IK2215: Network Design Report

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1 General Information

ASN: 120 **NETWORK:** 1.120.0.0/20

2 Network overview

This section contains an overview of network design.

2.1 Network diagram

The network design is illustrated in Figure 1 below.

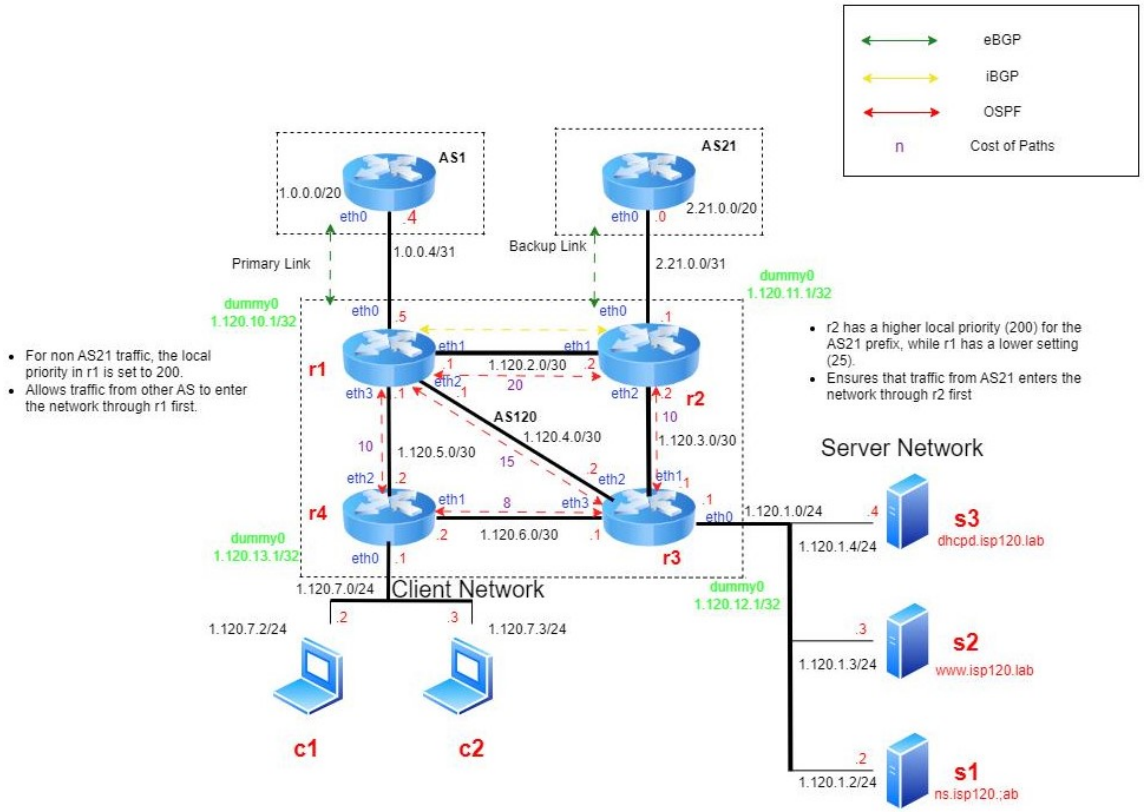

Figure 1: Network Diagram

The ISP network consists of multiple autonomous systems (AS1, AS2, AS3, AS12, AS21, and AS22), with AS1 and AS2 connecting to external DNS servers. At the core is AS120, featuring

four routers (R1, R2, R3, R4) that manage traffic between client (1.120.7.0/24) and server networks (1.120.1.0/24). The client and server networks communicate through R3 and R4, while AS3 serves as a backbone connecting AS1, AS2, and other systems. This setup provides efficient traffic flow, redundancy, and scalability across the ISP's infrastructure.

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.isp120.lab
r1	eth1	1.120.2.1/30	r1eth1.isp120.lab
r1	eth2	1.120.4.1/30	r1eth2.isp120.lab
r1	eth3	1.120.5.1/30	r1eth3.isp120.lab
r1	dummy0	1.120.10.1/32	r1d0.isp120.lab
r2	eth0	2.21.0.1/31	r2eth0.isp120.lab
r2	eth1	1.120.2.2/30	r2eth1.isp120.lab
r2	eth2	1.120.3.2/30	r2eth2.isp120.lab
r2	dummy0	1.120.11.1/32	r2d0.isp120.lab
r3	eth0	1.120.1.1/24	r3eth0.isp120.lab
r3	eth1	1.120.3.1/30	r3eth1.isp120.lab
r3	eth2	1.120.4.2/30	r3eth2.isp120.lab
r3	eth3	1.120.6.1/30	r3eth3.isp120.lab
r3	dummy0	1.120.12.1/32	r3d0.isp120.lab
r4	eth0	1.120.7.1/24	r4eth0.isp120.lab
r4	eth1	1.120.6.2/30	r4eth1.isp120.lab
r4	eth2	1.120.5.2/30	r4eth2.isp120.lab
r4	dummy0	1.120.13.1/32	r4d0.isp120.lab
s1	eth0	1.120.1.2/24	ns.isp120.lab
s2	eth0	1.120.1.3/24	www.isp120.lab
s3	eth0	1.120.1.4/24	dhcpd.isp120.lab
c1	eth0	1.120.7.2/24	c1.isp120.lab
c2	eth0	1.120.7.3/24	c2.isp120.lab

3 Routing and service implementation

This section describes 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 choose OSPF as the Interior Gateway Protocol (IGP) because OSPF is a link-state protocol suitable for dynamic routing in large-scale networks, capable of fast convergence based on link-state changes, and supporting fine-grained network path selection. We are going to plan the traffic by setting up the OSPF path cost and the primary and backup paths. First, we will determine the best path by manually adjusting the cost, the smaller the cost the higher the priority of the path. This will ensure that the cost of each path is unique, thus eliminating equivalent paths, and that the primary path is less costly than the backup path.

We will manually configure the costs of different paths to meet the following requirements:

Cost	r1	r2	r3	r4
r1	X	20	15	10
r2	20	X	10	-
r3	15	10	X	8
r4	10	-	8	X

Table 1: OSPF cost of direct link between routers. X represents a path to itself, - represents there's no direct link.

Table 2 and Table 3 below show the primary and secondary routing paths respectively.

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

Table 2: 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 r3	r3 r4
r2	r3	X	r1 r3	r1 r4
servers	r3 r4	r3 r1	X	r3 r1 r4
clients	r4 r3	r4 r1	r4 r1 r3	X

Table 3: 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

Inside the AS120, an iBGP connection is established between r1 and r2. Among them, r1 is the main internal BGP router, and r2 is the backup. Both routers are configured to advertise the aggregation prefix 1.120.0.0/20, which meets the requirement of only advertising the aggregation prefix and not more specific subnets.

Both routers have outbound routing map MAP_OUT applied. For routes that match the AS21 prefix (2.21.0.0/20), they perform AS path provisioning (prepend 120 120). This setting reduces the attractiveness of the path to AS21 via AS120, prompting other AS to choose the direct path to AS21. r1 establishes a BGP neighbor relationship with AS1 (1.0.0.4), implying that it is the primary egress point.

r2 has a higher local priority (200) for the AS21 prefix, while r1 has a lower setting (25). This ensures that traffic from AS21 enters the network through r2 first. r1 sets a high local priority (200) for non-AS21 traffic. This allows traffic from other AS to enter the network through r1 first.

By configuring similar but complementary policies on R1 and R2, it is ensured that the network will continue to function even when either router is offline. The configuration ensures that the AS120 provides transport services to the AS21 only when necessary (such as a primary link failure) and vice versa. Transmission services are not provided to other ASs.

3.2 Internet service

This section describes ISP implementation to fulfill service requirements.

3.2.1 DNS

S1 is used as a web server with an IP address of 1.120.1.2/24. The domain name 'isp120.lab' will be assigned to each host in the AS. We performed the following steps to complete the DNS server configuration: Using BIND9 and editing the internal files, configure the forward resolution zone for the domain name and create a resolution database file for the zone to define the mapping relationship between the domain name and the IP address. Then, configure the reverse resolution in the same way to ensure that the DNS server works properly. s1 is named 'ns.isp120.lab', s2 is named 'www.isp120.lab', and s3 is named 'dhcpd.isp120.lab'. When hosts receive an IP address from the DHCP server, the DNS IP address and default gateway will be assigned to them.

3.2.2 Web

S2 is used as the Web server. The ip address assigned to it is 1.120.1.3 and it is named as "www.isp113.lab". The web server main page "index.html" contains the following information:

- ASN: 120
- NETWORK: 1.120.0.0/20
- NAME1: <Xintong Mao>
- EMAIL1: <xintongm@kth.se>
- NAME2: <Shreyashee Roy>
- EMAIL2: <shrroy@kth.se>

3.2.3 DHCP

S3 is a DHCP server and r4 is a DHCP relay.The DHCP relay is used to transfer between the DHCP client and the DHCP server that are not in the same subnet, and that's why we select r4 as the DHCP relay. As a result, it requires a direct connection to the DHCP client network segment. However, it is not required to be directly connected to the network segment hosting the DHCP server. so we configure DHCP Relay on r4 to forward the client's DHCP request to the DHCP server.The IP address of s3 is "1.120.1.4/24", the domain name of s3 is "dhcpd.isp120.lab", and the IP address of r4 is "1.120.7.1/24". s3, as the DHCP server, can communicate with the client through r3 and forward the DHCP reply back to the client. During this process the router's routing table is properly configured to allow DHCP Discover and DHCP Offer messages to be transmitted between the client and the server.