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Transmission of IPv6 Packets over FDDI Networks

Status of this Memo

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1. Introduction

This document specifies the frame format for transmission of IPv6 packets and the method of forming IPv6 link-local addresses and statelessly autoconfigured addresses on FDDI networks. It also specifies the content of the Source/Target Link-layer Address option used in Router Solicitation, Router Advertisement, Neighbor Solicitation, Neighbor Advertisement and Redirect messages when those messages are transmitted on an FDDI network.

This document replaces RFC 2019, "Transmission of IPv6 Packets Over FDDI", which will become historic.

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. Maximum Transmission Unit

FDDI permits a frame length of 4500 octets (9000 symbols), including at least 22 octets (44 symbols) of Data Link encapsulation when long-format addresses are used. Subtracting 8 octets of LLC/SNAP header, this would, in principle, allow the IPv6 [IPV6] packet in the Information field to be up to 4470 octets. However, it is desirable to allow for the variable sizes and possible future extensions of the MAC header and frame status fields. The default MTU size for IPv6 packets on an FDDI network is therefore 4352 octets. This size may be reduced by a Router Advertisement [DISC] containing an MTU option which specifies a smaller MTU, or by manual configuration of each node. If a Router Advertisement received on an FDDI interface has an MTU option specifying an MTU larger than 4352, or larger than a manually configured value, that MTU option may be logged to system management but must be otherwise ignored.

For purposes of this document, information received from DHCP is considered "manually configured" and the term FDDI includes CDDI.

3. Frame Format

FDDI provides both synchronous and asynchronous transmission, with the latter class further subdivided by the use of restricted and unrestricted tokens. Only asynchronous transmission with unrestricted tokens is required for FDDI interoperability. Accordingly, IPv6 packets shall be sent in asynchronous frames using unrestricted tokens. The robustness principle dictates that nodes should be able to receive synchronous frames and asynchronous frames sent using restricted tokens.

IPv6 packets are transmitted in LLC/SNAP frames, using long-format (48 bit) addresses. The data field contains the IPv6 header and payload and is followed by the FDDI Frame Check Sequence, Ending Delimiter, and Frame Status symbols.

```
                      0                   1
                      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
                                     +-+-+-+-+-+-+-+-+
                                     |      FC       |
                     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     |          Destination          |
                     +-                             -+
                     |             FDDI              |
                     +-                             -+
                     |            Address            |
                     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     |            Source             |
                     +-                             -+
                     |             FDDI              |
                     +-                             -+
                     |            Address            |
                     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     |     DSAP      |     SSAP      |
                     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     |      CTL      |      OUI ...  |
                     +-+-+-+-+-+-+-+-+               +
                     |           ... OUI             |
                     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     |           Ethertype           |
                     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                     |             IPv6              |
                     +-                             -+
                     |            header             |
                     +-                             -+
                     |             and               |
                     +-                             -+
                     /            payload ...        /
                     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

                    (Each tic mark represents one bit.)
```

FDDI Header Fields:

FC   The Frame Code must be in the range 50 to 57
            hexadecimal, inclusive, with the three low order bits
            indicating the frame priority.

DSAP, SSAP Both the DSAP and SSAP fields shall contain the value AA
            hexadecimal, indicating SNAP encapsulation.

CTL   The Control field shall be set to 03 hexadecimal,
            indicating Unnumbered Information.

OUI The Organizationally Unique Identifier shall be set to 000000 hexadecimal.

Ethertype The Ethernet protocol type ("ethertype") shall be set to the value 86DD hexadecimal.

4. Interaction with Bridges

802.1d MAC bridges which connect different media, for example Ethernet and FDDI, have become very widespread. Some of them do IPv4 packet fragmentation and/or support IPv4 Path MTU discovery [RFC 1981], many others do not, or do so incorrectly. Use of IPv6 in a bridged mixed-media environment must not depend on support from MAC bridges, unless those bridges are known to correctly implement IPv6 Path MTU Discovery [RFC 1981, ICMPV6].

For correct operation when mixed media are bridged together by bridges which do not support IPv6 Path MTU Discovery, the smallest MTU of all the media must be advertised by routers in an MTU option. If there are no routers present, this MTU must be manually configured in each node which is connected to a medium with a default MTU larger than the smallest MTU.

5. Stateless Autoconfiguration

The Interface Identifier [AARCH] for an FDDI interface is based on the EUI-64 identifier [EUI64] derived from the interface's built-in 48-bit IEEE 802 address. The EUI-64 is formed as follows. (Canonical bit order is assumed throughout. See [CANON] for a caution on bit-order effects in LAN interfaces.)

The OUI of the FDDI MAC address (the first three octets) becomes the company_id of the EUI-64 (the first three octets). The fourth and fifth octets of the EUI are set to the fixed value FFFE hexadecimal. The last three octets of the FDDI MAC address become the last three octets of the EUI-64.

The Interface Identifier is then formed from the EUI-64 by complementing the "Universal/Local" (U/L) bit, which is the next-to-lowest order bit of the first octet of the EUI-64. For further discussion on this point, see [ETHER] and [AARCH].

For example, the Interface Identifier for an FDDI interface whose built-in address is, in hexadecimal,

34-56-78-9A-BC-DE

would be

36-56-78-FF-FE-9A-BC-DE.

A different MAC address set manually or by software should not be used to derive the Interface Identifier. If such a MAC address must be used, its global uniqueness property should be reflected in the value of the U/L bit.

An IPv6 address prefix used for stateless autoconfiguration [ACONF] of an FDDI interface must have a length of 64 bits.

6. Link-Local Addresses

The IPv6 link-local address [AARCH] for an FDDI interface is formed by appending the Interface Identifier, as defined above, to the prefix FE80::/64.

```
  10 bits            54 bits                  64 bits
+----------+-----------------------+----------------------------+
|1111111010|        (zeros)        |    Interface Identifier    |
+----------+-----------------------+----------------------------+
```

7. Address Mapping -- Unicast

The procedure for mapping IPv6 unicast addresses into FDDI link-layer addresses is described in [DISC]. The Source/Target Link-layer Address option has the following form when the link layer is FDDI.

```
 0                   1
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |    Length     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                               |
+-             FDDI            -+
|                               |
+-            Address          -+
|                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Option fields:

Type 1 for Source Link-layer address.
 2 for Target Link-layer address.

Length 1 (in units of 8 octets).

FDDI Address
 The 48 bit FDDI IEEE 802 address, in canonical bit order. This is the address the interface currently responds to, and may be different from the built-in address used to derive the Interface Identifier.

8. Address Mapping -- Multicast

An IPv6 packet with a multicast destination address DST, consisting of the sixteen octets DST[1] through DST[16], is transmitted to the FDDI multicast address whose first two octets are the value 3333 hexadecimal and whose last four octets are the last four octets of DST.

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0 0 1 1 0 0 1 1|0 0 1 1 0 0 1 1|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   DST[13]     |   DST[14]     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   DST[15]     |   DST[16]     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

9. Differences From RFC 2019

The following are the functional differences between this specification and RFC 2019.

"FDDI adjacency detection" has been removed, due to recent work in IEEE 802.1p.

The Address Token, which was a node's 48-bit MAC address, is replaced with the Interface Identifier, which is 64 bits in length and based on the EUI-64 format [EUI64]. An IEEE-defined mapping exists from 48-bit MAC addresses to EUI-64 form.

A prefix used for stateless autoconfiguration must now be 64 bits long rather than 80. The link-local prefix is also shortened to 64 bits.

10. Security Considerations

The method of derivation of Interface Identifiers from MAC addresses is intended to preserve global uniqueness when possible. However, there is no protection from duplication through accident or forgery.

11. References

[AARCH] Hinden, R. and S. Deering "IP Version 6 Addressing Architecture", RFC 2373, July 1998.

[ACONF] Thomson, S. and T. Narten, "IPv6 Stateless Address Autoconfiguration", RFC 2462, December 1998.

[CANON] Narten, T. and C. Burton, "A Caution On The Canonical Ordering Of Link-Layer Addresses", RFC 2469, December 1998.

[DISC] Narten, T., Nordmark, E. and W. Simpson, "Neighbor Discovery for IP Version 6 (IPv6)", RFC 2461, December 1998.

[ETHER] Crawford, M., "Transmission of IPv6 Packets over Ethernet Networks", RFC 2464, December 1998.

[EUI64] "Guidelines For 64-bit Global Identifier (EUI-64)", http://standards.ieee.org/db/oui/tutorials/EUI64.html.

[ICMPV6] Conta, A. and S. Deering, "Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification", RFC 2463, December 1998.

[IPV6] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", RFC 2460, December 1998.

[RFC 1981] McCann, J., Deering, S. and J. Mogul, "Path MTU Discovery for IP version 6", RFC 1981, August 1996.

[RFC 2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

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13. Full Copyright Statement