

IPv6 Address Allocation and Assignment Policy

How to read this draft document:

This document relates to a project to improve the readability of RIPE policy documents. If approved, it will replace [ripe-512](#), [ripe-451](#) and [ripe-233](#). To show you how the new document would be different to the current one, we made a summary of the changes made. This draft document shows only the proposed text.

If you want to print out the document, we recommend [downloading this PDF](#). Another version of this draft document containing both the current and the proposed text side-by-side [is available](#).

Summary of changes/comments

- Merger of three documents on IPv6 into one (ripe-512, ripe-451, ripe-233)
- Wording throughout the document has been improved
- Definition of End Site has moved higher up in the document; End Site is mentioned in the definition of “utilisation”, so it has to appear before that
- Definition and all references of NIR and IR removed
- Removed 5.7. Existing IPv6 address space holders: no longer relevant, no more /35
- Notes have been removed

Added in new draft document:

- Section 14.0 - Attribution
-

Abstract

This document defines the policies for the assignment and allocation of globally unique IPv6 addresses to Internet Service Providers (ISPs) and other organisations. It also describes the policies for IPv6 address space for special purposes, such as Internet Exchange Points and Internet Root Servers.

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1. Introduction

1.1. Overview

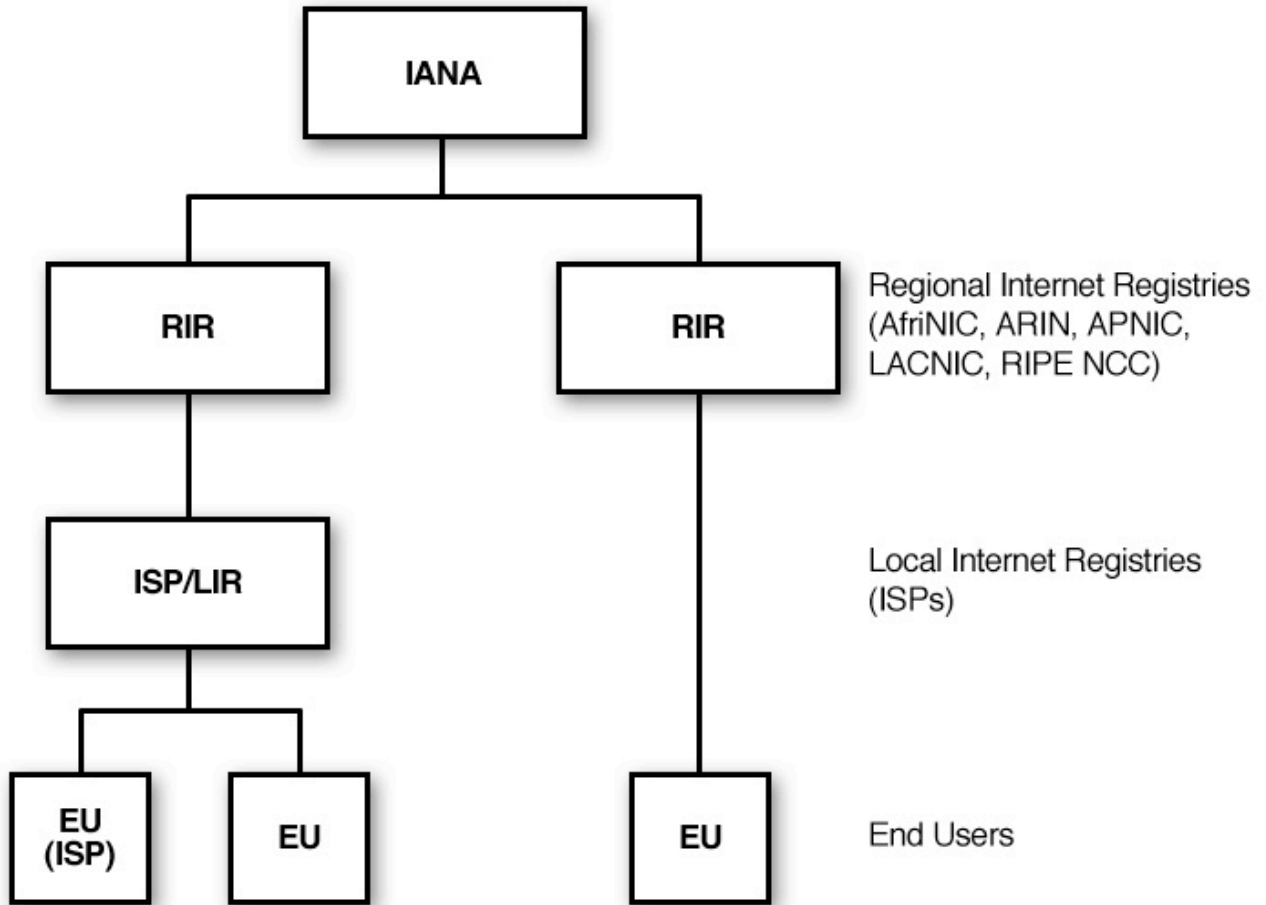
This document describes the policies for the allocation and assignment of globally unique IPv6 address space. It also describes the policies for address space for special purposes, such as Internet Exchange Points and Internet Root Servers.

[RFC4291](#) designates 2000::/3 to be global unicast address space that the Internet Assigned Numbers Authority (IANA) may allocate to the RIRs. In accordance with RFC4291, IANA allocated initial ranges of global unicast IPv6 address space from the 2000::/3 address block to the RIRs. This document describes the policies concerning the IPv6 allocations and assignments as developed by the RIPE community.

2.0 Definitions

The following terms and definitions are of particular importance to the understanding of the goals, environment and policies described in this document.

Responsibility for management of IPv6 address space is distributed globally in accordance with the hierarchical structure shown below.



2.1. Regional Internet Registry (RIR)

Regional Internet Registries are established and authorised by respective regional communities and recognised by the ICANN to serve and represent large geographical regions. The primary role of RIRs is to manage and distribute public Internet address space within their respective regions.

2.2. Local Internet Registry (LIR)

A Local Internet Registry is an organisation that assigns address space to the users of the network services that it provides. LIRs are generally ISPs whose customers are primarily End Users and possibly other ISPs.

2.3. Allocate

To “allocate” means to distribute address space to IRs for the purpose of subsequent distribution.

2.4. Assign

To “assign” means to delegate address space to an ISP or End User for specific use within the Internet infrastructure they operate. Assignments must only be made for specific purposes documented by specific organisations and are not to be sub-assigned to other parties.

2.5. End Site

An End Site in IPv6 policies is defined as an End User (subscriber) who has a business or legal relationship (same or associated entities) with a service provider:

- that assigns address space to the End User;
- that provides transit service for the End User to other sites;
- that carries the End User's traffic;
- that advertises an aggregate prefix route that contains the End User's assignment.

2.6. Utilisation

In IPv6, "utilisation" is only measured in terms of the bits to the left of the efficiency measurement unit (/56). In other words, "utilisation" effectively refers to the assignment of network prefixes to End Sites and not to the number of addresses assigned within individual End Site assignments. The actual usage of addresses within each assignment may be low when compared to IPv4 assignments.

Throughout this document, the term "utilisation" refers to the assignment of network prefixes to End Sites and not the number of addresses assigned within individual subnets within those End Sites.

2.7. HD-Ratio

The HD-Ratio is a way of measuring the efficiency of address assignment within an allocation ([RFC3194](#)). It is an adaptation of the H-Ratio originally defined in [RFC1715](#) and is expressed as follows:

$$HD = \frac{\text{Log (number of assigned address blocks)}}{\text{Log (maximum number of assignable address blocks)}}$$

More details are found in [appendix A](#).

3.0 Goals of IPv6 Address Space Management

IPv6 address space is a public resource that must be managed in a prudent manner to benefit the long-term interests of the Internet. Responsible address space management involves balancing a set of sometimes competing goals. The following goals are relevant to IPv6 address policy.

3.1. Uniqueness

Every assignment and/or allocation of address space must be unique. This is an absolute requirement for ensuring that every public host on the Internet can be uniquely identified.

3.2. Registration

Internet address space must be registered in a database accessible to appropriate members of the Internet community. This is necessary to ensure the uniqueness of each Internet address and to provide reference information for Internet troubleshooting at all levels. The goal of registration should be applied within the context of reasonable privacy considerations and applicable laws.

3.3. Aggregation

Wherever possible, address space should be distributed in a hierarchical manner, according to the topology of network infrastructure. This is necessary to permit the aggregation of routing information by ISPs and to limit the growth of Internet routing tables.

This goal is particularly important in IPv6 addressing, where the size of the total address pool creates significant implications for both internal and external routing.

IPv6 address policies should seek to avoid fragmentation of address ranges.

The RIPE NCC should apply practices that maximise the potential for additional allocations to be contiguous with previous allocations. However, the RIPE NCC cannot guarantee a contiguous allocation.

3.4. Conservation

Although IPv6 provides an extremely large pool of address space, address policies should avoid unnecessarily wasteful practices. Requests for address space should be supported by appropriate documentation and stockpiling of unused addresses should be avoided.

3.5. Fairness

All policies and practices relating to the use of public address space should apply fairly and equitably to all existing and potential members of the Internet community, regardless of their location, nationality, size, or any other factor.

3.6. Minimised Overhead

It is desirable to minimise the overhead associated with obtaining address space. Overhead includes the need to go back to the RIPE NCC for additional space too frequently, and the administrative work associated with managing address space that grows through a number of small successive incremental expansions rather than through fewer, but larger, expansions.

3.7. Conflict of Goals

The goals described above will often conflict with each other, or with the needs of individual IRs or End Users. All IRs evaluating requests for allocations and assignments must make judgments, seeking to balance the needs of the applicant with the needs of the Internet community as a whole.

In IPv6 address policy, the goal of aggregation is considered to be the most important.

4.0 IPv6 Policy Principles

To address the goals described in the previous section, the policies in this document follow the basic principles described below.

4.1. Address space not to be Considered Property

The policies in this document are based upon the understanding that globally unique IPv6 unicast address space is registered for use rather than owned as an asset. Specifically, IP addresses are allocated and assigned based on demonstrated and justified need. The allocations and assignments are registered in the RIPE Database. The allocation/assignment is only valid for as long as the original criteria under which the organisation qualified for an allocation or assignment are still valid.

In those cases where the organisation is not using the address space as intended, or is not complying with the policies and/or the responsibilities associated with it, the RIPE NCC reserves the right to deregister the address space.

When requesting additional address space or changes to existing address space, these requests will be evaluated according to the IPv6 policies that are current at that time.

4.2. Routability not Guaranteed

There is no guarantee that any address allocation or assignment will be globally routable.

However, the RIPE NCC must apply procedures that reduce the possibility of fragmented address space, which may lead to a loss of routability.

4.3. Minimum Allocation

The minimum allocation size for IPv6 address space is /32.

4.4. Consideration of IPv4 Infrastructure

If an existing IPv4 service provider requests IPv6 space for eventual transition of existing services to IPv6, the number of present IPv4 customers may be used to justify a larger request than would be justified if based solely on the IPv6 infrastructure.

5.0 Policies for Allocations and Assignments

5.1. Initial Allocation

5.1.1. Initial Allocation Criteria

To qualify for an initial allocation of IPv6 address space, an organisation must:

- a) be an LIR;
- b) have a plan for making sub-allocations to other organisations and/or End Site assignments within two years.

5.1.2. Initial Allocation Size

Organisations that meet the initial allocation criteria are eligible to receive a minimum allocation of /32.

Organisations may qualify for an initial allocation greater than /32 by submitting documentation that reasonably justifies the request. If so, the allocation size will be based on the number of existing

users and the extent of the organisation's infrastructure.

5.2. Additional Allocation

Organisations that hold an existing IPv6 allocation may receive an additional allocation in accordance with the following policies.

5.2.1. Additional Allocation Criteria

An additional allocation will be provided when an organisation (i.e. an ISP/LIR) satisfies the evaluation threshold of past address utilisation in terms of the number of sites in units of /56 assignments. The HD-Ratio ([RFC3194](#)) is used to determine the utilisation thresholds that justify the allocation of additional address space as described below.

5.2.2. Applied HD-Ratio

The HD-Ratio value of 0.94 is adopted as an acceptable address utilisation to justify the allocation of additional address space. Appendix A provides a table showing the number of assignments that are necessary to reach an acceptable utilisation value for a given address block size.

5.2.3. Additional Allocation Size

When an organisation has reached an acceptable utilisation for its allocated address space, it is immediately eligible to obtain an additional allocation that results in a doubling of the address space allocated to it. Where possible, the allocation will be made from an adjacent address block, meaning that its existing allocation is extended by one bit to the left.

If an organisation needs more address space, it must provide documentation justifying its requirements for a two-year period. The new allocation will be based on these requirements.

5.3. LIR-to-ISP Allocation

There is no specific policy for an organisation (LIR) to allocate address space to subordinate ISPs. Each LIR may develop its own policy for subordinate ISPs to encourage optimum utilisation of the total address block allocated to the LIR. The LIR is responsible for the registration of ALL assignments that are made from their allocation.

5.4. Assignment

LIRs must make IPv6 assignments in accordance with the following provisions.

5.4.1. Assignment Address Space Size

End Users are assigned an End Site assignment from their LIR or ISP. The size of the assignment is a local decision for the LIR or ISP to make, using a minimum value of a /64 (only one subnet is anticipated for the End Site).

5.4.2. Assignment of Multiple /48s to a Single End Site

When a single End Site requires an assignment shorter than a /48 or multiple /48, it must request the assignment providing documentation or materials that justify the request. These requests will be processed and evaluated by the RIPE NCC.

5.4.3. Assignment to Operator's Infrastructure

An organisation (i.e. ISP/LIR) may assign a network prefix per Point of Presence (PoP) as the service infrastructure of an IPv6 service operator. Each assignment to a PoP is regarded as one assignment regardless of the number of users using the PoP. A separate assignment can be obtained for the in-house operations of the operator.

5.5. Registration

An organisation holding an IPv6 allocation must register its IPv6 address assignments in the appropriate RIR database.

These registrations can be made either as individual assignments or by inserting an object with a status value of "AGGREGATED-BY-LIR" where the "assignment-size:" attribute contains the individual assignment size made to End Users. When more than a /48 is assigned to an organisation, it must be registered in the database as a separate object with status 'ASSIGNED'.

The LIR must be able to provide statistics on the number of individual assignments made on all "AGGREGATED-BY-LIR" object statuses so that the RIR can calculate and verify the HD-ratio in the case of audits or subsequent allocation requests.

5.6. Reverse Lookup

When the RIPE NCC delegates IPv6 address space to an organisation, it also delegates the responsibility to manage the reverse lookup zone that corresponds to the allocated IPv6 address space. Each organisation should properly manage its reverse lookup zone. When making an address space assignment, the organisation must delegate, when requested, the responsibility to the End User to manage the reverse lookup zone that corresponds to the assigned address space.

6.0 Assignments for Internet Experiments

Organisations often require deployment tests for new Internet services and technologies. These require numbering resources for the duration of the test.

The policy goal of resource conservation is of reduced importance when resources are issued on a temporary basis.

6.1 Defining the Experiment

An organisation receiving numbering resources must document the experiment. This may be in the form of a current IETF Experimental RFC ([RFC2026](#), see [Sec. 4.2.1](#)) or an “experiment proposal” detailing the resources required and the activities to be carried out.

6.2 Publication

The experiment proposal must be made public (e.g., published on a website) upon registration of the resources by the RIPE NCC. Following the conclusion of the experiment the results must be published free of charge and free from disclosure constraints.

6.3 Non-commercial Basis

Resources issued for an experiment must not be used for commercial purposes.

6.4 Period of the Temporary Resource Registration

The resources will be issued on a temporary basis for a period of one year. Renewal of the resource's registration is possible on receipt of a new request that details any continuation of the experiment during the extended period.

The resources issued cannot be used for a commercial service following the conclusion of the experiment.

6.5 Registration

The RIPE NCC will register the resources issued in the RIPE Database.

6.6 Making the Request

The request must be made by an LIR using the appropriate request form for the resource found at:

<https://www.ripe.net/ripe/docs/request-forms-supporting-notes>

7.0 IPv6 Provider Independent (PI) Assignments

To qualify for IPv6 PI address space, an organisation must:

- a) demonstrate that it will be multihomed
- b) meet the requirements of the policies described in the RIPE NCC document entitled "[Contractual Requirements for Provider Independent Resources Holders in the RIPE NCC Service Region](#)"

The RIPE NCC will assign the prefix directly to the End User organisations upon a request properly submitted to the RIPE NCC, either directly or through a sponsoring LIR.

The minimum size of the assignment is a /48. Organisations requesting a larger assignment (shorter prefix) must provide documentation justifying the need for additional subnets.

Additional assignments may also be made when the need is demonstrated and documented based on address usage, or because different routing requirements exist for additional assignments. When possible, these further assignments will be made from an adjacent address block.

Assignments will be made from a separate "designated block" to facilitate filtering practices.

The PI assignment cannot be further assigned to other organisations.

7.1 IPv6 Provider Independent (PI) Assignments for LIRs

LIRs can qualify for an IPv6 PI assignment for parts of its own infrastructure that are not used for customer End Sites. Where an LIR has an IPv6 allocation, the LIR must demonstrate the unique

routing requirements for the PI assignment.

The LIR must return the IPv6 PI assignment within a period of six months if the original criteria on which the assignment was based are no longer valid.

If an organisation already received a PI assignment before becoming an LIR, the PI assignment should be returned upon receiving an IPv6 allocation if there are no specific routing requirements to justify both.

8.0 Anycasting TLD and Tier 0/1 ENUM Nameservers

The organisations applicable under this policy are TLD managers, as recorded in the IANA's Root Zone Database, and ENUM administrators, as assigned by the ITU. The organisation may receive up to four /48 prefixes per TLD and four /48 prefixes per ENUM. These prefixes must be used for the sole purpose of anycasting authoritative DNS servers for the stated TLD/ENUM, as described in BCP126/[RFC4786](#).

Assignments for authoritative TLD or ENUM Tier 0/1 DNS lookup services are subject to the policies described in the RIPE Document entitled "[Contractual Requirements for Provider Independent Resource Holders in the RIPE NCC Service Region](#)".

Anycasting assignments are registered with a status of "ASSIGNED ANYCAST" in the RIPE Database and must be returned to the RIPE NCC if no longer in use for infrastructure providing authoritative TLD or ENUM Tier 0/1 DNS lookup services.

9.0 Internet Exchange Points (IXP)

An Internet Exchange Point is defined as a physical network infrastructure (layer 2) operated by a single entity whose purpose is to facilitate the exchange of Internet traffic between ISPs.

Exchange Point operators require address space for the peering mesh (peering LAN) that is independent from any of the address space in use by member networks or any other organisation. This specific policy applies only to this particular part of the infrastructure of the IXP. Addresses needed for any other purposes (e.g. additional services provided to the members, IXP office network etc.) should be requested separately.

To qualify for an assignment, the IXP must have a minimum of three ISPs connected. The IXP must have a transparent and published policy describing the requirements to join.

By default a /48 will be assigned. If the requesting organisation is confident that it will never need more than a single network they can request for a /64 to be assigned.

The RIPE NCC will assign the prefix directly to the IXP, upon a request properly submitted to the RIPE NCC, either directly or through a sponsoring LIR. IPv6 IXP address assignments are subject to the policies described in the RIPE NCC document entitled "Contractual Requirements for Provider Independent Resources Holders in the RIPE NCC Service Region".

Address space assigned under this policy may not be globally routable.

10.0 Internet DNS Root Servers

DNS resolvers and resolving name servers need to be pre-configured with the network addresses of the root name servers. This makes these addresses special and not easy to be changed.

Each (current or future) Internet DNS root server (as listed in the DNS root-servers.net zone) in the RIPE NCC Service Region will be assigned a block of IPv6 address space for the purpose of root server operations. The size of the block shall be the same as the size of the minimum allocation to Local Internet Registries (LIRs) valid at the time of the root server assignment.

The assigned prefix must be used for root server operations and support functions directly related to the operations, such as monitoring, statistics, etc. The assigned prefix is bound to the root server service itself and is not associated with the organisation(s) that operate the root server at a particular point in time.

These organisations should not use the address space to provide any services that are not related to the root server.

If the operational responsibility for a root server moves to a new organisation, the RIPE NCC should be notified so it can make the necessary updates to reflect the changes.

If the new location of the root server is outside the RIPE NCC Service Region, the address space must be returned to the RIPE NCC and a new assignment must be requested from the appropriate Regional Internet Registry (RIR).

If a root server stops operating completely, the address space must be returned to the RIPE NCC. The RIPE NCC will mark the prefix as "reserved" for a suitably long period of time.

11.0 References

[RFC1715] "The H Ratio for Address Assignment Efficiency", C. Huitema. November 1994, <http://www.ietf.org/rfc/rfc1715.txt>

[RFC2026] "The Internet Standards Process -- Revision 3 IETF Experimental RFC, <http://www.ietf.org/rfc/rfc2026.txt>, see Sec. 4.2.1

[RFC2462] "IPv6 Stateless Address Autoconfiguration", S. Thomson, T. Narten, 1998, <http://www.ietf.org/rfc/rfc2462.txt>

[RFC 4291] "IP Version 6 Addressing Architecture", R. Hinden, S. Deering. February 2006, <http://www.ietf.org/rfc/rfc4291.txt>

[RFC2928] "Initial IPv6 Sub-TLA ID Assignments", R. Hinden, S. Deering, R. Fink, T. Hain. September 2000 <http://www.ietf.org/rfc/rfc2928.txt>

[RFC3194] "The H-Density Ratio for Address Assignment Efficiency An Update on the H ratio", A. Durand, C. Huitema. November 2001, <http://www.ietf.org/rfc/rfc3194.txt>

[RFC4786] "Operation of Anycast Services", J. Abley, K. Lindqvist. December 2006, <http://www.ietf.org/rfc/rfc4786.txt>

12.0 Appendix A: HD-Ratio

The utilisation threshold T, expressed as a number of individual /56 prefixes to be allocated from IPv6 prefix P, can be calculated as:

$$T = 2 \frac{((56-P)*HD)}{1}$$

Thus, the utilisation threshold for an organisation requesting subsequent allocation of an IPv6 address block is specified as a function of the prefix size and target HD-Ratio. This utilisation refers to the use of /56s as an efficiency measurement unit, and does not refer to the utilisation of addresses within those End Sites. It is an address allocation utilisation ratio and not an address assignment utilisation ratio.

In accordance with the recommendations of [RFC3194](#), the HD-Ratio of 0.94 is the utilisation threshold for IPv6 address space allocations.

The following table provides equivalent absolute and percentage address utilisation figures for IPv6 prefixes, corresponding to an HD-Ratio of 0.94.

Prefix	Total /56s	/56s HD 0.94	Util %
10	70368744177664	10388121308479	14.76
11	35184372088832	5414630391777	15.39
12	17592186044416	2822283395519	16.04
13	8796093022208	1471066903609	16.72
14	4398046511104	766768439460	17.43
15	2199023255552	399664922315	18.17
16	1099511627776	208318498661	18.95
17	549755813888	108582451102	19.75
18	274877906944	56596743751	20.59
19	137438953472	29500083768	21.46
20	68719476736	15376413635	22.38
21	34359738368	8014692369	23.33
22	17179869184	4177521189	24.32
23	8589934592	2177461403	25.35

24	4294967296	1134964479	26.43
25	2147483648	591580804	27.55
26	1073741824	308351367	28.72
27	536870912	160722871	29.94
28	268435456	83774045	31.21
29	134217728	43665787	32.53
30	67108864	22760044	33.92
31	33554432	11863283	35.36
32	16777216	6183533	36.86

13.0 Appendix B: Background Information

13.1 Background

In 1999 the first provisional IPv6 policy was published in all regions.

This document was replaced in 2002 by a joint policy document. At the time it was considered important to have one policy for all regions to prevent RIR shopping. Over time regional policies started diverting from each other from 2004 onwards.

13.2 Acknowledgment

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14.0 Attribution

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