

November 28, 2000

Information Technology – High-Performance Parallel Interface – Encapsulation of ISO/IEC 8802-2 (IEEE Std 802.2) Logical Link Control Protocol Data Units (HIPPI-LE)

Secretariat : National Committee for Information Technology Standardization (NCITS)

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ABSTRACT

The described Specification provides an encapsulation of ISO/IEC 8802-2 (IEEE Std 802.2) Logical Link Control Protocol Data Units over the High-Performance Parallel Interface (HIPPI).

Contacts : T11.1 Chairman

Roger Ronald
Vieo, Inc.
Suite 1100
1411 East Campbell Road
Richardson, TX 75081
Voice : 972-437-9461
FAX : 972-994-0888
E-mail : rronald@pmr.com

T11.1 Vice Chairman

Don Woelz
Genroco Inc.
255 Info Highway
Slinger, WI 53086
Voice : 414-644-2505
Fax : 414-644-6667
E-mail : don@genroco.com

Technical Editor

Don Tolmie
Tolmie Enterprises
60 La Cueva
Los Alamos, NM 87544
Voice : 505-662-7110
E-mail : tolmie@concentric.net

Other Points of Contact:

<u>T11 Chairman</u>	<u>T11 Vice-Chairman</u>	<u>NCITS Secretariat</u>
Kumar Malavalli Brocade Communications 1901 Guadalupe Parkway San Jose, CA 95131	Edward L. Grivna Cypress Semiconductor 2401 East 86th Street Bloomington, MN 55425	NCITS Secretariat, ITI 1250 Eye Street, NW Suite 200 Washington, DC 20005
Voice : 408-487-8156	612-851-5046	202-737-8888
FAX : 408-524-8601	612-851-5087	202-638-4922
E-mail : kumar@brocade.com	elg@cypress.com	ncitssec@itic.nw.dc.us

T11.1 E-mail Reflector (for HIPPI and ST technical discussions and notification of things on the web site)

Internet address for subscribing to the reflector:	Majordomo@nsco.network.com
Message should contain a line stating...	subscribe hippy <your E-mail address>
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Please help us in this development process by sending comments, corrections, and suggestions to the Technical Editor, Don Tolmie, at tolmie@concentric.net. If you would like to address the whole group working on this document, send the comment(s) to hippi@nsco.network.com.

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American National Standard
for Information Technology –

**High-Performance Parallel Interface –
Encapsulation of ISO/IEC 8802-2 (IEEE Std 802.2)
Logical Link Control Protocol Data Units (HIPPI-LE)**

Secretariat

Information Technology Industry Council (ITI)

Approved November 14, 2000

American National Standards Institute, Inc.

Abstract

The described Specification provides an encapsulation of ISO/IEC 8802-2 (IEEE Std 802.2) Logical Link Control Protocol Data Units over the High-Performance Parallel Interface (HIPPI).

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Foreword (This foreword is not part of American National Standard NCITS 218-2000.)

This High-Performance Parallel Interface, Encapsulation of ISO/IEC 8802-2 (IEEE STD 802.2) Logical Link Control Protocol Data Units (HIPPI-LE) standard defines the HIPPI-LE Protocol Data Unit (PDU) format and interface for transporting (via HIPPI) PDUs conforming to ISO/IEC 8802-2 (IEEE Std 802.2) Logical Link Control.

This standard was developed by Task Group X3T9.3 of Accredited Standards Committee X3 during 1990. The standards approval process started in 1991 and the document was approved in 1993. This standard was revised by Task Group T11.1 in 1998-1999, mainly by removing the address resolution protocol.

This document includes an annex which is informative and is not considered part of the standard.

Requests for interpretation, suggestions for improvement or addenda, or defect reports are welcome. They should be sent to the National Committee for Information Technology Standards, 1250 Eye Street, NW, Suite 200, Washington, DC 20005.

This standard was processed and approved for submittal to ANSI by NCITS. Committee approval of the standard does not necessarily imply that all committee members voted for approval. At the time it approved this standard, the NCITS had the following members:

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Dave Michael, Vice-Chair
Monica Vago, Secretary

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Bull HN Information Systems, Inc.	Randall Kilmartin
Compaq Computer Corporation	Scott Jameson Stephen Heil (Alt.) John Hurd (Alt.)
Hewlett-Packard Company.....	Karen Higginbottom Wendy Fong (Alt.)
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Lucent Technologies, Inc.	Herbert Bertine Tom Rutt (Alt.)
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National Institute of Standards & Technology	Michael Hogan Bruce Rosen (Alt.) William LaPlant, Jr. (Alt.)
Oracle Corporation	Donald R. Deutsch Jim Melton (Alt.)
Panasonic Technologies, Inc.....	Terence Nelson Rudolf Vitti (Alt.)
Perennial	Barry Hedquist

<i>Organization Represented</i>	<i>Name of Representative</i>
Plum Hall, Inc.....	Thomas Plum Lana Lee Plum (Alt.)
Share, Inc.....	Dave Thewlis
Sony Electronics, Inc.	Ed Barrett
Sun Microsystems, Inc.....	John Hill Roger Martin (Alt.)
Unisys Corporation	Arnold F. Winkler Stephen Oksala (Alt.)
U.S. Department of Defense/DISA	Russ Richards Doris Bernardini (Alt.)
U.S. Department of Energy	Bruce White Carol Blackston (Alt.)
Xerox Corporation.....	Jean Baronas Kathleen O'Reilly (Alt.) Lisa Sabol (Alt.)

Technical Committee T11 on Device Level Interfaces, which reviewed this standard, had the following participants:

Kumar Malavalli, Chairman
Ed Grivna, Vice-Chairman

D. Allan	L. Hagins	M. O'Donnell
R. Allison	T. Hall	R. Pearson
G. Alvey	B. Ham	R. Pedersen
R. Atkinson	N. Harris	G. Penokie
D. Baldwin	V. Haydu	D. Peterson
D. Bannon	D. Hepner	S. Rahman
R. Beckett	B. Herzing	B. Raudebaugh
C. Binford	L. Hu	W. Rickard
R. Bossard	D. Instone	C. Ridgeway
P. Boulay	J. Johns	E. Rodriguez
J. Breher	L. Jones	R. Ronald
C. Brill	S. Jones	S. Roy
C. Carlson	M. Karg	J. Scheible
S. Carlson	J. Keller	J. Schroeder
T. Cobb	A. Kelley	E. Schurig
B. Collette	J. Kembel	P. Seto
J. Connell	R. Kembel	B. Smith
J. Coomes	B. Ketchum	R. Snively
R. Cornelius	S. Kipp	P. Spasic
D. Cravens	A. Kramer	J. Stai
R. Cummings	D. LaFollette	G. Stephens
Z. Daggett	M. Lamatsch	L. Stewart
R. Dahlgren	L. Lamers	A. Stone
J. D'Alessandro	A. Land	S. Swanson
S. Darnell	A. Langerman	J. Sylvia
J. Dedek	P. Levin	T. Szostak
D. Deming	T. Lindsay	L. Thorsbakken
M. DeWilde	B. Lynn	L. Torres
M. Dorsett	B. Mable	H. Truestedt
M. Dudek	P. Manka	J. Truestedt
B. Dugan	R. Marbot	S. Van Doorn
P. Dunlap	W. Martin	F. Van Roessel
J. Fan	C. Mcknett	M. Wakeley
M. Farley	S. Meyer	N. Wanamaker
S. Finch	G. Milligan	G. Warden
M. Fitzpatrick	D. Moore	K. White
D. Ford	M. Morandi	L. Whitfield
M. Foster	F. Mottini	J. Williams
R. Franse	H. Naidu	S. Wilson
K. Fredericks	J. Nauman	M. Wingard
E. Frymoyer	J. Neer	D. Ybarra
M. Gaffney	J. Nelson	J. Young
E. Gardner	C. Nieves	L. Young
M. Gerwig	C. Nogales	C. Zeitler
J. Golio	J. Nutter	P. Zoller

Task Group T11.1 on the High-Performance Parallel Interface, which revised this standard, had the following participants. Included are principal contributors who developed the original standard in X3T9.3.

Roger Ronald, T11.1 Chairman
Don Woelz, T11.1 Vice-Chairman
Don Tolmie, Technical Editor

B. Beach	B. Lynn
J. Bhat	M. McGowen
M. Boorman	A. Oakes
G. Boyd	E. Parish
H. Brandt	R. Pearson
E. Cady	I. Philp
G. Chesson	C. Pick
R. Cummings	J. Pinkerton
C. Davidson	J. M. Pittet
N. Droux	J. Renwick
J. Ellis	P. Rupert
S. Gillett	W. Sanderson
D. Hagerman	W. Smith
M. Halvorson	D. Somes
M. Howard	L. Stewart
L. Huff	R. Thomas
J. Hughes	R. Thomsen
D. Hyer	T. Truong
A. Kelley	B. Willard
L. Lamers	J. Young

American National Standard for Information Technology –

High-Performance Parallel Interface – Encapsulation of ISO/IEC 8802-2 (IEEE Std 802.2) Logical Link Control Protocol Data Units (HIPPI-LE)

1 Scope

This American National Standard specifies a common method for encapsulating ISO/IEC 8802-2 (IEEE Std 802.2) Logical Link Control Protocol Data Units (PDU) on HIPPI.

Characteristics of HIPPI-LE include:

- Encapsulation of arbitrary Protocol Data Units that conform to ISO/IEC 8802-2 (IEEE Std 802.2) Logical Link Control;
- Provision for 48-bit source and destination addresses conforming to IEEE 802.1A;
- Provision for eight forwarding classes to distinguish, for example, among ordinary data PDUs, PDUs for services that require bandwidth guarantees such as packet video, etc.

2 Normative references

The following standards contain provisions which, through reference in the text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are

encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

Copies of the following documents can be obtained from ANSI: Approved ANSI standards, approved and draft international and regional standards (ISO, IEC, CEN/CENELEC, ITUT) and approved foreign standards (including BSI, JIS, and DIN). For further information, contact ANSI Customer Service Department at 212-642-4900 (phone) 212-302-1286 (fax) or via the World Wide Web at <http://www.ansi.org>. Additional availability contact information is provided below as needed.

ANSI X3.210-1992, *High-Performance Parallel Interface, – Framing Protocol (HIPPI-FP)*

ANSI X3.222-1993, *High-Performance Parallel Interface, – Physical Switch Control (HIPPI-SC)*

ANSI/IEEE Std 802-1990, *IEEE Standards for Local and Metropolitan Area Networks: Overview and architecture (formerly known as IEEE Std 802.1A, Project 802: Local and Metropolitan Area Network Standard — Overview and Architecture)*

ISO/IEC 8802-2:1989 (ANSI/IEEE Std 802.2-1989), *Information Processing Systems – Local Area Networks – Part 2: Logical Link Control*

3 Definitions and conventions

3.1 Definitions

For the purposes of this standard, the following definitions apply.

3.1.1 802.2 LLC PDU: A PDU formatted according to ISO/IEC 8802-2 (IEEE Std 802.2) Logical Link Control.

3.1.2 HIPPI-LE PDU: A PDU that includes a HIPPI-LE header and an 802.2 LLC PDU and is formatted according to clause 6.

3.1.3 optional: A term referring to features that are not required by the standard. However, if any optional feature defined by the standard is implemented, it shall be implemented according to the standard.

3.1.4 protocol data unit (PDU): A formatted data set that is a logical unit of interchange between entities.

3.1.5 service data unit (SDU): A formatted data set that includes a PDU and optional information for the convenience of an implementer.

3.1.6 station management (SMT): The supervisory entity that monitors and controls HIPPI.

3.1.7 Switch Address: A value in the switch hardware domain which selects the route or end point of a HIPPI connection. The range and format depend on switch hardware. HIPPI-SC specifies two formats: Logical Address (12 bits) and Source Route (24 bits).

3.2 Editorial conventions

In this standard, certain terms that are proper names of service primitives, or similar terms are printed in uppercase to avoid possible confusion with other uses of the same words (e.g., TRANSFER). Any lowercase uses of these words have the normal technical English meaning.

The first letter of each word of service parameters, service primitive types, and similar terms is capitalized (e.g., Destination_Address, Status, Request). Any lowercase uses of these words have the normal technical English meaning.

3.3 Acronyms and other abbreviations

ARP	Address Resolution Protocol
CCI	connection control information
FP	Framing Protocol
HIPPI	High-Performance Parallel Interface
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
LE	Link Encapsulation
LESM	Link Encapsulation - Station Management
LLC	Logical Link Control
PDU	protocol data unit
RFC	Request For Comment
SMT	station management
SDU	service data unit
ULP	upper layer protocol

4 HIPPI-LE services to 802.2 LLC

This clause specifies the services provided by HIPPI-LE. The intent is to allow 802.2 LLC to operate correctly with HIPPI-LE. How many of the services described in this clause are chosen for a given implementation is up to the implementer; however, the set of HIPPI-LE services supplied shall be sufficient to satisfy the higher level protocol(s) being used. Service parameters are also optional and additional parameters not shown may be used as necessary. The services as defined in this standard do not imply any particular implementation, or any interface.

In this standard the 802.2 LLC and station management protocol (SMT) are service users, and the HIPPI-LE is the service provider to the 802.2 LLC and SMT. The primitives to 802.2 LLC are prefixed with LE_ and the SMT primitives are prefixed with LESM_.

The HIPPI-LE is also the service user of HIPPI-FP services, which are prefixed with FP_.

Figure 1 shows the relationship of the services provided by and used by HIPPI-LE.

4.1 Service primitives types

HIPPI service primitives are of four types:

- *Request primitives* are issued by a service user to initiate a service from the service provider;
- *Confirm primitives* are issued by the service provider to acknowledge a Request;
- *Indicate primitives* are issued by the service provider to notify the service user of a local event. This primitive is similar in nature to an unsolicited interrupt. Note that the local event may have been caused by a service Request;
- *Response primitives* are issued by a service user to acknowledge an Indicate.

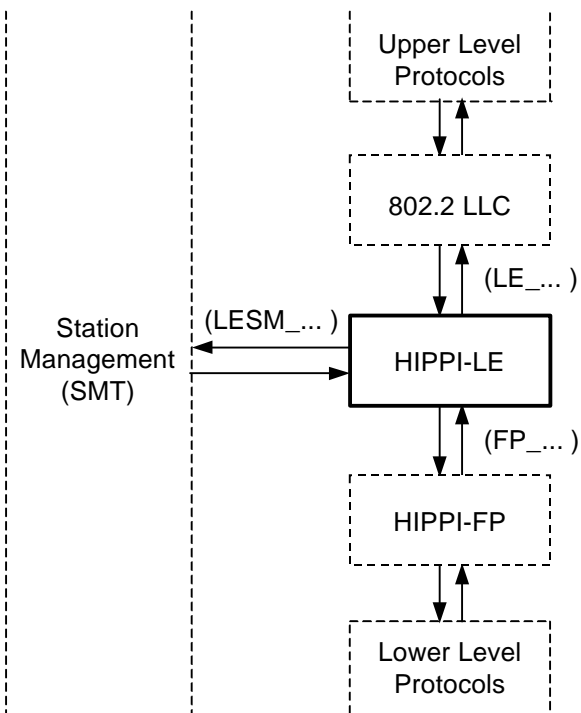


Figure 1 – HIPPI-LE service relationship

4.2 Sequences of primitives

The order of execution of service primitives is not arbitrary. Logical and time sequence relationships exist for all described service primitives. Time sequence diagrams are used to illustrate a valid sequence. Other valid sequences may exist. The sequence of events between peer users across the user/provider interface is illustrated. In the time sequence diagrams, the HIPPI-LE users are depicted on either side of the vertical bars while the service provider is in the center.

4.3 HIPPI-LE service primitive summary

802.2 LLC Data Transfer:

```

LE_TRANSFER.Request (
    Destination_Address,
    LE_SDU)

LE_TRANSFER.Confirm (Transmission_Status)

LE_TRANSFER.Indicate (
    Destination_Address,
    Source_Address,
    LE_SDU,
    Reception_Status)

LE_TRANSFER.Response
    
```

Local Station Management:

```

LESM_STATUS_CTRL.Request (Control)

LESM_STATUS_CTRL.Confirm (Status)

LESM_STATUS_CTRL.Indicate (Status)

LESM_STATUS_CTRL.Response
    
```

4.4 HIPPI-LE transfer service primitives

These primitives, as illustrated in figure 2, are used to transfer an 802.2 LLC PDU from source 802.2 LLC to destination 802.2 LLC.

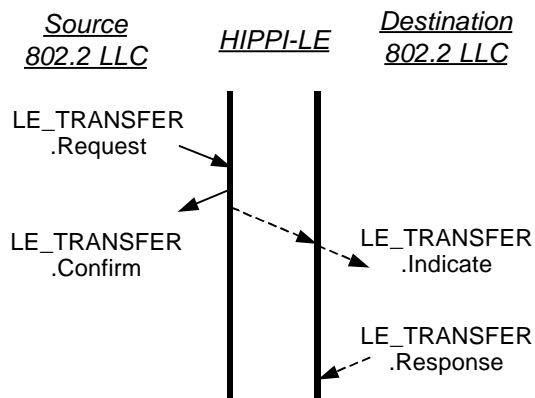


Figure 2 – Data transfer service primitive

4.4.1 LE_TRANSFER.Request

This primitive is issued by the source 802.2 LLC to request a data transfer to the destination 802.2 LLC. The HIPPI-LE PDU format is defined in 6.1.

```

LE_TRANSFER.Request (
    Destination_Address,
    LE_SDU)
    
```

Destination_Address is the information necessary to forward the HIPPI-LE PDU to its desired destination.

LE_SDU is the service data unit which includes the 802.2 LLC PDU that is to be sent.

NOTE 1 – The Requested_Service_Class parameter of 802.2 LLC is not used by HIPPI-LE.

Issued – The source 802.2 LLC issues this primitive to request a transfer of an 802.2 LLC PDU to a destination 802.2 LLC.

Effect – The Source HIPPI-LE shall accept the 802.2 LLC PDU for transmission. The HIPPI-LE shall build an LE_Header and D2_Area, as specified in 6.1, and invoke FP_TRANSFER.Request to send the HIPPI-LE PDU to the destination.

NOTE 2 – Significant performance loss may occur if the D2_Offset in the HIPPI-FP header is non zero, although receivers must be prepared to accept any D2_Offset allowed by HIPPI-FP.

4.4.2 LE_TRANSFER.Confirm

This primitive acknowledges the LE_TRANSFER.Request from the Source ULP.

```

LE_TRANSFER.Confirm (Transmission_Status)
    
```

Transmission_Status is used to pass status information back to the local requesting LLC entity. The content of the Transmission_Status is implementation dependent.

NOTE 3 – The Provided_Service_Class parameter of 802.2 LLC is not used by HIPPI-LE.

Issued – The HIPPI-LE issues this primitive to the Source 802.2 LLC to acknowledge the LE_TRANSFER.Request.

Effect – Unspecified.

4.4.3 LE_TRANSFER.Indicate

This primitive indicates to the 802.2 LLC that a HIPPI-LE PDU addressed to the HIPPI-LE entity at this particular destination has been received.

LE_TRANSFER.Indicate (
 Destination_Address,
 Source_Address,
 LE_SDU,
 Reception_Status)

Destination_Address includes the IEEE 48-bit address as contained in the Destination_IEEE_Address field of the received HIPPI-LE PDU.

Source_Address includes the IEEE 48-bit address as contained in the Source_IEEE_Address field of the received HIPPI-LE PDU.

LE_SDU is the service data unit that includes the encapsulated 802.2 LLC PDU as contained in the D2_Data_Set of the received HIPPI-LE PDU.

Reception_Status shall denote whether the received HIPPI-LE PDU was received with errors. Reception_Status may include other information.

NOTE 4 – The Requested_Service_Class parameter of 802.2 LLC is not used by HIPPI-LE.

Issued – The destination HIPPI-LE issues this primitive to the destination 802.2 LLC when a PDU for the 802.2 LLC has been received.

Effect – Unspecified.

NOTE 5 – This standard does not protect against errors that may be introduced by intermediate devices that interconnect HIPPI-PHs, e.g., re-ordered HIPPI bursts.

4.4.4 LE_TRANSFER.Response

This primitive acknowledges the LE_TRANSFER.Indicate from the Destination HIPPI-LE.

LE_TRANSFER.Response

Issued – The destination 802.2 LLC issues this primitive to acknowledge receipt of the LE_TRANSFER.Indicate.

Effect – Unspecified.

4.5 HIPPI-LE station management service primitives

These primitives, as illustrated in figure 3, are used to manage the local HIPPI-LE. These primitives may be used at either a source or destination HIPPI-LE.

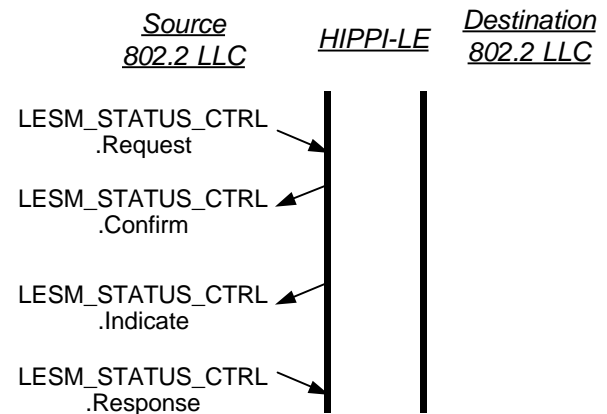


Figure 3 – Station management service primitives

4.5.1 LESM_STATUS_CTRL.Request

This primitive is issued to set HIPPI-LE parameters or to read the value of HIPPI-LE parameters. The parameters are implementation dependent and are not specified.

LESM_STATUS_CTRL.Request (Control)

Control represents the commands, parameters, and values to be acted on.

Effect – Unspecified.

4.5.2 LESM_STATUS_CTRL.Confirm

This primitive replies to the associated LESM_STATUS_CTRL.Request with status information.

LESM_STATUS_CTRL.Confirm (Status)

Status represents the parameters and values that were set or read as a result of the LESM_STATUS_CTRL.Request.

Effect – Unspecified.

4.5.3 LESM_STATUS_CTRL.Indicate

This primitive informs the SMT entity that an important event has occurred that affects the operation of the HIPPI-LE.

LESM_STATUS_CTRL.Indicate (Status)

Status represents the parameters and values that describe the event.

Effect – Unspecified.

4.5.4 LESM_STATUS_CTRL.Response

This primitive acknowledges the LESM_STATUS_CTRL.Indicate.

LESM_STATUS_CTRL.Response

Effect – Unspecified.

5 HIPPI-FP data framing services used by HIPPI-LE

HIPPI-LE is dependent on the capabilities of the lower layer, e.g., HIPPI-FP, for both data delivery and error detection.

The following are the HIPPI-FP primitives that are logically used by HIPPI-LE. The complete specification of these primitives is contained in the HIPPI Framing Protocol (HIPPI-FP) document. The exact mapping from the HIPPI-LE services to HIPPI-FP services is implementation dependent.

HIPPI-LE Data Transfer:

FP_TRANSFER.Request (
CCI,
ULP-id,
D1_Size,
D1_Data_Set,
D2_Size,
D2_Data_Set,
Keep_Connection,
Start_D2_on_Burst_Boundary)

FP_TRANSFER.Confirm

FP_TRANSFER_D1.Indicate (
ULP-id, CCI, Status,
D2_Size,
D2_Offset,
D1_Area_Size,
D1_Data_Set)

FP_TRANSFER_D2.Indicate (ULP-id,
CCI, Status,
D2_Size,
D2_Offset,
D2_Data_Set)

FP_TRANSFER.Response

6 HIPPI-LE data formats

The data transferred between the HIPPI-FP and HIPPI-LE is an ordered byte stream formatted as specified in the HIPPI-FP document.

6.1 HIPPI-LE PDU format

A HIPPI-LE PDU shall comprise two areas, (1) a D1_Area containing the LE_Header, and (2) a D2_Area containing the 802.2 LLC PDU.

6.1.1 LE_Header (D1_Data_Set)

The LE_Header shall comprise the D1_Data_Set.

The LE_Header shall be formatted as shown in figure 4. The image is shown as it would appear in 32-bit HIPPI words. The most-significant bit of the individual fields shown in figures 6 and 7 shall be at the left end of the field. The reserved field in figure 4 shall be transmitted as zeros.

FC is the 3-bit Forwarding Class for this 802.2 LLC PDU; the value ranges from 0 to 7. The value 0 shall be used as the default. The meaning of the other values is not specified.

Double_Wide (W) (1 bit) may contain one if the Destination whose address is given in the Source_Switch_Address field supports 64 bit HIPPI operation. Otherwise it shall contain zero.

NOTE 6 – The W bit is a hint to the receiver that it may make a return connection in 1600 Mbit/s mode.

Message_Type (M_Type) (4 bits) contains a code identifying the type of HIPPI-LE PDU. Undefined values are reserved; defined values (binary) are:

0000 Data PDU
 0011 Self Address Resolution Request PDU
 0100 Self Address Resolution Response PDU
 1100-1111 Locally Assigned

Destination_Address_Type (D_A_T) (4 bits) and Source_Address_Type (S_A_T) (4 bits) contain a code identifying the type of addresses in the Destination_Switch_Address and Source_Switch_Address fields, respectively. Defined values (binary) are:

0000 Address not present
 0001 HIPPI-SC Source Route (24 bits)
 0010 HIPPI-SC Logical Address (12 bits)
 0011-1011 Reserved
 1100-1111 Locally Assigned

Destination_Switch_Address is a 24-bit field containing the Switch Address of the Destination. If the address consists of less than 24 bits, it shall be right justified (occupying the least significant bits) in the field.

Source_Switch_Address is a 24-bit field containing the Switch Address of the Source. If the address consists of less than 24 bits, it shall be right justified (occupying the least significant bits) in the field.

NOTE 7 – The Double_Wide, Switch_Address, and Address_Type fields are of primary interest for the ARP protocol. Whether or not they are used with Data PDUs is implementation dependent.

Destination_IEEE_Address is the 48-bit Universal LAN MAC Address of the destination. This address space is specified by IEEE Standard 802.1A and the globally unique part of the space is administered by the IEEE. If the Destination_IEEE_Address is not known, then the value 0 shall be used.

NOTE 8 – Some network devices, e.g., 802 LANs, FDDI, and MAC-level bridges, require a non zero 48-bit Universal LAN MAC destination address in order to deliver a PDU.

LE_Locally_Administered is a 16-bit field which is locally administered for each HIPPI-LE network. The values in this field are not specified although the value 0 is suggested as a default.

Source_IEEE_Address is the 48-bit Universal LAN MAC Address of the source of this 802.2 LLC PDU. This address space is specified by IEEE Standard 802.1A and the globally unique part of the space is administered by the IEEE. It is recommended that every source of HIPPI-LE PDUs be assigned a Universal LAN MAC source address according to the method specified in IEEE Standard 802.1A. However, if the Source_IEEE_Address is not known or has not been assigned, then the value 0 shall be used.

NOTE 9 – Some network devices, e.g., 802 LANs, FDDI, and MAC-level bridges, require a non zero 48-bit Universal LAN MAC source address in order to provide two-way communication.

6.2 IEEE 48-bit address format

The IEEE Standard 802.1A specifies that a 48-bit Universal LAN MAC Address (ULA) is represented as an ordered string of six bytes numbered from 0 to 5. The least significant bit of byte 0 is the Individual/Group Address (I/G) bit. The next least significant bit is the Universally or Locally Administered Address (U/L) bit. The IEEE Standard 802.1A further specifies that the bytes be transmitted in the order 0 through 5.

Figure 5 shows how the bytes of an ULA (for either source or destination address) shall be mapped to two 32-bit HIPPI words in the LE_Header.

6.1.2 802.2 LLC PDU (D2_Data_Set)

The contiguous bytes of the 802.2 LLC PDU shall comprise the D2_Data_Set. See annex A for examples.

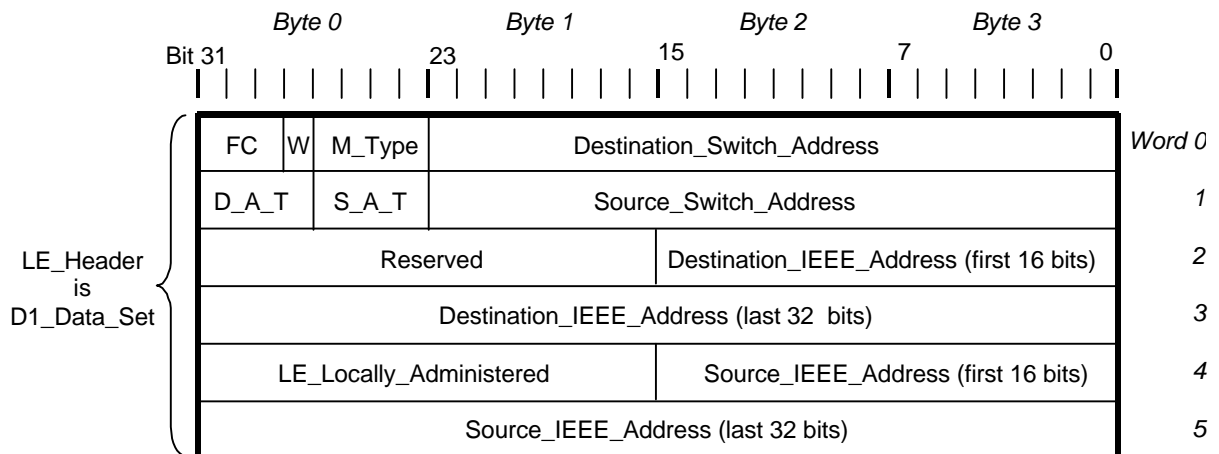


Figure 4 – HIPPI-LE header format

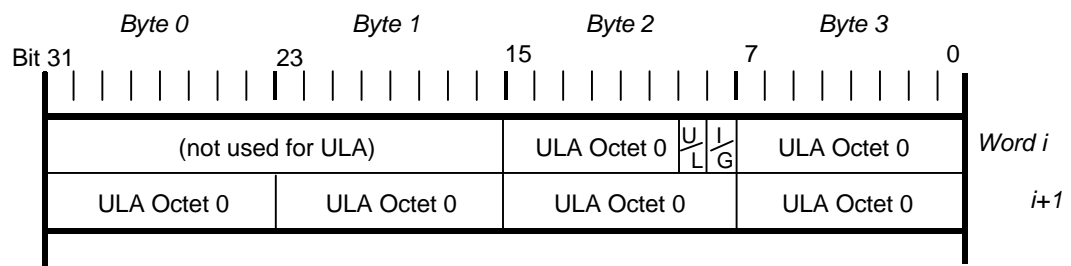


Figure 5 – Mapping of 6-byte IEEE universal LAN MAC address to two 32-bit HIPPI words in LE_Header

Annex A
(informative)

Example HIPPI packets containing HIPPI-LE PDUs

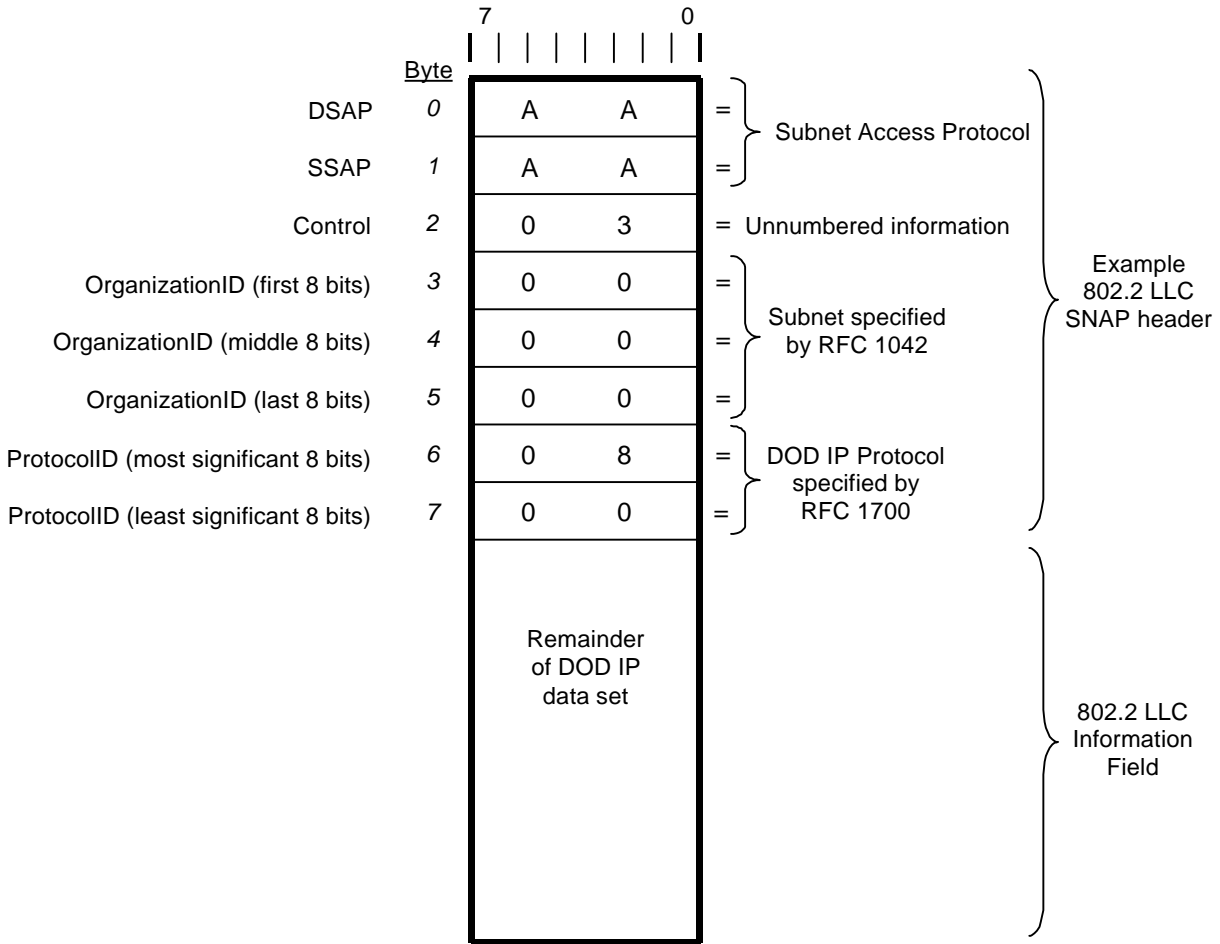


Figure A.1 – Example IEEE 802.2 LLC PDU as an ordered hex byte stream with information field = DOD IP data set as specified by the Internet Engineering Task Force in RFC 1042 and RFC 1700

RFC 1042, "A Standard for the Transmission of IP Datagrams over IEEE 802 Networks," and RFC 1700, "Assigned Numbers," are working standards documents from the TCP/IP internetworking community. Copies of these documents are available

from numerous electronic sources (e.g., <http://www.ietf.org>) or by writing to IETF Secretariat, c/o Corporation for National Research Initiatives, 1895 Preston White Drive, Suite 100 Reston, VA 20191-5434, USA.

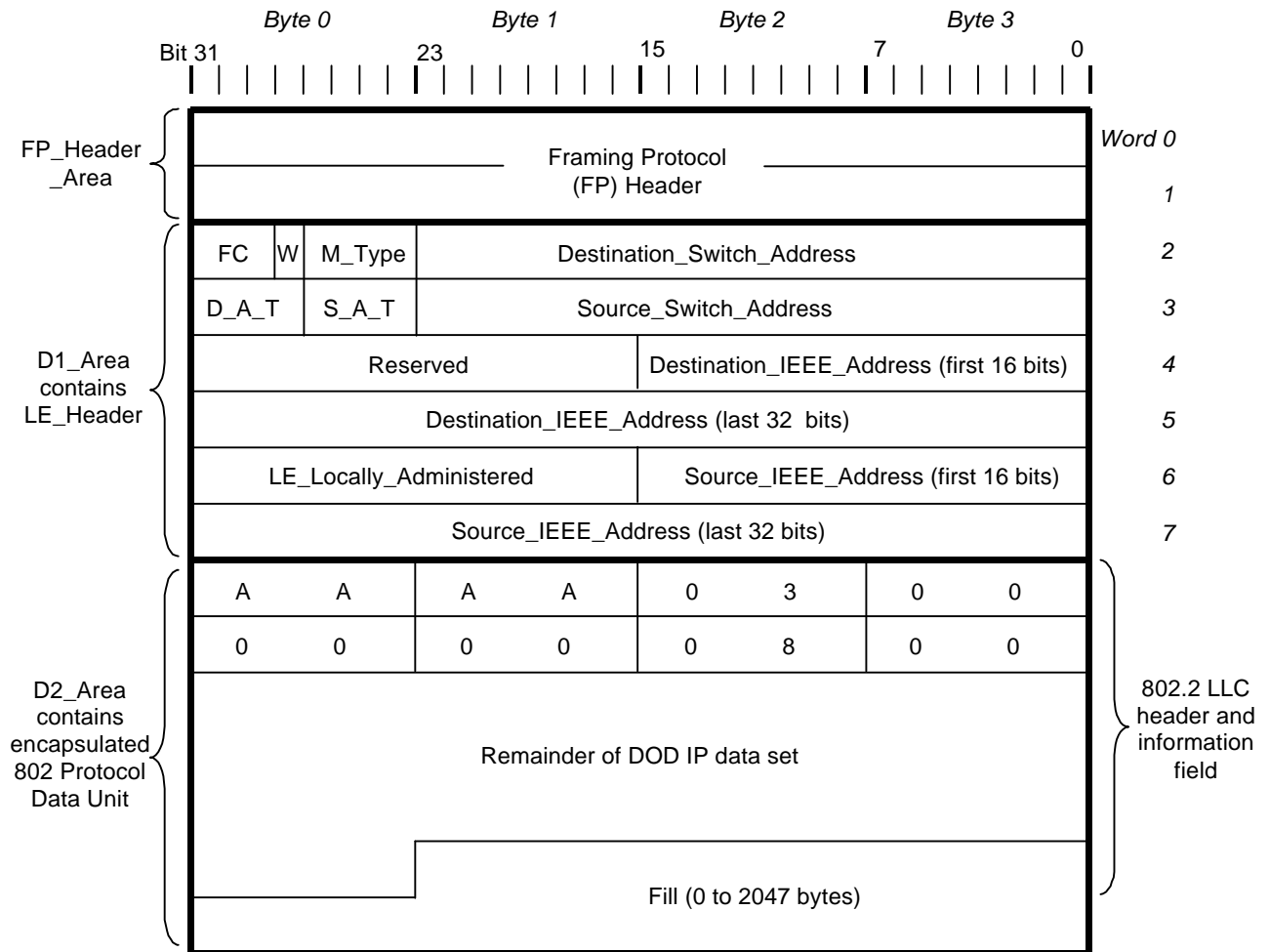


Figure A.2 – Example encapsulation of figure A.1 LLC PDU within a HIPPI packet with *suggested* fills and alignment, i.e., D1_Fill = 0 bytes and D2_Offset = 0

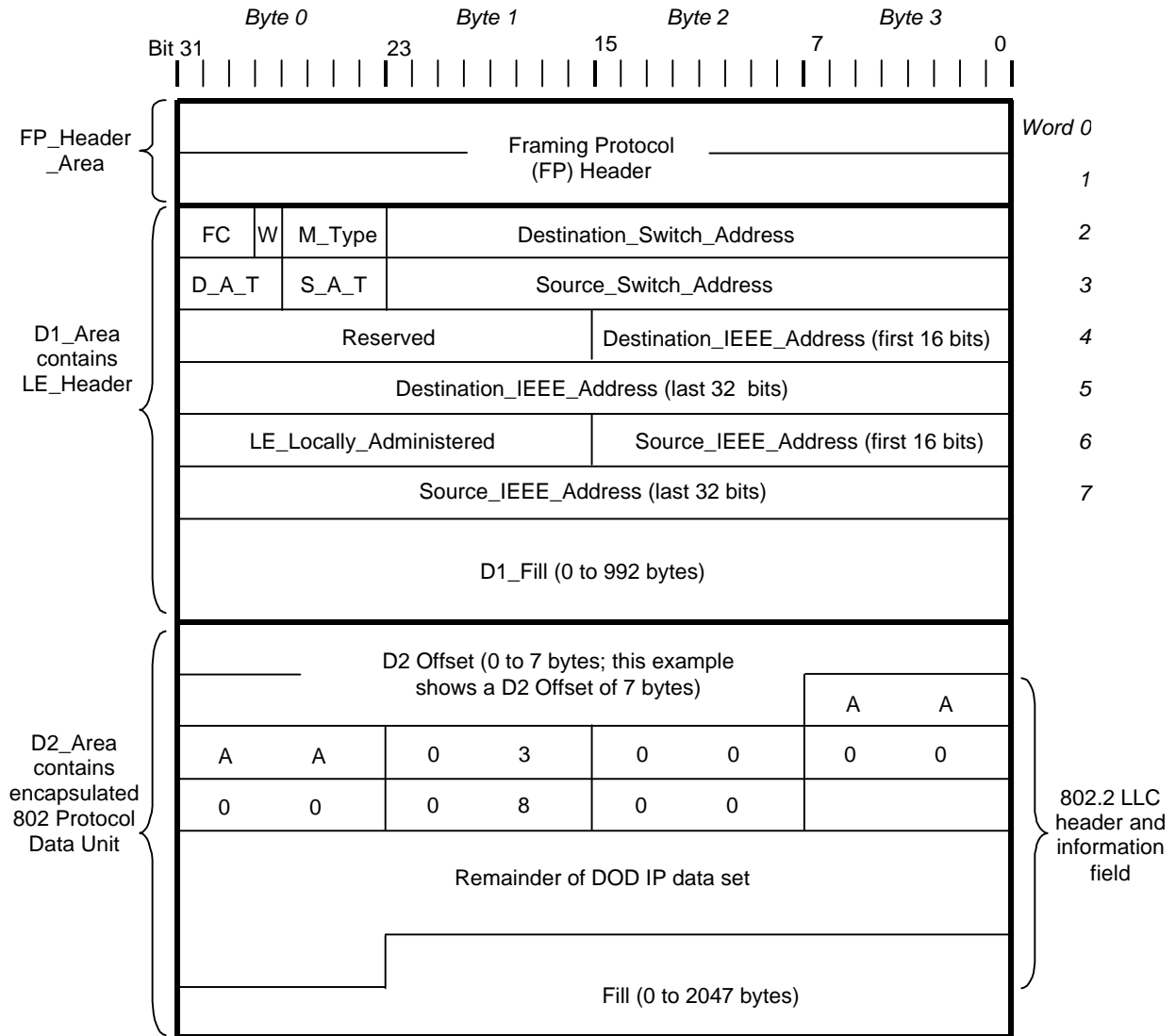


Figure A.3 – Example encapsulation of figure A.1 LLC PDU within a HIPPI packet with D2_Offset = 7 and a possibly non-empty D1_Fill

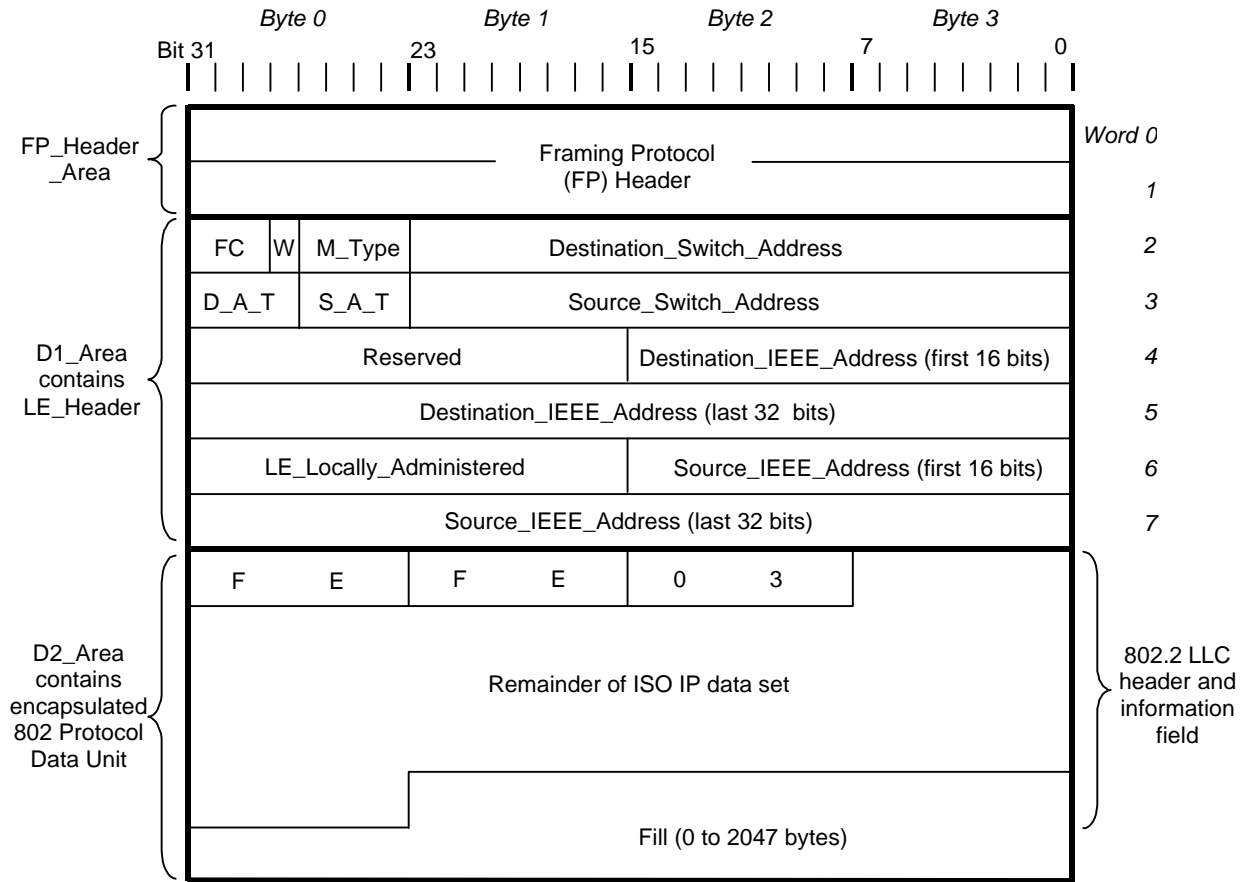


Figure A.4 – Example encapsulation of ISO IP PDU within a HIPPI packet with D1_Fill = 0 bytes and D2_Offset = 0