

## Globally Unique IPv6 Local Unicast Addresses

<[draft-hinden-ipv6-global-local-addr-00.txt](#)>

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### Abstract

This document defines an unicast address format that is globally unique and is intended for local communications, usually inside of a site. They are not expected to be routable on the global Internet given current routing technology.

## [1.0](#) Introduction

This document defines an IPv6 unicast address format that is globally unique and is intended for local communications [[IPV6](#)]. They are not expected to be routable on the global Internet given current routing technology. They are routable inside of a more limited area such as a site. They may also be routed between a limited set of sites.

Globally unique IPv6 local addresses have the following characteristics:

- Globally unique prefix.
- Well known prefix to allow for easy filtering at site boundaries.
- Allows sites to be combined with out creating any address conflicts or require renumbering of interfaces using these prefixes.
- Internet Service Provider independent and can be used for communications inside of a site without having any permanent or intermittent Internet connectivity.
- If accidentally leaked outside of a site via routing or DNS, there is no conflict with any other addresses.
- No requirement for applications to treat these address differently from any other kind of global unicast addresses.

This document defines the format of Globally Unique IPv6 Local addresses, how to allocate them, and usage considerations including routing, site border routers, DNS, application support, VPN usage, and guidelines for how to use for local communication inside a site.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC 2119](#)].

## [2.0](#) Acknowledgments

The underlying idea of creating globally unique IPv6 local addresses describe in this document been proposed a number of times by a variety of people. The author of this draft does not claim exclusive credit. Credit goes to Brian Carpenter, Christian Huitema, Aidan Williams, Andrew White, Michel Py, Charlie Perkins, and many others. The author would also like to thank Brain Carpenter, Charlie Perkins,



/11	37	137,438,953,472	15	0.049%
/10	38	274,877,906,944	30	0.098%
/9	39	549,755,813,888	59	0.195%
/8	40	1,099,511,627,776	118	0.391%
/7	41	2,199,023,255,552	236	0.781%
/6	42	4,398,046,511,104	473	1.563%

A very high utilization ratio of these allocations can be assumed because no internal structure is required in the field nor is there any reason to be able to aggregate the prefixes.

The author believes that a /7 prefix resulting in a 41 bit Global ID

is a good choice. It provides for a large number of assignments (i.e., 2.2 trillion) and at the same time uses less than .8% of the total IPv6 address space. It is unlikely that this space will be exhausted. If more than this was needed, then additional IPv6 address space could be allocated for this purpose.

For the rest of this document the FC00::/7 prefix and a 41-bit Global ID is used.

### [3.1](#) Global ID

The Global ID values of zero and all ones are reserved for future use and must not be assigned.

The allocation of global IDs should be pseudo-random. They should not be assigned sequentially or by locality. This to ensure that there is not any relationship between allocations and to help clarify that these prefixes are not intended to be routed globally. Specifically, these prefixes are designed to not aggregate.

Global IDs should be assigned centrally by a single allocation authority because they are pseudo-random and without any structure. This is easiest to accomplish if there is a single source of the assignments.

#### [3.1.1](#) Global ID Allocation Requirements

Global ID allocations should be

- Available to anyone in an unbiased manner.
- Permanent with no periodic fees.
- One time non-refundable allocation fee in the order of 10 Euros per allocation.
- The ownership of each individual allocation should be private, but should be escrowed.

The allocation authority should permit allocations to be obtained without having any sort of internet connectivity. For example in addition to web based registration they should support some methods like telephone, postal mail, fax, telex, etc. They should also accept a variety of payment methods and currencies.

The reason for the one time 10 Euro charge for each prefix is to provide a barrier to any hoarding of the these allocations but at the same time keep the cost low enough to not create a barrier to anyone needing one. The charge is non-refundable in order to keep overhead

low.

The ownership of the allocations is not needed to be public since the resulting addresses are intended to be used for local communication. It is escrowed to insure there are no duplicate allocations and in case it is needed in the future.

An example of a allocation authority is a non-profit organization such as the Public Internet Registry (PIR) that the Internet Society has created to manage the .org domain. They already know how to collect small sums efficiently and there are safeguards in place for the appropriate use of any excess revenue generated.

Note, there are many possible ways of of creating an allocation authority. It is important to keep in mind when reviewing alternatives that the goal is to pick one that can do the job. It doesn't have to be perfect, only good enough to do the job at hand. The author believes that the PIR would satisfy this requirement.

### [3.3](#) Routing

Globally IPv6 Local address are designed to be routed inside of a site in the same manner as other types of unicast addresses. They can be carried in any IPv6 routing protocol without any change.

It is expected that they would share the same subnet IDs if provider based global unicast addresses were being used concurrently [[GLOBAL](#)].

Any routing protocol that is used between sites is required to filter out any incoming or outgoing globally unique IPv6 local routes. The exception to this is if specific /48 globally unique IPv6 local routes have been configured to allow for inter-site communication.

If BGP is being used at the site border with an ISP, by default filters MUST be installed in the BGP configuration to keep any site-local prefixes from being advertised outside of the site or for site-local prefixes to be learned from another site. The exception to this is if there are specific /48 routes created for one or more globally unique IPv6 local prefixes.

### [3.4](#) Renumbering and Site Merging

The use of globally unique IPv6 local addresses in a site results in making communication using these addresses independent of renumbering a site's provider based global addresses.

When merging multiple sites none of the addresses created with these prefixes need to be renumbered because all of the addresses are unique. Routes for each specific prefix would have to be configured to allow routing to work correctly between the formerly separate sites.

### [3.5](#) Site Border Router and Firewall Filtering

While no serious harm will be done if packets with these addresses are sent outside of a site via a default route, it is recommended that they be filtered to keep any packets with globally unique IPv6 local destination addresses from leaking outside of the site and to keep any site prefixes from being advertised outside of their site.

Site border routers SHOULD install a black hole route for the Globally Unique IPv6 Local prefix FC00::/7. This will insure that packets with Globally Unique IPv6 Local destination addresses will not be forwarded outside of the site via a default route.

Site border routers and firewalls SHOULD NOT forward any packets with globally unique IPv6 local source or destination addresses outside of the site unless they have been explicitly configured with routing information about other globally unique IPv6 local prefixes. The default behavior of these devices SHOULD be to filter them.

### [3.6 DNS Issues](#)

Globally Unique IPv6 Local addresses SHOULD NOT be installed in the global DNS. They may be installed in a naming system local to the site or kept separate from the global DNS using techniques such as "two-faced" DNS.

If globally unique IPv6 local address are configured in the global DNS, no harm is done because they are unique and will not create any confusion. They may not be reachable, but this is a property that is common to all types of global IPv6 unicast addresses.

For future study names with globally unique IPv6 local addresses may be resolved inside of the site using dynamic naming systems such as Multicast DNS.

### [3.7 Application and Higher Level Protocol Issues](#)

Application and other higher level protocols can treat Globally Unique IPv6 Local addresses in the same manner as other types of

global unicast addresses. No special handling is required. This type of addresses may not be reachable, but that is no different from other types of IPv6 global unicast addresses. Applications need to be able to handle multiple addresses that may or may not be reachable any point in time.

### [3.8 Use of Globally Unique IPv6 Local Addresses for Local Communications](#)

IPv6 globally unique IPv6 local addresses, like global scope unicast addresses, are only assigned to nodes if their use has been enabled (via IPv6 address autoconfiguration [[ADDAUTO](#)], DHCPv6 [[DHCP6](#)], or manually) and configured in the DNS. They are not created automatically the way that IPv6 link-local addresses are and will not appear or be used unless they are purposely configured.

In order for hosts to autoconfigure globally unique IPv6 local addresses routers have to be configured to advertise globally unique IPv6 local /64 prefixes in router advertisements. Likewise, a DHCPv6 server must have been configured to assign them. In order for a node to learn the globally unique IPv6 local address of another node, the globally unique IPv6 local address must have been installed in the DNS. For these reasons, it is straight forward to control their usage in a site.

To limit the use of globally unique IPv6 local addresses the following guidelines apply:

- Nodes that are to only be reachable inside of a site, the local DNS should be configured to only include the globally unique IPv6 local addresses of these nodes. Nodes with only globally unique IPv6 local addresses must not be installed in the global DNS.
- Nodes that are to be limited to only communicate with other nodes in the site should be set to only autoconfigure globally unique IPv6 local addresses via [[ADDAUTO](#)] or to only receive globally unique IPv6 local addresses via [[DHCP6](#)]. Note: For the case where both global and globally unique IPv6 local prefixes are being advertised on a subnet, this will require a switch in the devices to only autoconfigure globally unique IPv6 local addresses.
- Nodes that are to be reachable from inside of the site and from outside of the site, the DNS should be configured to include the global addresses of these nodes. The local DNS may be configured to also include the globally unique IPv6 local addresses of these nodes.

- Nodes that can communicate with other nodes inside of the site



and outside of the site, should autoconfigure global addresses via [\[ADDAUTO\]](#) or receive global address via [\[DHCP6\]](#). They may also obtain globally unique IPv6 local addresses via the same mechanisms.

### [3.9](#) Use of Globally Unique IPv6 Local Addresses with VPNs

Globally unique IPv6 local addresses can be used for inter-site Virtual Private Networks (VPN) if appropriate routes are set up. Because the addresses are unique these VPNs will work reliably and have the additional property that they will continue to work if the individual sites are renumbered or merged.

## [4.0](#) Advantages and Disadvantages

### [4.1](#) Advantages

This approach has the following advantages:

- Provides globally unique local prefixes that can be used independently of any provider based IPv6 unicast address allocations. This is useful for sites not always connected to the Internet or sites that wish to have a distinct prefix that can be used to localize traffic inside of the site.
- Applications can treat these addresses in an identical manner as any other type of global IPv6 unicast addresses.
- Sites can be merged without any renumbering of the globally unique IPv6 local addresses.
- Sites can change their provider based IPv6 unicast address without disrupting any communication using globally unique IPv6 local addresses.
- Well known prefix that allows for easy filtering at site boundary.
- Can be used for inter-site VPNs.
- If accidentally leaked outside of a site via routing or DNS, there is no conflict with any other addresses.

### [4.2](#) Disadvantages

This approach has the following disadvantages:

- Not possible to route globally unique IPv6 local prefixes on the global Internet with current routing technology.
- Requires the creation of a central allocation authority.

## [5.0](#) Security Considerations

Globally unique IPv6 local addresses do not provide any inherent security to the nodes that use them. They may be used with filters at site boundaries to keep globally unique IPv6 local traffic inside of the site, but this is no more or less secure than filtering any other type of global IPv6 unicast addresses.

## [6.0](#) IANA Considerations

The IANA should allocate the FC00::/7 prefix for Globally Unique IPv6 Local addresses. The Global ID values of zero and all ones are reserved for future use and should not be assigned.

The IANA should setup a allocation authority for Globally Unique IPv6 Local prefixes. This allocation authority should consistent with the requirements described in [section 3.1](#) of this document.

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[draft-hinden-ipv6-global-local-addr-00.txt](#)

[Page 9]

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INTERNET-DRAFT      Globally Unique IPv6 Local Addresses

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