Address Space Allocation

This document describes the IP address plan we will use for this set of workshop exercises.

Wherever possible the plan tries to replicate real life as closely as possible.

The IPv4 address space used in these exercises is from subnets of 100.64.0.0/10 which is an IPv4 Shared Address block. **It must not be routed on the Internet.**

Note that 2001:DB8::/32 is the IPv6 Documentation Address block. **It must not be routed on the Internet.**

And finally note that the 2001:10::/28 address block has been listed in the IANA special registry for future use. **It must not be routed on the Internet.**

If using these labs as inspiration for your own infrastructure design, please replace all instances of private, documentation, and unassigned address space with your own address blocks.

End-Site networks

Typically end-site networks (such as Universities, Colleges, etc) will receive a public IPv6 /48 and a very small public IPv4 block from their network operator (be it an ISP and/or their NREN)

We will use an IPv4 /24 for these exercises, reflecting the fact that in reality an end-site organisation will use a large private block like a /16 internally, NATed out into a small public IPv4 block like the /24 we are using here. (The private IPv4 address space is included for completeness, but is not used in these exercises as we are focusing on the BGP and traffic engineering needs of Universities and NRENs.)

Group	Public IPv4	Private IPv4	IPv6	ASN
1	100.68.10.0/24	172.21.0.0/16	2001:DB8:10::/48	10
2	100.68.20.0/24	172.22.0.0/16	2001:DB8:20::/48	20
3	100.68.30.0/24	172.23.0.0/16	2001:DB8:30::/48	30
4	100.68.40.0/24	172.24.0.0/16	2001:DB8:40::/48	40
5	100.68.50.0/24	172.25.0.0/16	2001:DB8:50::/48	50
6	100.68.60.0/24	172.26.0.0/16	2001:DB8:60::/48	60

The list will continue in the same pattern if there are more groups.

Each group will then further partition their space as follows:

IPv4	IPv6	Description
100.68.X0.0/24	2001:DB8:X0::/48	Group address block
100.68.X0.0/26	2001:DB8:X0:0000::/50	Infrastructure space
100.68.X0.0/28	2001:DB8:X0:0000::/64	Router loopbacks
100.68.X0.16/28	2001:DB8:X0:0010::/60	Point-to-point links

100.68.X0.64/26	2001:DB8:X0:4000::/50	End user space 1
100.68.X0.128/26	2001:DB8:X0:8000::/50	End user space 2
100.68.X0.192/26	2001:DB8:X0:C000::/50	End user space 3

Where X is your group number (1,2,3...).

Prefixes for point-to-point links will be of length /30 for IPv4 and /127 for IPv6 (we will adopt the recommendations of RFC6164 for IPv6 inter-router links where we reserve a /64 for the link but subnet it as a /127):

IPv4	IPv6	Description
100.68.X0.16/30	2001:DB8:X0:10::/127	P2P #1
100.68.X0.20/30	2001:DB8:X0:11::/127	P2P #2
100.68.X0.24/30	2001:DB8:X0:12::/127	P2P #3
100.68.X0.28/30	2001:DB8:X0:13::/127	P2P #4

Router loopback address subnet masks will be /32 for IPv4 and /128 for IPv6:

IPv4	IPv6	Description
100.68.X0.1/32	2001:DB8:X0::1/128	BX1 Loopback
100.68.X0.2/32	2001:DB8:X0::2/128	BX2 Loopback
100.68.X0.3/32	2001:DB8:X0::3/128	CX1 Loopback

Note that the convention used here assigns the beginning of the IPv4 and IPv6 address space for use for infrastructure. This is generally a matter of choice: some network operators use the beginning of the space, others use the end of the space.

Commercial Internet Service Providers (ISPs)

Commercial network operators receive at minimum an IPv6 /32 from their regional internet registry. IPv4 allocations can range upwards from /22. We will use an IPv4 /16 for our exercises.

ISP	IPv4	IPv6	ASN
1	100.121.0.0/16	2001:18::/32	121
2	100.122.0.0/16	2001:19::/32	122

The point-to-point link addresses from the ISPs to the End-sites are listed next. Note that the ISP will get the low address, and the end-site gets the high address in the subnet.

Group	IPv4	IPv6
1	100.121.1.0/30	2001:18:0:10::/127
2	100.121.1.4/30	2001:18:0:11::/127
3	100.121.1.8.30	2001:18:0:12::/127
4	100.122.1.0/30	2001:19:0:10::/127
5	100.122.1.4/30	2001:19:0:11::/127
6	100.122.1.8/30	2001:19:0:12::/127

Note: The numbering started at the second /24 for the IPv4 point-to-point links to “end customers”.

The first /24 is kept for number infrastructure within the ISP, for example: loopbacks, internal point-to-point links, etc. The same applies to IPv6, where the first sixteen /64s were kept for loopbacks (the first /64) and internal point-to-point links (the next fifteen /64s).

National RENs (NRENs)

NRENs, like all network operators, receive at minimum an IPv6 /32 for their infrastructure. IPv4 allocations can range upwards from /22. We will use an IPv4 /16 for our exercises.

NREN	IPv4	IPv6	ASN
1	100.101.0.0/16	2001:11::/32	101
2	100.102.0.0/16	2001:12::/32	102

The point-to-point link addresses from the NRENs to the Campuses are listed next. Note that the NREN will get the low address, and the end-site gets the high address in the subnet.

Group	IPv4	IPv6
1	100.101.1.0/30	2001:11:0:10::/127
2	100.101.1.4/30	2001:11:0:11::/127
3	100.101.1.8.30	2001:11:0:12::/127
4	100.102.1.0/30	2001:12:0:10::/127
5	100.102.1.4/30	2001:12:0:11::/127
6	100.102.1.8/30	2001:12:0:12::/127

And finally we need addresses for the point-to-point links between the NRENs and ISPs. (As with previously, we keep the first /24 of IPv4 and first 16 /64s of IPv6 for the NREN's internal infrastructure.)

NREN - ISP	IPv4	IPv6
1	100.101.2.0/30	2001:11:0:20::/127
2	100.102.2.0/30	2001:12:0:20::/127

Regional REN (RREN)

Regional RENs, like all network operators, receive at minimum an IPv6 /32 for their infrastructure. IPv4 allocations can range upwards from /22. We will use an IPv4 /16 for our exercises.

We only need one RREN for this lab:

RREN	IPv4	IPv6	ASN
1	100.100.0.0/16	2001:10::/32	100

And we need addresses for the point-to-point links between the RREN and the NRENs. (As with previously, we keep the first /24 of IPv4 and first 16 /64s of IPv6 for the RREN's internal infrastructure.)

RREN-NREN	IPv4	IPv6

1	100.100.1.0/30	2001:10:0:10::/127
2	100.100.1.4/30	2001:10:0:11::/127

Internet Exchange Points (IXPs)

Internet Exchange Points do not have specific IP address needs outside of the peering LAN and the IXP Services infrastructure. The minimum allocation for an IXP would be a /24 for IPv4 and /64 for IPv6, so that the routers connecting to the IXP LAN have an IP address on that LAN. IXPs only need an ASN if they have a device known as a Route Server.

We have one IXP in this lab, serving as the peering interconnection point between the ISPs and the RREN. (An ASN is included for completeness.)

IPv4	IPv6	ASN
100.127.1.0/24	2001:DB8:FFFF:1::/64	65534

And the address assignments made at the IXP are as follows:

Peer	IPv4	IPv6
ISP1	100.127.1.1	2001:DB8:FFFF:1::1
ISP2	100.127.1.2	2001:DB8:FFFF:1::2
RREN	100.127.1.3	2001:DB8:FFFF:1::3