

Network Working Group
Request for Comments: 2073
Category: Standards Track

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January 1997

An IPv6 Provider-Based Unicast Address Format

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

1.0 Introduction

This document defines an IPv6 provider-based unicast address format for use in the Internet. The address format defined in this document is consistent with the "IPv6 Addressing Architecture" [ARCH] and the "An Architecture for IPv6 Unicast Address Allocation" [ALLOC], and is intended to facilitate scalable Internet routing.

The unicast address format defined in this document doesn't preclude the use of other unicast address formats.

2.0 Overview of the IPv6 Address

IPv6 addresses are 128-bit identifiers for interfaces and sets of interfaces. There are three types of addresses: Unicast, Anycast, and Multicast. This document defines a specific type of Unicast address.

In this document, fields in addresses are given specific names, for example "subscriber". When this name is used with the term "ID" (for "identifier") after the name (e.g., "subscriber ID"), it refers to the contents of the named field. When it is used with the term "prefix" (e.g., "subscriber prefix") it refers to all of the address up to and including this field.

The specific type of an IPv6 address is indicated by the leading bits in the address. The variable-length field comprising these leading bits is called the Format Prefix (FP).

This document defines an address format for the 010 (binary) Format Prefix for Provider-Based Unicast addresses. The same address format could be used for other Format Prefixes, as long as these Format Prefixes also identify IPv6 unicast addresses. Only the "010" Format Prefix is defined here.

3.0 IPv6 Provider-Based Unicast Address Format

This document defines an address format for the IPv6 provider-based unicast address assignment. It is expected that this address format will be widely used for IPv6 nodes connected to the Internet.

The address format defined in this document conforms to the "Architecture for IPv6 Unicast Address Allocation" [ALLOC]. Specifically, the format is designed to support aggregation of network layer reachability information at multiple levels of routing hierarchy.

For addresses of the format described in this document the address administration is organized into a three level hierarchy -- registry, provider, and subscriber. The address format defined here allows flexible address allocation at each level of the address administration hierarchy in such a way as to support a wide spectrum of demands for address allocation.

This document assumes that the Internet routing system doesn't make any assumptions about the specific structure and semantics of an IPv6 address, except for the structure and semantics of the Format Prefix part of the address, and the use of the "longest prefix match" algorithm (on arbitrary bit boundaries) for making a forwarding decision.

The address format defined in this document is intended to facilitate scalable Internet-wide routing that does not impose any constraints on connectivity among the providers, as well as among the providers and subscribers.

3.1 Provider-Based Unicast Address Structure

For the purpose of address allocation, the address format defined in this document consists of the following parts: Format Prefix, Registry ID, Provider ID, Subscriber ID, and an Intra-Subscriber part. The Intra-Subscriber part definition is the responsibility of the subscriber and is not defined in this document. The provider-based unicast address format is as follows:

3	5 bits	n bits	56-n bits	64 bits	
+---+	+-----+	+-----+	+-----+	+-----+	+-----+
010	RegistryID	ProviderID	SubscriberID	Intra-Subscriber	
+---+	+-----+	+-----+	+-----+	+-----+	+-----+

The following sections specify each part of the IPv6 Provider-Based Unicast address format. In general other allocation strategies are possible within this framework, but the ones described in this document will be used to assign IPv6 provider-based addresses.

3.2 Registry ID

With the growth of the Internet and its increasing globalization, much thought has been given to the evolution of the Network Layer address space allocation and assignment process. RFC 1466, "Guidelines for Management of IP Address Space", proposes a plan that defines distributed allocation and assignment of the IPv4 address space.

As the Internet transitions to IPv6, the plan for distributed allocation and assignment of the IPv4 address space established in RFC1466 forms a base for the distributed allocation and assignment of the IPv6 address space.

The Internet Assigned Number Authority (IANA) is the principal registry for the IPv6 address space. The IANA may allocate blocks of IPv6 addresses and delegate the assignment of those blocks to qualified Regional Registries. The IANA will serve as the default registry in cases where no delegated registration authority has been identified.

The Registry ID of the IPv6 provider-based unicast address format is intended to facilitate a broad geographic address allocation and facilitate the operations of the distributed Regional Registries.

The Registry ID immediately follows the format prefix part of an IPv6 address.

At present there are three Regional Registries: INTERNIC, RIPE NCC, and APNIC. In addition, address allocation could be done directly by the IANA. Corresponding to this division of address allocation, this document defines the following Registry IDs:

Regional Registry -----	Value (binary) -----
Multi-Regional (IANA)	10000
RIPE NCC	01000
INTERNIC	11000
APNIC	00100

All other values of the Registry ID are reserved by the IANA.

Use of the Multi-regional Registry ID permits flexibility in address assignments which are outside of the geographical regions already allocated. The IANA will be responsible for managing address space registration under the Multi-Regional Registry ID.

It is expected that the IANA, and any designated Regional Registries, allocate addresses in conformance with this overall scheme. Where there are qualifying Regional Registries established, primary responsibility for allocation from within that block will be delegated to that registry.

A Regional Registry may have more than one block of addresses allocated to it (as a result the Registry would have multiple Registry IDs associated with it).

3.3 Provider ID and Subscriber ID

This document leaves the organization of the Provider ID and Subscriber ID portions of address up to individual registries. Particularly the registry needs to define how much address space is given to providers and their subscribers. There are several issues which must be addressed when doing this. These include:

- o There will likely be a mixture of providers of different sizes.
- o Small providers will grow to become large providers.
- o Large providers will lose customers and become small providers. In extreme cases, the registry will require them to return some of their address space to the registry.
- o Organizations which need to be multi-homed to more than one provider will request a Provider ID assignment.

It is important that a registry design its Provider ID space to allow flexibility and at the same time use the address space efficiently.

3.3.1 Provider ID

The value of the Provider ID associated with an address block a registry allocates to a particular provider uniquely identifies this provider within the registry.

This document assumes that some subscribers may decide to acquire their address space directly from a registry, thus making their addresses independent of the provider(s) they are directly attached.

3.3.2 Subscriber ID

The structure and assignment strategy of Subscriber ID's is specified by each provider.

A (direct) provider may decide to group its subscribers into regions. This grouping may be useful when the (direct) provider is attached to another (indirect) provider at multiple points, as it allows the direct provider to exert a certain degree of control over the coupling between the attachment points and flow of the traffic destined to a particular subscriber (see Section 5.3.1 of [ALLOC]).

To accommodate such a grouping the (direct) provider may allocate some small number of high-order bits of the Subscriber ID as a Subscriber-Region ID. The purpose of a Subscriber-Region ID is to identify a group of subscribers that are within a close topological proximity to each other (from the provider's point of view), and thus could be reachable through a particular attachment point between the (direct) provider and other (indirect) provider(s).

3.4 Intra-Subscriber Part

This document leaves the organization of Intra-Subscriber portion of the address up to individual subscribers.

The provider-based unicast address format described in this document leaves 64 bits for the local portion of the address. The editors of this document recommend that subscribers use IPv6 auto-configuration capabilities [AUTO] to generate addresses using link-specific addresses as Interface ID such as 48 bit IEEE-802 MAC addresses. In this case 16 bits are left for the Subnet ID. This should be sufficient (e.g., 65,535 subnets) for all but the largest of subscribers. This is shown as follows:

	64 bits		16 bits		48 bits	
+-----		+-----		+-----		+
	Subscriber Prefix		Subnet ID		Interface ID	
+-----		+-----		+-----		+

Subscribers who need additional subnets (and who desire to continue to use 48 bit IEEE-802 MAC addresses for Interface ID's) can be accommodated by having the provider assign them a block of subscriber prefixes. Alternatively, an extremely large subscriber could be assigned its own Provider ID which would give it additional bits of address space to create its own local address hierarchy.

4.0 National Registries

A Regional Registry may allocate blocks of address space to several National Registries. The National Registry then becomes the entity that allocates address space to individual providers within the country served by the National Registry.

To create National Registries the Regional Registry may add a layer of hierarchy in the Provider ID field to create National Registries. The resulting Provider Prefix is as follows:

3	5 bits	n bits	m bits	56-n-m	64 bits
010	RegistryID	National RegistryID	Provider ID	Subscriber ID	Intra-Subscriber

This document assumes that within each regional registry there will be a relatively small number of national registries. The size of the National-Registry ID should be related to the number of countries in the region administrated by the regional registry and the number of providers expected to be in each country.

5.0 Acknowledgments

The editors would like to express our thanks to Jim Bound (Digital), Scott Bradner (Harvard), Brian Carpenter (CERN), Geoff Huston (AANET), and Tony Li (cisco) for their review and constructive comments.

6.0 References

- [ALLOC] Rekhter, Y., Li, T., "An Architecture for IPv6 Unicast Address Allocation", RFC 1887, December 1995.
- [ARCH] Hinden, R., "IP Version 6 Addressing Architecture", RFC 1884, December 1995.
- [AUTO] Thompson, S., "IPv6 Stateless Address Autoconfiguration", RFC 1972, August 1996.

7.0 Security Considerations

Security issues are not discussed in this memo.

8.0 Editors' Addresses

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