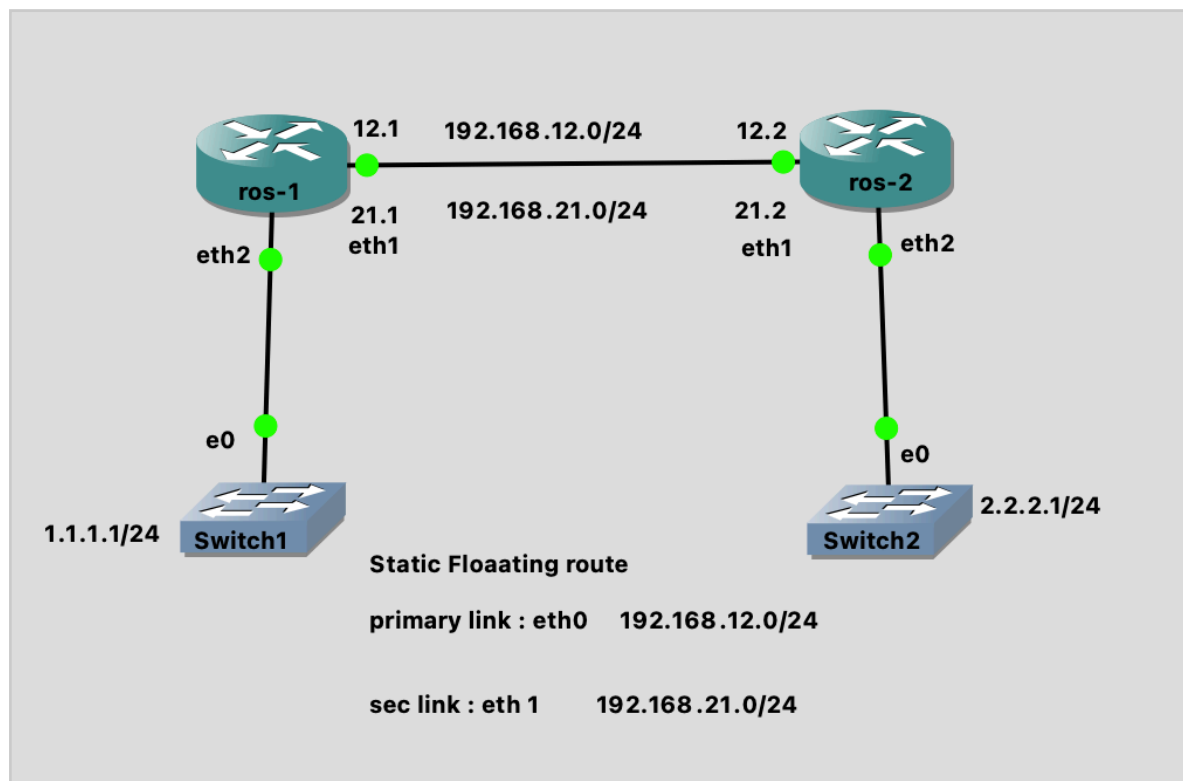
[admin@ROS1] > interface disable ether1

[admin@ROS1] > ip route print

```
 #    DST-ADDRESS     PREF-SRC      GATEWAY        DISTANCE
 1   S  2.2.2.0/24              192.168.12.2        1
 2 A S  2.2.2.0/24               192.168.21.2
2                              /walllaaaaaaaa
```

Checking Output, load balancing , linover checking
———————————

Simply unlink or remove the interface link from ros1 and ros2 as eth0

Static Floaating route

primary link : eth0   192.168.12.0/24

sec link : eth 1   192.168.21.0/24

```
[admin@ROS1] > ip route print
Flags: X — disabled, A — active, D — dynamic,
C — connect, S — static, r — rip, b — bgp, o — ospf, m — mme,
B — blackhole, U — unreachable, P — prohibit
 #       DST—ADDRESS        PREF—SRC          GATEWAY              DISTANCE
 0 ADC  1.1.1.0/24         1.1.1.1           ether3                      0
 1   S  2.2.2.0/24                           192.168.12.2                1
 2 A S  2.2.2.0/24                           192.168.21.2                2
 3 ADC  192.168.12.0/24    192.168.12.1      ether1                      0
 4 ADC  192.168.21.0/24    192.168.21.1      ether2                      0
```

==
ECMP
Equal Cost Multi-path Routing
==

Load balancing method, MikroTik is good for PCC

Ecmp use per connection load balancing.

Works in round robin SRC/DST to distribute the multiple traffic on network

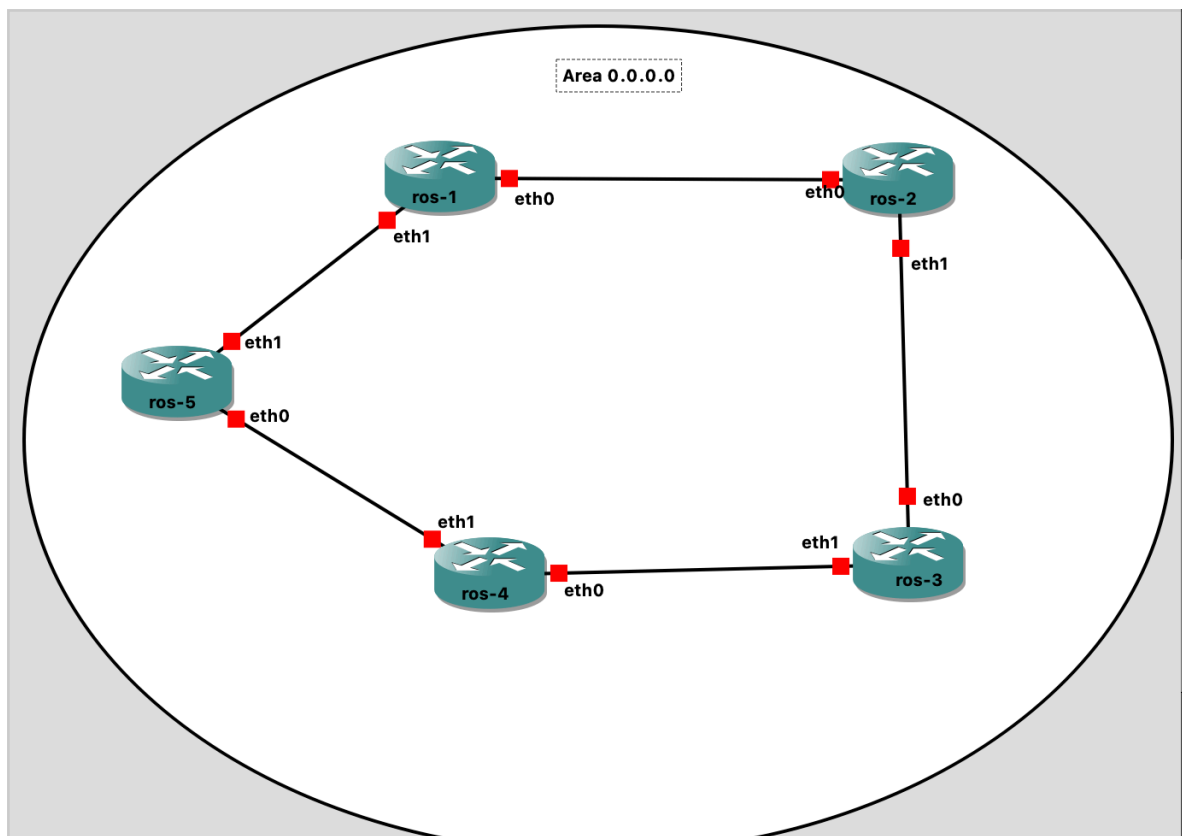==
OSPF
==

How link state protocol works
+++++++++++++++++++++
IGP have distance vector and link state protocol

Distance vector is old protocol, used by old Cisco protocol as RIP, EIGRP

Link state = OSPF   = Cisco, MikroTik all modern

Neighbourship between ros1 and ros2 ... vice versa

LSA.. Link state advertising ………. Says connectivity between interface

Areas is defined , more routers

LSDB: Link state database

Each router get best route from database, LSDB

SPF : shortest path Algo : dikastra Algo

OSPF tabe more CPU intensive

OSPF single area into?
++++++++++++++++++++

AREA: concept of area in OSPF is be confined routes.

Ospf area and routers task
++++++++++++++++++++

IP protocol = 89

First : define area= backbone area = default area= 0.0.0.0

[admin@MikroTik] /routing ospf>

.. -- go up to routing
area --
area-border-router --
as-border-router --
export -- Print or save an export script that can be used to restore
configuration
instance --

interface --
lsa --
nbma-neighbor --
neighbor --
network --
route --
sham-link --
virtual-link --

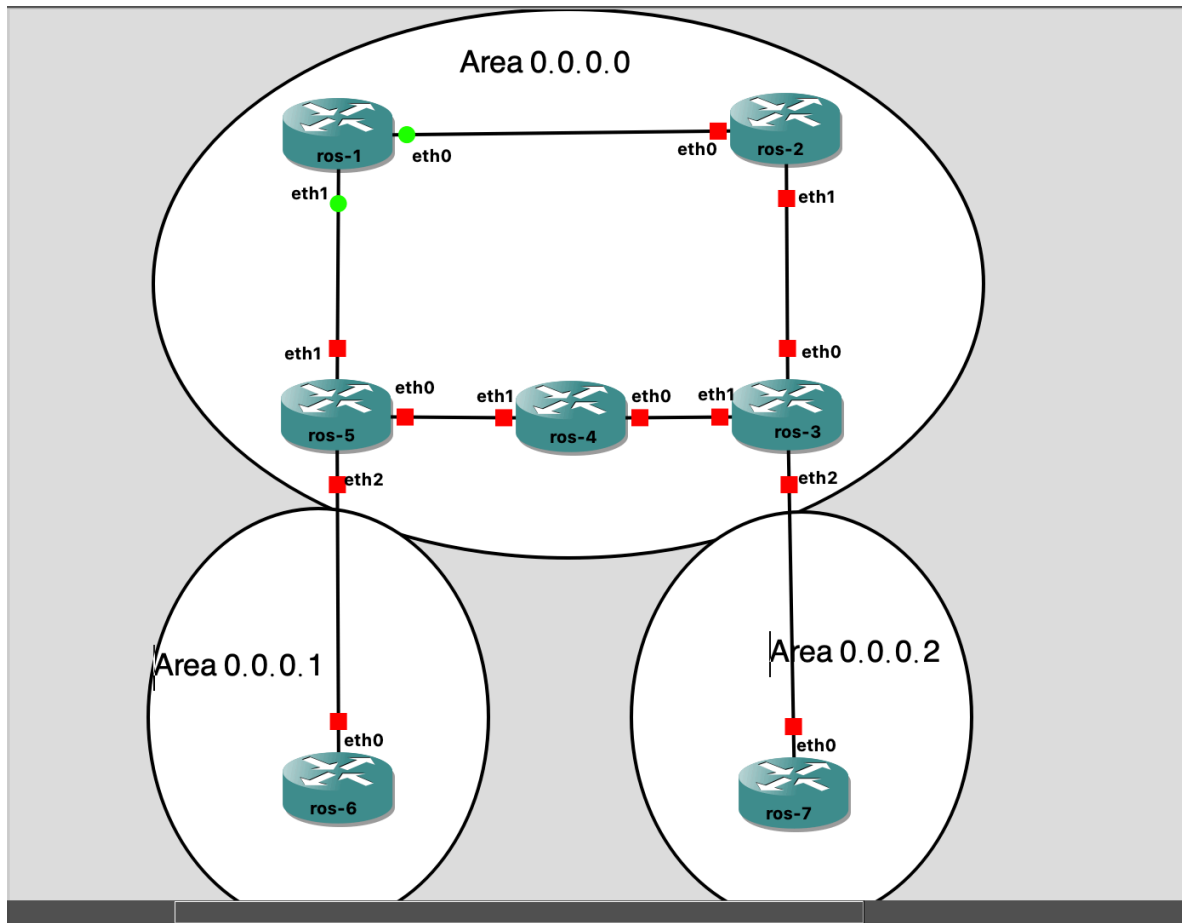**If we have 90 or more to connect ?**

Checks best path from 90 routers, so we need area

1 area we can put in MikroTik is 80 routers

Area makes isolated from each other

Area 0 don't matter area 1 and area 1 is isolated with area2

But area 0 is backbone of ospf, which pass from area0

Mikrotik use 32 bit for area

ROS1 is backbone router or internal or interior router

ROS4 is also interior router

ROS5 is in area 0 and 1, ie ABR- area boarder router ...... a router between boarder and backbone...more cpu intensive

ASBR: if any router is connected with another protocol , like ros2 may connect with RIP protocol
I.e ASBR.......Autonomous system boarder router

ABR summary
————————

Lab Aera on OSPF
++++++++++++++++++++

What is ECMP?
++++++++++++++++++++

What is ECMP?
++++++++++++++++++++

What is ECMP?
++++++++++++++++++++

==
Static Floating Route
==

What is ECMP?
++++++++++++++++++++

===
Static Floating Route
===

What is ECMP?
++++++++++++++++++++

What is ECMP?
+++++++++++++++++++++

What is ECMP?
++++++++++++++++++++++

What is ECMP?
++++++++++++++++++++++

```
==================================================
Static vs Dynamic Routing
==================================================
```

Need of Routing
++++++++++++++++++++

Need of Routing
++++++++++++++++++++

Need of Routing
++++++++++++++++++++

Need of Routing
++++++++++++++++++++

```
======================================================
Static vs Dynamic Routing
======================================================
```

Need of Routing
```
++++++++++++++++++++
```

Need of Routing
```
+++++++++++++++++++++
```

Need of Routing

++++++++++++++++++++

Need of Routing
++++++++++++++++++++