IK2215: Network Design Report

Zhuoer LIU
<zhuoer@kth.se>

Saaroopya Gutipalli
<saagut@kth.se>

October 8, 2024

1 General Information

ASN: 113 **NETWORK:** 1.113.0.0/20

2 Network overview

This section contains an overview of network design.

2.1 Network diagram

The network design is illustrated in Figure 1 below.

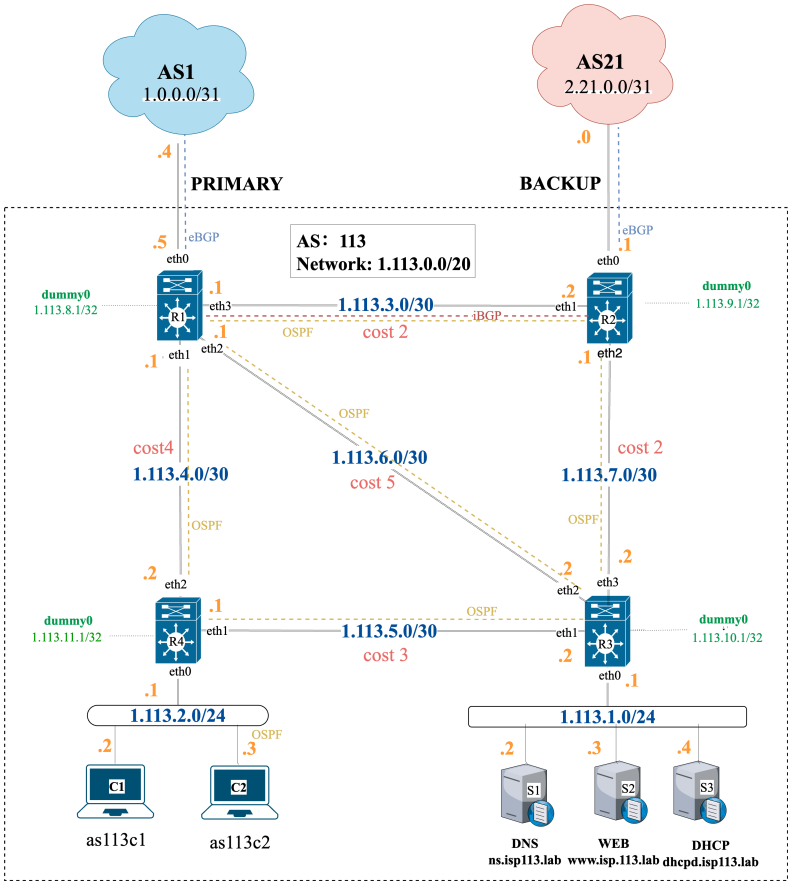

Figure 1: Network Diagram

2.2 IP address allocation

Device	Interface	IP address	Domain name
r1	eth0	1.0.0.5/31	r1eth0.isp113.lab
r1	eth1	1.113.4.1/30	r1eth1.isp113.lab
r1	eth2	1.113.6.1/30	r1eth2.isp113.lab
r1	eth3	1.113.3.1/30	r1eth3.isp113.lab
r1	dummy0	1.113.8.1/32	r1dum0.isp113.lab
r2	eth0	2.21.0.1/31	r2eth0.isp113.lab
r2	eth1	1.113.3.2/30	r2eth1.isp113.lab
r2	eth2	1.113.7.1/30	r2eth2.isp113.lab
r2	dummy0	1.113.9.1/32	r2dum0.isp113.lab
r3	eth0	1.113.1.1/24	r3eth0.isp113.lab
r3	eth1	1.113.5.2/30	r3eth1.isp113.lab
r3	eth2	1.113.6.2/30	r3eth2.isp113.lab
r3	eth3	1.113.7.2/30	r3eth3.isp113.lab
r3	dummy0	1.113.10.1/32	r3dum0.isp113.lab
r4	eth0	1.113.2.1/24	r4eth0.isp113.lab
r4	eth1	1.113.5.1/30	r4eth1.isp113.lab
r4	eth2	1.113.4.2/30	r4eth2.isp113.lab
r4	dummy0	1.113.11.1/32	r4dum0.isp113.lab
s1	eth0	1.113.1.2/24	ns.isp113.lab
s2	eth0	1.113.1.3/24	www.isp113.lab
s3	eth0	1.113.1.4/24	dhcpd.isp113.lab
c1	eth0	1.113.2.2/24	c1.isp113.lab
c2	eth0	1.113.2.3/24	c2.isp113.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 use **OSPF** as an intra-domain routing protocol because the size of our network is not particularly large and the fast convergence of OSPF is what we need.

Table 1 below shows the link costs for our setup.

Path	r1	r2	r3	r4
r1	X	2	5	4
r2	2	X	2	-
r3	5	2	X	3
r4	4	-	3	X

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

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

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

Under normal circumstances, the primary link is used for all traffic in and out during normal operation. The backup link is used for traffic to and from the neighboring AS (AS21) and is enabled in the event of a failure of the primary link. Our ISP only advertises the aggregation prefix for this network, which is 1.113.0.0/20, in all BGP routing updates; no more specific subnet prefixes are allowed.

BGP routing policy configuration is mainly used to control the path selection priority of traffic to and from the AS113. We chose to influence the flow of traffic between AS113 and other ASes by adjusting the BGP local-preference attribute and AS-PATH prepend. First we use *IP Prefix-List* to match out AS21 traffic(2.21.0.0/20).

- Inbound Routing Policy

For any traffic traveling from AS1 to AS113 with a destination IP that matches the AS21 network prefix, we adjust the *AS path* attribute on the chosen BGP route by prepending *AS113 AS113* to the AS path. This reduces the route's preference, ensuring that AS113 is not selected as a transit path to reach AS21. Similarly, for traffic routing from AS21 to AS113, we prepend *AS113 AS113* to the AS path of the chosen BGP route, thereby prioritizing the primary link for the traffic unless a failure occurs on that link.

- Outbound Routing Policy

Traffic originating from AS108 uses *Local-Preferences* to manage outbound traffic. To manage outbound traffic from AS113, we utilize *Local Preference* settings. By applying a BGP policy update command on router AS113r1 with a route-map that is based on a prefix list, we direct traffic out of AS113. Specifically, the local preference is set to 50 (below the default) for the chosen BGP route, while any other routes have a local preference set to 150 (above the default). Similarly, on router AS113r2, if traffic is destined for AS21 and originates from AS113, it will exit through AS113r2. Therefore, traffic from AS113 to AS21 routes through AS113r2, while traffic to other Autonomous Systems exits via AS113r1.

- Transit Traffic In our design, AS113 is not intended to serve as a transit path. For incoming traffic from AS1 with a destination in AS21, we prepend the AS-Prefix to the route to prevent AS113 from being used as a transit. Likewise, for any incoming traffic from AS21, we prepend the AS-Prefix to the route, irrespective of its destination. This setup should theoretically eliminate transit traffic issues, with the only exception being traffic that is directly connected from AS21.

We use dummy0 for iBGP and use IP address for eBGP. The dummy interface of AS113r1 is 1.113.8.1/32; the dummy interface of AS113r2 is 1.113.9.1/32.

3.2 Internet service

This section describes ISP implementation to fulfill service requirements.

3.2.1 DNS

Within an ISP, a DNS server is primarily used to resolve domain names to IP addresses, ensuring that users can access Internet resources quickly and easily. In our design, AS113s1 is used as the web server and IP address 1.113.1.2/24 is assigned to it. Each host within tour AS will be assigned with the domain "isp113.lab". BIND 9 is used to set up the DNS service in order to create and maintain a distributed host name and address database for computers on the network. We will configure it first and use it to ensure the DNS service works as expected. The AS113s1 is named ns.isp113.lab, AS113s2 is named www.isp113.lab and AS113s3 is named dhcpd.isp113.lab. The DNS IP address and default gateway will be assigned to the hosts when they receive the ip address from DHCP server.

3.2.2 Web

AS113s2 is used as the Web server. IP address is 1.113.1.3. and domain name is web.isp113.lab. The web server main page should be a simple text-based page named index.html and contain the following information:

- ASN:113
- NETWORK:1.113.0.0/20
- NAME1: <Zhuoer Liu>
- EMAIL1: <zhuoer@kth.se>
- NAME1: <Saaroopya Gutipalli>
- EMAIL1: <saagut@kth.se>

3.2.3 DHCP

The DHCP server and the DHCP relay play an important role in automatically assigning IP addresses and managing network resources. In our design, AS113s3 is used as the DHCP server and AS113r4 is the DHCP relay. The IP address allocated to the DHCP is 1.113.1.4 and named as dhcpd.isp113lab. The DHCP relay is used to transfer between the DHCP client and the DHCP server that are not in the same subnet,and so that's the main reason r4 is selected as the DHCP relay.

We initiate isc-dhcp service on AS113s3 and initiate isc-dhcp-relay service on AS113r4. The subnet which DHCP server service for is 1.113.2.0/24 and IP address assingned to the clients are 1.113.2.2 and 1.113.2.11.