# 1.1 a) What IP address assigned and what you observed?

We assigned two different Ip subnets to two different VLANS interface COTT-L2.10 and COTT-L2.20.

# For COTT-L2.10=15.200.0.1/24

# COTT-L2.20-15.200.2.1/24

Then we respectively assigned IP address to hosts in different campus switches.

# For ZENT

- 1. Student\_4: 15.200.2.5/24 default route via 15.200.2.1
- 2. Staff\_4: 15.200.0.5/24 default route via 15.200.0.1

# For NORD

- 1. Student\_1: 15.200.2.2/24 default route via 15.200.2.1
- 2. Staff\_1: 15.200.0.2/24 default route via 15.200.0.1

For SENF

- 1. Student\_2: 15.200.2.3/24 default route via 15.200.2.1
- 2. Staff\_2: 15.200.0.3/24 default route via 15.200.0.1

## For SACH

- 1. Student\_3: 15.200.2.4/24 default route via 15.200.2.1
- 2. Staff\_3: 15.200.0.4/24 default route via 15.200.0.1

Since we only assign IP address to different hosts according to VLANs interfaces we cannot communicate between hosts because switches do not forward packets across different VLANS. The interfaces connected between switch are in default VLANS. So, they cannot forward traffic belonging to one VLAN to another VLAN. Thus, we made switch ports connected to each other as trunk ports. From perspective of SACH switch, we assigned port-ZENT, port-NORD, port-SENF as trunk ports to carry traffic for VLAN 10 and VLAN 20. This enabled communication between hosts in VLANS.

# 1.1 b) The spanning tree before configuration looks like



Switch Nord is given bridge ID 1. So, this switch became the root bridge. All the traffic will pass through Nord switch making it a root.

In our setup we changed the bridge ID of SACH to 1 and made it root bridge. Also we assigned path cost between SENF to NORD as 4 as the link is 1 Gbps bandwidth link. Similarly, we also assigned ZENT to NORD path cost as 4, to force communication between them via Root Bridge. We also assigned ZENT to NORD and NORD to SENF port as alternative port to prevent loops in a spanning tree.

The reason behind choosing SACH as Root Bridge is, it can reach every other node in one hope. Similarly making some ports as alternative is to prevent loops in tree.

The output of ovs-vsctl show br0 for SACH

root@SACH:~# ovs	-ofctl show br0
OFPT_FEATURES_RE	PLY (xid=0x2): dpid:00003al63bc88d4c
n_tables:254, n_	buffers:256
capabilities: FL	OW_STATS TABLE_STATS PORT_STATS QUEUE_STATS ARP_MATCH_IP
actions: output	enqueue set_vlan_vid set_vlan_pcp strip_vlan mod_dl_src mod_dl_dst
mod_nw_src_mod_n	w_dst mod_nw_tos mod_tp_src mod_tp_dst
1(15-ZENT): add	lr:92:46:5c:cb:f6:a4
config:	0
state:	STP_FORWARD
current:	10GB-FD COPPER
speed: 1000	0 Mbps now, 0 Mbps max
2(15-NORD): add	lr:92:dl:9b:3e:85:03
config:	0
state:	STP_FORWARD
current:	10GB-FD COPPER
speed: 1000	0 Mbps now, 0 Mbps max
3(15-SENF): add	lr:5e:d8:bd:4e:3e:20
config:	0
state:	STP_FORWARD
current:	10GB-FD COPPER
speed: 1000	0 Mbps now, 0 Mbps max
4(15-student_3)	: addr:c6:2d:d7:80:13:c5
config:	0
state:	STP_FORWARD
current:	10GB-FD COPPER
speed: 1000	0 Mbps now, 0 Mbps max
5(15-staff_3):	addr:9a:5b:a5:6d:2e:f6
config:	0
state:	STP_FORWARD
current:	10GB-FD COPPER
speed: 1000	0 Mbps now, 0 Mbps max
LOCAL(br0): add	lr:3a:16:3b:c8:8d:4c
config:	PORT_DOWN
state:	LINK_DOWN
speed: 0 Mb	ops now, O Mbps max
OFPT_GET_CONFIG_	REPLY (xid=0x4): frags=normal miss_send_len=0

For Nord

```
root@NORD:~# ovs-ofctl show br0
OFPT FEATURES REPLY (xid=0x2): dpid:000082f5e4371943
n tables:254, n buffers:256
capabilities: FLOW STATS TABLE STATS PORT STATS QUEUE STATS ARP MATCH IP
actions: output enqueue set vlan vid set vlan pcp strip vlan mod dl src mod dl d
st mod nw src mod nw dst mod nw tos mod tp src mod tp dst
1(15-ZENT): addr:6e:02:77:31:fd:c3
     config:
                STP FORWARD
     state:
               10GB-FD COPPER
    current:
    speed: 10000 Mbps now, 0 Mbps max
 2(15-SACH): addr:fa:91:35:8d:f9:2e
    config:
               STP FORWARD
     state:
     current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
 3(15-SENF): addr:72:33:4e:3c:36:de
    config:
    state:
               STP BLOCK
    current:
               10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
 4(15-student 1): addr:36:69:1e:f5:73:f8
    config:
    state:
               STP FORWARD
    current: 10GB-FD COPPER
     speed: 10000 Mbps now, 0 Mbps max
 5(15-staff_1): addr:52:05:89:88:ba:86
    config:
               STP FORWARD
    state:
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
 6(15-vpn 1): addr:3a:ea:50:fb:e1:7e
    config:
    state:
                STP FORWARD
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
 LOCAL(br0): addr:82:f5:e4:37:19:43
    config:
                PORT DOWN
                LINK DOWN
     state:
    speed: 0 Mbps now, 0 Mbps max
OFPT GET CONFIG REPLY (xid=0x4): frags=normal miss_send_len=0
```

## 1.2) Trace route from BARC host to SANF host:

```
root@BARC_host:~# traceroute 15.107.0.1

traceroute to 15.107.0.1 (15.107.0.1), 30 hops max, 60 byte packets

1 BARC-host.group15 (15.103.0.2) 0.080 ms 0.019 ms 0.015 ms

2 NEWY-BARC.group15 (15.0.4.2) 1.079 ms 1.057 ms MIAM-BARC.group15 (15.0.6.2) 1.068 ms

3 SANF-MIAM.group15 (15.0.13.1) 1.382 ms SANF-NEWY.group15 (15.0.11.2) 1.363 ms SANF-MIAM.group15 (15.0.13.1) 1.325 ms

4 host-SANF.group15 (15.107.0.1) 1.303 ms 1.312 ms 1.471 ms

root@BARC_host:~#
```

#### 1.3) Listing all ospf costs

In COTTBUS router:

- 1. Port\_LOND=9
- 2. Port\_BARC=5

## In LONDON router:

- 1. Port\_BARC=4
- 2. Port\_COTT=9
- 3. Port\_NEWY=15

In BARCA router:

- 1. Port\_COTT=5
- 2. Port\_LOND=4
- 3. Port\_MIAM=17
- 4. Port\_NEWY=18
- 5. Port\_ACCR=25

In ACCR router:

- 1. Port\_SAOP=20
- 2. Port\_MIAM=28
- 3. Port\_BARC=25

In SAOP router:

- 1. Port\_NEWY=29
- 2. Port\_MIAM=22
- 3. Port\_ACCR=20

**IN MIAM router:** 

- 1. Port\_SAOP=22
- 2. Port\_SANF=5

- 3. Port\_NEWY=9
- 4. Port\_BARC=17
- 5. Port\_ACCR=28

In SANF router:

- 1. Port\_NEWY=4
- 2. Port\_MIAM=5

In NEWY router:

- 1. Port\_SAOP=29
- 2. Port\_SANF=4
- 3. Port\_MIAM=9
- 4. Port\_LOND=15
- 5. Port\_BARC=18

Traceroute report from SANF host to Cottbus loopback address

```
root@SANF_host:~# traceroute 15.152.0.1
traceroute to 15.152.0.1 (15.152.0.1), 30 hops max, 60 byte packets
1 SANF-host.group15 (15.107.0.2) 0.090 ms 0.022 ms 0.023 ms
2 NEWY-SANF.group15 (15.0.11.1) 0.291 ms 0.253 ms 0.238 ms
3 BARC-MIAM.group15 (15.0.6.1) 1.352 ms 1.474 ms 1.488 ms
4 15.152.0.1 (15.152.0.1) 1.446 ms 1.433 ms 1.461 ms
```

Yes as I assigned the cost the traceroute result is showing accordingly. I assigned same cost between SANF host and COTT router via

- 1. SANF-MIAM-BARC-COTT
- 2. SANF-NEWY\_BARCA\_COTT links.

Above shown picture also show the same thing and when I see the total route cost from SANF router to COTT router the route cost appear to be same.

# **1.4)** what update-source does and why to use it? Show the result of show IP BGP summary for router SANF.

-If the interface that connect two routers does not work then the connection between them is broken. Then BGP session goes down. So, the reason behind using update-source loopback is to make another connection between two routers. So, that on these faulty condition, data reaches to actual destination. BGP gives us an option to change the source of packets sent. In this case we can use Loopback interface as source of BGP packets sent between these neighbors. Loopback interfaces allow internal BGP connections to stay up no matter what interface is used to reach a neighbor. BGP summary for router SANF:

Peers 8, usir	ng 164 KiB	of mem	ory						
Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State/P
fxRcd									
15.151.0.1 28	4	15	10192	9865	0	0	0	6d15h49m	
15.152.0.1	4	15	10217	10089	0	0	0	6d23h18m	
15.153.0.1	4	15	10424	10114	0	0	0	01w0d00h	
15.154.0.1	4	15	10072	10090	0	0	0	6d23h20m	
15.155.0.1	4	15	38639	35888	0	0	0	03w3d21h	
15.156.0.1	4	15	13238036	5 10127	0	(	) (	) 01w0d00h	1
15.158.0.1	4	15	35899	35881	0	0	0	03w3d21h	
179.0.63.2 2	4	18	1210	5999	0	0	0	20:00:01	
Total number SANF_router#	of neighbo	ors 8							

**2.1)** When a border router shares the routing information learned via ebgp session over a link then it also shares that the next hop is the neighbor on that link. The ibgp routers also learn that next hop is the neighbor on ebgp session. One potential issue with iBGP is that it doesn't change the next hop IP address. Sometimes this can cause reachability issues. So next-hop-self is important for EBGP session but are set in ibgp routers. Show ip bgp command result :

15.152.0.1		100	0	14	16 i				
15.151.0.1		100	0	13	16 i				
15.156.0.1		100	0	13	16 i				
15.154.0.1	0	600	0	17	i				
15.157.0.1	0	100	0	18	i				
15.156.0.1		100	0	13	11 21	24	22	19	1
15.151.0.1		100	0	13	11 21	24	22	19	1
15.154.0.1		600	0	17	20 i				
15.155.0.1		100	0	22	24 21	i			
15.155.0.1	0	100	0	22	i				
15.151.0.1		100	0	13	16 1	4 2	23	i	
15.156.0.1		100	0	13	16 1	4 2	23	i	
15.155.0.1	0	100	0	24	i				
15.151.0.1		100	0	13	16 1	4 2	25	i	
15.156.0.1		100	0	13	16 1	4 2	25	i	
15.152.0.1		100	0	14	1 4 2	25	i		
15.155.0.1	0	100	0	28	i				
15.152.0.1		100	0	14	1 4 2	25	i		
15.155.0.1	0	100	0	26	i				
15.155.0.1		100	0	26	27 i				
15.155.0.1	0	100	0	28	i				
	15.152.0.1 15.151.0.1 15.154.0.1 15.154.0.1 15.157.0.1 15.151.0.1 15.151.0.1 15.155	15.152.0.1         15.151.0.1         15.156.0.1         15.154.0.1         15.157.0.1         0         15.156.0.1         15.157.0.1         15.151.0.1         15.155.0.1         15.155.0.1         15.155.0.1         15.155.0.1         15.155.0.1         15.155.0.1         15.155.0.1         15.155.0.1         15.155.0.1         15.155.0.1         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0         15.155.0.1         0	$\begin{array}{cccccccccccccccccccccccccccccccccccc$						

My prefix advertisement available for neighboring AS:

1/.100.1		20	0	44	44	41	0	<u>.</u>					
17.155.0.1		50	0	22	24	21	8	9 i					
17.155.0.1		50	0	22	24	21	10	i					
17.151.0.1		20	0	15	15	15	13	11	i				
17.151.0.1		20	0	15	15	15	13	16	5	12	i		
17.151.0.1		20	0	15	15	15	13	i					
17.151.0.1		20	0	15	15	15	14	i					
17.156.0.1	0	20	0	15	i								
17.151.0.1	0	20	0	15	i								
17.152.0.1	0	20	0	16	i								
17.157.0.1	0	100	0	i									
17.153.0.1	0	100	0	i									
17.158.0.1	0	100	0	i									
17.151.0.1	0	100	0	i									
17.152.0.1	0	100	0	i									
17.156.0.1	0	100	0	i									
17.155.0.1	0	100	0	i									
0.0.0.0	0		32768	i									
17.151.0.1		20	0	15	15	15	18	i					
17.151.0.1		20	0	15	15	15	13	11	21	24	22	19	i
17.157.0.1	0	100	0	20	i								
17.155.0.1		50	0	22	24	21	i						
17.155.0.1	0	50	0	22	i								
	17.155.0.1 17.155.0.1 17.151.0.1 17.151.0.1 17.151.0.1 17.151.0.1 17.151.0.1 17.151.0.1 17.151.0.1 17.152.0.1 17.152.0.1 17.152.0.1 17.155.0.1 17.155.0.1 17.151.0.1 17.151.0.1 17.155.0.1 17.155.0.1 17.155.0.1	17.155.0.1         17.155.0.1         17.155.0.1         17.151.0.1         17.151.0.1         17.151.0.1         17.151.0.1         17.151.0.1         17.151.0.1         17.151.0.1         17.151.0.1         17.151.0.1         0         17.152.0.1         0         17.152.0.1         0         17.152.0.1         0         17.152.0.1         0         17.155.0.1         0         17.151.0.1         17.155.0.1         0.0.0.0         17.151.0.1         17.155.0.1         0.0.0.0         17.155.0.1         0.17.155.0.1         0.17.155.0.1	17.155.0.1 $50$ $17.155.0.1$ $50$ $17.155.0.1$ $50$ $17.151.0.1$ $20$ $17.151.0.1$ $20$ $17.151.0.1$ $20$ $17.151.0.1$ $20$ $17.151.0.1$ $20$ $17.151.0.1$ $0$ $17.151.0.1$ $0$ $17.151.0.1$ $0$ $17.152.0.1$ $0$ $17.152.0.1$ $0$ $17.152.0.1$ $0$ 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Traceroute result from BARC host to another peer BARC:

```
root@BARC_host:~# traceroute 16.101.0.1

traceroute to 16.101.0.1 (16.101.0.1), 30 hops max, 60 byte packets

1 BARC-host.group15 (15.103.0.2) 0.548 ms 0.378 ms 0.067 ms

2 LOND-BARC.group15 (15.0.12.2) 0.250 ms 0.192 ms 0.170 ms

3 179.0.55.1 (179.0.55.1) 2.565 ms 2.502 ms 2.433 ms

4 MIAM-ACCR.group13 (13.0.9.2) 3.898 ms 3.842 ms 3.785 ms

5 SANF-MIAM.group13 (13.0.13.1) 3.942 ms 3.872 ms 4.077 ms

6 179.0.56.2 (179.0.56.2) 6.309 ms 6.119 ms 5.977 ms

7 BARC-COTT.group16 (16.0.1.2) 6.128 ms 6.034 ms 6.159 ms

8 host-LOND.group16 (16.101.0.1) 6.159 ms 5.988 ms 5.964 ms

root@BARC_host:~#
```

2.2) Out route-map configured in NEWY router



The first command route-map IXP\_OUT permit 10 means: create a route map named IXP\_OUT with which is permitted and sequence number is 10

Match IP address prefix list own-prefix means I am matching my IP that I assigned in own\_prefixs which will be permitted.

SET community is setting up a community representing with IXP number and other AS number where route map will be applied and this route map will be advertised to these community through IXP.

For remaining part I donot see proper configuration done.

3.1) BGP community used for peer 16 is 15:160

BGP community used for provider 13 through SAOP 15:130

Provider 13 through LOND: 15:131

Customer through MIAM: 15:170

Customer through ACCR: 15:171

Customer through MIAM 15:180

```
route-map 17_IN permit 10
set community 15:170
set local-preference 500
!
route-map 17_OUT permit 10
match ip address prefix-list MY_PREFIX
```

Here route Map 17\_In is created with permit sequence 10 where the routes learned are represented by a community value while route map 17\_OUT show own prefix being advertised.

Here is what I see in AS 16.

*> 13.0.0.0/8	179.0.59.1		500	0	14	5	12 :	13 :	i.		
*> 14.0.0.0/8	179.0.59.1	0	500	0	14	i					
*>i15.0.0.0/8	16.152.0.1		100	0	13	15	15	15	15	15	i
* i16.0.0.0/8	16.156.0.1	0	100	0	i						
* i	16.158.0.1	0	100	0	i						

The configuration done is not proper that's why packet is being forwarded from provider not directly through peer

3.3) In order to influence the inbound traffic destined to my prefix from provider connected to COTT in priority, I made the as-path length small compared to other provider. Since local preference value is same, as-path prepending became the legitimate choice. So while creating route-map out, I just prepended as path in provider connected through SAOP and LOND. As-path prepending is not a reliable choice in some cases. So, this might be a possible drawback. So, only trusting as-path is a dangerous option.

3.4) Since, I have two provider in same AS(13), I prepended as-path and advertised to neighbor in LOND router. This makes as-path length more in LOND router which made obvious to choose SAOP provider link.

```
route-map LOND_OUT permit 20
match community 1
set as-path prepend 15 15 15 15
!
route-map MAP_IN permit 10
set community 15:131
!
line vty
!
end
LOND_router# conf t
```

3.5) when I saw in looking glass I found that AS 6 hijacked my prefix with more specific prefix announcement than me. AS 6 announce 15.0.0.0/10 prefix, which was more specific than 15.0.0.0/8.SO my prefix was hijacked.

To mitigate hijack and to get traffic back to my AS, I made another specific prefix announcement 15.0.0/16

The countermeasures to stop prefix hijacks are:

- a) Make more specific prefix announcement
- b) Protocol level security is available which matches or binds which AS system is announcing which prefix. The protocol is called BGPsec.