IK2215: Network Design Report

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1 General Information

ASN: 108 **NETWORK:** 1.108.0.0/20

2 Network overview

The figure illustrates the network topology for our lab project. The setup includes four routers and five hosts, comprising three servers and two clients. In this configuration, routers r1 and r2 function as eBGP routers, connecting AS1 and AS21. Both r1 and r3 are connected to all other routers, while r2 and r4 are connected to two routers each. The three servers are connected to r3, while the two clients are connected to r4.

2.1 Network diagram

The network design is illustrated in Figure 1 below.

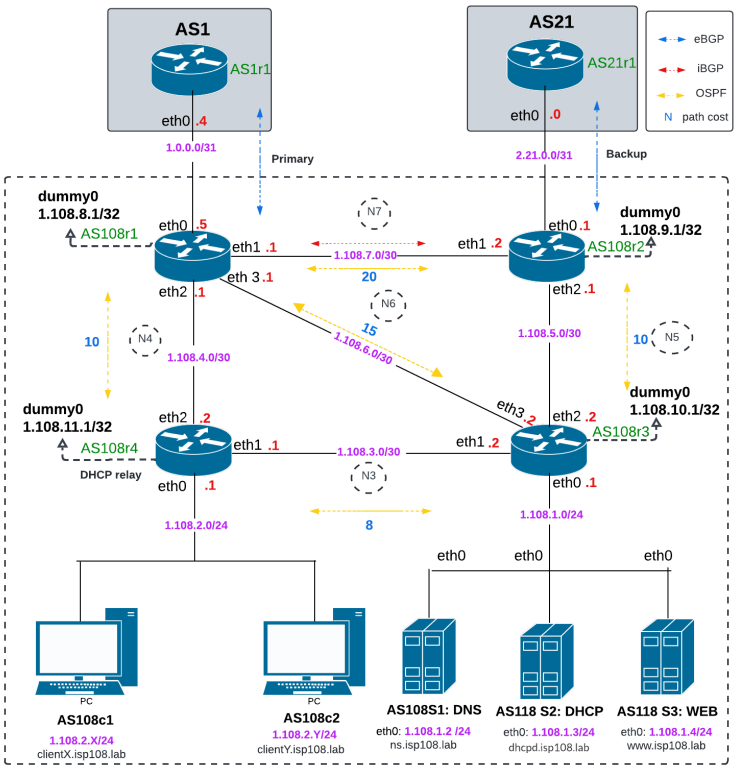

Figure 1: Network Diagram

2.2 IP address allocation

The IP addresses and domain names of all device interfaces are shown in the table below.

Device	Interface	IP address	Domain name
r1	eth0	1.0.0.5/31	r1eth0.isp108.lab
r1	eth1	1.108.7.1/30	r1eth1.isp108.lab
r1	eth2	1.108.4.1/30	r1eth2.isp108.lab
r1	eth3	1.108.6.1/30	r1eth3.isp108.lab
r1	dummy0	1.108.8.1/32	r1dum0.isp108.lab
r2	eth0	2.21.0.1/31	r2eth0.isp108.lab
r2	eth1	1.108.7.2/30	r2eth1.isp108.lab
r2	eth2	1.108.5.1/30	r2eth2.isp108.lab
r2	dummy0	1.108.9.1/32	r2dum0.isp108.lab
r3	eth0	1.108.1.1/24	r3eth0.isp108.lab
r3	eth1	1.108.3.2/30	r3eth1.isp108.lab
r3	eth2	1.108.5.2/30	r3eth2.isp108.lab
r3	eth3	1.108.6.2/30	r3eth3.isp108.lab
r3	dummy0	1.108.10.1/32	r3dum0.isp108.lab
r4	eth0	1.108.2.1/24	r4eth0.isp108.lab
r4	eth1	1.108.3.1/30	r4eth1.isp108.lab
r4	eth2	1.108.4.2/30	r4eth2.isp108.lab
r4	dummy0	1.108.11.1/32	r4dum0.isp108.lab
s1	eth0	1.108.1.2/24	ns.isp108.lab
s2	eth0	1.108.1.3/24	dhcpd.isp108.lab
s3	eth0	1.108.1.4/24	www.isp108.lab
c1		1.108.2.X/24	clientX.isp108.lab
c2		1.108.2.Y/24	clientY.isp108.lab

3 Routing and service implementation

This section describes the ISP implementation to realize routing and service requirements.

3.1 Routing

This section describe ISP implementation to fulfill routing requirements.

3.1.1 Intra-domain routing

We will be using the **OSPF** routing protocol, which converges quickly and makes it easy to add a *COST* attribute to each path to select a primary and secondary path for each router to ensure that your network remains operational in the event of a failure of one of the internal links, both of which are deterministic paths. The specific And for incoming traffic from AS21, we will append s are shown in the diagram above.The paths including:

- r1 to client network and vice versa
- r1 to server network and vice versa
- r2 to client network and vice versa
- r2 to server network and vice versa
- client network to server network and vice versa

There are at least two non-intersecting routing paths between two devices that keeps the network running even if one of the paths fails. The primary and secondary routing paths are as follows:

Path	r1	r2	servers	clients
r1	X	-	r3	r4
r2	-	X	r3	r4 r3
servers	r3	r3	X	r4 r3
clients	r4	r3 r4	r3 r4	X

Table 1: Intermediate nodes in the primary routing path from row to column. X represents a path to itself, - represents a direct link without any intermediate node.

Path	r1	r2	servers	clients
r1	X	-	r3 r4	r4 r3
r2	-	X	r3 r1	r4 r1
servers	r4 r3	r1 r3	X	r4 r1 r3
clients	r3 r4	r1 r4	r3 r1 r4	X

Table 2: Intermediate nodes in the secondary routing path from row to column (when the primary routing path fails). X represents a path to itself, - represents a direct link without any intermediate node.

3.1.2 Inter-domain routing

Our AS is connected to the top service provider (AS1) through border router r1, using the **eBGP** inter-domain routing protocol, and to a neighbouring AS (AS21), which is a customer of another top service provider, through border router r2, using **eBGP**. Typically, the primary link is used for all traffic (incoming and outgoing). Traffic to and from the neighbouring AS (AS21) will use the direct path on the backup link. We will establish an **iBGP** connection between r1 and r2 within AS108. We categorise the traffic that occurs in the AS108 area into three scenarios, and we have adopted different inter-domain routing BGP policies to differentiate between the primary and backup paths to ensure that packets destined for other autonomous systems use the primary link under normal conditions and switch to the backup link in the event of a failure.

Routers running BGP will select the next hop based on certain attributes:

- First, BGP prefers the path with the highest $Local - Preference$.
- Second, BGP prefers the path with the shortest $AS - Path$.

Outgoing Traffic This section focuses on traffic originating from AS108, using $Local - Preferences$ to manage outgoing traffic. We used the BGP policy update command for **Prefix-List** based **Route-Map** for traffic that wants to originate from router AS108r1 out of AS108 if its destination IP address is the IP address of the AS21 network. We then set the $Local - Preference$ of its selected BGP route to 80 (lower than the default) and set the $Local - Preference$ of any other route to 200 (higher than the default). Conversely, on router AS108r2, for traffic that wants to pass out of router AS108r2 to AS108, if its destination IP address is the IP address of the AS21 network. We then set its $Local - Preference$ to 200 and the other routes to 80. with this configuration, traffic from AS108 to AS21 will exit through AS108r2, and traffic to other ASes will exit through AS108r1.

Incoming Traffic This section focuses on traffic destined for AS108. On router AS108r1, we base the BGP policy update command for **Route-Map** on **Prefix-List**. For any traffic that wants to pass from AS1r1 to AS108, if its destination IP address matches the AS21 network IP address prefix, we reconfigure the $AS - Path$ attribute of its selected BGP route by appending **'AS108 AS108'** to the front end of the $AS - Path$ for that route. Thereby effectively lowering its priority. This ensures that traffic will not choose the AS108 as a transit traffic to reach the AS21. For any traffic that wants to router AS21r1 into AS108, we add **'AS108 AS108'** to the $AS - Path$ attribute

of its selected BGP route, forcing the traffic to use the primary link unless it goes down. The reason for adding two AS Paths is to consider contention for routes to AS2 in favour of the primary link.

Transit Traffic In our design, in fact, AS108 will not be used as part of transit traffic. We can divide the incoming traffic to AS108 into two parts, for the incoming traffic from AS1, it may only adopt AS108 as a transit route to reach AS21, but in our design, for the incoming traffic from AS1, as long as its destination address is AS21, we append **AS-Prefix** to the And for incoming traffic from t it from becoming a transit traffic. For incoming traffic from AS21, we will append the **AS-Prefix** to its route regardless of its destination address. Theoretically, there will be no transit traffic problem except for directly connected traffic from AS21.

We will use the dummy0 interface (a logical IP address) for **iBGP**, while actual IP addresses will be utilized for **eBGP**.And we can add a description of the prefix aggregation at the beginning of the BGP definition, declaring the network and ensuring that only 1.108.0.0/20 is published to other ASes.

3.2 Internet service

This section describes ISP implementation to fulfil service requirements.

3.2.1 DNS

In our design, s1 is used as a **DNS** server and the IP address 1.108.1.2/24 is assigned to it. Each host in our AS will be assigned the domain name 'isp108.lab'. The **DNS** service will be configured using BIND, which will build and manage a database of hostnames and IP addresses in the network, including forward and reverse lookup tables. It also contains the root DNS and the lab DNS information.

3.2.2 Web

The device AS108s3 serves as the **Web** Server within the network. Like the other servers, it is part of the 1.108.1.0/24 subnet and is assigned the IP address 1.108.1.4/24. It can also be accessed using the domain name www.isp108.lab. The main webpage of the server should be a text-based HTTP file. The content is the ASN number of the group and personal information as requested in the project outline.

3.2.3 DHCP

The device AS108s3 functions as the **DHCP** server, while AS108r4 acts as the **DHCP** relay agent. The **DHCP** server is assigned the IP address 1.108.1.3/24 and is accessible via the domain name dhcpd.isp108lab. The isc-dhcp service runs on AS108s3 eth0, and the isc-dhcp-relay service runs on AS108r4 eth0,eth1,eth2. Potential clients use the **DHCP** relay agent to forward DHCP packets to the server through the AS108r3 router. The **DHCP** server manages the 1.108.2.0/24 subnet, assigning IP addresses to clients within the range 1.108.2.2 to 1.108.2.11 by order.