IK2215: Network design report

1 General information

ASN: <AS120>

NETWORK: 1.120.0.0/20

NAME1: <Yuyang Liu>

EMAIL1: <yyliu@kth.se>

NAME2: <Weiran Wang>

EMAIL2: <weiranw@kth.se>

2 Network overview

2.1 Network diagram

Figure 1 demonstrates how AS120 is working, i.e., the intra-operation in AS120. As can be seen in Figure 1, there are four routers (r1, r2, r3 and r4) and five hosts (three servers i.e., s1, s2 and s3, and two clients, c1 and c2). Specifically speaking, r1 and r2 play the role of eBGP which connects to AS1 and AS2 respectively. Furthermore, r1 also connects with r2, r3 and r4. Correspondingly, r3 connects with r2 and r4. Three servers are connected to r3 as well and among them, s1 is used as a DNS server in AS120 and cannot run other Internet services. The r4 is connected to a client network with two clients, which get networking information automatically from a DHCP server that resides in a server network. The clients are mainly used to verify that everything is working correctly. The more detailed information such as an IP address block, interfaces will be given in section 2.2 IP address allocation.

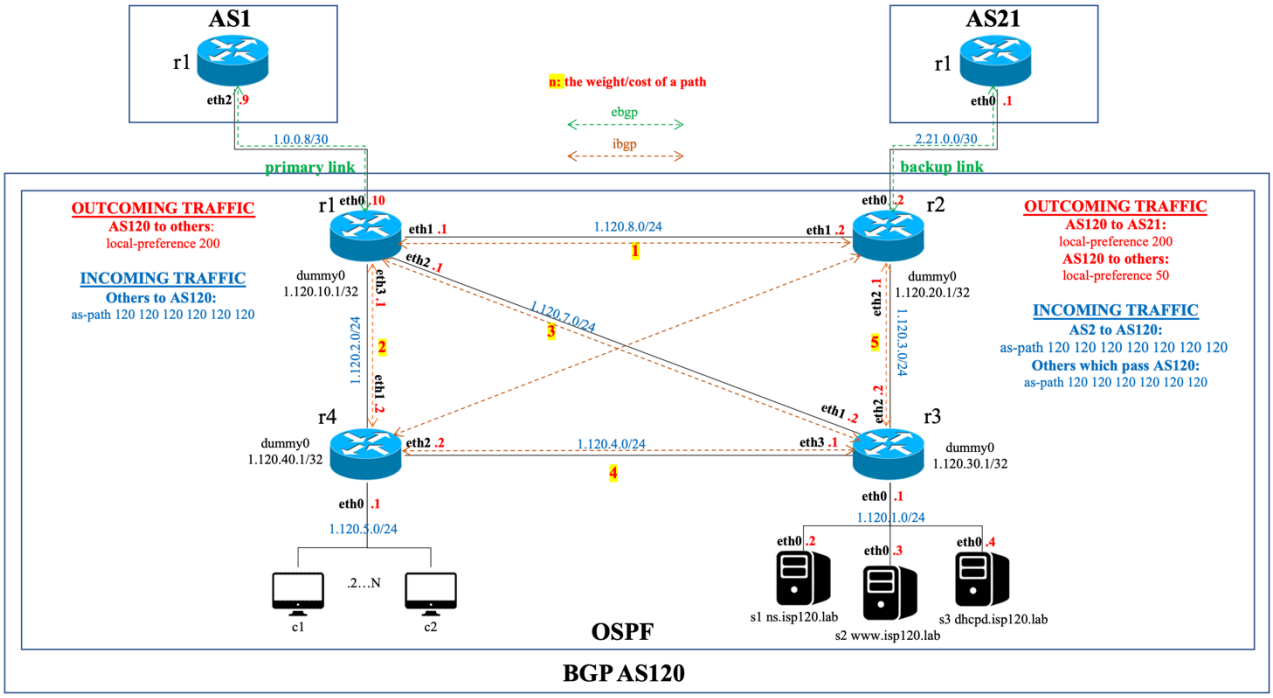


Fig.1 topology graph

2.2 IP address allocation

A constructed ip address allocation is shown in the table 1 below.

Table 1 ip address allocation

Device	Interface	Subnet	IP Address
		AS120	
r1	eth0	1.0.0.8/30	1.0.0.10
	eth1	1.120.0.0/24	1.120.8.1
	eth2	1.120.7.0/24	1.120.7.1
	eth3	1.120.2.0/24	1.120.2.1
	dummy0		1.120.10.1/32
r2	eth0	2.21.0.0/30	2.21.0.2
	eth1	1.120.0.0/24	1.120.8.2
	eth2	1.120.3.0/24	1.120.3.1
	dummy0		1.120.20.1/32
r3	eth0	1.120.1.0/24	1.120.1.1
	eth1	1.120.7.0/24	1.120.7.2
	eth2	1.120.3.0/24	1.120.3.2
	eth3	1.120.4.0/24	1.120.4.1
	dummy0		1.120.30.1/32

r4	eth0	1.120.5.0/24	1.120.5.1
	eth1	1.120.2.0/24	1.120.2.2
	eth2	1.120.4.0/24	1.120.4.2
	dummy0		1.120.40.1/32
client			
c1	eth0	1.120.5.0/24	
c2	eth0	1.120.5.0/24	
server			
s1	eth0	1.120.1.0/24	1.120.1.2
s2	eth0	1.120.1.0/24	1.120.1.3
s3	eth0	1.120.1.0/24	1.120.1.4

3 Routing and service implementation

3.1 Routing

3.1.1 Intra-domain routing

We are going to use the OSPF protocol as the intra-domain routing.

OSPF uses Dijkstra, the shortest path algorithm, to determine the transmission route. It converges faster and doesn't need to send update messages regularly. The routing broadcast update of the OSPF only occurs when the routing status changes. And OSPF uses ip multicast to send link status update information, which can save bandwidth to some extent.

We will change the cost on every single router manually to make sure that traffic will traverse a certain path we want and there are no equal-cost paths between two end-to-end points. In addition, we choose the r1 to be the edge router and the r2 to be the backup edge router. Since AS1 is the top-tier provider of AS120 and it is directly connected to the r1, we manage our routers' cost in a certain way to make the packets all traverse through r1 in normal operations.

For further details about a certain path, Figure 1 can be referred according to the OSPF protocol.

As is shown in network topology diagram, all routers have at least two disjoint paths and the network stays operational when one of the internal links fails. The primary and second path a certain traffic will traverse are as below:

- r1 to client and vice versa:

  Primary path: r1 - r4 - client network (1.120.2.0/24, 1.120.5.0/24)

  Secondary path: r1 - r3 - r4 - client network (1.120.7.0/24, 1.120.4.0/24, 1.120.5.0/24)

- r2 to client and vice versa:

  Primary path: r2 - r1 - client network (1.120.8.0/24, 1.120.2.0/24, 1.120.5.0/24)

Secondary path: r2 - r1 - r3 - r4 - client network (1.120.0.0/24, 1.120.7.0/24, 1.120.4.0/24, 1.120.5.0/24)

- r1 to server and vice versa:

  Primary path: r1 - r3 - server network (1.120.7.0/24, 1.120.1.0/24)

  Secondary path: r1 - r2 - r3 - server network (1.120.8.0/24, 1.120.3.0/24, 1.120.1.0/24)

- r2 to server and vice versa:

  Primary path: r2 - r3 - server network (1.120.3.0/24, 1.120.1.0/24)

  Secondary path: r2 - r1 - r3 - server network (1.120.8.0/24, 1.120.7.0/24, 1.120.1.0/24)

- client to server and vice versa:

  Primary path: client network - r4 - r3 - server network (1.120.5.0/24, 1.120.4.0/24, 1.120.1.0/24)

  Secondary path: client network - r4 - r1 - r3 - server network (1.120.5.0/24, 1.120.2.0/24, 1.120.7.0/24, 1.120.1.0/24)

3.1.2 Inter-domain routing

According to the Project Guideline, the requirements for inter-domain routing are as followed:

- Use the primary link to AS1 for all traffic except for AS21 (both for incoming and outcoming)
- Use the direct and backlink to connect with AS21.
- ASes cannot use AS120 as a transit to other ASes during normal operation.

We will set up a BGP area which contains r1-r4, where r1 will be the DR and the r2 will be the BDR in AS120. Furthermore, we will reset the ***local-preference*** and use ***route-map***, ***access-list***, ***as-path prepend*** and many other commands to make sure that those packets whose destination is other autonomous systems will go over the primary link in normal operations and go over the backup links if a certain link breaks down. Routers running BGP will select the next hop regarding local-preference and as-path under the same attributes:

- First, BGP prefers the path with a higher local-preference.
- Then, BGP prefers the path with a shorter as-path.

For packets coming out of AS120 (outcoming traffic), the local preference of r1 for all other ASes will be set to 200 which is above the default value i.e., 100. At the same time, we use the '***match ip address***' to filter the traffic originating from as120r2 to as21r1 out and set the local preference to 200. Moreover, the local preference of other traffic whose destination is any other ASes to 50. By doing so, we can enhance the private link between AS120 and AS21 and make packets go over the primary link to other autonomous systems.

For the packets incoming to AS120 (incoming traffic), we will filter the ip address by whether its destination is AS120 or it just passes by AS120. The specific operation for as120r1 and as120r2 incoming traffic is as followed.

For the potential traffic which may just pass the AS120, on as120r1 we use the '***as-path prepend***' command to add 6 virtual as-paths which is shown like 'set as-path prepend 120 120 120 120 120 120'. Simultaneously, for as120r2, we do nothing on the traffic between as120r2 and as2r1, but for the rest of ASes which are about to use AS120 as a transfer autonomous system, 6 virtual as-paths are added to avoid this circumstance. Besides, to meet the requirement that other ASes cannot use AS21 to enter AS120, 7 virtual as-paths are added.

By this way, the private link is enhanced even if there is a link failure in or out of the AS120, e.g. the failure of the link between as120r1 and as1r1 or the failure of the link between as1r1 and as2r2. What's more, by doing so can we prevent the potential loop at the same time, because there will always be a best path and an optional path.

As for internal BGP peerings, we will use dummy0 address and for external BGP peers we will use ip address. The ip of dummy interface of rX is 1.120.X0.1/32 where X is a variable ranging from 1 to 4, e.g. the dummy interface of r1 is 1.120.10.1/32.

3.2 Internet service

3.2.1 DNS

According to the project guideline, s1 is used for the web server and an ip address of 1.120.1.2/24 is assigned to it.

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 our network. Since BIND 9 is already installed on the container in the docker image, we can configure it first and then use it directly to ensure that our DNS service works as expected. The as120s1 is named as ns.isp120.lab, as120s2 is named as www.isp.lab and as120s3 is named as dhcp.isp120.lab.

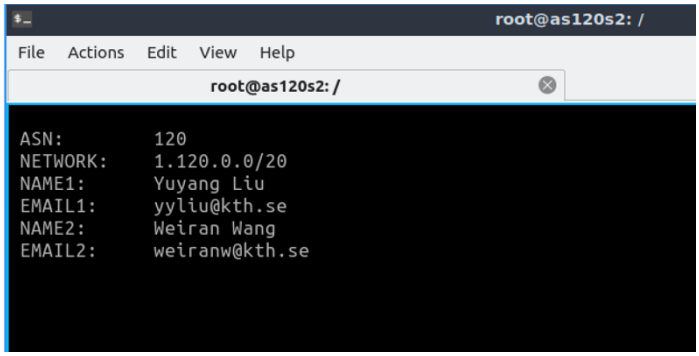
By using ip helper-address command on r4, any DHCP query will automatically be forwarded to the server. Both forward lookup and reverse lookup can be used in our project. The DNS ip address and default gateway are also assigned to the hosts when they receive the ip address from DHCP Server.

ns.isp120.lab	1.120.1.2
dhcpd.isp120.lab	1.120.1.4
www.isp120.lab	1.120.1.3
gw.isp120.lab	1.120.1.1
gw-client.isp120.lab	1.120.5.1

3.2.2 Web

s2 is used for the web server and ip address 1.120.1.3/24 with eth0 is assigned.

In Apache2, We change the default configuration of 000-default.conf file into:”Server Name: isp120.lab, DocumentRoot /var/www/html/index.html” and we also edit the index.html file by vim. The contents which will be implementing are



3.2.3 DHCP

s3 is used for the DHCP server and r4 is the DHCP relay agency. The ip address 1.120.1.4/24 with eth0 is assigned to the DHCP server and 1.120.5.1 is assigned

We initiate isc-dhcp-server service on as120s3 and initiate isc-dhcp-relay service on as120r4. The subnet which the dhcp server service for is 1.120.5.0 and the ip address assigned randomly to the clients is range from 1.120.5.10 to 1.120.5.99.