

Internet Engineering Task Force
Internet-Draft
Updates: [4291](#), 5156, 6303, 6724
(if approved)
Intended status: Standards Track
Expires: August 24, 2013

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February 20, 2013

A Larger Loopback Prefix for IPv6
draft-smith-v6ops-larger-ipv6-loopback-prefix-04

Abstract

During the development and testing of a network application, it can be useful to run multiple instances of the application using the same transport layer protocol port on the same development host, while also having network access to the application instances limited to the local host. Under IPv4, this has commonly been possible by using different loopback addresses within 127/8. It is not possible under IPv6, as the loopback prefix of ::1/128 only provides a single loopback address. This memo proposes a new larger loopback prefix that will provide many IPv6 loopback addresses. The processing rules for this new larger loopback prefix also allow sending or forwarding of packets containing these addresses beyond the originating router under certain circumstances.

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1. Introduction

During the development and testing of a network application, it can be useful to run multiple instances of the application on the same development host. It may also be useful or important for network access to these application instances to be limited to only the development host itself.

Networked applications that use fixed and usually well known transport layer protocol ports will typically accept incoming traffic on that port for any address assigned to the host. This will prevent multiple instances of the application running on the same port. This port reuse limitation can be overcome by having each application instance bind to different individual addresses available on the host.

Under IPv4, the 127/8 loopback prefix [[RFC1122](#)] provides many addresses that have commonly been able to be used to run multiple instances of an application on the same port, while also limiting access to the local host.

The IPv6 addressing architecture [[RFC4291](#)] only specifies a single loopback address (::1/128). Multiple IPv6 loopback addresses are not available to bind application instances to when using the same port on the same host.

The IPv4-Mapped IPv6 Address form of 127/8, ::ffff:127.0.0.0/104 [[RFC4291](#)], could be used to provide more host local loopback addresses. However these addresses do not have native IPv6 address properties. For example, they cannot accommodate 64 bit Interface Identifiers. Other current and future IPv6 address forms that contain IPv4 addresses or prefixes, such as IPv4-Embedded IPv6 Addresses [[RFC6052](#)], have or are likely to have similar or other drawbacks.

A Unique Local IPv6 Unicast Address (ULA) prefix [[RFC4193](#)] could be used to increase the number of addresses available on the local host. However this prefix would need to be generated and configured at least once by a system administrator or operator. Without additional configuration, traffic towards addresses not assigned to the local host would not be prevented from leaving the host, and access may not be limited to the local host. A ULA prefix would not be well known, and would not be easy to remember and type accurately without violating the randomness requirements of the Global ID component of a ULA prefix. Using hostnames in DNS or the local host's name resolution file (e.g., /etc/hosts) to overcome the effort required to remember or type a ULA prefix may not be possible for some types of applications which directly deal with IPv6 addresses.

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This memo proposes a new larger IPv6 loopback prefix that provides many more loopback addresses, has properties of native IPv6 addresses, and is easy to remember and type accurately. As with ::1/128, it is intended to be automatically configured during system initialisation, making it ubiquitous. Unlike ::1/128, the processing rules for this prefix match those of IPv4's 127/8. These rules allow sending or forwarding of packets with the new larger loopback prefix addresses beyond the originating router under certain circumstances.

This memo, if published, updates [[RFC4291](#)], [[RFC5156](#)], [[RFC6303](#)] and [[RFC6724](#)].

1.1. Requirements Language

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](#) [[RFC2119](#)].

2. Larger Loopback Prefix Requirements

A new larger loopback prefix should attempt to satisfy all of the following requirements. It should:

- o be a well known prefix,
- o be within an existing special purpose prefix, such as 0000::/8 (the parent prefix of the current IPv6 loopback address),
- o be easy for a human to remember [[EASY-NUMBERS](#)],
- o be easy for a human to type accurately [[DOET](#)],
- o cover the existing IPv6 loopback prefix,
- o support 64 bit Interface Identifiers,
- o provide a large number of /64 subnets.

3. Proposed Larger Loopback Prefix

Ideally, the prefix length of ::1/128 could be shortened, resulting in a new single larger loopback prefix for IPv6, such as ::/48. However, if the existing loopback prefix length is shortened enough to satisfy all of the larger loopback prefix requirements, it would then cover the IPv4 Mapped IPv6 Address prefix, ::ffff:0.0.0.0/96, and prevent its use described in [[RFC4038](#)].

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Giving up the requirement of covering the existing IPv6 loopback prefix, the proposed new larger loopback prefix is:

```
0001:0000:0000:0000:0000:0000:0000:0000/32
```

or concisely,

```
1::/32
```

This prefix satisfies all remaining larger loopback prefix requirements.

Allocating a /32 prefix for the loopback function may seem excessive, as a /48 length prefix would satisfy the larger loopback prefix requirements. However, within the parent 0000::/8 special purpose prefix, there are approximately 16 million /32 prefixes, so a single /32 for the larger loopback prefix is easily afforded. A /32 larger loopback prefix will satisfy all current and likely future uses of the loopback function.

4. Address Assignment and Configuration

Consistent with the IPv6 Addressing Model [[RFC4291](#)], each address within the larger loopback prefix is always logically assigned to one of the node's interfaces, although not necessarily the same interface for all addresses. This means that the node acts as though all addresses within the larger loopback prefix have been configured on one or more interfaces. Applications will accept packets destined to any of the larger loopback prefix addresses, unless the application is bound to a specific larger loopback address. Typically the addresses will be logically assigned to one or more virtual "loopback" interfaces, which locally returns or loops outgoing packets back to the same node that originated the packets.

It is also common to configure a well known loopback address on the loopback interface during system initialisation, making a loopback address visible to the system operator or user [[DOET](#)]. For IPv4, this address is 127.0.0.1/8; for IPv6, it is ::1/128. For the new larger loopback prefix, the address automatically configured on the loopback interface should be:

```
1::1/64
```

This address will be easy for a human to both remember [[EASY-NUMBERS](#)][[DOET](#)] and type accurately [[DOET](#)].

A /64 prefix length has been chosen over /32 to provide a 64 bit

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Interface Identifier for the loopback interface. This is different from the use of the whole loopback prefix length when configuring 127.0.0.1/8 or ::1/128.

Some nodes may support more than one loopback interface. These subsequent loopback interfaces, when initialised, should be assigned a larger loopback /64 prefix locally unique within the node. All addresses within the assigned /64 are logically assigned to the interface. Additionally, the "::1" address for the subnet should be configured on the loopback interface, making it visible to a system operator or user [[DOET](#)].

/64 subnet identifier uniqueness could be achieved by using the loopback interface instance number as the subnet identifier, with the first instance numbered 0 to suit the use of 1::1/64 on the first loopback interface. For example, the second loopback interface could be assigned 1:0:0:1::/64, while the forth loopback interface could be assigned 1:0:0:3::/64. Alternatively, the interfaces' ifIndex [[RFC1213](#)] could be used to determine these subsequent interfaces' loopback /64 subnet identifier. Other schemes which ensure subnet identifier uniqueness would be acceptable.

It should be possible for an operator to remove these automatically configured loopback addresses. It should also be possible for an operator to configure further loopback addresses from within the assigned /64, or addresses from other parts of the larger loopback prefix, including other /64s assigned to other loopback interfaces. Other addresses within the assigned /64(s) would continue to be logically assigned to the subsequent loopback interface. Configuration of addresses is for operational visibility and convenience [[DOET](#)], and does not change the behaviour of non-visible logically assigned addresses.

The larger loopback prefix addresses that are outside of the subsequent loopback interface assigned /64s would continue to be logically assigned to the oldest loopback interface.

[5. Larger Loopback Prefix Processing Rules](#)

[5.1. Host Rules](#)

[5.1.1. Packets Originated with Larger Loopback Source and/or Destination Addresses](#)

Packets originated with larger loopback source and/or destination addresses MUST be returned to the origin host for standard processing by the local IPv6 protocol implementation. They MUST NOT be sent

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over any external links attached to the host.

If the implementation supports multiple loopback interfaces, and they have been assigned prefixes and addresses from within the larger loopback prefix, the egress loopback interface **SHOULD** be the interface assigned the matching destination loopback address. The ingress loopback interface **MUST** be the interface assigned the matching destination loopback address. This will facilitate loopback interface specific handling of the looped traffic, such as traffic filtering or traffic conditioning, which may be useful during network application development. Note that standard IPv6 longest match packet forwarding will facilitate this multiple loopback interface processing.

All addresses within the larger loopback prefix **MUST** always be considered assigned to one of the host's interfaces, consistent with IPv6's Addressing Model [[RFC4291](#)]. Ingress packets, once they have passed any interface specific policies, **MUST** be delivered to the appropriate protocol module (e.g., such as TCP, SCTP, UDP or ICMPv6) interested in packets with the destination larger loopback prefix address for further processing.

5.1.2. Packets Received Externally With Larger Loopback Source and/or Destination Addresses

Packets with larger loopback source and/or destination addresses received over any of the external links attached to the host **MUST** be dropped. ICMPv6 error messages, such as Destination Unreachable messages, **MUST NOT** be generated for these dropped packets.

Implementation suggestion: For these dropped packets, it may be useful to generate an appropriate system log message, indicating a packet with an invalid source or destination address (a "martian" [[RFC1812](#)]) was received over an external interface. By default, these messages should be suppressed. If they are enabled, they should be appropriately rate limited to prevent a system log denial-of-service attack.

5.2. Router Rules

IPv4 loopback packet processing rules for routers, specified in [[RFC1812](#)], by default prohibited forwarding of packets with 127/8 destinations, other than those originated locally and returned back to the router itself. A software switch could be provided to disable this prohibition. This special case of allowing forwarding of packets towards 127/8 destinations has been taken advantage of by [[RFC4379](#)], for MPLS troubleshooting purposes. An equivalent function for IPv6 is provided by using the IPv4-Mapped IPv6 prefix of ::ffff:

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127.0.0.0/104.

The existing ::1/128 packet processing rules for routers are the same as those for IPv6 hosts [[RFC4291](#)].

For the new larger loopback prefix, the IPv6 router processing rules are changed to match those of IPv4, to suit future uses similar to the MPLS troubleshooting case.

[5.2.1.](#) Packets Originated with Larger Loopback Source and/or Destination Addresses

By default, a router MUST follow the host processing rules, described previously, for packets originated with larger loopback source and/or destination addresses.

A software switch MAY be provided to permit packets with larger loopback source and/or destination addresses to be sent via an external interface. If provided, this software switch MUST default to being switched off.

[5.2.2.](#) Packets Received Externally With Larger Loopback Source and/or Destination Addresses

By default, a router MUST follow the host processing rules, described previously, for packets received externally with larger loopback source and/or destination addresses.

A software switch MAY be provided to permit received packets with larger loopback source and/or destination addresses to be forwarded via an external interface. This software switch MUST default to being switched off.

[6.](#) Default Address Selection

For the purposes of default address selection [[RFC6724](#)], as with ::1/128, addresses within the larger loopback prefix MUST be treated as having link-local scope, and must have a "preferred" configuration status.

Within the address selection default policy table [[RFC6724](#)], the larger loopback prefix is to be assigned a precedence value of 60. As the existing ::1/128 loopback address has a precedence value of 50, given a choice, a larger loopback prefix address will be chosen as a destination address over ::1/128.

Within the address selection default policy table [[RFC6724](#)], the

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larger loopback prefix is to be assigned a label value of 14, for use during source address selection.

These default address selection changes should be enabled at the same time that the larger loopback prefix and corresponding processing rules are enabled on a node.

7. DNS Considerations

The DNS zone for 1::/32, 0.0.0.0.1.0.0.0.IP6.ARPA, SHOULD be served locally. [[RFC6303](#)] provides further discussion regarding local serving of DNS zones for non-global IP address spaces.

8. Acknowledgements

Nick Hilliard provided valuable review, comments and advice on this memo.

Review and comments were provided by, in alphabetical order, Bill Atwood, Brian Carpenter, Roland Chan, Chris Chaundy, Owen DeLong, Chris Donovan, Matts Kallioniemi, Erik Kline and Tina Tsou. Thanks to Bill for persisting with advice on grammar errors. Owen DeLong does not agree with what is proposed in this memo, however his review and comments, as with the other reviewers' comments, have helped improve it.

This memo was prepared using the xml2rfc tool.

9. IANA Considerations

IANA is requested to allocate 0001::/32 from within 0000::/8 of the Internet Protocol Version 6 Address Space, for use as a larger loopback prefix for IPv6, as detailed in this memo, and to record it in the [[IANA-IPV6REG](#)].

10. Security Considerations

During deployment of a new larger loopback prefix, there will be a transition period where some hosts and routers have implemented the larger loopback processing rules defined in this memo while others haven't. These legacy hosts and routers will forward larger loopback prefix traffic using conventional unicast processing. For traffic towards non-local larger loopback addresses, traffic will most likely leave the legacy originating host via its default route, and may be

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forwarded by legacy routers using their default route. This may unintentionally disclose sensitive information.

Packet filters, matching traffic with larger loopback source and/or destination addresses, should be used to prevent unintended forwarding of loopback traffic. They should be deployed at the following locations:

- o on the legacy hosts themselves,
- o on legacy routers interconnecting different networks, such as on a router interconnecting a private network and the Internet,
- o on appropriate security domain boundary legacy routers within the local network, if not all legacy routers within the local network.

Routes for the new larger loopback prefix should not be announced or accepted if received, unless necessary for special cases where packets with larger loopback prefix addresses are allowed to be forwarded.

11. Change Log [RFC Editor please remove]

[draft-smith-larger-ipv6-loopback-prefix-00](#), initial version,
2012-07-24

[draft-smith-larger-ipv6-loopback-prefix-01](#), much less verbose
version, 2012-08-17

[draft-smith-larger-ipv6-loopback-prefix-02](#), clarifications,
2013-01-07

- o clarification that the larger loopback prefix should fall within ::/8, the parent prefix of ::/128 and ::1/128
- o Change from 1::/48 to 1::/32
- o text about logically assigning addresses to interface(s), as per IPv6 addressing model
- o automatic loopback address configuration to multiple loopback interfaces
- o local serving of 0.0.0.1.0.0.0.IP6.ARPA zone in DNS

[draft-smith-larger-ipv6-loopback-prefix-03](#), clarifications,
2013-02-07

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- o default address selection precedence and label values
- o comment about other IPv4 in IPv6 address forms
- o more clarifications
- o grammar corrections

[draft-smith-larger-ipv6-loopback-prefix-04](#), minor fixups, 2013-02-20

- o usability references (DOET and EASY-NUMBERS)
- o minor clarifications
- o grammar corrections

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[IANA-IPV6REG]

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