IPv6 FUNDAMENTALS TRAINING COURSE

The "IPv6 Fundamentals Training Course" is a one-day in person course that tackles what IPv6 is and the need for IPv6 in today's networks. It also includes basic information on how to plan your deployment and addressing plans.

Goals

- Explain what IPv6 is and its format
- Identify the different types of IPv6 Addresses
- Learn about obtaining an IPv6 allocation, address space types, and registering them in the RIPE Database
- Explain the IPv6 protocol functions with a focus on the Neighbor Discovery Protocol and address auto-configuration
- Understand how best to plan an IPv6 deployment

Pre-Requisites

It is assumed you are familiar with common IP terminology and have practical knowledge of running an IP network.

Course Content

- Introduction
- IPv4?
- IPv6 Address Basics
- Getting it
    - *Exercise: Making Assignments*
- IPv6 Protocol Basics
    - *Exercise: Addressing Plan*
- IPv6 Packets
- Deploying
    - *Exercise: Configuring IPv6*
- Real life IPv6 Deployments
- Tips

- Training Material: **https://www.ripe.net/training-material**
- Feedback Survey: **https://www.ripe.net/feedback/bv6//**
- Contact us: **learning@ripe.net**
- Learning and Development Services: **www.ripe.net/support/training**

Training Material

RIPE NCC

IPv6 Address Notation Exercise

In case multiple answers are possible, please circle all correct ones.

1. You have a /32 prefix starting with 2001:0db8. How do you search for it in the RIPE Database?

A. 2001:0db8
B. 2001:0db8/32
C. 2001:0db8::/32
D. 2001:db8::/32

2. How do you correctly compress the following IPv6 address:

2001:0db8:0000:0000:0000:0000:0000:0c50

A. 2001:0db8:0:0:0:0:0:0c50
B. 2001:0db8::0c50
C. 2001:db8::c50
D. 2001:db8::c5

3. How do you correctly compress the following IPv6 address:

2001:0db8:0000:0000:b450:0000:0000:00b4

A. 2001:db8::b450::b4
B. 2001:db8::b450:0:0:b4
C. 2001:db8::b45:0000:0000:b4
D. 2001:db8:0:0:b450::b4

4. How do you correctly compress the following IPv6 address:

2001:0db8:00f0:0000:0000:03d0:0000:00ff

A. 2001:0db8:00f0::3d0:0:00ff
B. 2001:db8:f0:0:0:3d0:0:ff
C. 2001:db8:f0::3d0:0:ff
D. 2001:0db8:0f0:0:0:3d0:0:0ff

5. How do you correctly compress the following IPv6 address:

2001:0db8:0f3c:00d7:7dab:03d0:0000:00ff

A. 2001:db8:f3c:d7:7dab:3d:0:ff
B. 2001:db8:f3c:d7:7dab:3d0:0:ff
C. 2001:db8:f3c:d7:7dab:3d0::ff
D. 2001:0db8:0f3c:00d7:7dab:03d::00ff

6. How do you access your IPv6 webserver at 2001:db8::8080 on port 8080 using a web browser?

A. https://2001:db8::8080:8080
B. https://2001:0db8:0000:0000:0000:0000:0000:8080:8080
C. https://[2001:db8::8080]:8080
D. You cannot use the IPv6 address, you have to rely on DNS

For more information, please read RFC 5952 - A Recommendation for IPv6 Address Text Representation

Making Assignments

The goal of this exercise is to practice the assignment process. The work is done in groups so that you can learn from each other. Your group's task is to make an IPv6 assignment and register the assignment in the RIPE Database.

Assumptions

You work for the LIR nl.ripencc-ts.
Your LIR has a /32 allocation: 2001:db8::/32

You are working together with a start-up company called Future Casa on a project called "Smart Home 6".
Future Casa wants to use IPv6 address space from your registry.
You will announce the space aggregated in your allocation.
Future Casa will use LTE (4G) to connect each home and all the homes are in the same network. Each home gets an IPv6 block from a pool when the base unit is connected.

Product Description

The "Smart Home 6" project is an ambitious one. Each home will be equipped with a base unit that connects wirelessly to the nearest 4G access point. No cables are required! The base unit will serve as a central hub for a variety of different devices that can be connected and controlled from an app on your smartphone or computer. Most of the devices will also have manual controls on them.

The devices that can be connected are supported by the services provided within the "Smart Home 6" framework.



These services include:

- controlling the house lights
- monitoring window and door activity
- a closed-circuit webcam monitoring system
- temperature meters that can interact with the room heating devices
- controlling and monitoring several household appliances, like the refrigerator
- VoIP communication devices to make phone calls from any room
- a home wifi router to connect your computers and other Internet devices
- a wifi guestnet for visitors

At any moment, a customer can subscribe (or unsubscribe) to any of the smart home services that are offered. The base unit will automatically configure a subnet for the new service, depending on the QoS and security settings defined by the vendor and the user.

New services and devices are being developed and will be automatically supported by the Smart Home 6 base unit in the near future.

Phase 1

For phase 1, Future Casa wants to connect 4000 Smart Homes.

Collect Information

- Read the product description and options, and ask questions to the product manager from Future Casa to determine the size of the assignment per smart home
- Consider the IPv6 prefix size per smart home

What is the total amount of address space you will need to connect all the smart homes?

How would you register the address space in the RIPE Database?

Phase 2

If this project is a success, in the foreseeable future Future Casa wants to connect one million smart homes. This is Phase 2 of the project.

What is the total amount of address space you will need to connect all the smart homes?

How would you register the address space in the RIPE Database?



Making Assignments - Phase 1

inet6num:	
netname:	
descr:	
country:	
admin-c:	FC1356-RIPE
tech-c:	LC6420-RIPE
status:	
assignment-size:	
mnt-by:	LIR-MNT
created:	(generated by RIPE DB)
last-modified:	(generated by RIPE DB)
source:	RIPE

Making Assignments - Phase 2

inet6num:	
netname:	
descr:	
country:	
admin-c:	FC1356-RIPE
tech-c:	LC6420-RIPE
status:	
assignment-size:	
mnt-by:	LIR-MNT
created:	(generated by RIPE DB)
last-modified:	(generated by RIPE DB)
source:	RIPE

Addressing Plan Exercise

You are a small colocation and broadband provider and you are an LIR. You received a /32 allocation:
2001:db8::/32

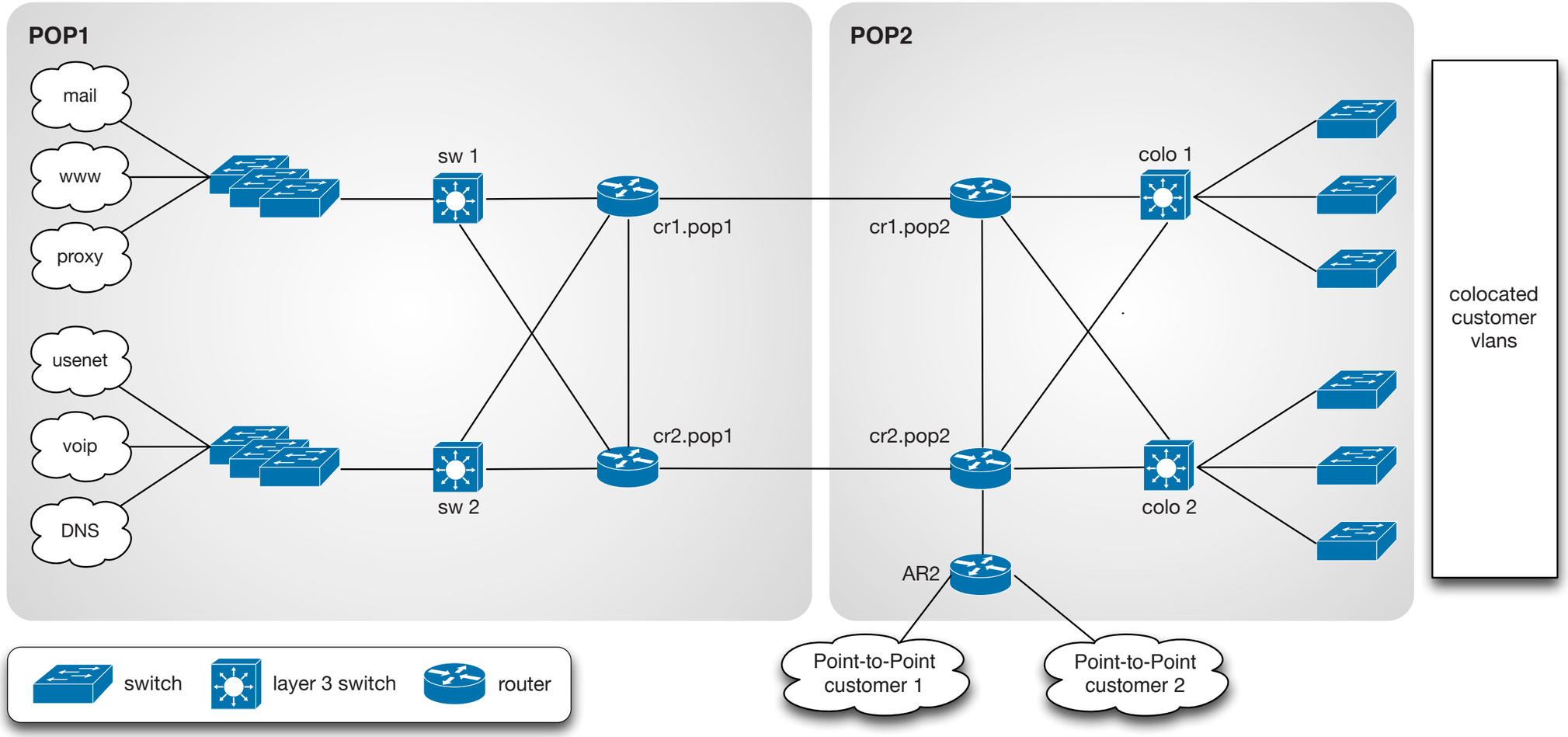
You currently have 2 Point-to-Point customers and 500 colocation customers. 250 colocation customers are connected on each switch. Also, on your own infrastructure you provide e-mail, www, proxy, usenet, VoIP and DNS services to them in a 'software as a service' structure.

Step 1: Assign the /48 per POP
Step 2: Decide the size of the assignments per device
Step 3: Decide the size of the customer assignments
Step 4: Fill in the addressing plan accordingly

Some things to consider:

- The most important goal with IPv6 is aggregation.
- You can assign a /48 per POP without sending a request to the RIPE NCC.
- For your most important connections/equipment, use the easiest to remember addresses. (loop-backs etc.)
- For administrative ease (DNS and your mind), it is recommended you assign on 4-bit boundary

Prefix	Number of /64 subnets
/48	65.536
/52	4096
/56	256
/60	16
/64	1



Your prefix: 2001:db8::/32

POP1

- Infrastructure
  - loopback addresses
  - mail server vlan
  - www server vlan
  - proxy server vlan
  - usenet server vlan
  - VoIP server vlan
  - DNS server vlan
- cr1.pop1
- sw1
- cr2.pop1
- sw2

POP2

- cr1.pop2
- cr2.pop2
- colo1
- colo2
- ar
  - P2P Customer Connection 1
  - P2P Customer Connection 2

Customer Assignments

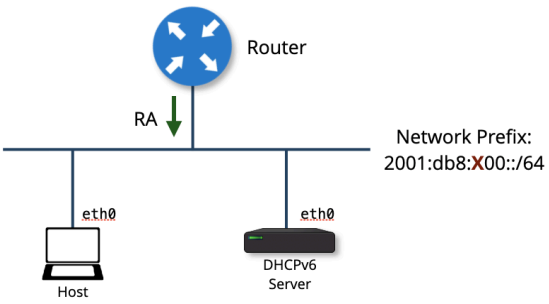
- Colocation Customers (500)
- P2P Customer 1 Subnet
- P2P Customer 2 Subnet

Configuring IPv6:

Host Configuration

In this exercise, you will try out different methods to configure an IPv6 host:

1. Provide an online prefix for SLAAC with Router Advertisement – No DNS / No DHCPv6
2. Provide an online prefix for SLAAC with Router Advertisement – Provide the DNS servers using RDNSS option
3. Provide an online prefix for SLAAC with Router Advertisement – Provide the DNS servers using DHCPv6
4. No SLAAC – Use the RA 'M' flag to 'Manage the address configuration' and get an IPv6 address and DNS from the DHCPv6 server



Network Diagram

Your RIPE NCC Access Account

All services that the RIPE NCC offers are supported by the RIPE NCC Access Single Sign-On (SSO) system, including the hands-on lab environment used for this course (Workbench).

You must have a RIPE NCC Access account with Two-Factor Authentication (2FA) enabled to take this training course. If you do not have an account yet, create one in advance by following these instructions.

If you already have a RIPE NCC Access account, go to access.ripe.net and try to log in. If you have any issues accessing your account, let the trainers know so they can try to help you.

Entering the lab environment

1. Go to https://workbench.ripe.net and log in using your RIPE NCC Access account.
2. The trainer will give you a **seat number** (Number X) and a **code** to access the lab.
3. After logging in, find the [**name of the course**] lab,
4. Select your **seat number** from the dropdown menu
5. Enter the **code** provided by the trainer
6. Click on the **Join lab** button to access the lab.

.

Configuration Cheat Sheet

HOST	ROUTER
### # Check for IP address and DNS ### ip addr ip -6 route cat /etc/resolv.conf	### # Enable Router Advertisements ### configure interface eth0 no ipv6 nd suppress-ra end

---

HOST	ROUTER
### # Check for DNS ### cat /etc/resolv.conf	### # Enable RDNSS ### configure interface eth0 ipv6 nd rdnss 2001:db8::53 ipv6 nd suppress-ra no ipv6 nd suppress-ra end

---

HOST	ROUTER

```
###
# Check for DNS
###

cat /etc/resolv.conf
```

```
###
# Enable O-flag
###

configure
interface eth0
ipv6 nd other-config-flag
ipv6 nd suppress-ra
no ipv6 nd suppress-ra
end
```

HOST

```
###
# Check for IP address and DNS
###

ip addr
ip -6 route
cat /etc/resolv.conf
```

ROUTER

```
###
# Enable M-flag | Disable A-flag
###

configure
interface eth0
ipv6 nd managed-config-flag
ipv6 nd prefix 2001:db8:X00::/64
no-autoconfig
no ipv6 nd rdnss 2001:db8::53
ipv6 nd suppress-ra
no ipv6 nd suppress-ra
end
```

IPv6 Address Auto-configuration Timeline

