

Australian/New Zealand Standard[®]

**Information processing systems—
Local area networks**

**Part 1: Overview of local area
network standards—System load
protocol**

**(Supplement to
AS/NZS 4802.1:1996)**

[Information technology—Telecommunications and information
exchange between systems—Local and metropolitan area
networks—Common specifications, Part 4: System load protocol]

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee IT/1, Information Systems—Interconnection. It was approved on behalf of the Council of Standards Australia on 24 February 1997 and on behalf of the Council of Standards New Zealand on 21 February 1997. It was published on 5 June 1997.

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Part 1: Overview of local area network standards—System load protocol

(Supplement to AS/NZS 4802.1:1996)

Originated in Australia as AS 4802.1 Supplement 2—1992.
Jointly revised and designated AS/NZS 4802.1 Supplement 2:1997.

PUBLISHED JOINTLY BY:

STANDARDS AUSTRALIA
1 The Crescent,
Homebush NSW 2140 Australia

STANDARDS NEW ZEALAND
Level 10, Radio New Zealand House,
155 The Terrace,
Wellington 6001 New Zealand

ISBN 0 7337 1149 9

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee IT/1, Information Systems—Interconnection. It is identical with and has been reproduced from ISO/IEC 15802-4:1994, *Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Common specifications*, Part 4: System load protocol.

The objective of this Standard is to provide users of computer network with a specification of a set of services and protocol for those aspects of management concerned with the loading of systems on IEEE 802 type LANs.

Users of this Standard are advised by Standards Australia and Standards New Zealand, under arrangements made with ISO and IEC, as well as certain other Standards organizations, that the number of this Standard is not reproduced on each page; its identity is shown only on the cover and title pages.

For the purpose of this Standard, the source text should be modified as follows:

- (a) *Terminology* The words ‘this Australian/New Zealand Standard’ should replace the words ‘this International Standard’ wherever they appear.
- (b) *Decimal marker* Substitute a full point for a comma where it appears as a decimal marker.
- (c) *References* The references to international Standards should be replaced by references, where appropriate, to the following Australian or Joint Australian/New Zealand Standards:

<i>Reference to International Standard or other publication</i>		<i>Australian or Joint Australian/New Zealand Standards</i>	
IEEE		AS	
802	Standards for Local and Metropolitan Area Networks: Overview and Architecture	4802	Information processing systems—Local area networks
802-1F	Part 1: Common Definitions and Procedures for IEEE 802 Management Information	4802.1	Part 1: Overview and architecture
ISO		AS/NZS	
7498	Information processing systems— Open Systems Interconnection— Basic Reference Model	2777	Information processing systems— Open Systems Interconnection— Basic reference model
		2777.1	Part 1: The basic model
7498.4	Part 4: Management framework	AS	
8802	Information processing systems— Local area networks	2777.4	Part 4: Management framework
8802-2	Part 2: Logical link control	4802	Information processing systems— Local area networks
ISO/IEC		4802.2	Part 2: Logical link control
8824	Information technology— Open Systems Interconnection— Specification of Abstract Syntax Notation One (ASN.1)	3625	Information technology— Open Systems Interconnection— Specification of Abstract Syntax Notation One (ASN.1)

ISO/IEC		AS	
8825	Information technology— Open Systems Interconnection— Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)	3626	Information technology— Open Systems Interconnection— Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1)
9595	Information technology— Open Systems Interconnection— Common management information service definition	3965	Information technology— Open Systems Interconnection— Common management information service definition
9596	Information technology— Open Systems Interconnection— Common management information protocol	3964	Information technology— Open Systems Interconnection— Common management information protocol
9596-1	Part 1: Specification	3964.1	Part 1: Specification
9646	Information technology— Open Systems Interconnection— Conformance testing methodology and framework	AS/NZS 4103	Information technology— Open Systems Interconnection— Conformance testing methodology and framework
9646-1	Part 1: General concepts	4103.1	Part 1: General concepts
9646-2	Part 2: Abstract test suite specification	4103.2	Part 2: Abstract test suite specification
10165	Information technology— Open Systems Interconnection— Management information services— Structure of management information	4151	Information technology— Open Systems Interconnection— Structure of management information
10165-4	Part 4: Guidelines for the definition of managed objects	4151.4	Part 4: Guidelines for the definition of managed objects
TR 10178	Information technology— Telecommunications and information exchange between systems— The structure and coding of Logical Link Control addresses in Local Area Networks	4147	Information technology— Telecommunications and information exchange between systems— The structure and coding of logical link control addresses in local area networks
TR 10735	Information technology— Telecommunications and information exchange between systems— Standard Group MAC Addresses	4228	Information technology— Telecommunications and information exchange between systems— Standard group medium access control addresses

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AUSTRALIAN/NEW ZEALAND STANDARD

Information processing systems—Local area networks

Part 1:

Overview of local area network standards—System load protocol

(Supplement to AS/NZS 4802.1:1996)

Part 4: System load protocol

1. Overview

Stations in a network may, from time to time, require a portion of their local addressable memory space to be loaded using information held on a remote station. In multivendor networks, the provision of standardized mechanisms to achieve this functionality is desirable.

In order to accommodate efficient loading of multiple stations with the same information at the same time, it is desirable to provide facilities for performing the load process on a multicast basis as well as on a point-to-point basis. The System Load Protocol provides both capabilities.

The protocol assumes two types of device in any load operation:

- a) Loadable Device (LD), which is capable of accepting a load from a Load Server.
- b) Load Server (LS), which is capable of providing a load for a Loadable Device.

A load operation can be initiated by

- a) An LD requesting data from an LS.
- b) A third party requesting an LD to accept data by means of a management request, using the Load operation specified in clause 9, and specifically in 9.2.1.3, in the description of the Load operation. When an LD accepts such a request, it will then request data from an LS in the normal manner.

The loadable data is termed an image. An image is broken down into Groups that, in turn, consist of blocks. The protocol allows flexibility in the choice of image and block size. It does not state the number of Groups in an image or the number of octets in a block.

The System Load Protocol relies on IEEE 802.2 Logical Link Control (LLC) Type 1 services (see ISO 8802-2¹) operating over any compatible MAC and Physical Layer.

The System Load Protocol allows the use of IEEE 802.1B LAN/MAN Management [ISO/IEC DIS 15802-2] to manage aspects of its operation. This use is described in 9.3. In addition, the managed objects have been defined in such a way that it is also possible to use CMIP (ISO/IEC 9596) as the management protocol, as described in 9.4.

¹Information on references can be found in clause 3.

The System Load Protocol may be used in conjunction with other management protocols. It provides a load capability not provided by general-purpose management protocols. The general-purpose management protocols provide the capabilities of parameter manipulation, event reporting, and action invocation that support and enhance the load facility. For example, a load of one system might be invoked from another system by means of management intervention.

The following clauses describe

- a) The System Load architecture.
- b) The services provided by System Load.
- c) The semantics and syntax of the System Load Protocol, including the state machines that describe the operation of the System Load Protocol machine.
- d) The semantics of the load-related management objects.

Annex C provides further information regarding the application of the protocol.

To evaluate conformance of a particular implementation, it is necessary to have a statement of which capabilities and options have been implemented for a given protocol. Such a statement is called a Protocol Implementation Conformance Statement (PICS). Annex A to this International Standard contains the PICS proforma for the System Load Protocol.

2. Scope

The System Load Protocol specification defines a protocol to load the memory of data processing equipment installed on IEEE 802 networks. To this end the specification

- a) Defines the protocol data unit (PDU) formats for loading an end system.
- b) Defines the protocol for loading an end system.
- c) Describes the services required of the end system being loaded (Loadable Device or LD) to successfully complete a load operation.
- d) Describes the services required of the end system providing the load (Load Server or LS) to successfully complete a load operation.
- e) Defines the semantic aspects of managed objects of the LD and LS that permit the manipulation of the operational parameters of the LD and LS state machines, announcement of load servers, and the third-party initiation of a load.
- f) Defines the syntax used when performing management operations via the IEEE 802.1B LAN/MAN Management Protocol (ISO/IEC DIS 15802-2).
- g) Defines the syntax used when performing management operations via the CMIP Systems Management Protocol (ISO/IEC 9596-1).

The specification discusses the LS in only as much detail as is necessary to define the loading protocol. Management and LS decisions, such as what to do as a result of LS or LD events or when an LS or Manager fails, are LS and Manager implementation issues and are beyond the scope of this document.

The protocol is specified to convey images consisting of data (in blocks) of unspecified format. The content and format of data blocks are application-specific; this standard does not place any constraints on

- a) The form, content, or meaning of the images that may be conveyed by means of the protocol;
- b) The manner in which data blocks are processed subsequent to their being received by a loadable device.

This International Standard provides the PICS proforma for the System Load Protocol in compliance with the relevant requirements, and in accordance with the relevant guidance, given in ISO/IEC 9646-2.

3. References

The following standards contain provisions which, through references in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

IEEE Std 802-1990, IEEE Standards for Local and Metropolitan Area Networks: Overview and Architecture (ANSI).²

IEEE Std 802.1F-1993, IEEE Standards for Local and Metropolitan Area Networks: Common Definitions and Procedures for IEEE 802 Management Information.

ISO 7498-4 : 1989, Information technology—Open Systems Interconnection—Basic Reference Model—Part 4: Management framework.³

ISO 8802-2 : 1989 [ANSI/IEEE Std 802.2-1989], Information processing systems—Local area networks—Part 2: Logical link control.

ISO/IEC 8824 : 1990, Information technology—Open Systems Interconnection—Specification of Abstract Syntax Notation One (ASN.1).

ISO/IEC 8825 : 1990, Information technology—Open Systems Interconnection—Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).

ISO/IEC 9595 : 1991, Information technology—Open Systems Interconnection—Common management information service definition.

ISO/IEC 9596-1 : 1991, Information technology—Open Systems Interconnection—Common management information protocol—Part 1: Specification.

ISO/IEC 9646-1 : 1991, Information technology—Open Systems Interconnection—Conformance testing methodology and framework—Part 1: General concepts.

ISO/IEC 9646-2 : 1991, Information technology—Open Systems Interconnection—Conformance testing methodology and framework—Part 2: Abstract test suite specification.

ISO/IEC 10165-4 : 1992, Information technology—Open Systems Interconnection—Management information services—Structure of management information—Part 4: Guidelines for the definition of managed objects.

ISO/IEC TR 10178, Information technology—Telecommunications and information exchange between systems—The structure and coding of Logical Link Control addresses in Local Area Networks.

ISO/IEC TR 10735, Information technology—Telecommunications and information exchange between systems—Standard Group MAC Addresses.

²IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

³ISO and ISO/IEC publications are available from the ISO Central Secretariat, 1 rue de Varembe, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse. In the US, they are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

ISO/IEC DIS 15802-2...⁴ [ANSI/IEEE Std 802.1B-1992 and IEEE Std 802.1k-1993], Draft Standard for Local and Metropolitan Area Networks: LAN/MAN Management.

4. Definitions

The following terms are used throughout this International Standard in a specialized manner:

4.1 Image: The data structure contained in the Load Server that the Loadable Device wishes to load.

4.2 Loadable Device (LD): A station on the network that is capable of accepting a load from a Load Server.

4.3 Load Server (LS): A station on the network that is capable of providing a load for a Loadable Device.

This International Standard uses the following terms defined in ISO/IEC 9646-1:

- a) PICS proforma
- b) protocol implementation conformance statement (PICS)
- c) static conformance review

Other management-specific terms are defined in IEEE 802.1B LAN/MAN Management (ISO/IEC DIS 15802-2).

5. Authority

In cases where there are discrepancies between the text descriptions, state diagrams, and the state tables, the state tables are to be considered as the authority.

6. Architecture

This clause contains an overview of the System Load architecture. Figure 1 depicts the architectural components and interfaces. There are three major architectural components involved in System Load:

- a) System Load User (SLU)
- b) System Load Entity (SLE)
- c) System Load Layer Management Entity (SL_LME)

A brief description of each of these components follows:

The SLU is a user of System Load Services. The user of these services may be a provider of load images (LS) or a requester of load images (LD) or both.

In order to perform its function, the SLU may be required to communicate with an SLU in another station. The SLUs intercommunicate in a peer-to-peer manner, using the communication services provided by the SLE. This communication is described in terms of the roles that each SLU and associated SLE plays in a particular instance of communication, either the role of an LD or an LS. These terms are used for descriptive purposes only and do not imply system capabilities in any other context. An LD requests to be loaded with an image. An LS acts on behalf of the requesting LD to provide an image.

⁴Currently at state of Draft International Standard.

The System Load Service is provided by means of the System Load Protocol. Two architectural components are associated with the operation of the protocol. These are the SLE and the SL_MIB.

The SLE performs System Load communication functions on behalf of its SLU.

The SL_MIB is a set of managed objects associated with the SLE. It provides the management functions and management information specific to the management of the SLE, allowing it to be managed in a manner analogous to managing a layer. The managed object class definitions for the SL_MIB are contained in clause 9. IEEE 802.1B [ISO/IEC DIS 15802-2] describes how the functionality of these managed objects may be accessed by means of management protocol.

The SLE makes use of the underlying services of IEEE 802 LLC Type 1 (ISO 8802-2) in order to convey SL_PDUs. The use of other services is not precluded; however, this standard does not specify any conformance-related aspects of the use of any other services.

The load-specific services of the SLE are described in clause 7.

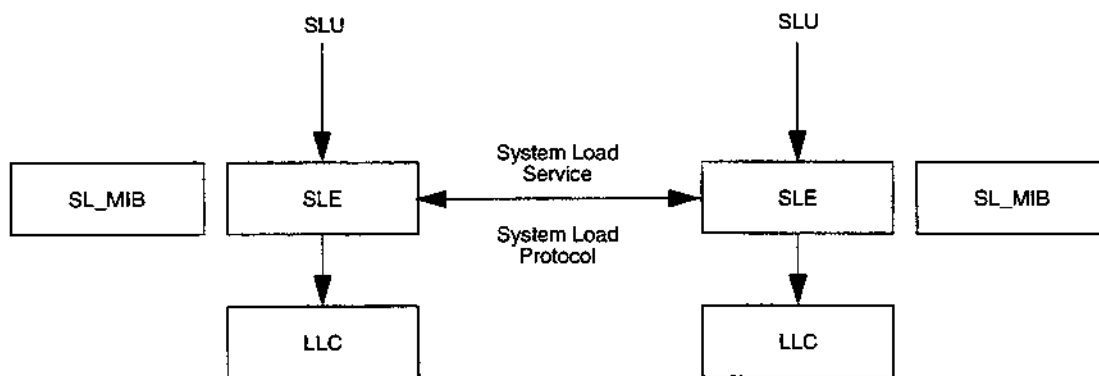


Figure 1—System Load architecture

7. Service definition

This clause defines the services provided by the System Load Entity (SLE) to the System Load User (SLU) at the System Load Service Boundary.

The following primitives are defined for the SLU to request service from the SLE:

- SYSTEM_LOAD.request**, by which the SLU requests that a load operation be performed.
- SYSTEM_LOAD.confirm**, by which the SLE confirms the success or failure of the corresponding request.
- SYSTEM_LOAD.indication**, by which the SLE informs the SLU that an image is required in order to perform a requested load operation.
- SYSTEM_LOAD.response**, by which the SLU returns the required image or reason for not providing the image.

The time sequence of these service primitives is shown in figure 2.

In addition, general-purpose management services provided by IEEE 802.1B LAN/MAN Management (ISO/IEC DIS 15802-2) and the CMIS/CMIP standards (ISO/IEC 9595 and 9596) support the load facility:

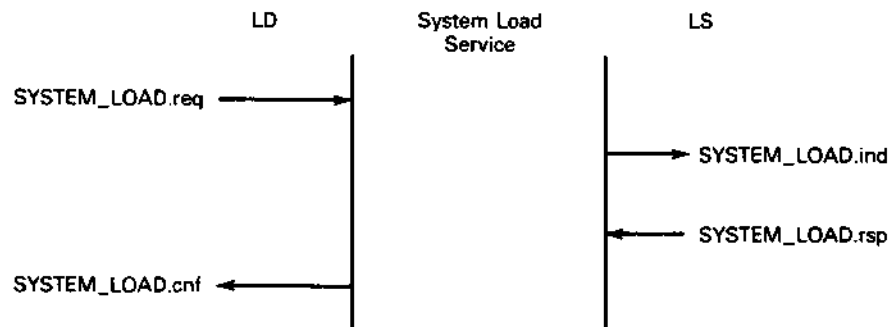


Figure 2—Sequence of SYSTEM_LOAD primitives

NOTE—The definition of the System Load Service in terms of these primitives and their associated parameters is for clarity only, and should not be construed as placing constraints on the nature of real implementations.

7.1 SYSTEM_LOAD.request

This primitive is the service request primitive for the System Load Service.

7.1.1 Semantics of the service primitive

```

SYSTEM_LOAD.request (
    load_info,
    load_reason
)
  
```

- `load_info` specifies information that may be used to determine the image to be loaded.
- `load_reason` specifies the reason that the load is desired. The load reason parameter shall have one of the following values:

Unspecified:	No reason is specified.
PowerUp:	The system or some part of it has had power restored.
ForcedLoad:	The load has been forced remotely via a systems management action.
OperationalFailure:	An operational failure has occurred resulting in the necessity for a load.
LoadFailure:	A previous load attempt has failed.
Reconfiguration:	A configuration change requiring load has occurred.
Private Reason:	An implementation-specific reason.

7.1.2 When generated

This primitive is used by the SLU whenever it needs to have part or all of its system loaded.

7.1.3 Effect of receipt

The effect of this primitive is that the SLE shall request the load from one or more load servers.

7.2 SYSTEM_LOAD.indication

This primitive is the service indication primitive for the System Load Service.

7.2 SYSTEM_LOAD.indication

This primitive is the service indication primitive for the System Load Service.

7.2.1 Semantics of the service primitive

```
SYSTEM_LOAD.indication (
    load_info,
    load_reason
)
```

- load_info specifies information that may be used to determine the image to be loaded. The load_info parameter shall take the value provided in the corresponding SYSTEM_LOAD.request primitive.
- load_reason specifies the reason that the load is desired. The load_reason parameter shall take the value provided in the corresponding SYSTEM_LOAD.request primitive.

7.2.2 When generated

This primitive is generated upon receipt of a LoadRequestPDU by the SLE.

7.2.3 Effect of receipt

The effect of this primitive is that the SLU shall return the required image or reason for not returning the image in a SYSTEM_LOAD.response primitive.

7.3 SYSTEM_LOAD.response

This primitive is the service response primitive for the System Load Service.

7.3.1 Semantics of the service primitive

```
SYSTEM_LOAD.response (
    status,
    image
)
```

- status specifies the success or failure of the load request. The status parameter shall take one of the following values:

success:	The image is available and supplied.
not_available:	The image is not available for the indicated load.

- image is the image to be provided by the load; it is not provided if status is not success.

7.3.2 When generated

This primitive is used by the SLU to return the image indicated in the corresponding SYSTEM_LOAD.indication primitive.

7.3.3 Effect of receipt

The effect of this primitive is that the SLE shall attempt to perform the load.

7.4 SYSTEM_LOAD.confirm

This primitive is the service confirmation primitive for the System Load Service.

7.4.1 Semantics of the service primitive

```
SYSTEM_LOAD.confirm (
    status,
    image
)
```

- status specifies the success or failure of the load request. The status parameter shall take one of the following values:

success:	The load was correctly performed.
no_response:	No server responded to the request.
incomplete:	A load was attempted but never successfully completed.
invalid_response:	An invalid load response(s) was (were) received with parameters inconsistent with the corresponding load request.

- image is the image provided by the load; it is not provided if status is not success.

7.4.2 When generated

This primitive shall be generated by the SLE upon completion of performing or attempting to perform the load requested; it returns the success or failure of the request and the image requested (if successful).

7.4.3 Effect of receipt

Unspecified.

8. Protocol specification

8.1 Summary of Protocol Data Units (PDUs)

The protocol is described in terms of Load PDUs exchanged between an LD and an LS.

- A LoadRequestPDU is sent from an LD to an LS or an LS group address to request a load image.
- A LoadResponsePDU is sent from an LS to an LD or an LD group address to inform the LD(s) that the LS is willing to send a load image.
- A GroupStatusPDU is sent from an LD to an LS in order to request portions of a load image.
- A GroupStatusRequestPDU is sent from an LS to an LD or an LD group address in order to ask an LD or LDs if portions of a load image are needed.
- A LoadDataPDU is sent from the LS to an LD or an LD group address. It contains a portion of a load image.

The process of loading an image is performed by transmitting the image as a number of Blocks, each of which is of a fixed size for a particular load operation, except, possibly, for the last Block of the load. Each set of 256 consecutive Blocks is defined to be a Group. The last Group of the image may contain less than 256 Blocks, and the last Block of the image may be only partially full. The number of Groups and Blocks in a given image is therefore calculated as follows:

$$\text{Number of Blocks} = \frac{\text{Image size} + \text{Block size} - 1}{\text{Block size}}$$

$$\text{Number of Groups} = \frac{\text{Number of Blocks} + 255}{256}$$

NOTE—The equations for Number of Blocks and Number of Groups assume integer arithmetic; integer division will discard any remainder.

The following subclauses describe the content and semantics associated with each PDU.

8.2 LoadRequestPDU

8.2.1 Function

The function of the LoadRequestPDU is to request a system load from an LS or a set of LS's. It is issued by the LD.

8.2.2 Semantics

The following describes the fields of the LoadRequestPDU and the associated semantics:

ExchangeID

This field is an identifier that the LD may use to uniquely identify a load request. The value is determined by the LD. This field is optional and need only be used if the LD has multiple simultaneous outstanding requests.

LoadAddress

This field specifies the MAC address to which the LD requires the LS to send the load data. If present, the address shall be either the station's own individual MAC address or a group MAC address. If not present, the LS shall choose either the individual MAC address of the LD, or a group MAC address.

NOTE—The LD has the following options with respect to the choice of address on which it is prepared to accept PDUs from the LS. They are as follows:

- a) If LoadAddress specifies the specific MAC address, then the LD is only prepared to accept PDUs on this address.
- b) If LoadAddress specifies a group MAC address, the LD will not recognize any other group MAC address; however, the LS may choose to use the LD's individual MAC address or the indicated group MAC address at its own discretion.
- c) If LoadAddress is not present, the LD is prepared to accept PDUs addressed to its individual MAC address or any group MAC address of the LS's choosing. If the LS chooses to use the individual MAC address of the LD, this is derived from the addressing information provided by the underlying service.

BlockSize

This field specifies the maximum data block size in octets which the station can accept for loading. It is the number of octets in the LoadData field of the LoadDataPDU. It ranges from 1 to 32 767.

MinBlockDelay

This field specifies the minimum delay in milliseconds required between transmission of data blocks in order to minimize errors due to depletion of resources at the LD. It ranges from 0 to 32 767. The consequences, if data blocks are received with less than MinBlockDelay separation between them, are unspecified.

MaxBlockDelay

This optional field specifies the maximum amount of delay in milliseconds which the LD will tolerate between transmission of individual data blocks. It shall be larger than MinBlockDelay but less than or equal to 32 767. If not provided, the maximum value shall be assumed. This value should generally be specified as large as possible, providing the LS with the maximum flexibility in “merging” load requests. The consequences, if MaxBlockDelay is exceeded, are unspecified.

LoadReason

This optional field contains the reason for sending the LoadRequestPDU. The value of this field shall be the same as that supplied in the load_reason parameter of the associated SYSTEM_LOAD.request primitive. If not provided, a value of Unspecified shall be assumed.

LoadInfo

LoadInfo is an optional field of the LoadRequestPDU. It may be used to describe the equipment that is requesting the load and the image requested.

LoadInfo is subdivided into PrivateID, StationID, and ImageID. All three fields are optional.

PrivateID is unadministered and is available for implementation-specific use.

StationID is a substructured field that contains information describing the device that is requesting the load. It contains an administered field, ManufacturerID, and two unadministered fields, DeviceTypeID and RevisionNumber. Each of the three fields are optional. The ManufacturerID is an Organizationally Unique Identifier (OUI) administered by the IEEE, as described in 5.2 of IEEE Std 802-1990. When present, the ManufacturerID provides the context within which the unadministered fields of LoadInfo may be interpreted.

ImageID is an unadministered field that contains information describing a requested load image. ImageID may be an explicit image name, a symbolic reference to one or more images, or some other implementation-specific form.

The LS may use the information provided in LoadInfo in order to determine the image to send to the requesting device. The LS may return some or all LoadInfo fields to the requesting LD as well as additional implementation-specific information.

8.2.2.1 When generated

The LoadRequestPDU is generated by an LD upon determining that it needs to obtain a load. An LD may make this determination itself (by unspecified means) or be instructed to do so by a general network manager (via the action service of the general-purpose systems facility).

8.2.2.2 Effect of receipt

On receipt of a LoadRequestPDU, an LS determines whether it can provide the load of the requesting LD. If so, the LS sends a LoadResponsePDU, then waits for the LD to send a GroupStatusPDU. If the LS cannot load the requesting LD, it does not send a LoadResponsePDU.

8.3 LoadResponsePDU

8.3.1 Function

The function of the LoadResponsePDU is to respond positively to one or more LoadRequestPDUs.

8.3.2 Semantics

The following describes the fields of the LoadResponsePDU and the associated semantics:

ExchangeID

This field is used by the LD to identify the corresponding request. If the LoadRequestPDU contained an ExchangeID, the LoadResponse PDU shall contain an ExchangeID with the same value as that contained in the LoadRequestPDU.

LoadAddress

This field specifies the MAC address to which the LS will send subsequent LoadPDUs of the requested load. If this field is absent from the LoadRequestPDU, the LS shall specify the MAC address to be used. See also 8.2.2, LoadAddress.

BlockSize

This specifies the size of the data blocks that the LS will send. It is the number of octets in the LoadData field of the LoadDataPDU. It ranges from 1 to 32 767.

MinBlockDelay

This field specifies the minimum amount of time in milliseconds which the LD can expect between transmissions of successive data blocks.

MaxBlockDelay

This field specifies the maximum amount of delay in milliseconds that the LD can expect between transmission of individual data blocks. It shall be larger than MinBlockDelay. It shall include not only the maximum delay that the LS may insert, but also the maximum delay expected to be introduced by the network.

The minimum possible value of MaxBlockDelay will result in the most rapid detection of errors. The value should be the sum of the MinBlockDelay, the expected “poor case” LS implementation delay, and the expected “poor case” network delay, which may be available in the LSNetDelay parameter (see LS parameter definitions).

NOTE—Successive data block transmissions should be separated by [MinBlockDelay + LSNetDelay], since if one PDU is delayed by the maximum and the next delayed not at all, they may arrive closer together than MinBlockDelay. Clearly, the returned value of MaxBlockDelay should be greater than or equal to the returned value of MinBlockDelay.

ReferenceID

This field specifies an identifier provided by the LS that is used to identify all subsequent PDUs associated with this load operation. This may be any 16-bit value.

NOTE—This identifier uniquely identifies a particular load in the context of a given LS.

NumberBlocks

This field specifies the total number of data blocks associated with this load operation. It ranges from 1 to 65 535.

LoadSelector

The LoadSelector is an optional field that may be used by the LD to choose between multiple eligible LS load “offers.” The LS may assign this field any value in the range of –128 to 127. See 8.3.3.

ImageInfo

ImageInfo is an optional field that describes the load image the LS will send. It may contain any or all of the LoadInfo fields sent in the LoadRequestPDU as well as additional information.

8.3.2.1 When generated

The LoadResponsePDU is generated by the LS after determining that it is prepared to provide the load of an LD from which it has received a LoadRequestPDU. If the LS is not already performing a load of the requested image, after sending the LoadResponsePDU, the LS waits for a GroupStatusPDU before proceeding with the load.

8.3.2.2 Effect of receipt

The LD may receive more than one LoadResponsePDU if there is more than one LS present that is prepared to load it. The LD selects an LS from those that send a LoadResponsePDU, by sending a GroupStatusPDU to the LS that is to provide the load. The LD then waits for subsequent load-related PDUs from the selected LS.

The LD uses the value of NumberBlocks to calculate the number of Groups in the load (see 8.1). The image is sent from the LS in groups. There may be up to 256 Groups (Group number 0 to 255). Except for the last Group, there are 256 blocks within each Group (block number 0 to 255). The 256-block Group size is consistent with the size of the bitmap described in 8.4.2.

8.3.3 Additional comments

When more than one LS offers to provide the load with equally acceptable parameters (e.g., MaxBlockDelay, ImageInfo), the LD may choose the LS that sent the highest LoadSelector value. The LD may make an arbitrary choice of eligible LS's in the event of a tie. The mechanism whereby the LS decides on a value of LoadSelector is not defined by this standard.

This field may be used in order to facilitate load sharing as well as to discourage multiple simultaneous instances of the same load. Refer to annex C.

8.4 GroupStatusPDU

8.4.1 Function

A GroupStatusPDU is sent by the LD to the LS in order to request the load of specific blocks. The LD sends a GroupStatusPDU to the individual MAC address of the LS that is to provide the load. Thereafter, the LD sends GroupStatusPDUs in order to request the retransmission of blocks.

8.4.2 Semantics

The following describes the fields of the GroupStatusPDU and the associated semantics:

ReferenceID

This field is the identifier provided by the LS in the LoadResponsePDU.

GroupNumber

This optional field indicates to which Group number the requested blocks belong. It ranges from 0 to 255. If this field is absent, a default value of “all groups” is assumed by the LS.

RequiredBlocks

This field specifies which blocks from the specified Group number are required by this LD. There are two possible forms:

- RequiredBlocks may be a 256-bit map (BitMap) in which each “set” bit corresponds to a required block from the specified GroupNumber. This form may occur only if GroupNumber is present. The BitMap is encoded with the most significant bit as bit 0, corresponding to block number 0 in a field of 8 bits.
- It may indicate that all blocks or no blocks of a load image or Group are needed for reassembly (RequiredBlocksCode).

8.4.2.1 When generated

The LD sends a GroupStatusPDU to the individual MAC address of the LS that is to provide the load.

If the LD needs all the blocks of the load image, it sends a GroupStatusPDU with no GroupNumber field but with a RequiredBlocks field that indicates that all blocks are needed.

If the LD needs only a partial load, it sends a GroupStatusPDU for each Group of the load image for which it requires blocks. Thereafter, the LD sends GroupStatusPDUs to the LS in order to request the retransmission of blocks.

A GroupStatusPDU shall be generated at the end of each Group during the load if there are required blocks outstanding.

At least one GroupStatusPDU shall be sent in response to a GroupStatusRequestPDU if there are required blocks outstanding.

The LD may send multiple GroupStatusPDUs, if required, without delay between transmissions.

8.4.2.2 Effect of receipt

If the LS is not already performing a load of the requested image, after sending a LoadResponsePDU, the LS waits for a GroupStatusPDU. If no GroupStatusPDU is received, the LS does not proceed with the load. If a GroupStatusPDU is received, the LS records the blocks needed for the load and proceeds with their transmission.

If the LS receives a GroupStatusPDU for the reference ID of the load in progress, it merges the blocks of the load image indicated in the GroupStatusPDU with the blocks it has left to send.

8.5 GroupStatusRequestPDU

8.5.1 Function

A GroupStatusRequestPDU is issued by the LS to determine if the LDs involved in the load require blocks of the load image. The GroupStatusRequestPDU may be sent to the individual MAC address of an LD or sent to a number of LDs by use of a group MAC address.

8.5.2 Semantics

The following describes the fields of the GroupStatusRequestPDU and the associated semantics:

ReferenceID

This field is the identifier provided by the LS in the LoadResponsePDU.

When generated

The LS shall generate the GroupStatusRequestPDU at the end of each pass through the image.

8.5.2.1 Effect of receipt

If, on receipt of a GroupStatusRequestPDU, an LD requires blocks from any Groups of the load, it returns a GroupStatusPDU for each Group for which it requires blocks. If the LD does not require blocks, it shall not reply to the GroupStatusRequestPDU.

8.6 LoadDataPDU

8.6.1 Function

The function of the LoadDataPDU is to transmit a data block from the LS to the LD(s) involved in the load.

8.6.2 Semantics

The following describes the fields of the LoadDataPDU and the associated semantics:

ReferenceID

This field is the identifier provided by the LS in the LoadResponsePDU.

GroupNumber

This field specifies to which Group number the data block belongs. It ranges in value from 0 to 255.

Block

This field contains the number of the data block within the Group which is being sent. It ranges in value from 0 to 255.

LoadData

This field contains the data to be loaded. Note that each LoadDataPDU should generally be an independent unit of information since the protocol does not guarantee delivery of LoadData PDUs in order.