Sheridan College	
Course	TELE31063: Network Engineering 3
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Assignment#4 ISP Routing Design	
Performed Date	10 Dec 2021
Instructor's Sign	(marks)

Follow the procedure to configure your topology:
<mark>NO SUBMISSION OF ZIPPED FILE. 1 mark will be deducted if submitted zipped file!!!!</mark>

1. Before is the IP assignment given to you, you need to do subnetting and assign for your own IP. Please keep in my mind of efficiency of routing is related to a good IP Assignment.

The diagram indicates a typical ISP setup in mini version. ISP#1 AS number is 123.

Description	IPv4 Big Block	IPv6 Big Block	Subnet Size Suggestion
Service Customer Block	24.4.0.0/20	2560:1234::/32	/22 per phub and /48 per phub (Each phub may have more than one

			access router)
Infrastructure (loopback, ptp etc)	11.0.0.0/16	2607:f798:1234 ::/48	/32 for loopback, /30 for ptp. /128 for loopback, /127 for ptp but reserve a /64

Peering Transit Information:

AS#179
Public Transit ptp: 74.165.123.8/30; 2450:74:165:123:8::/127
Public Transit ptp: 74.165.123.4/30; 2450:74:165:123:4::/127
Public Transit Router Loopback: 74.165.123.7/32;
2450:74:165:123:7::123/128
Public Transit Switch routes: 11.12.0.0/16, 2433:11:12::/48
Local Exchange:
AS#345
Local Exchange ptp: 34.171.11.16/30; 2173:34:171:11:16::/127
Local Exchange router loopback:
34.171.12.123/32;2173:34:171:12::123/128

Please provide a table to indicate your IP address Assignment.

R1	Lo0	11.1.1.1/32	2607:f798:1234::1/128
	F0/0	24.4.0.1/22	2560:1234::1/48
	G1/0	11.0.0.1/30	2607:f798:1234:0001::0/127
	G2/0	11.0.0.5/30	2607:f798:1234:0002::0/127
	G3/0	24.4.4.1/22	2560:1234:4::1/48
R2	Lo0	11.2.2.2/32	2607:f798:1234::2/128
	G1/0	11.0.0.2/30	2607:f798:1234:0001::1/127
	G2/0	11.0.0.9/30	2607:f798:1234:0003::0/127
R3	Lo0	11.3.3.3/32	2607:f798:1234::3/128
	G1/0	11.0.0.6/30	2607:f798:1234:0002::1/127
	G2/0	11.0.0.13/30	2607:f798:1234:0004::0/127
R4	Lo0	11.4.4.4/32	2607:f798:1234::4/128
	G1/0	11.0.0.10/30	2607:f798:1234:0003::1/127
	G2/0	11.0.0.14/30	2607:f798:1234:0004::1/127
	G3/0	74.165.123.5/30	2450:74:165:123:4::0/127

	G4/0	74.165.123.9/30	2450:74:165:123:8::0/127
	G5/0	34.171.11.17/30	2173:34:171:11:16::0/127
R5	Lo0	74.165.123.55	2450:74:165:123:5::123/128
	F0/0	11.12.0.1/22	2433:11:12::/48
	G1/0	74.165.123.6/30	2450:74:165:123:4::1/127
R6	Lo0	34.171.12.123/32	2173:34:171:12::123/128
	G1/0	34.171.11.18/30	2173:34:171:11:16::1/127
R7	Lo0	74.165.123.7/32	2450:74:165:123:7::123/128
	F0/0	11.12.4.1/22	2433:11:12::1/48
	G1/0	74.165.123.10/30	2450:74:165:123:8::1/127

Route Aggregation

11.0.0.0/30			24.4.0.0/22	
11.0.0.4/30	11.0.0.0/28		24.4.4.0/22	24.4.0.0/21
11.0.0.8/30				
11.0.0.12/30				

2. Routing Deployment

2a. Please deploy the right protocols and allow to advertise to AS179 with aggregation in the ASBR. Make sure all switch routes can reach each other.


```
R7#traceroute 24.4.0.1 source 11.12.4.1
Type escape sequence to abort.
Tracing the route to 24.4.0.1
VRF info: (vrf in name/id, vrf out name/id)
  1 74.165.123.9 16 msec 20 msec 20 msec
  2 11.0.0.9 [AS 123] 44 msec 44 msec 40 msec
  3 11.0.0.1 [AS 123] 64 msec 64 msec 64 msec
R7#traceroute 24.4.4.1 source 11.12.4.1
Type escape sequence to abort.
Tracing the route to 24.4.4.1
VRF info: (vrf in name/id, vrf out name/id)
  1 74.165.123.9 20 msec 20 msec 20 msec
  2 11.0.0.9 [AS 123] 32 msec 32 msec 32 msec
  3 11.0.0.1 [AS 123] 44 msec 44 msec 40 msec
R7#
```

From R7 it takes R4 to R2 then to R1.

```
R7#sh ip bgp
BGP table version is 11, local router ID is 74.165.123.7
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
              x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
 *>  11.0.0.0/28      74.165.123.9             0             0 123 ?
 *>  11.1.1.1/32      74.165.123.9                           0 123 ?
 *>  11.4.4.4/32      74.165.123.9             0             0 123 ?
 *>  11.12.4.0/22     0.0.0.0                  0         32768 ?
 *>  24.4.0.0/21      74.165.123.9             0             0 123 ?
 *>  34.171.11.16/30  74.165.123.9             0             0 123 ?
 *>  34.171.12.123/32 74.165.123.9                           0 123 345 ?
 *>  74.165.123.4/30  74.165.123.9             0             0 123 ?
 *>  74.165.123.7/32  0.0.0.0                  0         32768 ?
 *   74.165.123.8/30  74.165.123.9             0             0 123 ?
 *>                   0.0.0.0                  0         32768 ?
R7#
```

```
R5#sh ip bgp
BGP table version is 10, local router ID is 74.165.123.6
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
              x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
 *>  11.0.0.0/28      74.165.123.5             0             0 123 ?
 *>  11.1.1.1/32      74.165.123.5                           0 123 ?
 *>  11.4.4.4/32      74.165.123.5             0             0 123 ?
 *>  11.12.0.0/22     0.0.0.0                  0         32768 ?
 *>  24.4.0.0/21      74.165.123.5             0             0 123 ?
 *>  34.171.11.16/30  74.165.123.5             0             0 123 ?
 *>  34.171.12.123/32 74.165.123.5                           0 123 345 ?
 *   74.165.123.4/30  74.165.123.5             0             0 123 ?
 *>                   0.0.0.0                  0         32768 ?
 *>  74.165.123.8/30  74.165.123.5             0             0 123 ?
R5#
```

```
R5#sh bgp ipv6 unicast
BGP table version is 53, local router ID is 74.165.123.55
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
              x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
 *>  2173:34:171:11:16::/127
                      2450:74:165:123:4::
                                                           0 123 345 ?
 *>  2173:34:171:12::123/128
                      2450:74:165:123:4::
                                                           0 123 345 ?
 *>  2433:11:12::/48  ::                       0         32768 ?
 *>  2450:74:165:123:4::/127
                      ::                       0         32768 ?
 *>  2450:74:165:123:5::123/128
                      ::                       0         32768 ?
 *>  2560:1234::/48   2450:74:165:123:4::
                                                           0 123 ?
 *>  2560:1234::/45   2450:74:165:123:4::
                                               0           0 123 i
 *>  2560:1234:4::/48 2450:74:165:123:4::
                                                           0 123 ?
 *>  2607:F798:1234::/98
                      2450:74:165:123:4::
                                               0           0 123 i
 *>  2607:F798:1234::1/128
                      2450:74:165:123:4::
                                                           0 123 ?
 *>  2607:F798:1234:1::/127
                      2450:74:165:123:4::
                                                           0 123 ?
 *>  2607:F798:1234:2::/127
                      2450:74:165:123:4::
                                                           0 123 ?
R5#
```

```
R7#sh bgp ipv6 unicast
BGP table version is 53, local router ID is 74.165.123.7
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
              x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
 *>  2173:34:171:11:16::/127
                      2450:74:165:123:8::
                                                        0 123 345 ?
 *>  2173:34:171:12::123/128
                      2450:74:165:123:8::
                                                        0 123 345 ?
 *>  2433:11:12::/48   ::                      0       32768 ?
 *>  2450:74:165:123:7::123/128
                      ::                       0       32768 ?
 *>  2450:74:165:123:8::/127
                      ::                       0       32768 ?
 *>  2560:1234::/48    2450:74:165:123:8::
                                                        0 123 ?
 *>  2560:1234::/45    2450:74:165:123:8::
                                               0        0 123 i
 *>  2560:1234:4::/48  2450:74:165:123:8::
                                                        0 123 ?
 *>  2607:F798:1234::/98
                      2450:74:165:123:8::
                                               0        0 123 i
 *>  2607:F798:1234::1/128
                      2450:74:165:123:8::
                                                        0 123 ?
 *>  2607:F798:1234:1::/127
                      2450:74:165:123:8::
                                                        0 123 ?
 *>  2607:F798:1234:2::/127
                      2450:74:165:123:8::
                                                        0 123 ?
R7#
```

25%

Which path is taken for R1 customer routes to reach AS179. Please printscreen traceroute result and paste in below space.

```
R1#traceroute 11.12.0.1 source 24.4.0.1
Type escape sequence to abort.
Tracing the route to 11.12.0.1
VRF info: (vrf in name/id, vrf out name/id)
  1 11.0.0.2 24 msec 16 msec 20 msec
  2 11.0.0.10 44 msec 44 msec 44 msec
  3 74.165.123.6 [AS 123] 64 msec 64 msec 64 msec
R1#traceroute 11.12.0.1 source 24.4.4.1
Type escape sequence to abort.
Tracing the route to 11.12.0.1
VRF info: (vrf in name/id, vrf out name/id)
  1 11.0.0.2 20 msec 24 msec 20 msec
  2 11.0.0.10 44 msec 40 msec 44 msec
  3 74.165.123.6 [AS 123] 64 msec 64 msec 68 msec
R1#traceroute 11.12.4.1 source 24.4.0.1
Type escape sequence to abort.
Tracing the route to 11.12.4.1
VRF info: (vrf in name/id, vrf out name/id)
  1 11.0.0.2 12 msec 20 msec 24 msec
  2 11.0.0.10 40 msec 44 msec 44 msec
  3 74.165.123.10 [AS 123] 64 msec 64 msec 64 msec
R1#traceroute 11.12.4.1 source 24.4.4.1
Type escape sequence to abort.
Tracing the route to 11.12.4.1
VRF info: (vrf in name/id, vrf out name/id)
  1 11.0.0.2 16 msec 20 msec 20 msec
  2 11.0.0.10 44 msec 44 msec 44 msec
  3 74.165.123.10 [AS 123] 64 msec 64 msec 64 msec
R1#
```

From R1 all customer routes to every connection to switch 3

(10%)

2b. Now use BGP attribute to manipulate the outbound traffic from R1 to use R3 as primary path and R2 as secondary path. Please describe your solution.

Because we want R1 to use R3 as a primary path regardless of the route. I used a route-map with only set local-preference to achieve this, because we do not need to match ip.

```
router bgp 64812
no bgp default ipv4-unicast
neighbor 11.0.0.2 remote-as 123
neighbor 2607:f798:1234:0001::1 remote-as 123
neighbor 11.0.0.6 remote-as 123
neighbor 2607:f798:1234:0002::1 remote-as 123
!
address-family ipv4
neighbor 11.0.0.2 activate
neighbor 11.0.0.2 send-community both
neighbor 11.0.0.2 route-map secondary in
neighbor 11.0.0.6 activate
neighbor 11.0.0.6 send-community both
neighbor 11.0.0.6 route-map primary in
redistribute connected
!
address-family ipv6
neighbor 2607:f798:1234:0001::1 activate
neighbor 2607:f798:1234:0001::1 send-community both
neighbor 2607:f798:1234:0001::1 route-map secondary in
neighbor 2607:f798:1234:0002::1 activate
neighbor 2607:f798:1234:0002::1 send-community both
neighbor 2607:f798:1234:0002::1 route-map primary in
redistribute connected
!
route-map primary permit 10
set local-preference 110
!
route-map secondary permit 10
set local-preference 90
!
end
```

(15%)

2c. Now use BGP attribute to manipulate the inbound traffic from switch 3 using R7 to reach switch 1 and using R5 to reach switch 2

destination.   Please document your solution and verification from below space.

On R5 and R7:

```
router bgp 179
no bgp default ipv4-unicast
neighbor 74.165.123.5 remote-as 123
neighbor 2450:74:165:123:4::0 remote-as 123
neighbor 11.12.4.1 remote-as 179
neighbor 2433:11:12::1 remote-as 179
!
address-family ipv4
neighbor 74.165.123.5 activate
neighbor 74.165.123.5 route-map local-exchange out
neighbor 74.165.123.5 route-map from_R5 out
neighbor 11.12.4.1 activate
redistribute connected
!
address-family ipv6
neighbor 2450:74:165:123:4::0 activate
neighbor 2433:11:12::1 activate
redistribute connected
!
ip access-list extended 101
permit icmp host 24.4.4.1 host 11.12.0.1
!
route-map local-exchange
set community no-export
!
route-map from_R5
match ip address 101
set as-path prepend 179
!
end
```

```
router bgp 179
no bgp default ipv4-unicast
neighbor 74.165.123.9 remote-as 123
neighbor 2450:74:165:123:8::0 remote-as 123
neighbor 11.12.0.1 remote-as 179
neighbor 2433:11:12:: remote-as 179
!
address-family ipv4
neighbor 74.165.123.9 activate
neighbor 74.165.123.9 route-map local-exchange out
neighbor 74.165.123.9 route-map from_R7 out
neighbor 11.12.0.1 activate
redistribute connected
!
address-family ipv6
neighbor 2450:74:165:123:8::0 activate
neighbor 2433:11:12:: activate
redistribute connected
!
ip access-list extended 101
permit icmp host 24.4.0.1 host 11.12.4.1
!
route-map local-exchange
set community no-export
!
route-map from_R7
match ip address 101
set as-path perpend 179
!
end
```

(25%)

3. Please use the correct BGP policy to export the correct routes to the local exchange

R5:

```
router bgp 179
no bgp default ipv4-unicast
neighbor 74.165.123.5 remote-as 123
neighbor 2450:74:165:123:4::0 remote-as 123
neighbor 11.12.4.1 remote-as 179
neighbor 2433:11:12::1 remote-as 179
!
address-family ipv4
neighbor 74.165.123.5 activate
neighbor 74.165.123.5 route-map local-exchange out
neighbor 74.165.123.5 route-map from_R5 out
neighbor 11.12.4.1 activate
redistribute connected
!
address-family ipv6
neighbor 2450:74:165:123:4::0 activate
neighbor 2433:11:12::1 activate
redistribute connected
!
ip access-list extended 101
permit icmp host 24.4.4.1 host 11.12.0.1
!
route-map local-exchange
set community no-export
!
```

R7:

```
router bgp 179
no bgp default ipv4-unicast
neighbor 74.165.123.9 remote-as 123
neighbor 2450:74:165:123:8::0 remote-as 123
neighbor 11.12.0.1 remote-as 179
neighbor 2433:11:12:: remote-as 179
!
address-family ipv4
neighbor 74.165.123.9 activate
neighbor 74.165.123.9 route-map local-exchange out
neighbor 74.165.123.9 route-map from_R7 out
neighbor 11.12.0.1 activate
redistribute connected
!
address-family ipv6
neighbor 2450:74:165:123:8::0 activate
neighbor 2433:11:12:: activate
redistribute connected
!
ip access-list extended 101
permit icmp host 24.4.0.1 host 11.12.4.1
!
route-map local-exchange
set community no-export
!
```

```
R6#sh ip bgp
BGP table version is 13, local router ID is 34.171.12.123
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
              x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

     Network          Next Hop            Metric LocPrf Weight Path
 *>  11.0.0.0/28      34.171.11.17             0             0 123 ?
 *>  11.4.4.4/32      34.171.11.17             0             0 123 ?
 *   34.171.11.16/30  34.171.11.17             0             0 123 ?
 *>                   0.0.0.0                  0         32768 ?
 *>  34.171.12.123/32 0.0.0.0                  0         32768 ?
 *>  74.165.123.4/30  34.171.11.17             0             0 123 ?
 *>  74.165.123.8/30  34.171.11.17             0             0 123 ?
R6#
```

Only routes that are local or in the AS connected to local exchange are shown no routes from the transit provider.

(10%)

4. What are the best practices that should implement on R4 peering policy to all external AS? Please include the corresponding configurations with below space and implement in your topology.

To remove private AS routes on R4:

```
router bgp 123
no bgp default ipv4-unicast
neighbor 11.0.0.9 remote-as 123
neighbor 2607:f798:1234:0003::0 remote-as 123
neighbor 11.0.0.13 remote-as 123
neighbor 2607:f798:1234:0004::0 remote-as 123
neighbor 74.165.123.6 remote-as 179
neighbor 2450:74:165:123:4::1 remote-as 179
neighbor 74.165.123.10 remote-as 179
neighbor 2450:74:165:123:8::1 remote-as 179
neighbor 34.171.11.18 remote-as 345
neighbor 2173:34:171:11:16::1 remote-as 345
!
address-family ipv4
neighbor 11.0.0.9 activate
neighbor 11.0.0.9 next-hop-self
neighbor 11.0.0.13 activate
neighbor 11.0.0.13 next-hop-self
neighbor 74.165.123.6 activate
neighbor 74.165.123.6 send-community both
neighbor 74.165.123.6 remove-private-as
neighbor 74.165.123.6 route-map bogon in
neighbor 74.165.123.10 activate
neighbor 74.165.123.10 send-community both
neighbor 74.165.123.10 remove-private-as
neighbor 74.165.123.10 route-map bogon in
neighbor 34.171.11.18 activate
neighbor 34.171.11.18 send-community both
neighbor 34.171.11.18 remove-private-as
aggregate-address 11.0.0.0 255.255.255.240 as-set summary-only
aggregate-address 24.4.0.0 255.255.248.0 as-set summary-only
aggregate-address 74.165.123.0 255.255.255.0 summary-only
!
```

No bogon routes on R4:

```
address-family ipv4
neighbor 11.0.0.9 activate
neighbor 11.0.0.9 next-hop-self
neighbor 11.0.0.13 activate
neighbor 11.0.0.13 next-hop-self
neighbor 74.165.123.6 activate
neighbor 74.165.123.6 send-community both
neighbor 74.165.123.6 remove-private-as
neighbor 74.165.123.10 activate
neighbor 74.165.123.10 send-community both
neighbor 74.165.123.10 remove-private-as
neighbor 34.171.11.18 activate
neighbor 34.171.11.18 send-community both
neighbor 34.171.11.18 remove-private-as
aggregate-address 11.0.0.0 255.255.255.240 as-set summary-o
aggregate-address 24.4.0.0 255.255.248.0 as-set summary-onl
aggregate-address 74.165.123.0 255.255.255.0 summary-only
!
address-family ipv6
neighbor 2607:f798:1234:0003::0 activate
neighbor 2607:f798:1234:0003::0 send-community both
neighbor 2607:f798:1234:0003::0 next-hop-self
neighbor 2607:f798:1234:0004::0 activate
neighbor 2607:f798:1234:0004::0 send-community both
neighbor 2607:f798:1234:0004::0 next-hop-self
neighbor 2450:74:165:123:4::1 activate
neighbor 2450:74:165:123:4::1 send-community both
neighbor 2450:74:165:123:4::1 remove-private-as
neighbor 2450:74:165:123:8::1 activate
neighbor 2450:74:165:123:8::1 send-community both
neighbor 2450:74:165:123:8::1 remove-private-as
neighbor 2173:34:171:11:16::1 activate
neighbor 2173:34:171:11:16::1 send-community both
neighbor 2173:34:171:11:16::1 remove-private-as
!
ip prefix-list def_out seq 5 deny 0.0.0.0/0 le 32
!
ip community-list 10 permit 65333:888
!
route-map bogon
match community 10
set ip next-hop 192.168.1.1
!
end
```

(15%)
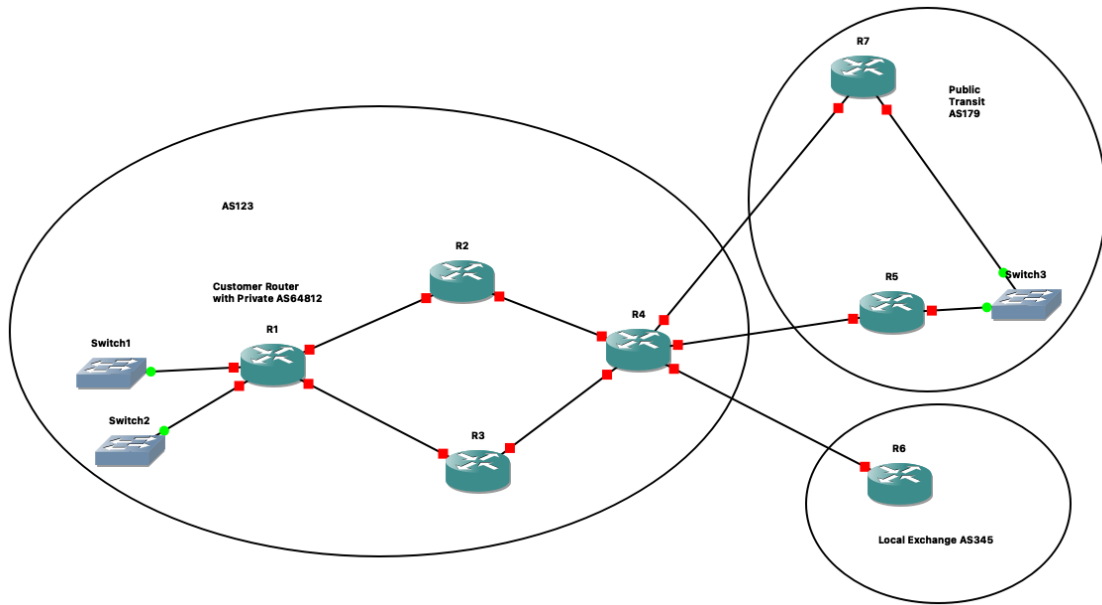
Figure 1 Network Topology

Submission Documents:

Description	Check
Tele31063 lab 4 .doc	
Configuration of all routers in one txt file	