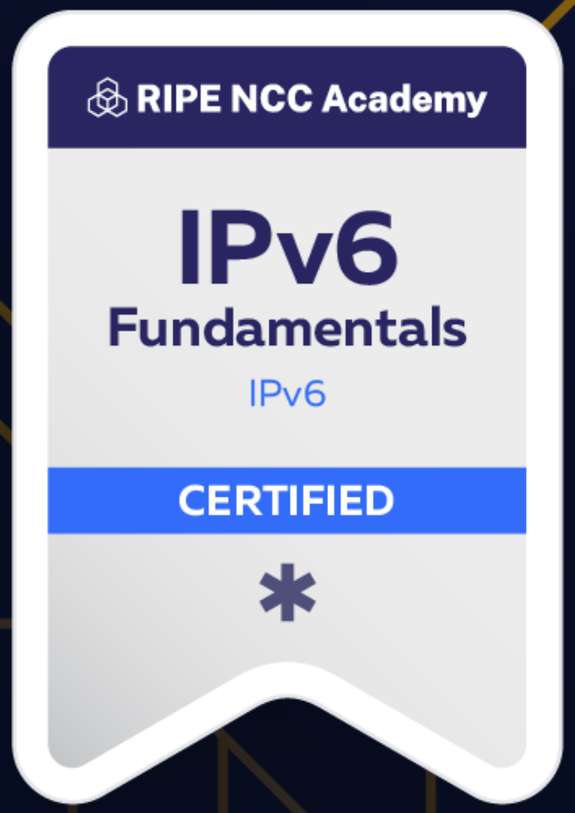

IPv6 Fundamentals

Exam Guide

IPv6 Fundamentals - Exam Guide

The IPv6 Fundamentals exam is intended for individuals who are familiar with best current practices in IPv6.

Recommended Knowledge:

It is recommended that candidates have at least three months of experience in working with IPv6 addresses and creating an IPv6 addressing plan and/or have participated in an IPv6 training course, or followed IPv6 webinars or have taken the IPv6 e-learning course on the RIPE NCC Academy.

The exam validates the ability to:

- Identify the advantages of IPv6 deployment
- Write an IPv6 address according to the best current practices
- Identify the scope of the different IPv6 address types
- Calculate IPv6 subnets
- Identify the different IPv6-related protocols
- Identify the different and security concerns of the IPv6 protocol
- Create an IPv6 addressing plan
- Recognise the application of specific IPv6 transition mechanisms

Exam Structure:

50	60 minutes	70
Number of questions	**Time limit**	**Passing score**

Each LIR receives three exam vouchers per year. Registered LIR contacts can claim these vouchers in the RIPE NCC Academy Dashboard.

Types of Questions

The exam contains different types of questions:

Multiple choice: Has one correct response and three incorrect responses.
Multiple response: Has two or more correct responses out of five or more alternatives.
Matching: contains a list of items or statements that must be correctly matched to another list of items or statements.
Drag and drop: Drag words or images into gaps in a paragraph of text or a base image.

Unanswered questions are scored as incorrect.

Unscored Items:

The exam may contain items that are included in the exam to trial run new exam questions for other RIPE NCC certifications. These items are not identified and will not count towards your score. Only the scored items are worth 100% of your score.

Exam Content Distribution:

Domain	Percent of Exam
Introduction to IPv6	4%
IPv6 Address Architecture	32%
IPv6 Protocols	44%
IPv6 Policies and Addressing Plans	20%

How can you study for the exam?

E-learning course

Taking our free online self-paced IPv6 Fundamentals e-learning course in the RIPE NCC Academy is the best way to prepare yourself for the IPv6 Fundamentals exam. The course consists of thirteen modules and takes you about fifteen hours to complete.

- Covers all exam knowledge and skills
- Available for free

Go to the RIPE NCC Academy

Face-to-face training course

RIPE NCC members can attend an in-person IPv6 Fundamentals training course. We offer courses throughout our service region, and attending a course is a great way to learn directly from our trainers and your peers.

- Partially covers exam knowledge and skills
- Courses for members only

Register for a face-to-face course

Webinars

We also offer several live online webinars on IPv6-related topics, such as addressing plans and filtering. This is an easy way to interact directly with our trainers and ask them your questions!

- Partially covers exam knowledge and skills
- Live webinars are available to all

Register for a webinar

Exam Outline

To pass the exam, you must possess the minimum level of knowledge, skills and abilities in understanding and performing the following:

1. Introduction to IPv6

1.1. Purpose and advantages of IPv6 deployment

1.1.1 Recognise how IPv4 exhaustion affects the development of the Internet

1.1.2 Identify the advantages of deploying IPv6

1.1.3 Describe the challenges/impact of NAT/CGN solutions in the development of the Internet

1.1.4 Identify the challenges with IPv6-only networks and IPv4-only networks

2. IPv6 Address Architecture

2.1. IPv6 Address Notation and address types

2.1.1 Describe the parts of an IPv6 address: network prefix and Interface ID

2.1.2 Write and compress an IPv6 address according to the Best Current Practices stated in RFC5952 (e.g., leading zeros, zero compression,upper/lower case, port numbers, whois search,etc

2.1.3 Identify the different IPv6 address types and their function/scope in a network/interface (RFC 4038; 4193; 4291, https://www.iana.org/assignments/ipv6-address-space/)

2.1.4 Identify the specific ranges used for each IPv6 address type

2.2. Subnetting in IPv6

2.2.1 Calculate subnets in IPv6

2.2.2 Calculate the amount of prefixes inside a bigger IPv6 block

2.2.3 Apply Best Current Practices to IPv6 subnetting (subnet sizes) for operations (RFC 4291)

2.2.4 Describe the importance of IPv6 subnetting

2.2.5 Define subnetting

2.2.6 Apply the 4 bit-boundary rule for subnetting

2.2.7 Subdivide any size IPv6 address blocks into any size smaller blocks (e.g. dividing a /32 into /36 or /48 or /64, limited to the nibble boundaries)

2.2.8 Calculate the total number of blocks that fit in a larger block (e.g. how many /48s fit in a /32)

3. IPv6 Protocols

3.1. IPv6 protocol basics

3.1.1 Describe how Neighbor Discovery works

3.1.2 Describe how SLAAC works

3.1.3 Explain the options available for IPv6 autoconfiguration (M, O, A, L flags)

3.1.4 Identify the Solicited Node Multicast Address

3.1.5 Explain how Solicited Node multicast addresses are created and used

3.1.6 Describe how Multicast works in IPv6

Exam Outline

3.1.7 Explain the importance of multicast in IPv6
3.1.8 Identify the main characteristics of IPv6 and how they impact a network

3.2. IPv6 packets
3.2.1 Identify the components of the IPv6 part of the packet (Basic header & extension headers)
3.2.2 Describe the Basic IPv6 header
3.2.3 Identify the main IPv6 extension headers
3.2.4 Identify the common values of Next Header Fields
3.2.5 Describe the importance of the IPv6 headers order
3.2.6 Describe the usage of the IPv6 extension headers
3.2.7 Describe how fragmentation works in IPv6
3.2.8 Describe the path MTU Discovery (PMTU-D) process in IPv6
3.2.9 Describe the importance of each supporting protocol used in IPv6 (PMTU-D, DHCPv6, DAD, ND, NUD, SLAAC, etc)
3.2.10 Describe how Neighbor Discovery Protocol works in IPv6 (Link scope, Five messages, Multicast addresses)
3.2.11 Identify the elements of Neighbor Discovery in IPv6 and their importance

3.3. Supporting protocols and IPv6 deployment
3.3.1 Explain the purpose of DAD (Duplicate Address Detection)
3.3.2 Explain the purpose of NUD (Neighbor Unreachability Detection)
3.3.3 Explain the function of the MLD protocol (Multicast Listener Discovery)
3.3.4 Classify the MLD protocol messages
3.3.5 Describe the purpose of Address Resolution (equivalent to ARP in IPv4)
3.3.6 Describe the purpose of Router Discovery
3.3.7 Identify the different ways of assigning address in IPv6 (manual config, SLAAC, RA + DHCPv6 (M or O flags)
3.3.8 Identify the configuration information provided by Router Advertisement messages
3.3.9 Describe privacy extensions for SLAAC
3.3.10 Describe Cryptographically Generated Addresses (CGA)
3.3.11 Ex Describe the process to generate Global Unicast IPv6 addresses (link prefix + Random interface ID) plain
3.3.12 Explain how DHCPv6 works
3.3.13 Describe the importance of DHCPv6 for IPv6 deployment
3.3.14 Identify which information can be sent using DHCPv6
3.3.15 Identify DHCPv6 scenarios (stateful vs. stateless)
3.3.16 Identify IPv6 DNS records
3.3.17 Create reverse DNS in IPv6
3.3.18 Identify how IPv6 is supported in forward and/or in reverse DNS (AAAA, ip6.arpa)

Exam Outline

3.3.19 Identify the security aspects to consider with IPv6 networks (RA, human error,etc)
3.3.20 Identify solutions to overcome existing and new security risks (RA Guard, SEND, etc)
3.3.21 Select the basic network design principles to be used in an IPv6 deployment
3.3.20 Identify solutions to overcome existing and new security risks (RA Guard, SEND, etc)
3.3.21 Select the basic network design principles to be used in an IPv6 deployment

3.4. Transition Mechanisms
3.4.1 Identify the IPv6 Transition Mechanisms
3.4.2 Identify the use case of a specific Transition Mechanism
3.4.3 Identify what elements to consider when creating a transition strategy
3.4.4 Describe dual-stack and its pros and cons
3.4.5 Describe tunneling and its pros and cons
3.4.6 Identify examples of tunneling transition mechanisms
3.4.7 Describe translation and its pros and cons

4. IPv6 Policies and Addressing Plans

4.1. RIPE Policies and IPv6
4.1.1 Identify the requirements/procedures to receive and distribute IPv6 address space according to the current RIPE policies (considering criteria for different subnet sizes)
4.1.2 Distinguish between IPv6 allocations, assignments and sub-allocations
4.1.3 Identify IPv6 assignments/sub-allocations in the RIPE Database
4.1.4 Identify how the different RIPE Database inet6num object statuses apply to real network situations
4.1.5 Identify the criteria for different possible allocation sizes (users, network extension, hierarchical/geo structure, longevity and security levels)

4.2 Addressing Plans
4.2.1 Create an Addressing Plan according to the current best practices in IPv6
4.2.2 Choose the recommended prefix lengths for infrastructure (POPs, routers, LAN, Point-to-point links etc) and for end user assignments (home, business, point-to-point links, etc)
4.2.3 Differentiate between infrastructure and end user address space
4.2.4 Justify that a /64 is the minimum subnet size to be assigned to an end user
4.2.5 Identify the importance of using IPAM tools

Learning Resources

1. Introduction to IPv6

1.1. Purpose and advantages of IPv6 deployment

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
1.1.1 Recognise how IPv4 exhaustion affects the development of the Internet	Module 1.1, 1.2	Yes				
1.1.2 Identify the advantages of deploying IPv6	Module 3.3	Yes	Partially			
1.1.3 Describe the challenges/impact of NAT/CGN solutions in the development of the Internet	Module 1.1	Yes				
1.1.4 Identify the challenges with IPv6-only networks and IPv4-only networks	Module 1.1, 1.2		Partially			

2. IPv6 Address Architecture

2.1. IPv6 address notation and address types

2.1.1 Describe the parts of an IPv6 address: network prefix and Interface ID	Module 2.2	Yes	Yes	Yes	Yes
2.1.2 Write and compress an IPv6 address according to the Best Current Practices stated in RFC5952	Module 2.1	Yes		Yes	
2.1.3 Identify the different IPv6 address types and their function/scope in a network/interface	Module 2.3	Yes	Yes	Yes	
2.1.4 Identify the specific ranges used for each IPv6 address type	Module 2.2	Yes	Partially	Yes	
2.1.5 Generate an IPv6 ULA (Unique Local Address) prefix	Module 4.1	Yes		Yes	

Learning Resources

2.2. Subnetting in IPv6

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
2.2.1 Calculate subnets in IPv6	Module 2.2	Yes		Yes		
2.2.2 Calculate the amount of prefixes inside a bigger IPv6 block	Module 2.2	Yes		Yes		Partially
2.2.3 Apply Best Current Practices to IPv6 subnetting (subnet sizes) for operations (RFC 4291)	Activity 2a	Yes		Yes	Yes	Yes
2.2.4 Describe the importance of IPv6 subnetting	Module 2.2	Yes		Yes	Yes	
2.2.5 Define subnetting	Module 2.2	Yes		Yes	Yes	
2.2.6 Apply the 4 bit-boundary rule for subnetting	Module 2.2	Yes		Yes	Yes	Partially
2.2.7 Subdivide any size IPv6 address blocks into any size smaller blocks	Module 2.2	Yes		Yes	Yes	
2.2.8 Calculate the total number of blocks that fit in a larger block (e.g. how many /48s fit in a /32).	Module 2.2	Yes		Yes	Partially	

Learning Resources

3. IPv6 Protocols

3.1. IPv6 protocol basics

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
3.1.1 Describe how Neighbor Discovery works	Module 3.2, 3.3	Yes	Partially			
3.1.2 Describe how SLAAC works	Module 3.3	Yes				
3.1.3 Explain the options available for IPv6 autoconfiguration (M, O, A, L flags)	Module 3.3	Partially	Partially			
3.1.4 Identify the Solicited Node Multicast Address	Module 3.2	Yes	Partially			
3.1.5 Explain how Solicited Node multicast addresses are created and used	Module 3.2	Yes	Partially			
3.1.6 Describe how Multicast works in IPv6	Module 3.2	Yes	Partially			
3.1.7 Explain the importance of multicast in IPv6	Module 3.2	Yes	Yes			
3.1.8 Identify the main characteristics of IPv6 and how they impact a network	Module 3.3	Yes	Yes			

Learning Resources

3.2. IPv6 packets

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
3.2.1 Identify the components of the IPv6 part of the packet (Basic header & extension headers)	Module 3.1	Yes	Yes			
3.2.2 Describe the Basic IPv6 header	Module 3.1	Yes	Yes			
3.2.3 Identify the main IPv6 extension headers	Module 3.1	Yes	Yes			
3.2.4 Identify the common values of Next Header Fields	Module 3.1	Yes				
3.2.5 Describe the importance of the IPv6 headers order	Module 3.1	Yes	Yes			
3.2.6 Describe the usage of the IPv6 extension headers	Module 3.1	Yes	Yes			
3.2.7 Describe how fragmentation works in IPv6	Module 3.1, 3.3	Yes	Yes			
3.2.8 Describe the path MTU Discovery (PMTU-D) process in IPv6	Module 3.3	Yes				
3.2.9 Describe the importance of each supporting protocol used in IPv6 (PMTU-D, DHCPv6, DAD, ND, NUD, SLAAC, etc)	Module 3.3	Yes	Partially			
3.2.10 Describe how Neighbor Discovery Protocol works in IPv6 (Link scope, Five messages, Multicast addresses)	Module 3.2, 3.3	Yes	Yes			
3.2.11 Identify the elements of Neighbor Discovery in IPv6 and their importance	Module 3.2, 3.3	Yes	Yes			

Learning Resources

3.3. Supporting protocols and IPv6 deployment

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
3.3.1 Explain the purpose of DAD (Duplicate Address Detection)	Module 3.3	Yes	Yes			
3.3.2 Explain the purpose of NUD (Neighbor Unreachability Detection)	Module 3.3	Yes	Yes			
3.3.3 Explain the function of the MLD protocol (Multicast Listener Discovery)	Module 3.2	Yes	Yes			
3.3.4 Classify the MLD protocol messages	Module 3.2	Yes	Yes			
3.3.5 Describe the purpose of Address Resolution (equivalent to ARP in IPv4)	Module 3.2, 3.3	Yes	Yes			
3.3.6 Describe the purpose of Router Discovery	Module 3.3	Yes	Yes			
3.3.7 Identify the different ways of assigning address in IPv6 (manual config, SLAAC, RA + DHCPv6 (M or O flags)	Module 3.3	Yes	Partially			
3.3.8 Identify the configuration information provided by Router Advertisement messages	Module 3.3	Yes	Partially			
3.3.9 Describe privacy extensions for SLAAC	Module 3.3	Yes	Yes			
3.3.10 Describe Cryptographically Generated Addresses (CGA)	Module 3.3	Yes	Yes			
3.3.11 Describe the process to generate Global Unicast IPv6 addresses (link prefix + Random interface ID)	Module 3.3	Yes	Yes			

Learning Resources

3.3. Supporting protocols and IPv6 deployment

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
3.3.12 Explain how DHCPv6 works	Module 3.3, 5.3	Yes	Yes			
3.3.13 Describe the importance of DHCPv6 for IPv6 deployment	Module 3.3, 5.3	Yes				
3.3.14 Identify which information can be sent using DHCPv6	Module 3.3, 5.3	Yes	Yes			
3.3.15 Identify DHCPv6 scenarios (stateful vs. stateless)	Module 3.3, 5.3	Yes	Yes			
3.3.16 Identify IPv6 DNS records	Module 3.3, 5.3	Yes				
3.3.17 Create reverse DNS in IPv6	Module 3.3, 5.3	Yes				
3.3.18 Identify how IPv6 is supported in forward and/or in reverse DNS (AAAA, ip6.arpa)	Module 3.3, 5.3	Yes				
3.3.19 Identify the security aspects to consider with IPv6 networks (RA, human error,etc)	Module 5.3	Partially	Yes			
3.3.20 Identify solutions to overcome existing and new security risks (RA Guard, SEND, etc)	Module 5.3	Partially	Yes			
3.3.21 Select the basic network design principles to be used in an IPv6 deployment	Module 5.1	Partially	Partially			

Learning Resources

3.4. Transition Mechanisms

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
3.4.1 Identify the IPv6 Transition Mechanisms	Module 5.3		Partially			
3.4.2 Identify the use case of a specific Transition Mechanism	Module 5.3		Partially			
3.4.3 Identify what elements to consider when creating a transition strategy	Module 5.3		Partially			
3.4.4 Describe dual-stack and its pros and cons	Module 5.3		Yes			
3.4.5 Describe tunneling and its pros and cons	Module 5.3		Yes			
3.4.6 Identify examples of tunneling transition mechanisms	Module 5.3					
3.4.7 Describe translation and its pros and cons	Module 5.3		Yes			

Learning Resources

4. IPv6 Policies and Addressing Plans

4.1. RIPE Policies and IPv6

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
4.1.1 Identify the requirements/procedures to receive and distribute IPv6 address space according to the current RIPE policies	Module 4.1	Yes		Yes		
4.1.2 Distinguish between IPv6 allocations, assignments and sub-allocations	Module 4.1	Yes		Yes		Partially
4.1.3 Identify IPv6 assignments/sub-allocations in the RIPE Database	Module 4.2	Yes		Yes		Yes
4.1.4 Identify how the different RIPE Database inet6num object statuses apply to real network situations.	Module 4.2	Yes		Yes		Yes
4.1.5 Identify the criteria for different possible allocation sizes	Module 4.1	Yes		Yes		

Learning Resources

4.2. Addressing Plans

	RIPE NCC Academy IPv6 Fundamentals [15 hours]	**Training Course** IPv6 Basics [1 day]	**Training Course** IPv6 Security [1 day]	**Webinar** Introduction to IPv6 [2 hours]	**Webinar** IPv6 Addressing Plans [1 hour]	**Webinar** IPv6 in the RIPE Database 1 hour]
4.2.1 Create an Addressing Plan according to the current best practices in IPv6	Module 5.2	Yes			Yes	
4.2.2 Choose the recommended prefix lengths for infrastructure and for end user assignments	Module 4.1, 5.2	Yes		Yes	Yes	
4.2.3 Differentiate between infrastructure and end user address space	Module 4.2, 5.2	Yes		Partially	Yes	
4.2.4 Justify that a /64 is the minimum subnet size to be assigned to an end user	Module 5.2	Yes		Yes	Yes	
4.2.5 Identify the importance of using IPAM tools	Module 5.2	Yes			Yes	

Support

If you have any questions regarding the exam, please send an email to Exams Support

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