

# IK2215: Network Design Report

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## 1 General Information

ASN: 107

NETWORK: 1.107.0.0/20

## 2 Network overview

Figure 1 shows the ISP network designed in this lab project. Four routers (r1, r2, r3, r4), three servers (s1, s2, s3) and two clients (c1, c2) are connected in this network. The four routers use OSPF as intra-domain routing protocol. R1 and r2 respectively uses eBGP peering with routers in AS1 and AS21, while peering with each other using iBGP. Three servers, including DNS server, Web server and DHCP server, are connected to one subnet with r3. Two clients are linked to r4 (DHCP relay agent). These clients are assigned with dynamic IP address and domain name by DHCP server.

### 2.1 Network diagram

The network design is illustrated in Figure 1 below.

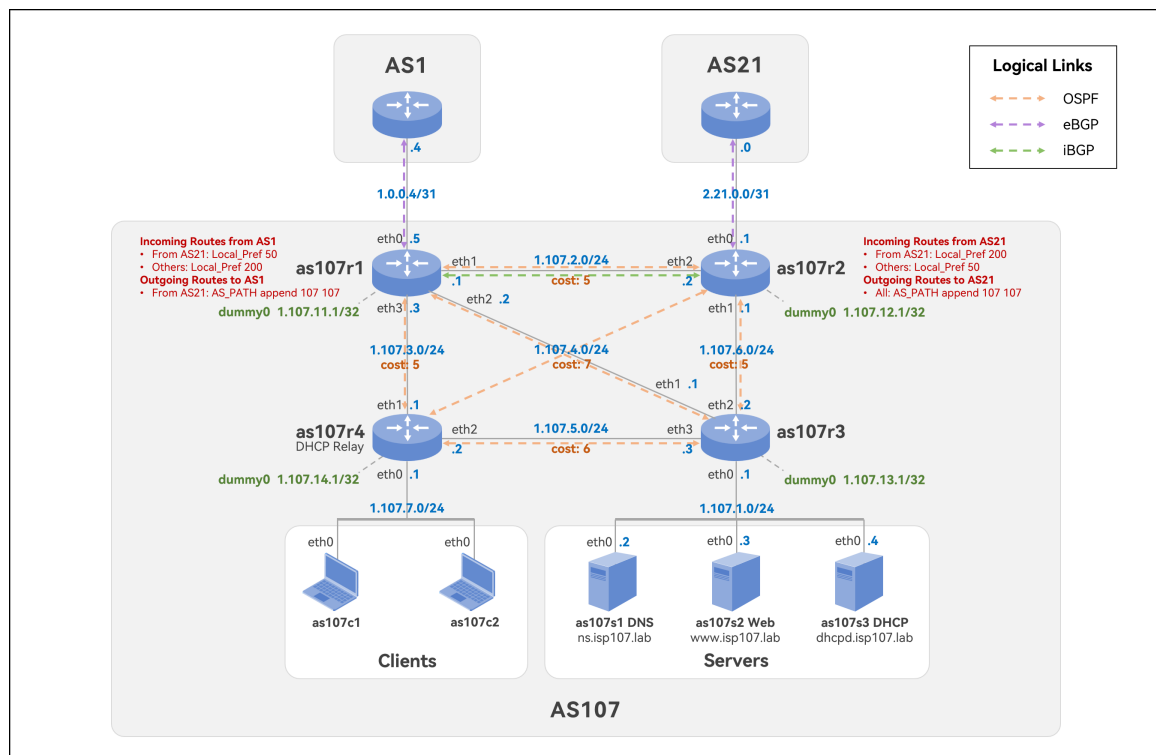


Figure 1: Network Diagram

## 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
as107r1	eth0	1.0.0.5/31	r1eth0.isp107.lab
as107r1	eth1	1.107.2.1/24	r1eth1.isp107.lab
as107r1	eth2	1.107.4.2/24	r1eth2.isp107.lab
as107r1	eth3	1.107.3.3/24	r1eth3.isp107.lab
as107r1	dummy0	1.107.11.1/32	r1dum.isp107.lab
as107r2	eth0	2.21.0.1/31	r2eth0.isp107.lab
as107r2	eth1	1.107.6.1/24	r2eth1.isp107.lab
as107r2	eth2	1.107.2.2/24	r2eth2.isp107.lab
as107r2	dummy0	1.107.12.1/32	r2dum.isp107.lab
as107r3	eth0	1.107.1.1/24	r3eth0.isp107.lab
as107r3	eth1	1.107.4.1/24	r3eth1.isp107.lab
as107r3	eth2	1.107.6.2/24	r3eth2.isp107.lab
as107r3	eth3	1.107.5.3/24	r3eth3.isp107.lab
as107r3	dummy0	1.107.13.1/32	r3dum.isp107.lab
as107r4	eth0	1.107.7.1/24	r4eth0.isp107.lab
as107r4	eth1	1.107.3.1/24	r4eth1.isp107.lab
as107r4	eth2	1.107.5.2/24	r4eth2.isp107.lab
as107r4	dummy0	1.107.14.1/32	r4dum.isp107.lab
as107s1	eth0	1.107.1.2/24	ns.isp107.lab
as107s2	eth0	1.107.1.3/24	www.isp107.lab
as107s3	eth0	1.107.1.4/24	dhcpd.isp107.lab
as107c1	eth0	1.107.7.10...20/24	client10...20.isp107.lab
as107c2	eth0	1.107.7.10...20/24	client10...20.isp107.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

The intra-domain routing configuration involve four routers within AS107: r1, r2, r3, and r4. Considering routing protocols like RIP using hops as metric will lead to several equal costs in routing. OSPF routing is used as intra-domain routing protocol to introduce link costs to control the configuration of primary paths and secondary paths.

As107r1 and as107r2, as border routers, inject BGP routes in other routers thus to control routing inside the AS. Besides, the design avoids loop by manipulating the IGP metric on as107r2, at the same time support traffic inside AS107 flowing from as107r2 to as107r1.

Table 1 and Table 2 below show the primary and secondary routing paths within AS107 respectively.

#### 3.1.2 Inter-domain routing

It is required that under normal circumstances the connection between as107r1 and as1r1 is used as primary link. The connection between as107r2 and as21r1 is used as backup link as well as a direct connect link (A direct link between as107r2 and as21r1 means the traffic between the two ASes will use this link instead of the primary link).

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

In the AS107 network, as107r1 and as107r2 are BGP border routers. There is iBGP peering between as107r1 and as107r2, eBGP peering between as107r1 and as1r1, and another eBGP peering between as107r2 and as21r1.

In this project, the configuration of inter-domain routing considers the traffic attempt to get in/out of AS107 as well as traffic that potentially pass AS107. As107r1 and as107r2 use inbound filtering to limit routes redistributed from IGP to BGP. They also use next-hop-self to configure reachability and routes to other ASes. The design use 'network 1.107.0.0/20' to add the aggregate prefix to BGP. To meet the designing requirement, the design configures Local Preference and AS Path are configured in the design. The design also use route maps and IP prefix filter to selectively control the traffic.

**Outgoing Traffic** This part only consider the traffic originates from AS107. The design use Local Preference to control the outgoing traffic. On as107r1, the Local Preference of routes including AS21 are set to 50 (lower than default), while the Local Preference of other routes are set to 200 (higher than default). On as107r2, the Local Preference of routes including AS21 are set to 200, while the others set to 50. By configurations above, traffic from AS107 to AS21 will use as107r2 as exit, and traffic to other ASes will use as107r1 instead.

**Incoming Traffic** This part only consider the traffic set AS107 as its destination. The design use AS Path to control the incoming traffic. On as107r1, incoming traffic that includes IP addresses in AS21 will be appended 'AS107 AS107' to its AS Path to make the path longer, thus have lower priority. This will insure traffic from AS21 prefer the direct link to as107r2. On as107r2, all incoming traffic will have their AS Path appended 'AS107 AS107', this will force traffic to use the primary link (when its not fail). AS21 will still use the direct link because it's shorter than another.

**Passing Traffic** Since AS107 will make AS Path of traffic from AS21 to AS107 longer, traffic will not use AS107 as transit network and pass to other ASes. For example, when selecting route from AS21 to AS1, the path going through AS107 will be prepended extra AS paths. In this way, the path going through AS2 will be selected instead for it is shorter.

**Primary Link Failure** The routing configuration is based on dynamic routing, so the routing will automatically change when failure occurs. When there is link failure, another link will be used since all the routing information is broadcast and routes are known to other ASes. When a route with shorter AS Path is down, another route will take its place. The same will apply for routes affected by Local Preference.

Dummy0 interfaces are used for BGP peering to avoid routing failure when certain link is down. By the configuration above, the routing of AS107 will fulfill the design requirement.

## **3.2 Internet service**

This section describes ISP implementation to fulfill service requirements.

### **3.2.1 DNS**

The device as107s1 is used as the DNS Server. It is located under the 1.107.1.0/24 subnet together with other available servers. The DNS has an 1.107.1.2 IP address. As other servers, it will be connected through the eth0 interface into the as107r3 router. It will also be available under the ns.isp107.lab domain. We ensure the integrity of the DNS service by having it be connected to as107r3 which can be accessed directly from other available routers in the network. Thus, a potential client that is connected to as107r4 would forward the request to as107r3 which then would forward to its final destination at the DNS server. For that we will use BIND9 configuration for the DNS service, with it we can configure forward and reverse addresses and zones addresses look-ups to be used to and from other devices.

### **3.2.2 Web**

The device as107s2 is used as the the Web Server of the network. Similarly, to other servers, it is under the 1.107.1.0/24 subnet, and has an IP address of 1.107.1.3. It is also accessible through www.isp107.lab domain name. We have setup our web server by running an Apache HTTP server.

### **3.2.3 DHCP**

The device as107s3 is used as the DHCP Server, and the as107r4 is used as the DNS Relay. The DHCP Server has an IP address of 1.107.1.4, and also has a dhcp.isp107.lab domain name. The potential clients will use the DHCP Relay agent to forward the DHCP packets to the DHCP Server through the as107r3 router. We have configured the DHCP services using the ISC DHCP service, by applying the ISC DHCP Relay on the as107r4 on its eth0, eth1, eth2 interfaces, and ISC DHCP Server on the as107s3 on the eth0 interface. This configuration allows the clients acquire dynamic IP addresses from the DHCP server.