RIPE NCC

RIPE NETWORK COORDINATION CENTRE

Introduction to IPv6

Webinar

RIPE NCC Learning & Development

This session is being recorded

Take two polls!

Tell us about yourself!

2 min.

Overview

IPv6 Address Basics

Exercise: Address Notation

Q&A

Getting it

Q&A

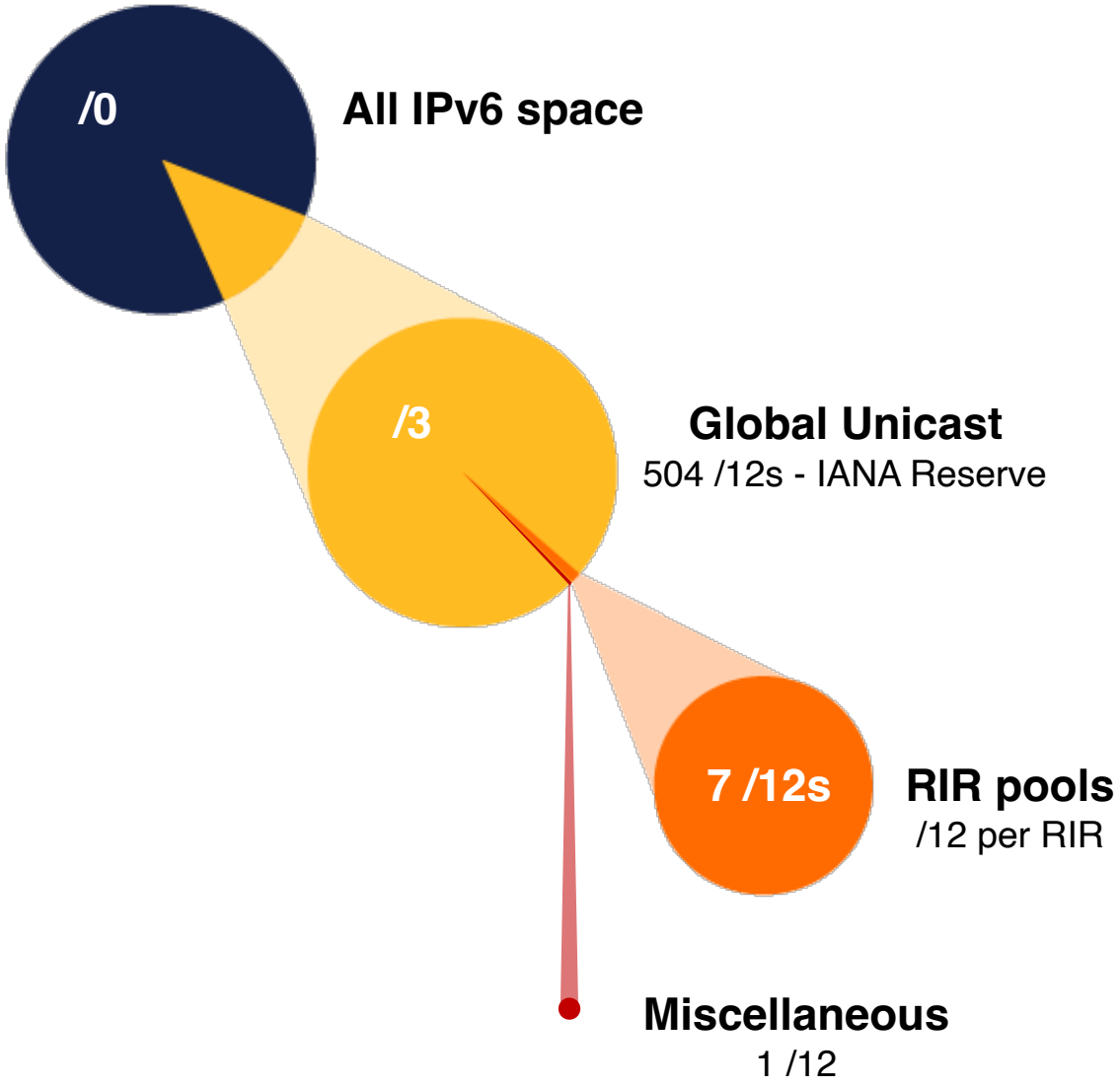
Exercise: Making Assignments

Q&A

Key Takeaways and Tips

IPv6 Address Basics

IP Address Distribution



RIR Pools

October 2006

RIR	IPv6 Range
AFRINIC	2C00:0000::/12
APNIC	2400:0000::/12
ARIN	2600:0000::/12
LACNIC	2800:0000::/12
RIPE NCC	2A00:0000::/12

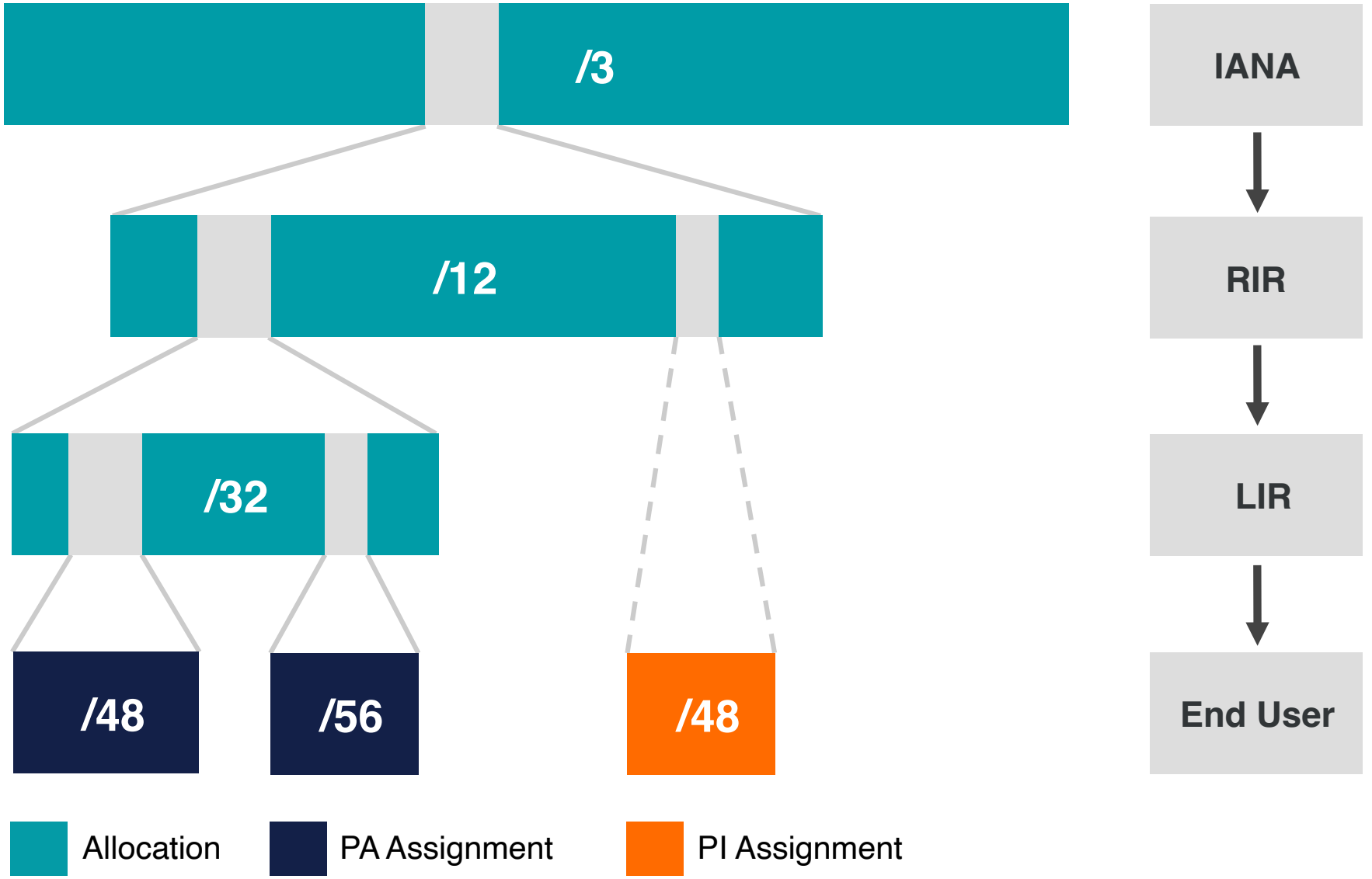
June 2019

RIPE NCC	2A10:0000::/12

November 2019

ARIN	2630:0000::/12

IP Address Distribution



IPv6 Address Basics

- IPv6 address: **128 bits**
  - 32 bits in IPv4
- Every subnet should be a **/64**
- Customer assignments (sites) between:
  - **/64** (1 subnet)
  - **/48** (65,536 subnets)
- Minimum allocation size **/32**
  - 65,536 /48s
  - 16,777,216 /56s

Multiple address types

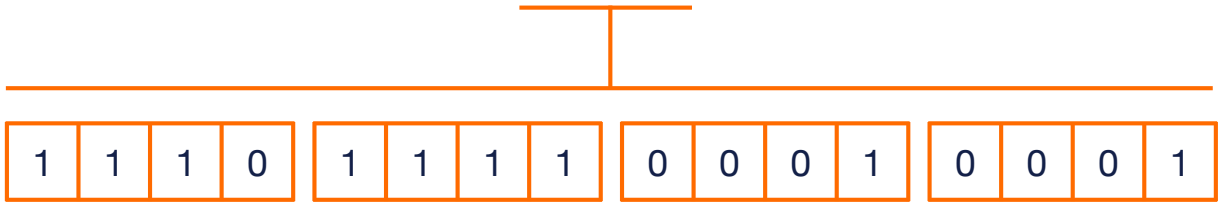
Addresses	Range	Scope
Unspecified	::/128	n/a
Loopback	::1	host
IPv4-Embedded	64:ff9b::/96	n/a
Discard-Only	100::/64	n/a
Link Local	fe80::/10	link
Global Unicast	2000::/3	global
Unique Local	fc00::/7	global
Multicast	ff00::/8	variable

Address Notation

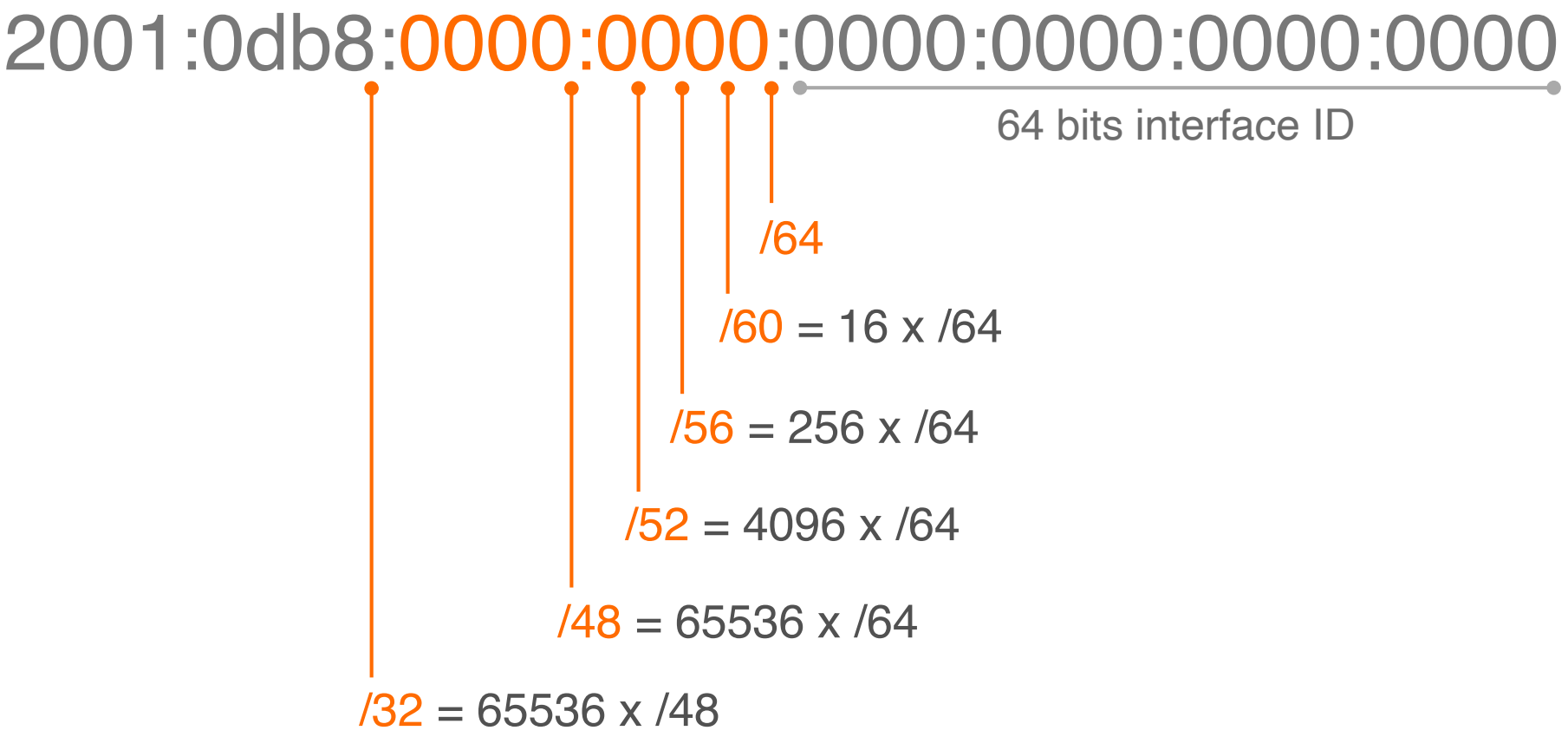
2001:0db8:003e:ef11:0000:0000:c100:004d

2001:0db8:003e:ef11:0000:0000:c100:004d

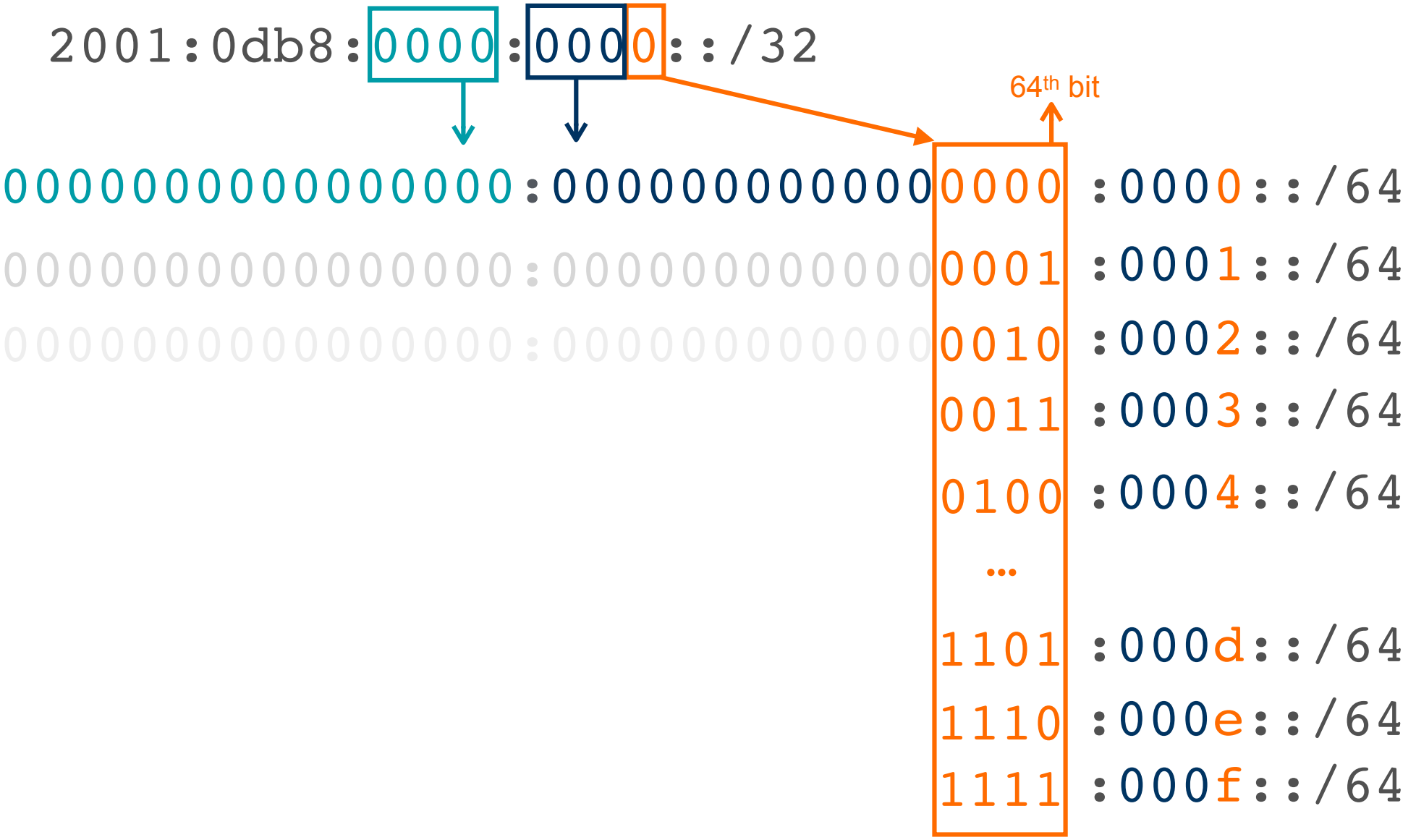
2001:db8:3e:ef11: 0:0:c100:4d



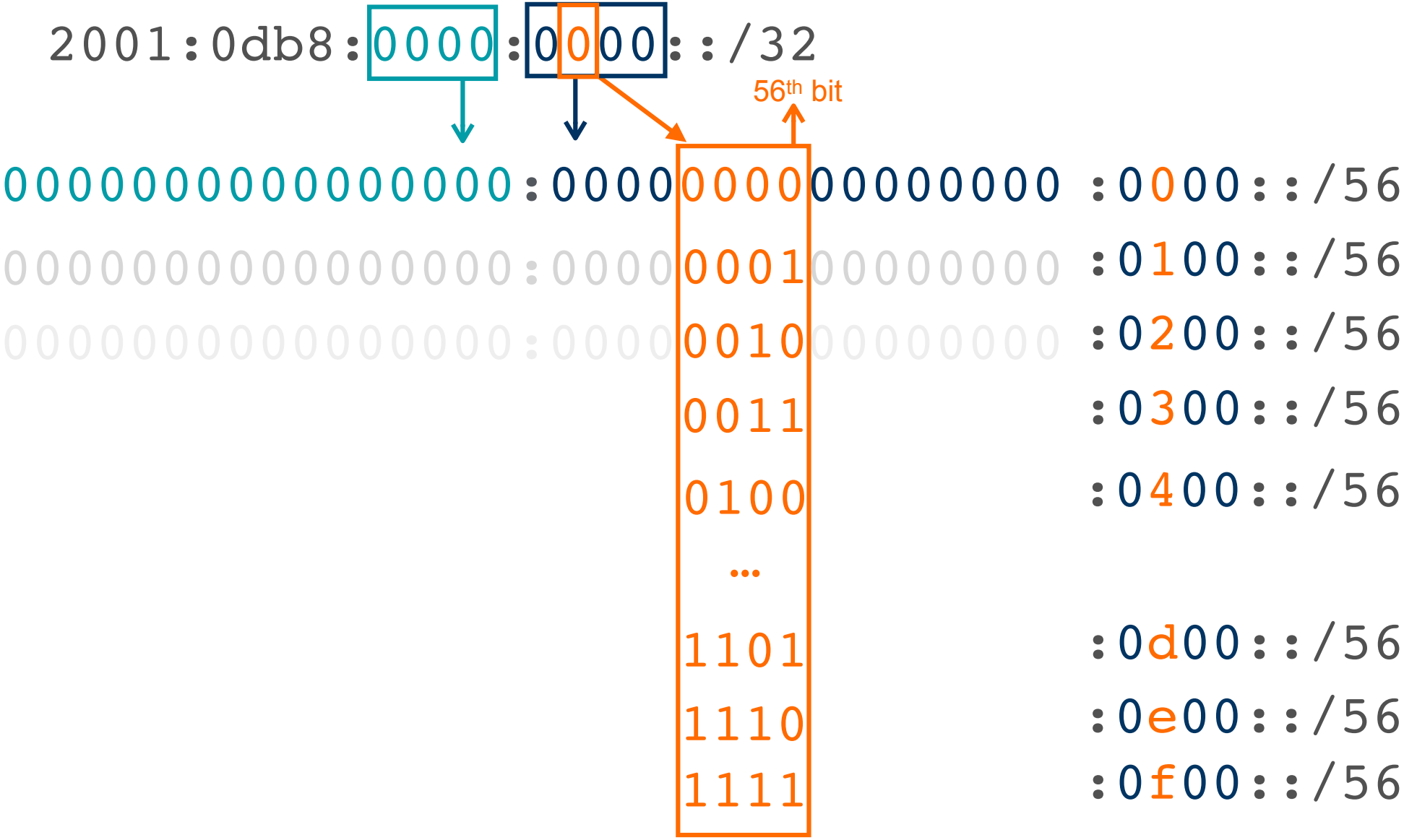
IPv6 Subnetting



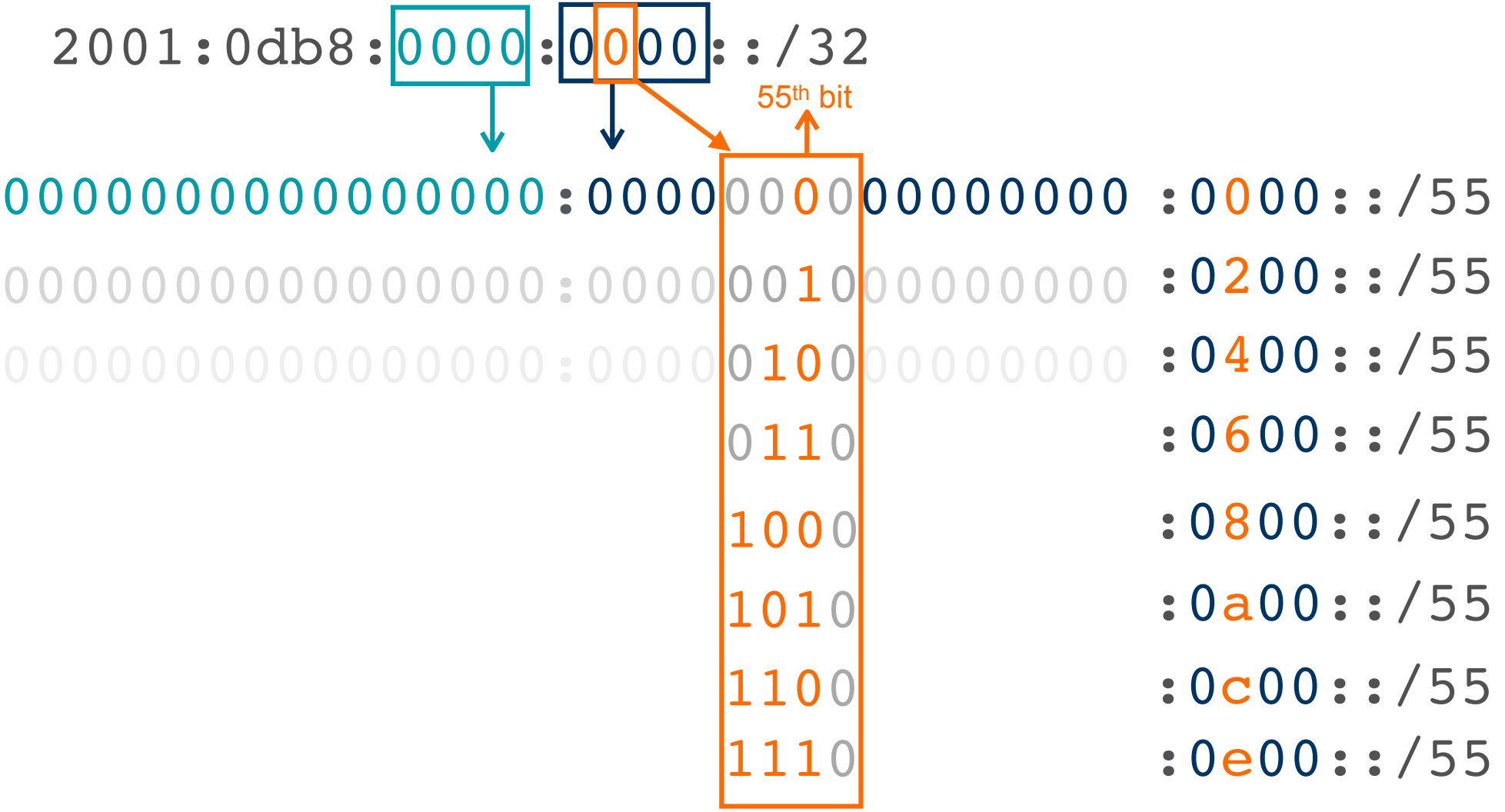
IPv6 Subnetting - /64 subnets



IPv6 Subnetting - /56 subnets



IPv6 Subnetting - /55 subnets



IPv6 Address Notation

Exercise

Question #1

You have a /32 prefix starting with **2001:0db8**.

How do you search for it in the RIPE Database?

Question #1 Answer

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

Question #2

How do you correctly compress the following IPv6 address:

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

Question #2 Answer

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

Question #3

How do you correctly compress the following IPv6 address:

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

Question #3 Answer

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

Question #4

How do you correctly compress the following IPv6 address:

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

Question #4 Answer

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

Question #5

How do you correctly compress the following IPv6 address:

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

Question #5 Answer

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

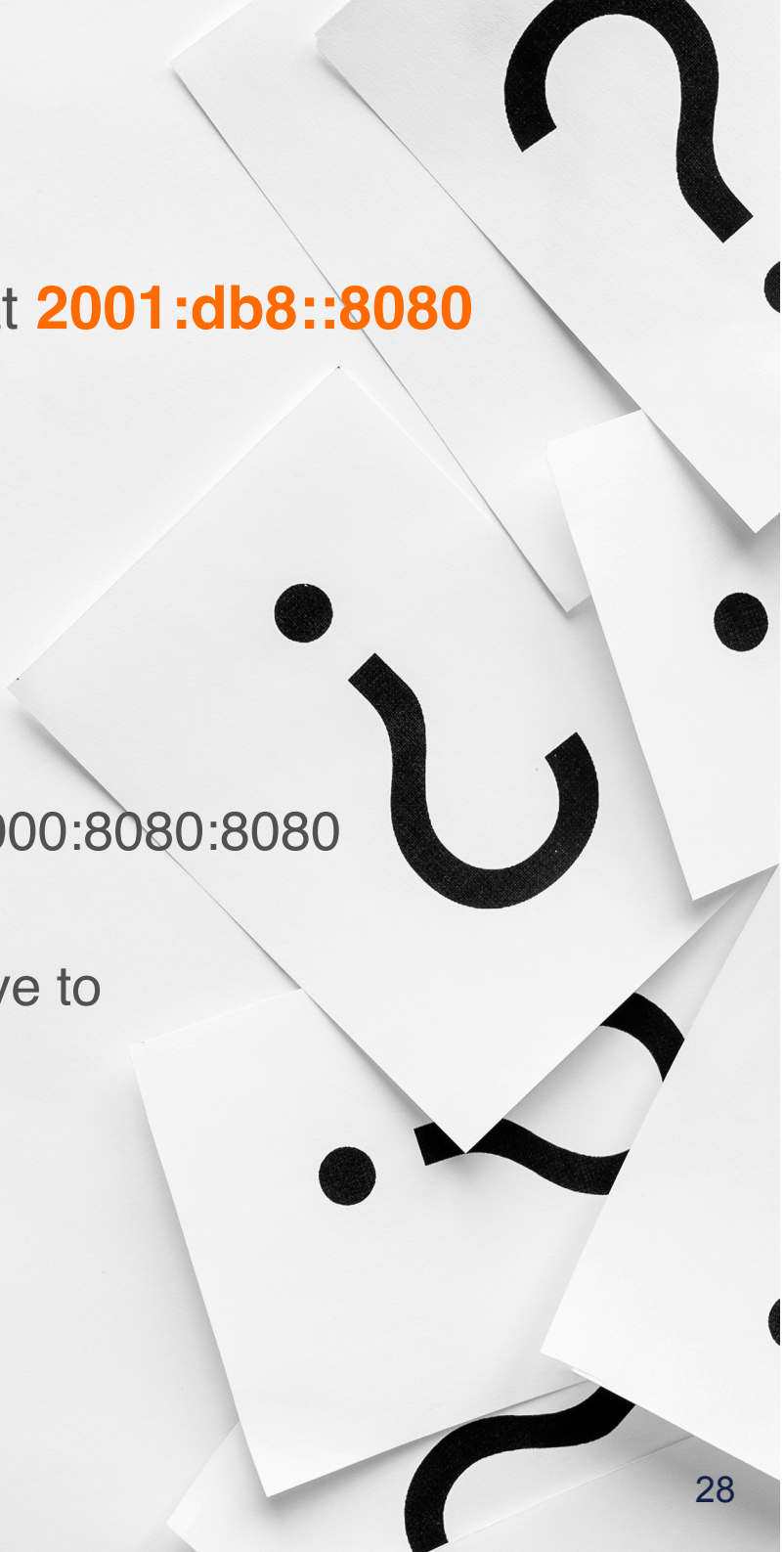
Question #6

How do you access your IPv6 web server at **2001:db8::8080** on port 8080 using a web browser?

Question #6 Answer

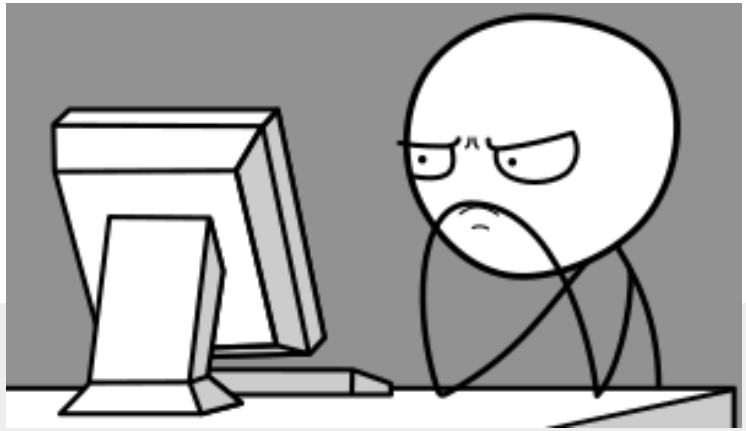
How do you access your IPv6 web server at **2001:db8::8080** on port 8080 using a web browser?

a. http://2001:db8::8080:8080
b. http://2001:0db8:0000:0000:0000:0000:0000:8080:8080
c. http://[2001:db8::8080]:8080
d. You cannot use the IPv6 address, you have to rely on DNS



IPv6 Notation - RFC 5952

For more information, please read RFC 5952:
“A Recommendation for IPv6 Address Text Representation”



Link to the RFC:
https://datatracker.ietf.org/doc/html/rfc5952

Questions

Getting It

Getting an IPv6 allocation

- To qualify, an organisation **must**:
  - Be an LIR
  - Have a plan for making assignments within two years
- Minimum allocation size **/32**
  - **Up to a /29** without additional justification
  - More if justified by customer numbers and network extension
  - Additional bits based on hierarchical and geographical structure, planned longevity and security levels

Customer Assignments

- Give your customers enough addresses
  - **Minimum /64**
  - Up to /48
- Originally, for more than /48, send in request form
- Every assignment **must be registered** in the RIPE Database

RIPE Policy Proposal 2019-06

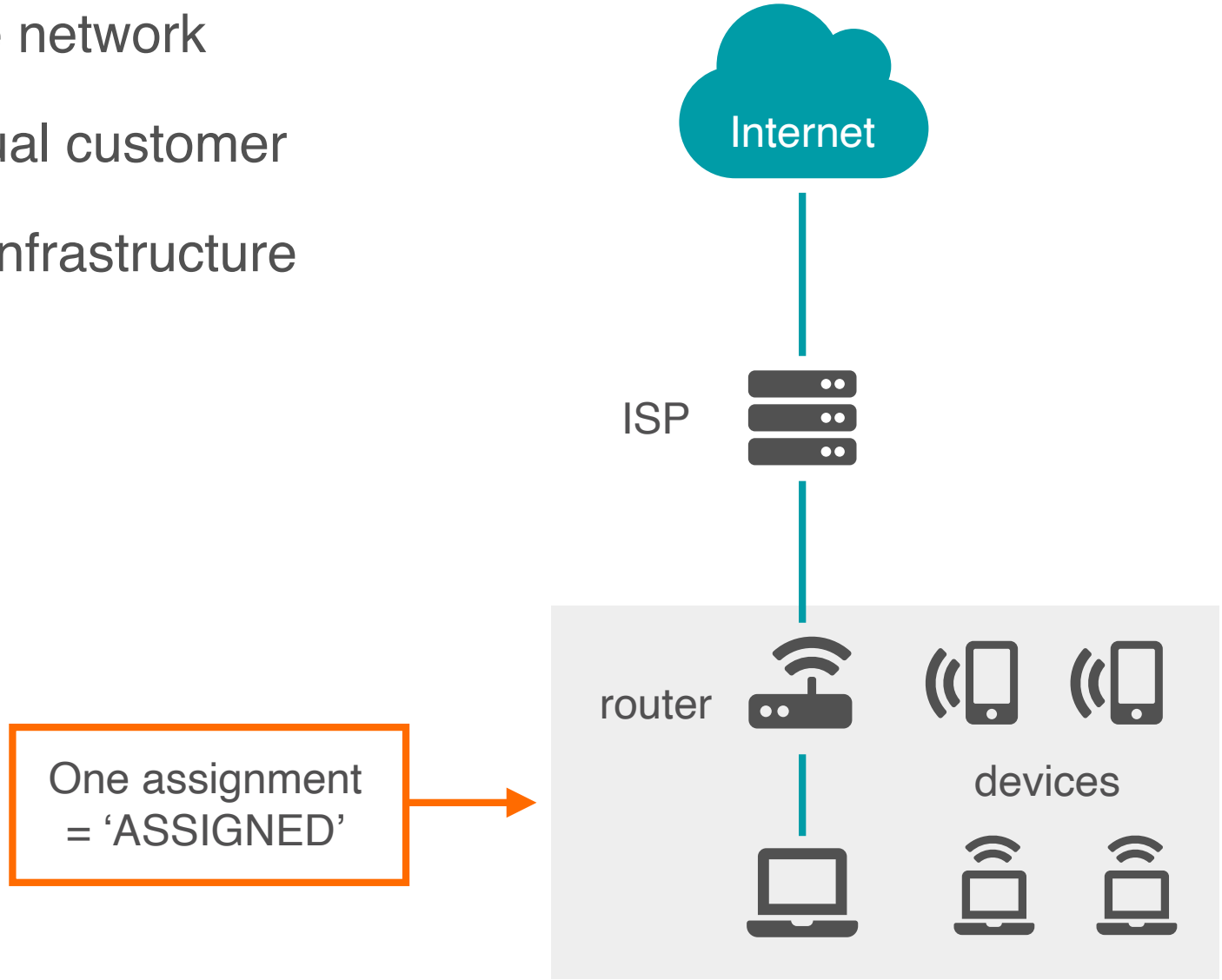
- LIR can create assignments larger than /48 **without a request**
- **Will need to justify** it if there is an audit or if LIR requests subsequent allocation

Comparison IPv4 and IPv6 status

IPv4		IPv6
ALLOCATED PA	**Allocation**	ALLOCATED-BY-RIR
ASSIGNED PA	**Assignment**	ASSIGNED
	Group of Assignments	AGGREGATED-BY-LIR
SUB-ALLOCATED PA	**Sub-Allocation**	ALLOCATED-BY-LIR
ASSIGNED PI	**PI Assignment**	ASSIGNED PI

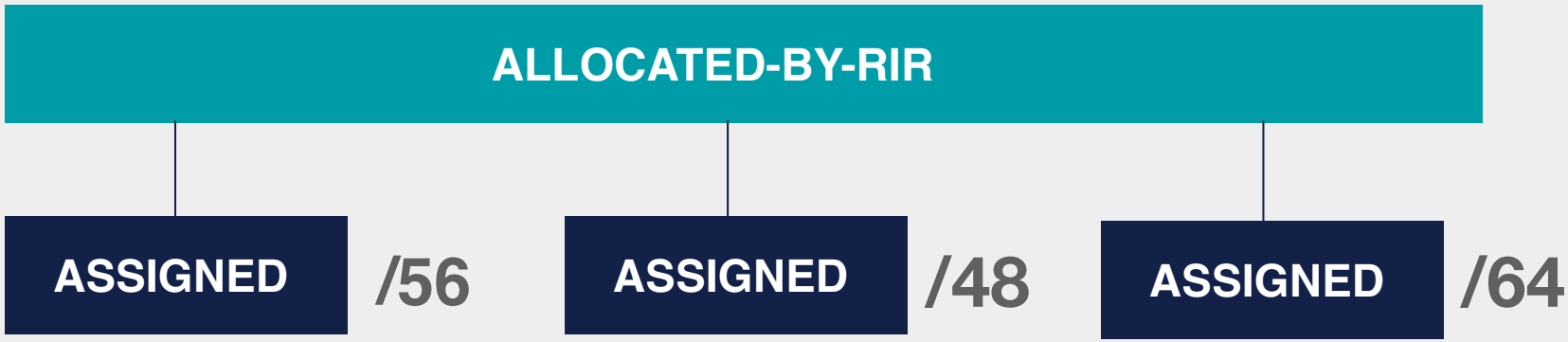
Examples ASSIGNED

- One single network
- An individual customer
- Your own infrastructure



Using ASSIGNED

- Represents one assignment
- Minimum assignment size is a /64

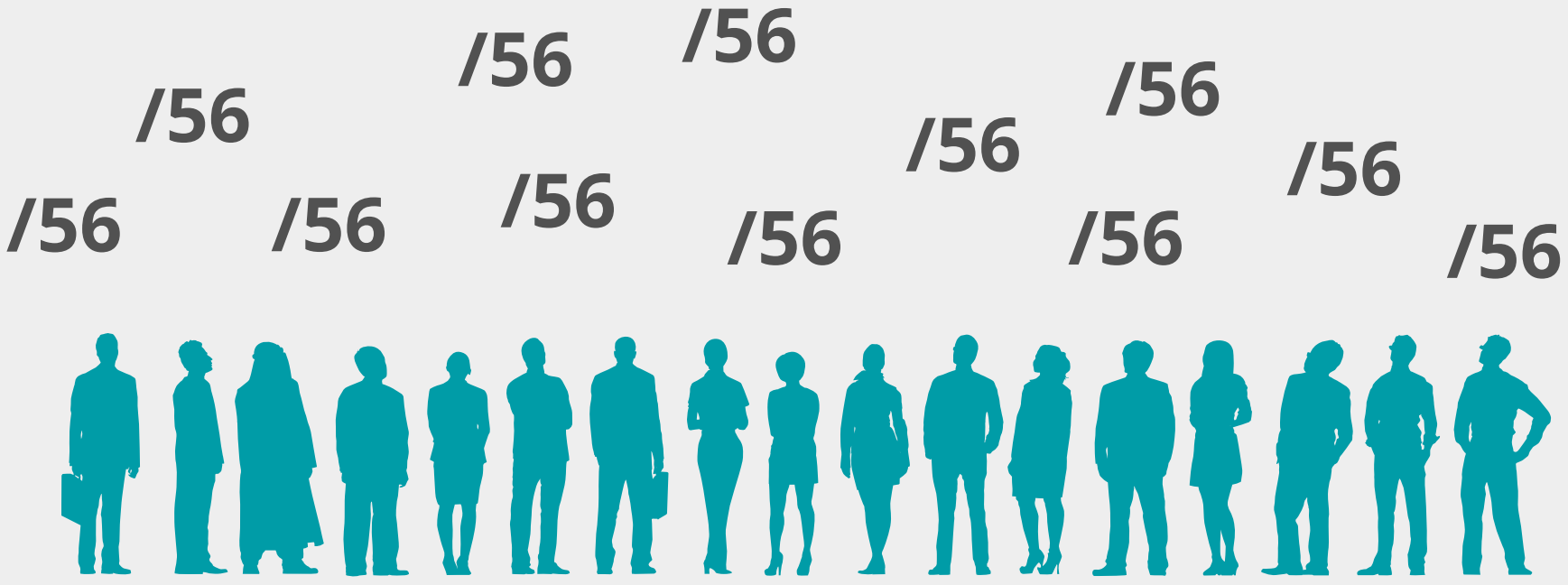


Using ASSIGNED - Example Object

inet6num:	**2001:db8:1000::/48**
netname:	CUSTOMER-NET
country:	NL
admin-c:	ADM321-RIPE
tech-c:	NOC123-RIPE
status:	**ASSIGNED**
mnt-by:	LIR-MNT
created:	2015-05-31T08:23:35Z
last-modified:	2015-05-31T08:23:35Z
source:	RIPE

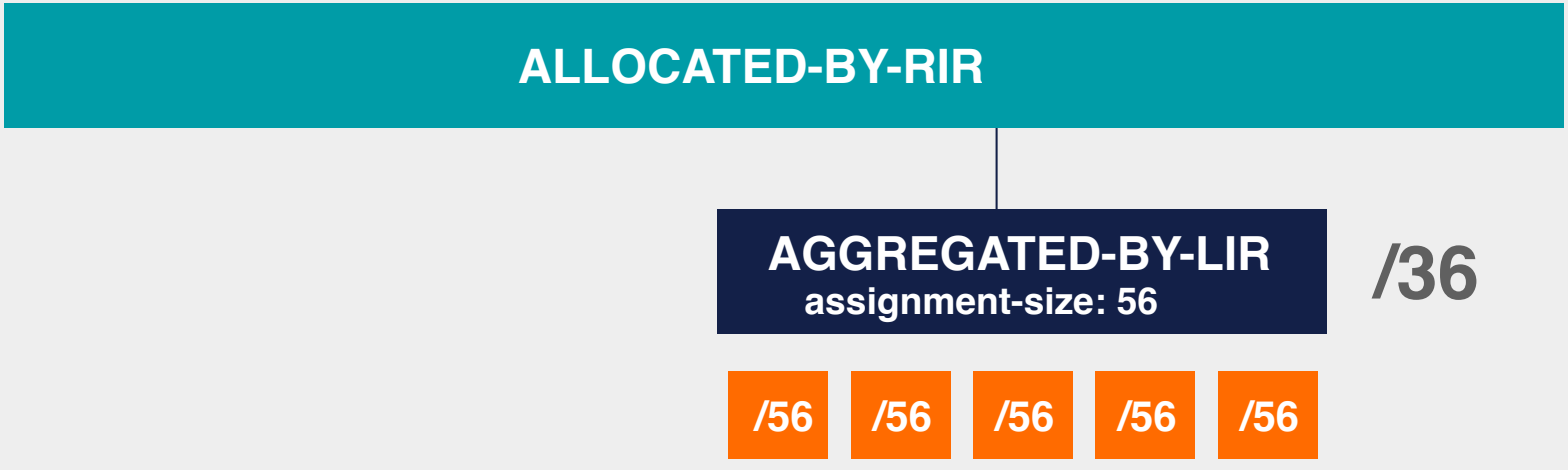
Examples AGGREGATED-BY-LIR

- Group of customers
- Same assignment size



Using AGGREGATED-BY-LIR

- Can be used to group customers
  - For example: Residential broadband customers
- **“assignment-size:”** = assignment of each customer



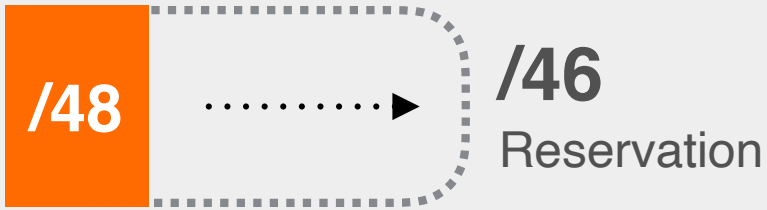
Using AGGREGATED-BY-LIR - Example

inet6num:	**2001:db8:1000::/36**
netname:	DSL-Broadband-Pool
country:	NL
admin-c:	ADM321-RIPE
tech-c:	NOC123-RIPE
status:	**AGGREGATED-BY-LIR**
assignment-size:	**56**
mnt-by:	LIR-MNT
notify:	noc@example.net
created:	2015-05-31T08:23:35Z
last-modified:	2015-05-31T08:23:35Z
source:	RIPE

Examples ALLOCATED-BY-LIR

Reservation for a large customer

Large Customer



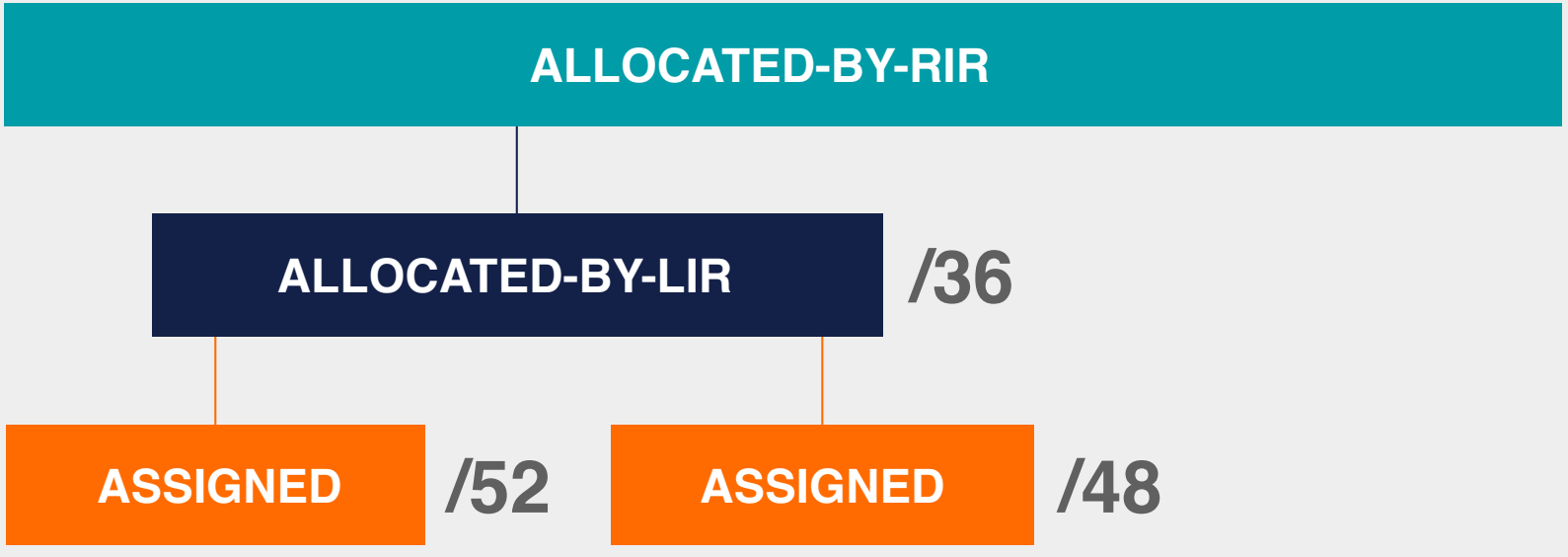
Branch office or department

Branch Office

Using ALLOCATED-BY-LIR

Can be used for customers with **potential for growth**

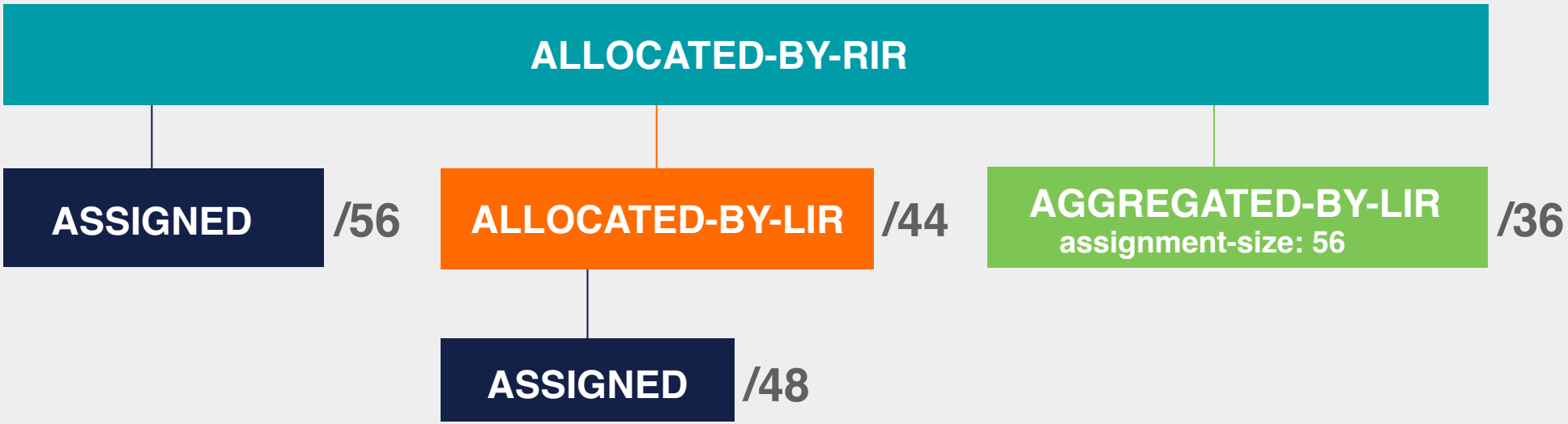
- Or for your own infrastructure
- Or to delegate address space to a downstream ISP



Using ALLOCATED-BY-LIR - Example

inet6num:	**2001:db8:50::/44**
netname:	Branch-Office-Network
country:	NL
admin-c:	ADM321-RIPE
tech-c:	NOC123-RIPE
status:	**ALLOCATED-BY-LIR**
mnt-by:	**LIR-MNT**
mnt-lower:	**BRANCH-OFFICE-MNT**
notify:	noc@example.net
created:	2015-05-31T08:23:35Z
last-modified:	2015-05-31T08:23:35Z
source:	RIPE

Overview


ALLOCATED-BY-RIR
ASSIGNED
/56
ALLOCATED-BY-LIR
/44
AGGREGATED-BY-LIR
assignment-size: 56
/36
ASSIGNED
/48

Getting IPv6 PI Address Space

- To qualify, an organisation must:
  - **Meet** the contractual **requirements** for provider independent resources
  - LIRs must demonstrate special **routing requirements**
- Minimum assignment size: **/48**
- PI space **cannot** be used for sub-assignments

Unique Local Addresses

- Prefixes from fc00::/7
  - Only from the **fd00::/8** block
- Should **not** be routed on the Internet
- Generate a random 40-bit Global ID and insert it into fdxx:xxxx:xxxx

Global ID:	da24154e1d
Prefix:	fdda:2415:4e1d::/48

Questions


Let’s take a
5 minute
break!


WELCOME
WE ARE
OPEN
PLEASE COME IN

Making Assignments

Exercise

Create assignments for a smart city!

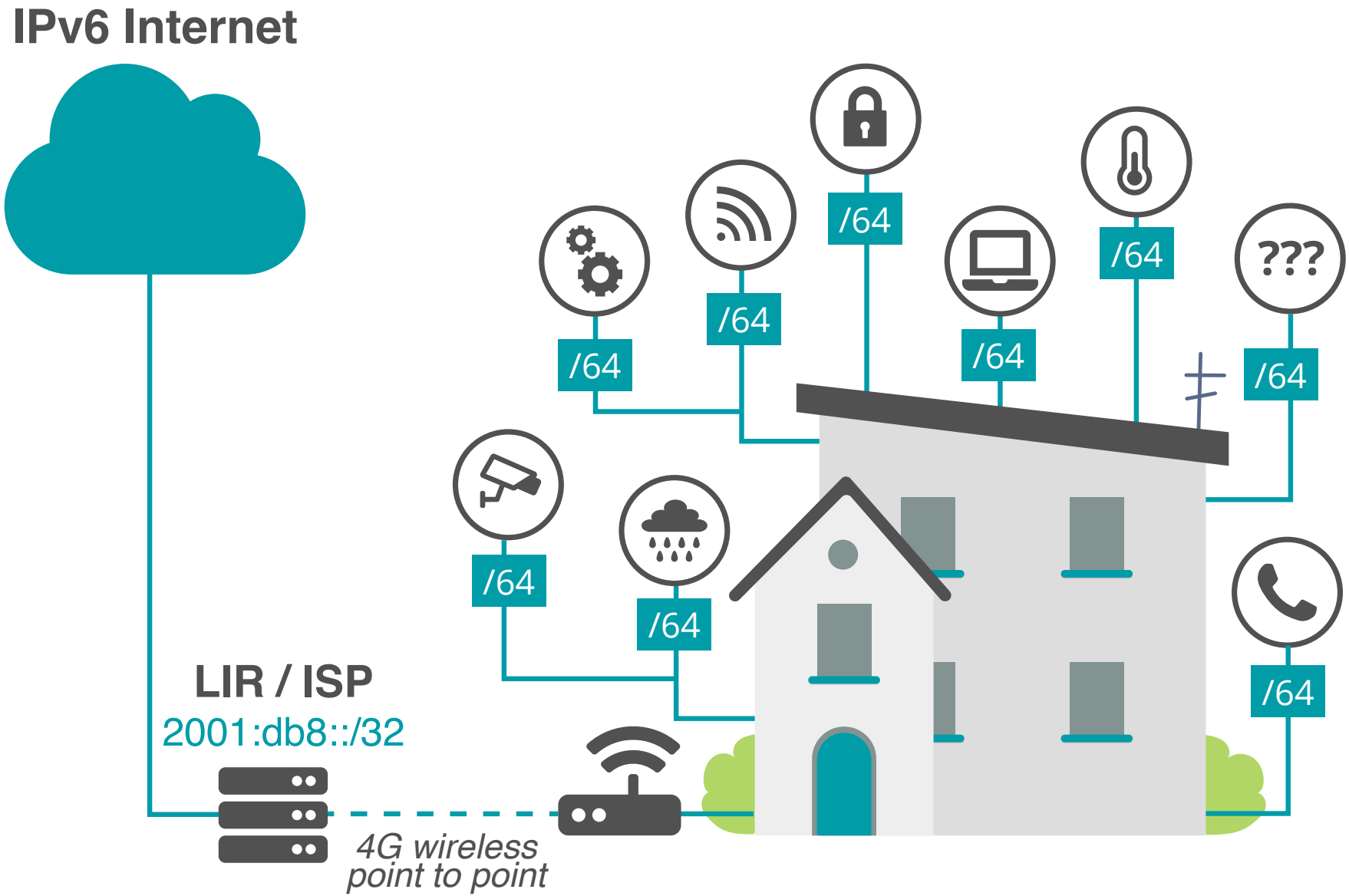
Context

- You work for the LIR: **nl.ripencc-ts**
- Your LIR has a /32 allocation: **2001:db8::/32**
- Your customer Future Casa is working on a project called “Smart Home 6”
- They need IPv6 addresses from your address space
- Future Casa wants to connect **1 million** Smart Homes

Product Description

- Each home will be equipped with a 4G-enabled base unit
- The base unit will be the central gateway for smart services inside the house
- Each smart service runs on a **dedicated subnet**
- Services can be enabled or disabled at any point from a user's smartphone app
- Future Casa will be rolling out **new services in the future**

Smart Home 6 Network Diagram



Activity 1

Take the poll!

Which prefix should you assign to each smart home?

2 min.

Calculations…

- **/64 = 1 subnet**
  - Not enough. We need one subnet alone for the p2p conn.
- **/63 = 2 subnets**
  - Not enough subnets.
  - Not on the 4-bit boundary!
- **/60 = 16 subnets**
  - Is it enough to meet the future needs?
  - You want to avoid having to renumber!

Calculations…

- **/56 = 256 subnets**
  - Sounds reasonable. How many subnets can a house need?

- **/52 = 4096 subnets**
  - More than enough.

- **/48 = 65K subnets**
  - Definitely more than enough.

Activity 2

Take the poll!

Given that each smart home will be assigned a **/56**, what is the total address space required for **1 million** smart homes?

3 min.

Calculations…

One million smart homes

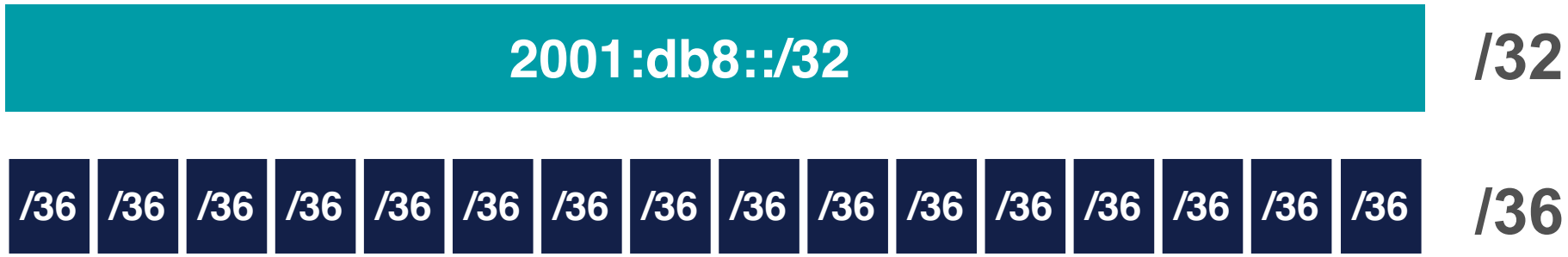
x

/56 per home

=

/36

Possible options for /36 subnets



2001:db8:0000::/36

2001:db8:1000::/36

2001:db8:2000::/36

2001:db8:3000::/36

2001:db8:4000::/36

2001:db8:5000::/36

2001:db8:6000::/36

2001:db8:7000::/36

2001:db8:8000::/36

2001:db8:9000::/36

2001:db8:a000::/36

2001:db8:b000::/36

2001:db8:c000::/36

2001:db8:d000::/36

2001:db8:e000::/36

2001:db8:f000::/36

Activity 3

Take the poll!

You have decided to use **2001:db8:1000::/36** for the Smart Homes project.

What **status** would you use to register this address space in the RIPE DB?

2 min.

Solution RIPE Database object

inet6num:	2001:db8:1000::/36
netname:	SMART-HOME-6
descr:	Smart Home 6 network
country:	NL
admin-c:	RM1204-RIPE
tech-c:	RM1204-RIPE
status:	**AGGREGATED-BY-LIR**
assignment-size:	**56**
mnt-by:	**LIR-MNT**
notify:	noc@lir-example.com
created:	2015-05-31T12:34:01Z
last-modified:	2015-05-31T12:34:01Z
source:	RIPE

Solution RIPE Database object

inet6num:	2001:db8:1000::/36
netname:	SMART-HOME-6
descr:	Smart Home 6 network
country:	NL
admin-c:	RM1204-RIPE
tech-c:	RM1204-RIPE
status:	**ALLOCATED-BY-LIR**
mnt-by:	**LIR-MNT**
mnt-lower:	**SMART-CASA-MNT**
notify:	noc@lir-example.com
created:	2015-05-31T12:34:01Z
last-modified:	2015-05-31T12:34:01Z
source:	RIPE

Questions

Key Takeaways and Tips

- Get your allocation from the RIPE NCC
- Study your address space needs factoring in **future growth**
- Register **every assignment** in the RIPE Database
- Plan every step and test
- Check your hardware and software

RIPE-772 Document

- “Requirements for IPv6 in ICT Equipment”
  - Best Current Practice describing what to ask for when requesting IPv6 Support
  - Useful for tenders and RFPs
  - Original version was ripe-554
  - Ripe-554 Originated by the Slovenian Government
  - Adopted by various others (Germany, Sweden)

Link to the document:

https://www.ripe.net/publications/docs/ripe-772

Customers And Their /48

- Customers have no idea how to handle **65,536 subnets**!
- Provide them with information!

Link to the document:

https://www.ripe.net/support/training/material/basicipv6-addressing-plan-howto.pdf

What's Next in IPv6

Webinars

Attend another webinar live wherever you are.

- Introduction to IPv6 (2 hrs)
- IPv6 Host Configuration (2 hrs)
- IPv6 Addressing Plan (1 hr)
- Basic IPv6 Protocol Security (2 hrs)
- IPv6 Associated Protocols (2 hrs)
- IPv6 Security Myths, Filtering and Tips (2 hrs)

For more info click the link below

learning.ripe.net

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- Advanced IPv6 (17 hrs)
- IPv6 Security (8.5 hrs)

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- IPv6 Fundamentals (15 hrs)
- IPv6 Security (24 hrs)

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- IPv6 Security - Expert

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What did you think about this session?

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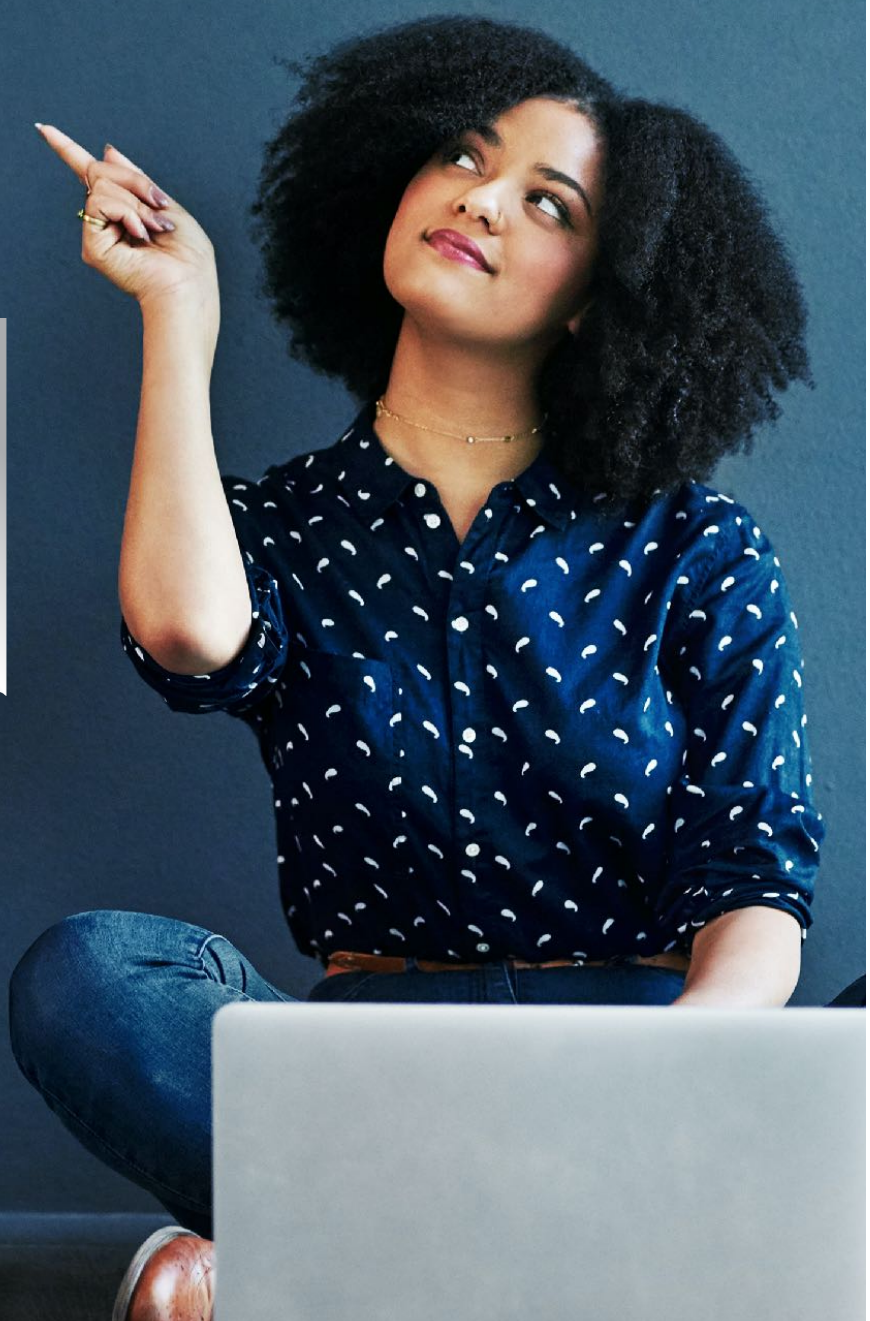
https://getcertified.ripe.net/

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Finis
Lõpp
Amaia
Tmiem
Liðugt
Kpaj
Sfârşit
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