

The length of the prefix of an IPv6 link-local address ranges from 10 to 127

[draft-petrescu-6man-ll-prefix-len-08](#)

Abstract

A rejected Errata to [RFC4291](#) "IPv6 Addr Archi" on the topic of link-local addresses 'needs' a draft. This is an answer to that need.

The length of the prefix of an IPv6 link-local address is variable. The minimal value is 10 decimal. The maximum value is 127 decimal.

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1. Definitions and Statements

The prefix of an IP address is formed by the *n* leftmost bits of the address. (in a left-to-right writing system).

The prefix of an IP address is used for goals such as: identify the type of an IPv6 address (link-local, global, others), identify the belonging of an IP address to a particular subnetwork, assist the forwarding (or not forwarding) decisions, and others.

The minimal length of the prefix of an IPv6 link-local address (the value of *n*) is equal to 10 decimal. The maximum is 127.

The prefix of an IPv6 link-local address is represented textually as "fe80::/n", where *n* MAY be any value between 10 and 127.

Regardless of the prefix length, the leftmost 10 bits of an IPv6 link-local address MUST be set to binary 1111111010 (hexadecimal fe80).

The illustration of an IPv6 link-local address is:

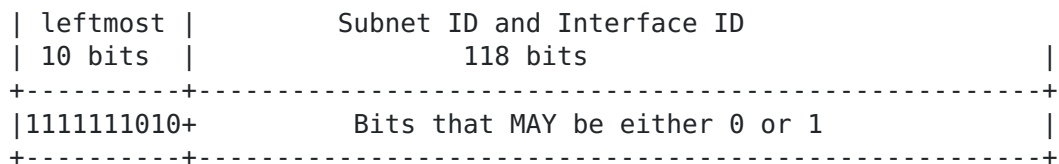


Figure 1: The IPv6 link-local address

Examples: fe80::1/10, fe80:1::1/32 and fe80::1:1/64 are all IPv6 link-local addresses; their prefix lengths are 10, 32 and 64 respectively. Each such IPv6 address has the leftmost 10 bits equal to binary 1111111010.

The Difficulty: the number binary 1111111010 can not be written in hexadecimal without specifying the number of significant bits (fe80::/10); yet that does not make it a 'prefix'. Converting 1111111010 to hexadecimal leads to 3FA (because in a left-to-right writing system the leading 0s before comma are irrelevant); yet '3FA' is not commonly known to be the leading bits of an IPv6 link-local address, fe80::/10 is.

2. Terminology

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].

prefix: a contiguous string of bits valid for forwarding operations and for subnet formation. A prefix MUST have an integer length value from 1 to 127 (except when the prefix length is for default route, in which case the value is 0) and a prefix length must be indicated in its textual representation (e.g. 2001:db8::/32 is the prefix and 32 is the prefix length).

textual representation of a prefix: e.g. fe80::/64.

n leading bits: the first n bits in a string of bits read from left to right in a writing system that is read left-to-right. E.g. the 10 leading bits of the fe80::/64 textual representation of the IPv6 link-local prefix are 1111111010.

3. Context

The RFC "IPv6 Address Archi" illustrates the format of the link-local addresses. From the illustration it MAY be understood that the length of the link-local prefix is 10 bits of value 1111111010 and 54 0 bits.

IANA lists the "IPv6 prefix", and "Address Block", to be "fe80::/10" on its website. It is possible that in the future the IETF could decide to use the bits 11-53.

The [RFC 2464](#) "IPv6-over-Ethernet" states that the prefix for link-local addresses is "fe80::/64".

[RFC 6874](#), "Representing IPv6 Zone Identifiers in Address Literals and Uniform Resource Identifiers" specifies the link-local addresses to be under prefix "fe80::/10".

[RFC 8415](#) "DHCPv6" considers link-local addresses are indicated by the prefix fe80::/10.

[RFC4291](#) requires that an IPv6 link-local address be assigned on each interface. Yet, it does not require the link-local prefix to be associated to an interface.

[RFC4861](#) requires that the link local prefix be present in the Prefix List associated with an interface, although it does not specify the length of the link local prefix.

Several knowledgeable interpretations state that, generally speaking, the prefix length of link-local addresses is 10, but it is 64 in the particular case of Stateless Address-Autoconfiguration (SLAAC). In this latter case, the prefix is named a "subnet prefix", or "prefix on a link", and it is "fe80::/64".

Implementations of an IPv6 stack in a particular operating system (linux) allow for the manual configuration of both prefix lengths 64 and 10 for link-local addresses.

In another operating system the prefix length for link-local addresses can not be explicitly specified by the end user, but may be indirectly derived from two distinct textual formats by using an unspecified rule.

In yet another operating system (BSD) an end user can not use a link-local address whose value is fe80:1::1; because in that OS the hosts drop incoming packets whose or destination address matches fe80::/10 and contains a non-0 value in bits 15-31 (like fe80:1::1 does).

In a particular operating system (openbsd), it is possible to run SLAAC with Interface Identifiers of length different than 64, e.g. 100; this implements [RFC7217](#). In that same operating system it is not possible to use an Interface Identifier of length 100. At the same time, in another operating system (linux) it is possible to use Interface Identifiers of length 100, yet SLAAC does not work with IID that is not 64. In an ideal linux-bsd operating system any length of IID would be possible.

The loopback interface is required to have a link-local address too ([RFC4291](#)), although some OSs dont (linux). The [RFC4007](#) clarifies that, somehow.

Misconfigurations and lack of interoperability MAY arise between computers that use mixed prefix lengths for link-local addresses.

A memo describes the use of IPv6 link-local addresses in applications. The filename of the Internet Draft is [draft-smith-ipv6-link-locals-apps-00](#).

Historical note: earlier, the link-local prefix `fe80::/10` and site-local prefix `fec0::/10` were grouped into a common `fe80::/9`. If bits 10-64 were 0 then the prefix was a link-local, otherwise a site-local. The site-local addresses were later deprecated by [RFC 3879](#).

4. Example of use of LL Prefix Length 32

This figure shows two routers each with two interfaces; one such interface is connected to the other router; there are two interfaces that point elsewhere.

```

i1 ----- i2      i3-----i4
--|Router1|-----|Router2|---
-----

```

i2 address is `fe80:12::1:1/32` ('12' means subnet between R1 and R2, '1' is R1, 2nd '1' is 'front' interface)
i3 address is `fe80:12::2:2/32`

Figure 2: Figure

One router's interface (connected to the other router) uses address `fe80:12::1:1/32` and the other router's corresponding interface uses address `fe80:12::2:2/32`.

5. Security Considerations

The clarification of the definition of the prefix length of the IPv6 link-local prefix at IANA is: call it 'leading bits' and not 'prefix', or state that the IPv6 prefix length of link-local addresses is 10 decimal. This clarification has beneficial impact in the algorithm implementation for calculation of the opaque and stable Interface Identifiers for IPv6 link-local addresses. It also positively impacts some implementations of IPv6 forwarding.

6. IANA Considerations

IANA is requested to change the name of the column head in the table that depicts the "Internet Protocol Version 6 Address Space". The name should be "The n leading bits of an address" instead of "IPv6 Prefix".

The desired effect of this change is that the IPv6 link-local prefix be "fe80::/n" and that the 10 leading bits of this prefix be 1111111010. A second effect is that the textual representation "fe80::/10" as an IPv6 link-local prefix should disappear from that IANA page, because it is wrong.

7. Contributors

Listed from 6man WG discussion.

8. Acknowledgements

The following persons are acknowledged for the discussion that is reflected in this draft. Not all points are reflected. Some points are copied almost entirely.

Ole Troan, Scott Timothy Morizot, Brian Carpenter, Fred Baker, Mark Smith, Peter Occil, Philip Homburg, Albert Manfredi,  –3/4 ’BAE (TATUYA Jinmei), Fernando Gont, Christian Huitema, Simon Hobson, Matthew Petach, Yucel Guven, Sander Steffann, Dennis Ferguson, Musa Stephen Honlue, Fred Templin.

Peter Paluch submitted the Errata suggestion to [RFC 4291](#) about link-local addresses, and Brian Haberman rejected it, by requiring a draft. Igor Lubashev pointed to that Errata.

9. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.

[Appendix A](#). ChangeLog

The changes are listed in reverse chronological order, most recent changes appearing at the top of the list.

-08: added explanation of which RFC requires the LL address to be present, and which requires the LL prefix to be present; named the OSs, instead of staying generic; explained that the lack of

requirement of ll address on lo in [RFC4291](#) is covered by another [RFC4007](#); explained that openbsd allows variable len IID for GUAs but not for LLs, yet linux allows the reverse, and concluded on an obvious ideal.

-07: added the fact that DHCPv6 spec considers the link-local addresses to be fe80::/10; added a valuable explanation of ll behaviour of a particularly important OS.

-04: added an example advantage of using prefix length 32.

-03:

-02: corrected a typo in "fe80::/1" and added a 7-bit encoding for one persons name (in addition to the japanese-shift-jis encoding which is not understood by xml2rfc.)

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