



RIPE NCC
RIPE NETWORK COORDINATION CENTRE

Introduction to IPv6

Webinar

February 2025

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

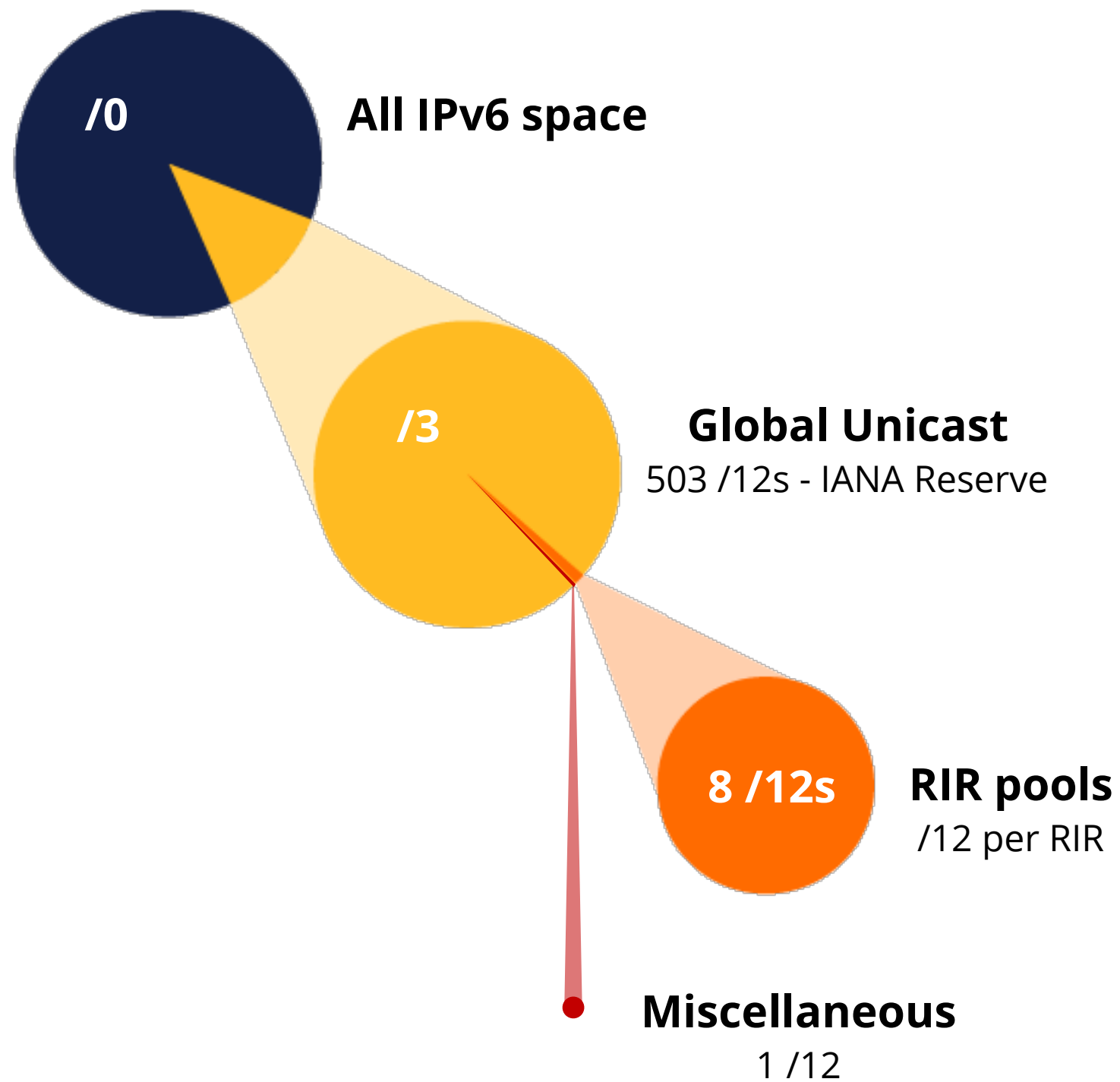
Q&A

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
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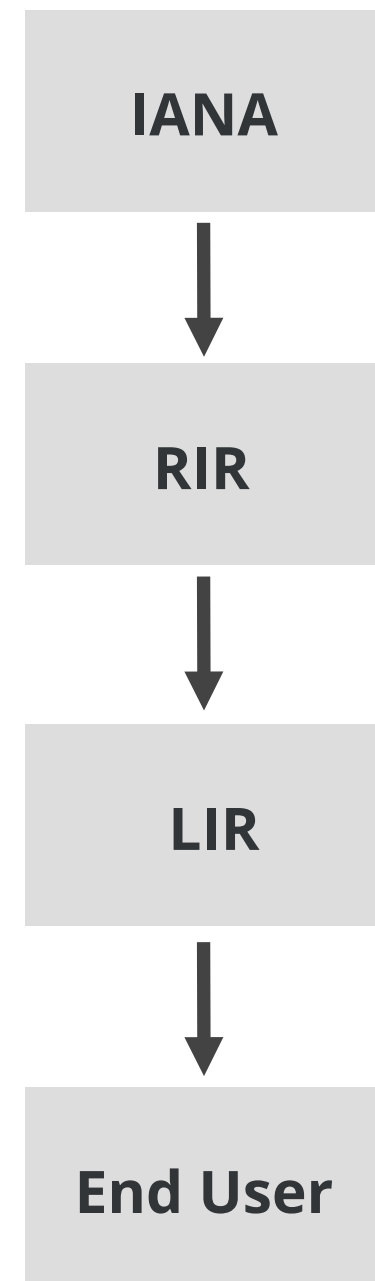
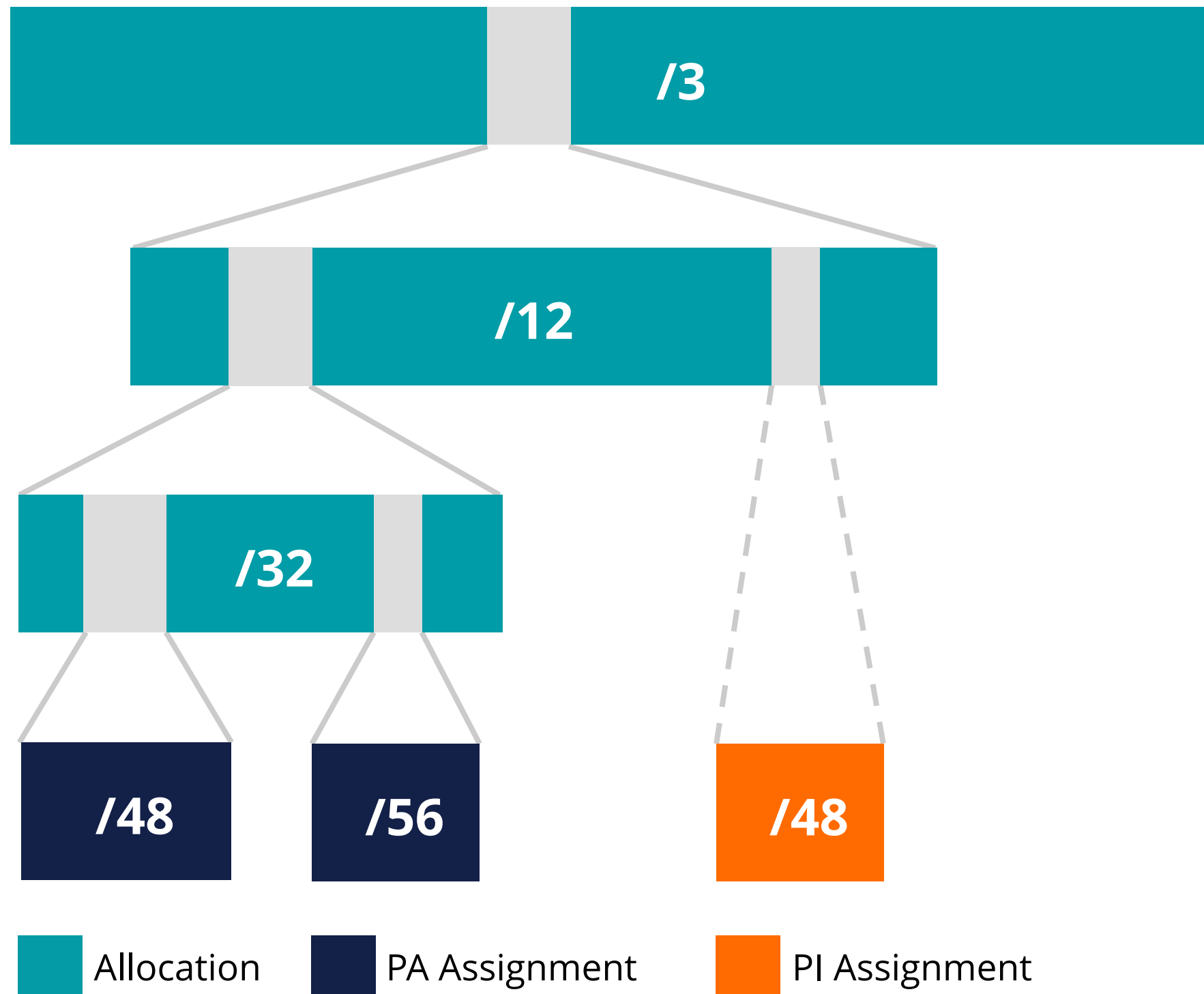
November 2019

ARIN	2630:0000::/12
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November 2024

APNIC	2410:0000::/12
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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

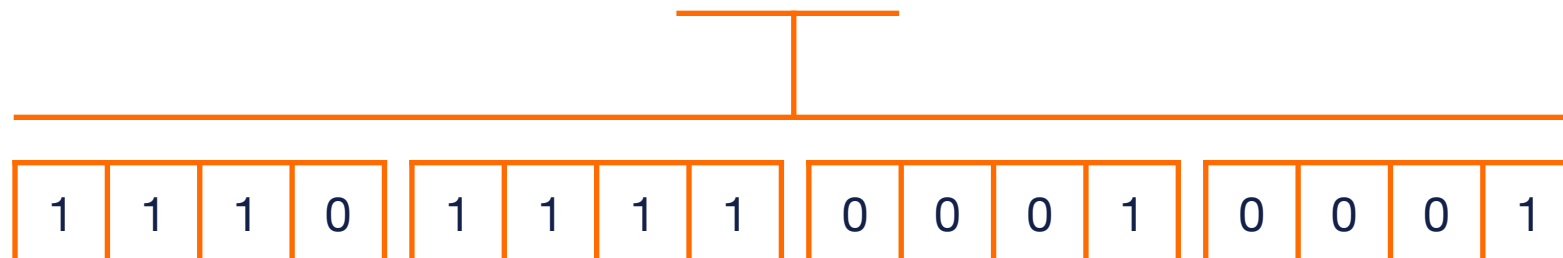
Address Notation



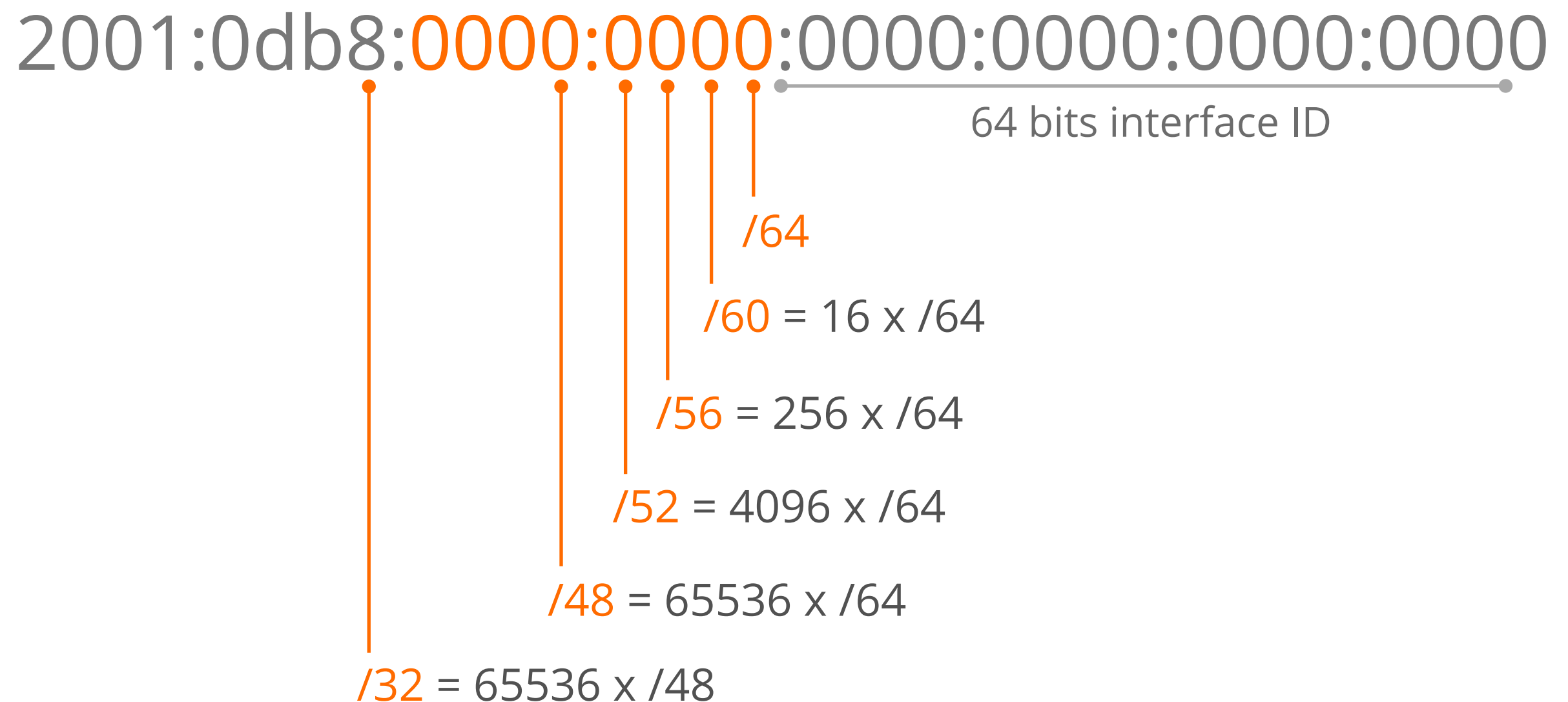
2001:0db8:003e:ef11:0000:0000:c100:004d

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

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



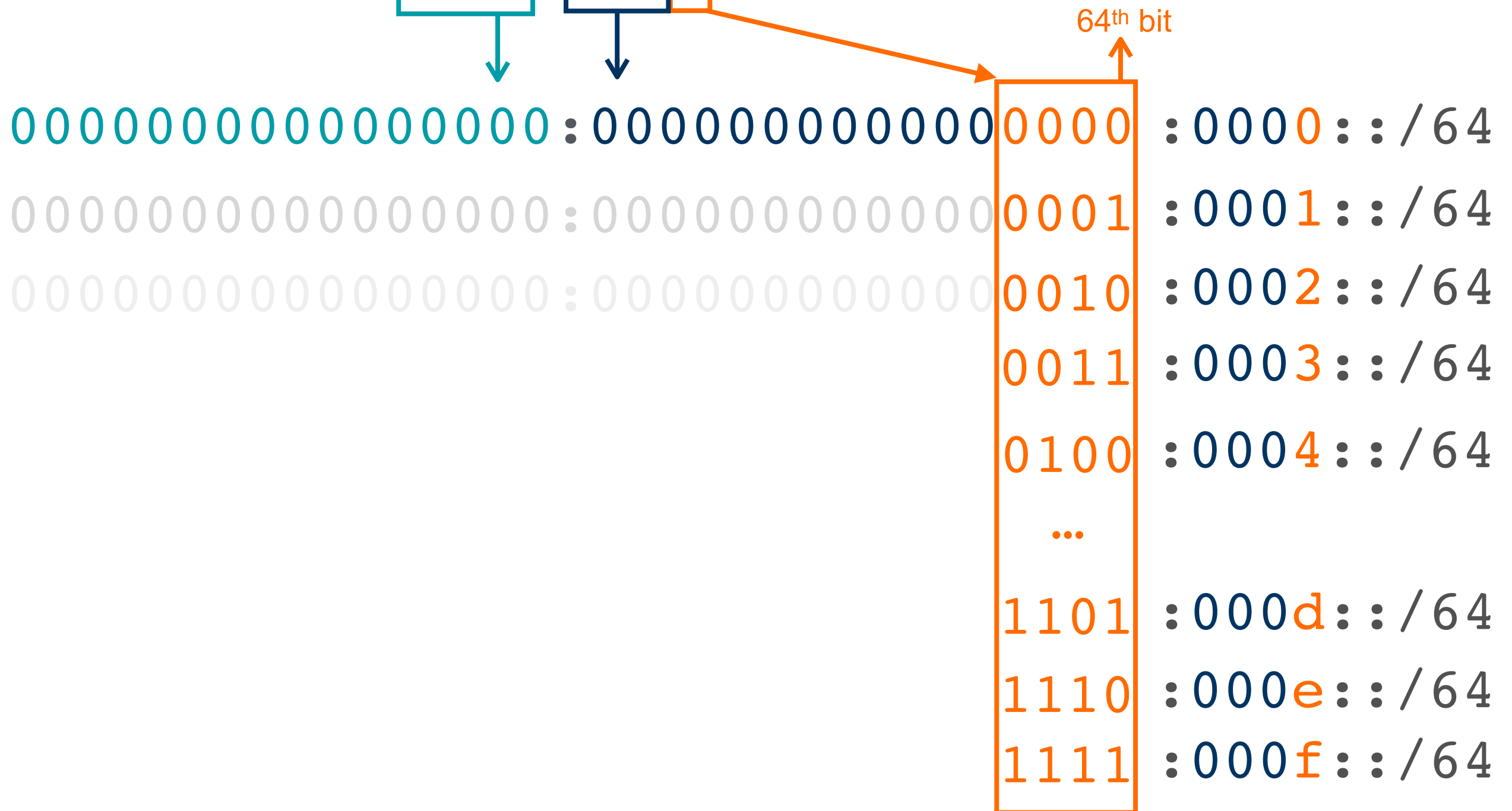
IPv6 Subnetting



IPv6 Subnetting - /64 subnets



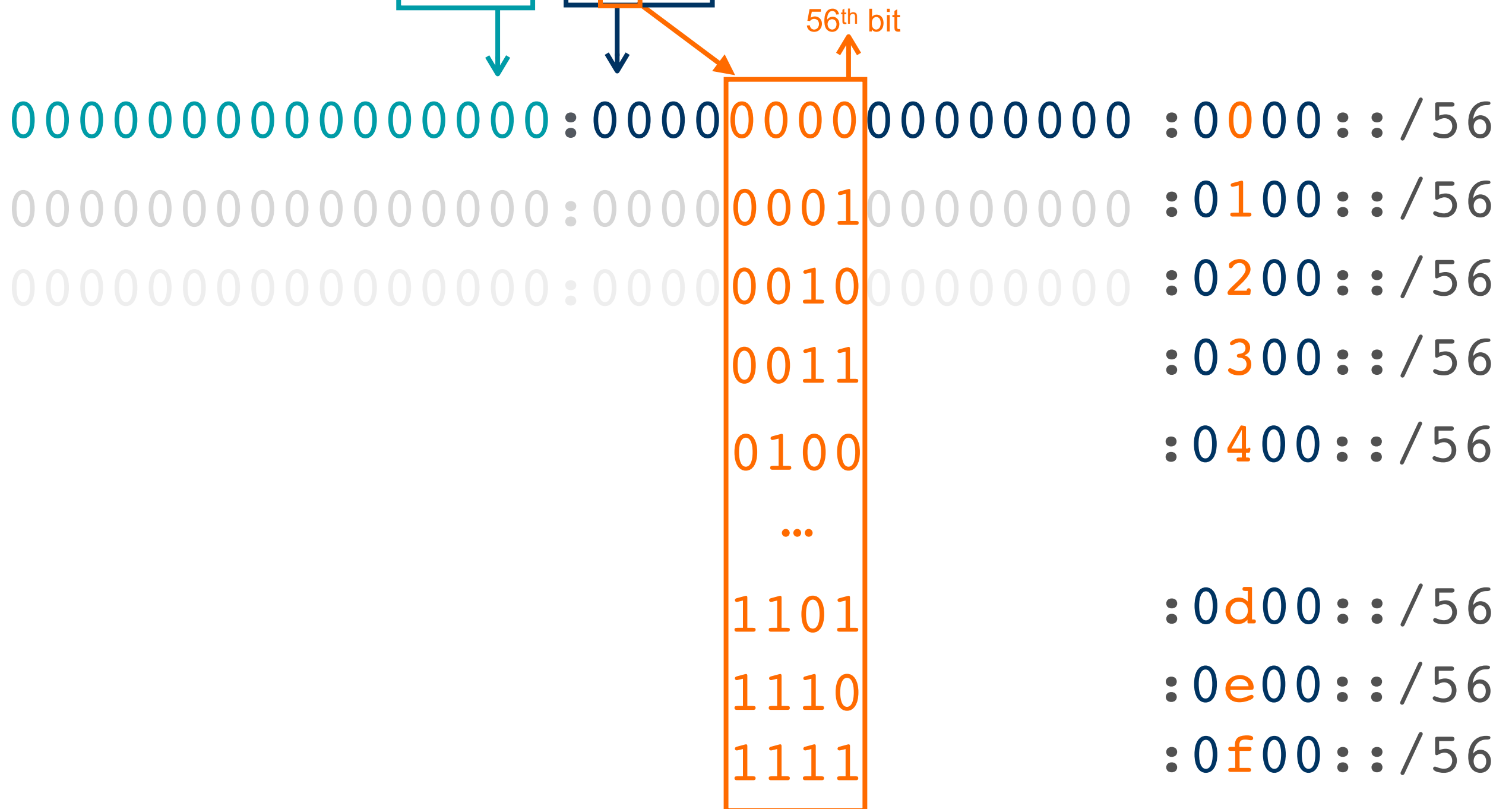
2001:0db8:0000:0000::/32



IPv6 Subnetting - /56 subnets



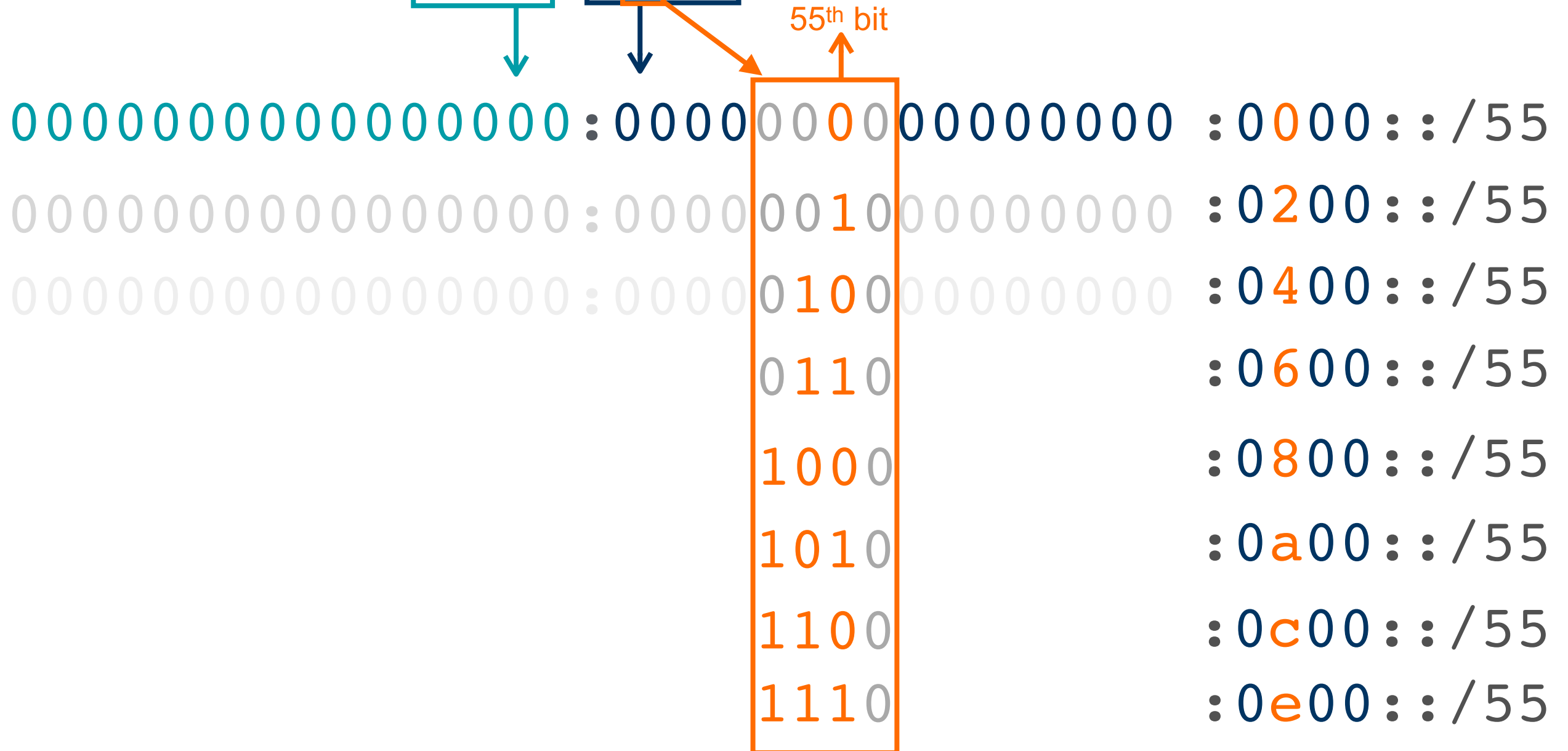
2001:0db8:0000:0000::/32



IPv6 Subnetting - /55 subnets



2001:0db8:0000:0000::/32





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?

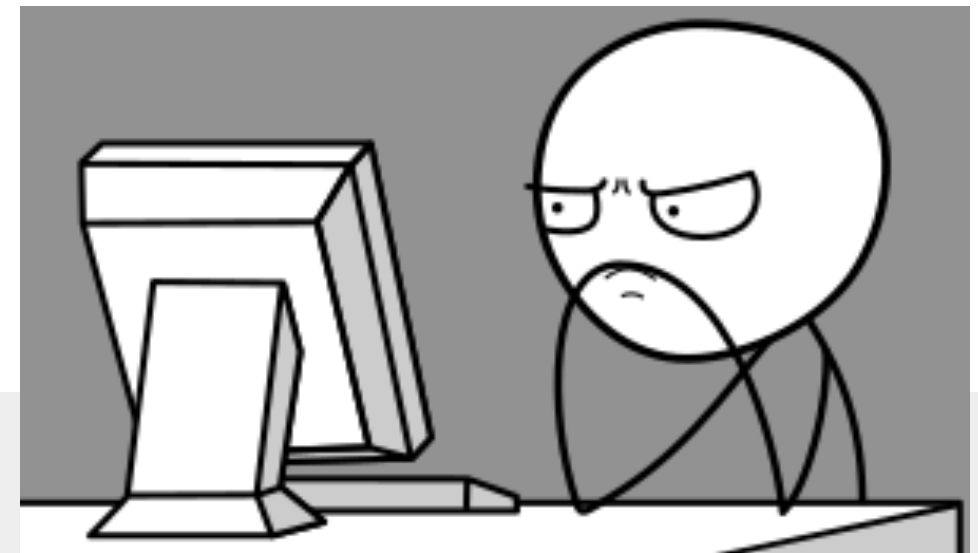
- a. `http://2001:db8::8080:8080`
- b. `http://2001:0db8:0000:0000:0000:0000:0000:8080:8080`
- ✓ c. `http://[2001:db8::8080]:8080`
- d. You cannot use the IPv6 address, you have to rely on DNS

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

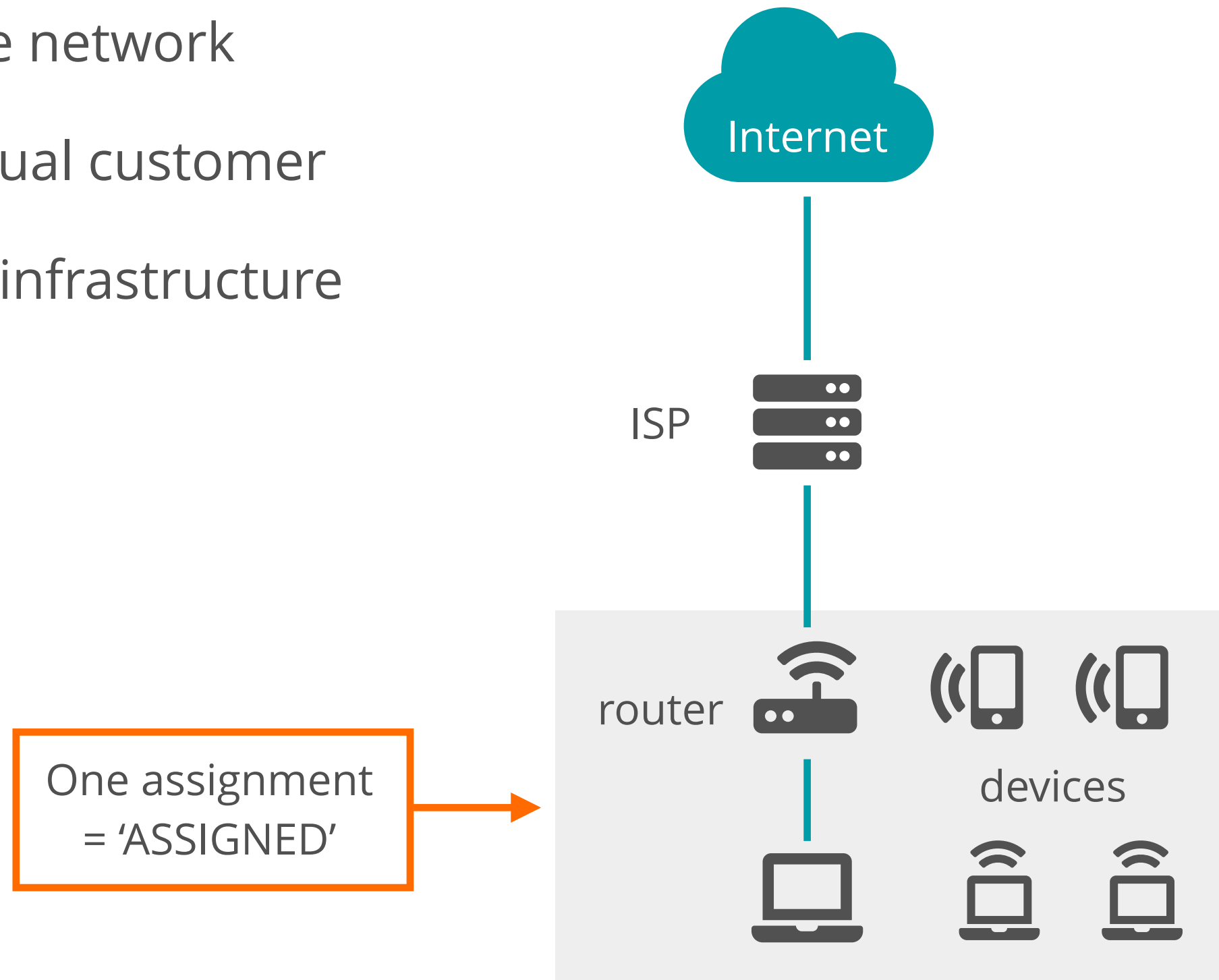


IPv4		IPv6
ALLOCATED PA	Allocation	ALLOCATED-BY-RIR
ASSIGNED PA	Assignment	ASSIGNED
AGGREGATED-BY-LIR	Group of Assignments	AGGREGATED-BY-LIR
SUB-ALLOCATED PA	Sub-Allocation	ALLOCATED-BY-LIR
ASSIGNED PI	PI Assignment	ASSIGNED PI

Examples ASSIGNED



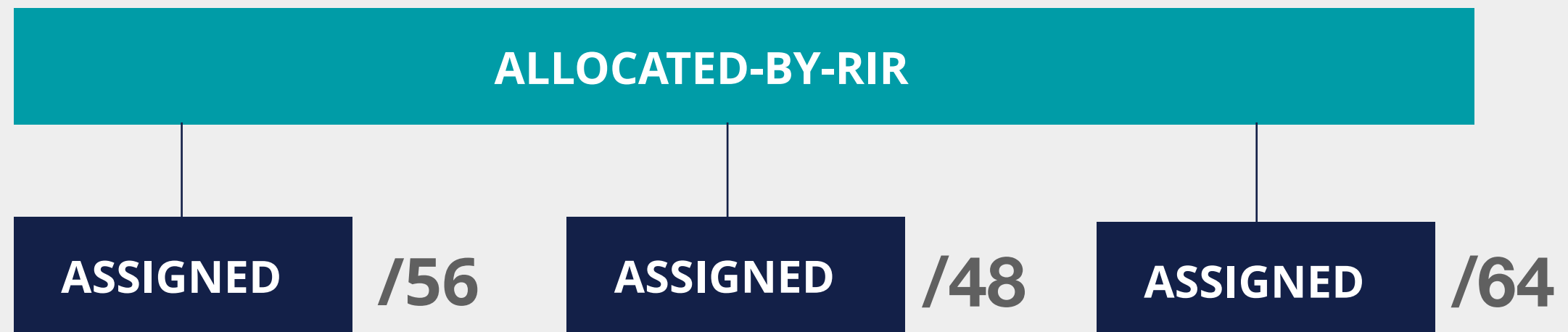
- One single network
- An individual customer
- Your own infrastructure



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

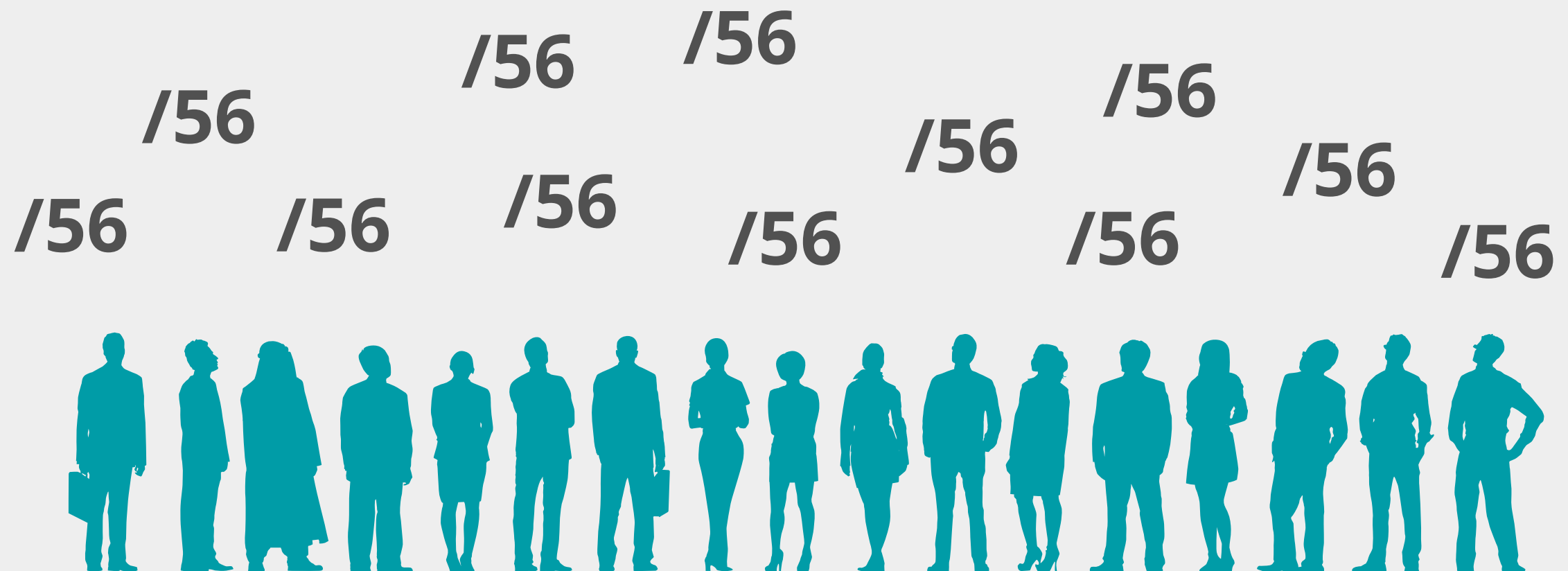
last-modified: 2015-05-31T08:23:35Z

source: RIPE

Examples AGGREGATED-BY-LIR



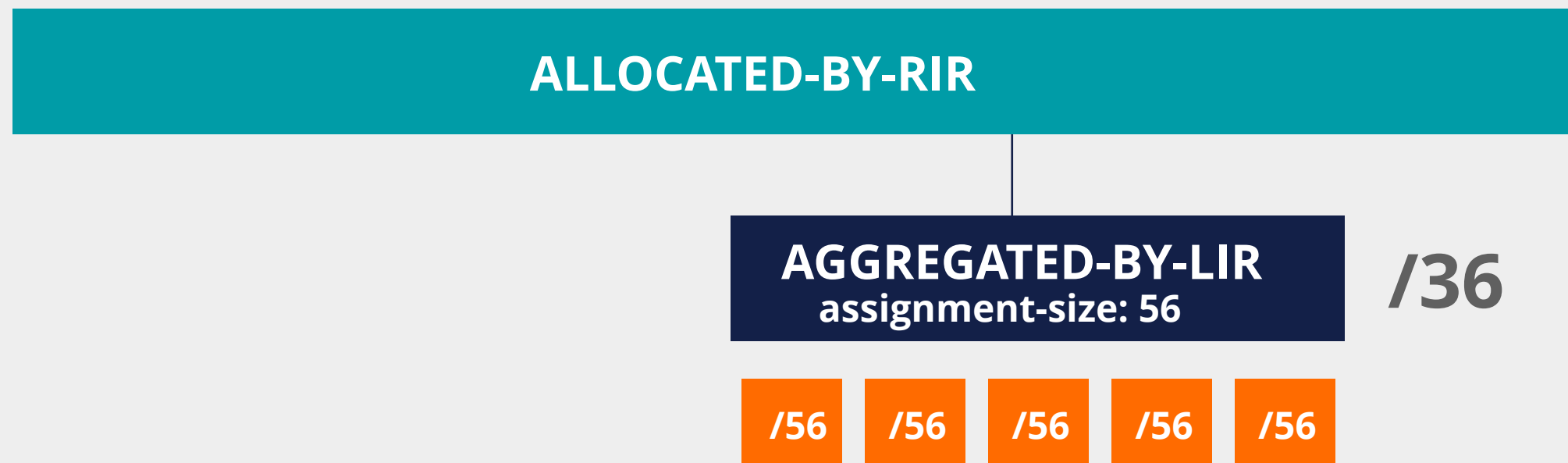
- Group of customers
- Same assignment size



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

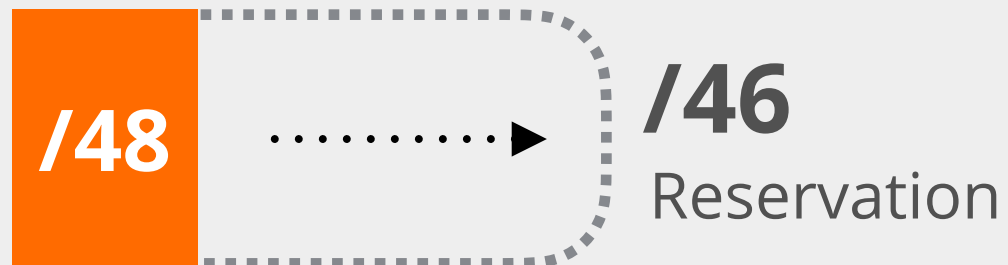
Examples ALLOCATED-BY-LIR



Reservation for a large customer



Large Customer



Branch office or department



Branch Office

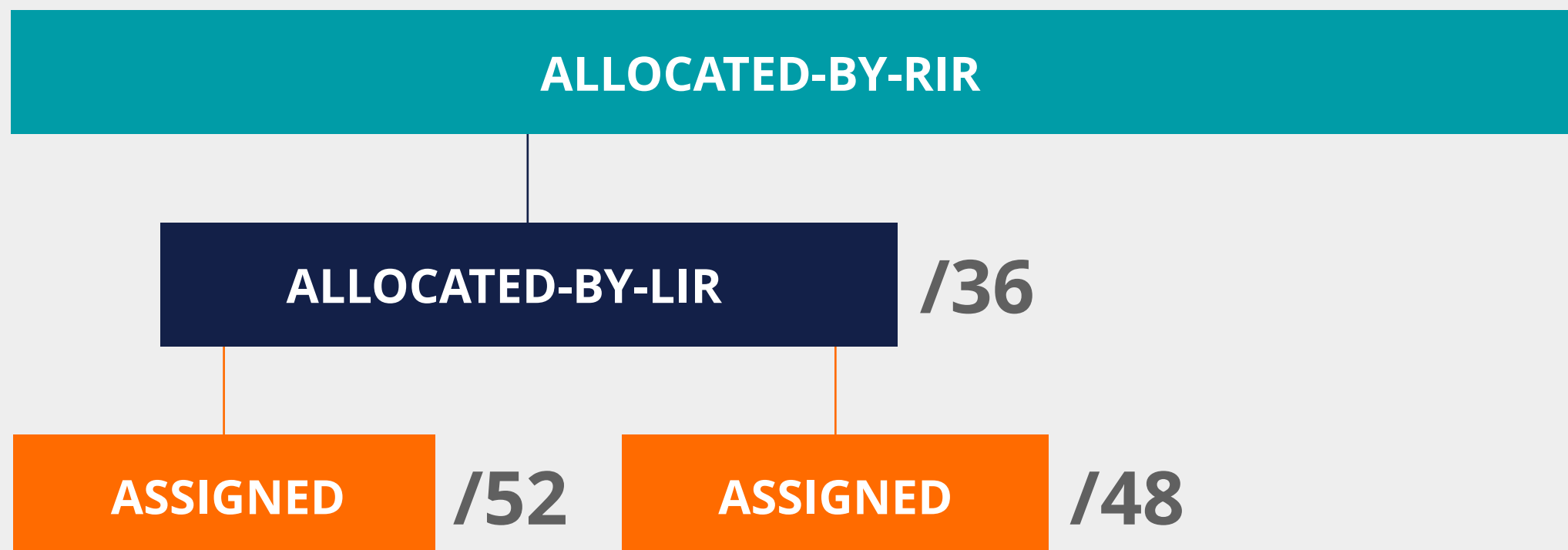


Using **ALLOCATED-BY-LIR**



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

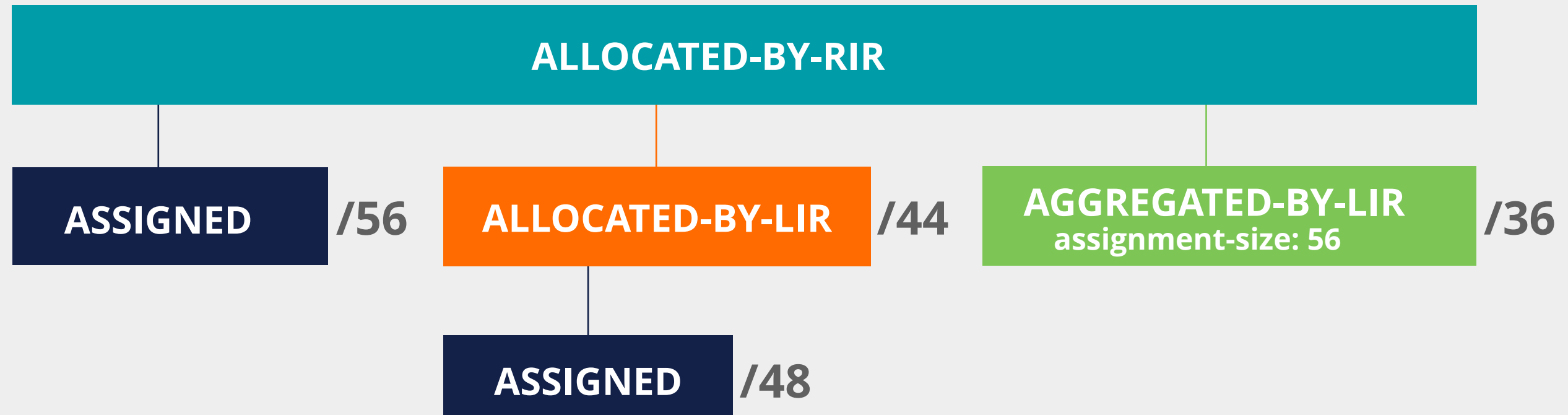
notify: noc@example.net

created: 2015-05-31T08:23:35Z

last-modified: 2015-05-31T08:23:35Z

source: RIPE

Overview



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 fd**xx:xxxx:xxxx**

Global ID: da24154e1d

Prefix: fd**da: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

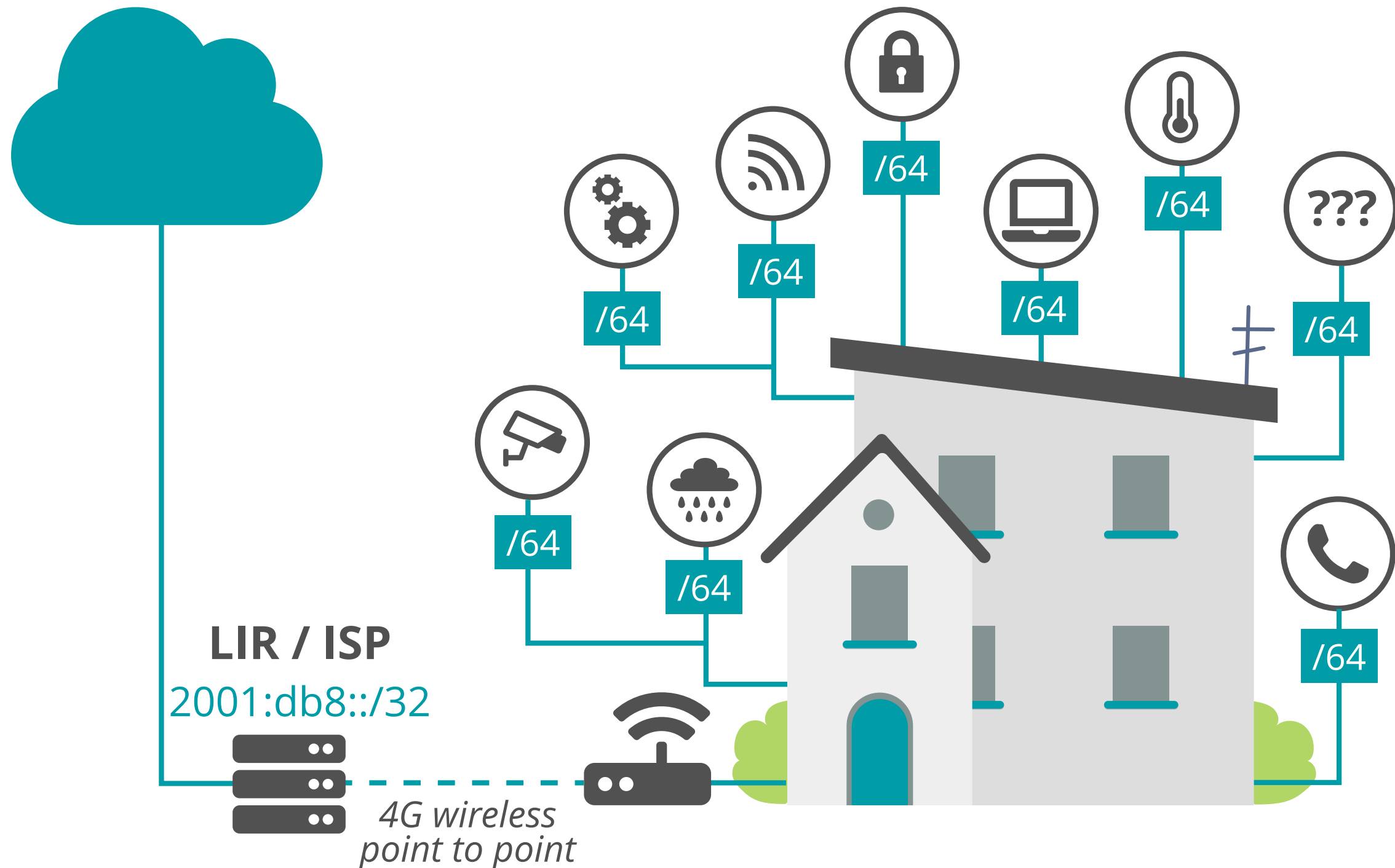


- Each home will be equipped with a 4G-enabled base unit
- The base unit will be the central gateway for smart services inside the house
- Each smart service runs on a **dedicated subnet**
- Services can be enabled or disabled at any point from a user's smartphone app
- Future Casa will be rolling out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

Smart Home 6 Network Diagram



IPv6 Internet





Activity 1

Take the poll!

Which prefix should you assign to each smart home?





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::/32

/32

/36

/36

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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?



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>



Questions



We want your feedback!



What did you think about this session?

Take our survey at:

<https://www.ripe.net/feedback/ipv61/>



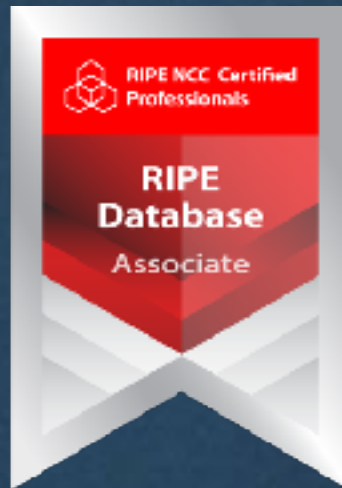
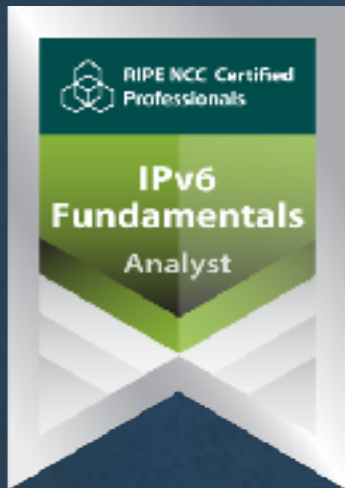


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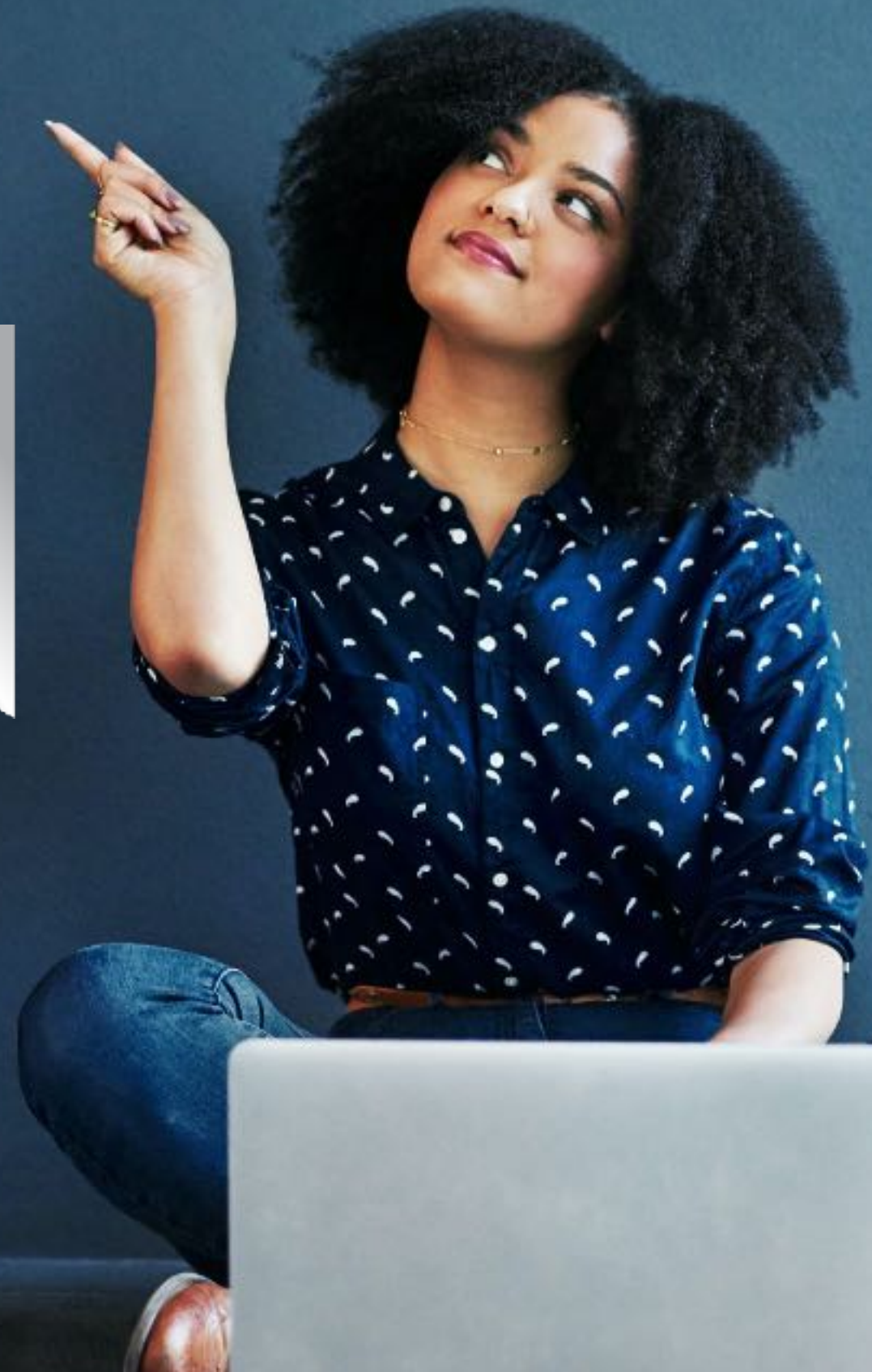




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Attend another webinar live wherever you are.

- ❖ Introduction to IPv6 (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
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- ❖ Advanced IPv6 (17 hrs)
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- ❖ IPv6 Security (24 hrs)



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- ❖ IPv6 Security - Expert



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