        A Method for the Transmission of IPv6 Packets over FDDI Networks

Status of this Memo

Introduction

   This memo specifies the MTU and frame format for transmission of IPv6
   [IPV6] packets on FDDI networks, including a method for MTU
   determination in the presence of 802.1d bridges to other media. It
   also specifies the method of forming IPv6 link-local addresses on
   FDDI networks and the content of the Source/Target Link-layer Address
   option used the the Router Solicitation, Router Advertisement,
   Neighbor Solicitation, and Neighbor Advertisement messages described
   in [DISC], when those messages are transmitted on an FDDI network.
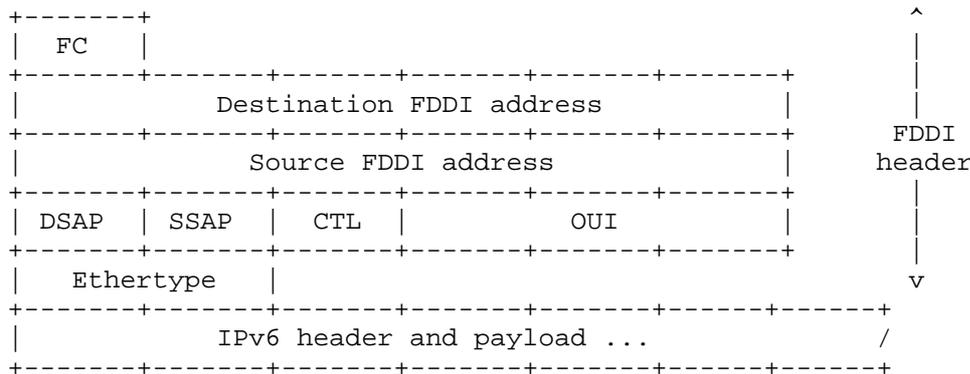
Maximum Transmission Unit

   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 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 to 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 a
   smaller value on each node. If a Router Advertisement is received
   with an MTU option specifying an MTU larger than the default or the
   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".

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.

```
      +-------+                                                  ^
      |  FC   |                                                  |
      +-------+-------+-------+-------+-------+-------+           |
      |       Destination FDDI address        |                 |
      +-------+-------+-------+-------+-------+-------+        FDDI
      |          Source FDDI address          |            header
      +-------+-------+-------+-------+-------+-------+           |
      | DSAP  | SSAP  | CTL   |       OUI             |           |
      +-------+-------+-------+-------+-------+-------+           |
      |  Ethertype    |                                          v
      +-------+-------+-------+-------+-------+------+------+
      |           IPv6 header and payload ...               /
      +-------+-------+-------+-------+-------+------+------+
```

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. The Frame Code should be in the range 51 to
            57 hexadecimal, inclusive, for reasons given in the next
            section.

DSAP, SSAP Both the DSAP and SSAP fields shall contain the value AA
            hexadecimal, indictating 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.

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 [PMTU],
   many others do not, or do so incorrectly. Use of IPv6 in a bridged
   mixed-media environment should not depend on support from MAC
   bridges.

   For correct operation when mixed media are bridged together, 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 larger
   default MTU. Multicast packets on such a bridged network must not be
   larger than the smallest MTU of any of the bridged media. Often, the
   subnetwork topology will support larger unicast packets to be
   exchanged between certain pairs of nodes. To take advantage of
   high-MTU paths when possible, nodes transmitting IPv6 on FDDI should
   implement the following simple mechanism for "FDDI adjacency
   detection".

   A node which implements FDDI adjacency detection and has it enabled
   on an FDDI interface must set a non-zero LLC priority in all Neighbor
   Advertisement, Neighbor Solicitation and, if applicable, Router
   Advertisement frames transmitted on that interface. (In IEEE 802
   language, the user_priority parameter of the M_UNITDATA.request
   primitive must not be zero.) If FDDI adjacency detection has been
   disabled on an FDDI interface, the priority field of those frames
   must be zero.

   Note that an IPv6 frame which originated on an Ethernet, or traversed
   an Ethernet, before being translated by an 802.1d bridge and
   delivered to a node's FDDI interface will have zero in the priority
   field, as required by [BRIDGE]. (There's a fine point here: a
   conforming bridge may provide a management-settable Outbound User
   Priority parameter for each port. However, the author is unaware of
   any product that provides this optional capability and, in any case,
   the default value for the parameter is zero.)

   If a node N1 receives, in an FDDI frame with a non-zero LLC priority,
   a valid Router Advertisement, Neighbor Advertisement, or Neighbor
   Solicitation from a node N2, then N1 may send unicast IPv6 packets to
   N2 with sizes up to the default IPv6 FDDI MTU (4352 octets),
   regardless of any smaller MTU configured manually or received in a
   Router Advertisement MTU option. N2 may be the IPv6 destination or
   the next hop router to the destination.

   Nodes implementing FDDI adjacency detection must provide a
   configuration option to disable the mechanism. This option may be
   used when a smaller MTU is desired for reasons other than mixed-media
   bridging. By default, FDDI adjacency detection should be enabled.
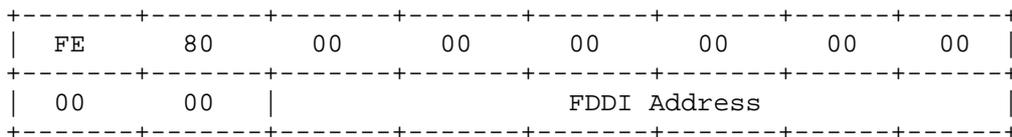
   The only contemplated use of the LLC priority field of the FC octet
   is to aid in per-destination MTU determination. It would be
   sufficient for that purpose to require only that Router
   Advertisements, Neighbor Advertisements, and Neighbor Solicitations
   sent on FDDI always have non-zero priority. However, it may be
   simpler or more useful to transmit all IPv6 packets on FDDI with
   non-zero priority.

Stateless Autoconfiguration and Link-Local Addresses

   The address token [CONF] for an FDDI interface is the interface's
   built-in 48-bit IEEE 802 address, in canonical bit order and with the
   octet in the same order in which they would appear in the header of
   an ethernet frame. (The individual/group bit is in the first octet
   and the OUI is in the first three octets.) A different MAC address
   set manually or by software should not be used as the address token.

   An IPv6 address prefix used for stateless autoconfiguration of an
   FDDI interface must be 80 bits in length.

   The IPv6 Link-local address [AARCH] for an FDDI interface is formed
   by appending the interface's IEEE 802 address to the 80-bit prefix
   FE80::.

        +-------+-------+-------+-------+-------+-------+------+------+
        | FE   80   00   00   00   00   00   00 |
        +-------+-------+-------+-------+-------+-------+------+------+
        | 00   00 | FDDI Address |
        +-------+-------+-------+-------+-------+-------+------+------+

Address Mapping -- Unicast

   The procedure for mapping IPv6 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.

```
      +-------+-------+-------+-------+-------+-------+------+------+
      | 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 as the
             address token.

Address Mapping -- Multicast

   An IPv6 packet with a multicast destination address DST 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, ordered from more to least significant.

```
        +-------+-------+-------+-------+-------+-------+
        |  33   |  33   | DST13 | DST14 | DST15 | DST16 |
        +-------+-------+-------+-------+-------+-------+
```

Security Considerations

    Security considerations are not addressed in this memo.

Acknowledgments

    Erik Nordmark contributed to the method for interaction with bridges.

References

    [AARCH] Hinden, and S. Deering, "IP Version 6 Addressing
            Architecture", RFC 1884, December 1995.

    [BRIDGE]ISO/IEC 10038 : 1993 [ANSI/IEEE Std 802.1D] Media access
            control (MAC) bridges.

    [CONF] Thomson, S., and T. Narten, "IPv6 Stateless Address
            Autoconfiguration", RFC 1971, August 1996.

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            for IP Version 6 (IPv6), RFC 1970, August 1996.

    [IPV6] Deering, S., and R. Hinden, "Internet Protocol, Version 6
            (IPv6) Specification", RFC 1883, August 1996.

    [PMTU] Mogul, J., and S. Deering, "Path MTU Discovery", RFC 1191,
            November 1990.

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