TECHNICAL REPORT

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Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements —

Part 1: Overview of Local Area Network Standards

Technologies de l'information — Télécommunications et échange d'information entre systèmes — Réseaux locaux et métropolitains — Exigences spécifiques —

Partie 1: Vue d'ensemble des normes de réseaux locaux

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 8802 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC TR 8802-1, which is a Technical Report of type 3, was prepared by ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

This third edition cancels and replaces the second edition (ISO/IEC TR 8802-1:1997), which has been technically revised.

ISO/IEC 8802 consists of the following parts, under the general title *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements*:

— *Part 1: Overview of Local Area Network Standards* [Technical Report]

— *Part 2: Logical link control*

— *Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

— *Part 4: Token-passing bus access method and physical layer specifications*

— *Part 5: Token ring access method and physical layer specifications*

— *Part 6: Distributed Queue Dual Bus (DQDB) access method and physical layer specifications*

— *Part 9: Integrated Services (IS) LAN Interface at the Medium Access Control (MAC) and Physical (PHY) Layers*

— *Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications*

— *Part 12: Demand-Priority access method, physical layer and repeater specifications*

Introduction

This technical report introduces the set of International Standards produced to facilitate the interconnection of information processing systems connected to a Local Area Network (LAN). The LAN is a peer-to-peer communications network provided by a single broadcast domain that enables all end stations to exchange information. As a consequence it does not inherently provide privacy. A LAN is in general owned, used, and operated by a single organisation and falls within a single administrative domain.

In November 1999 a Category C liaison was established between ISO/IEC JTC 1 SC 6 WG 1 and WG 3, and the IEEE 802 LMSC to foster closer collaboration in the standards making process. To that end cooperative working practices have been established such that, both parties are able to contribute their particular and unique strengths to the standards making process without introducing time delays into the other's procedures; and, each has output for which they are responsible which records their involvement in that process.

There are two distinct elements to the cooperative working practice. The first provides the means whereby ISO/IEC JTC 1 National Bodies are able to contribute to the technical work of the IEEE 802 standards developments; and the second, via the IEEE Sponsor ballot process, provides the more formal mechanism whereby ISO/IEC JTC 1 National Bodies can review IEEE 802 work which is nearing completion of the standards process. It is this latter element of procedure which provides input into the revision of this technical report providing the record of ISO/IEC JTC 1 National Body participation in the standards making process.

This technical report therefore provides a source of reference to all International Standards that relate to local area networks; specifically the ISO/IEC 8802 technologies and FDDI, and in addition is the location where ISO/IEC JTC 1 SC 6 involvement in IEEE 802 standards development is recorded and any endorsements to particular IEEE 802 standards are noted.

Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements —

Part 1:
Overview of Local Area Network Standards

1 Scope

This technical report provides an introduction to the set of International Standards which describe local area networks, specifically those which make use of the 48-bit MAC address format.

The MAC technologies described in this technical report have in common the ability to provide sufficient capability to support the MAC Service which is defined in ISO/IEC 15802-1.

The scope of this Technical Report is therefore limited to those International Standards which describe processes and procedures resident in the Data Link and Physical Layers of the OSI Basic Reference Model and can be said to relate to local area networks.

This technical report does not itself describe new Service or Protocol definitions. Its intent is to set the context for local area networks which include both the International Standards describing FDDI and the technologies described by the set of ISO/IEC 8802 International Standards.

Additionally this technical report provides the record of cooperative work between ISO/IEC JTC 1 SC 6 WG 1 and the IEEE 802 LMSC as a part of the Category C liaison established in November 1999 either through the usual Fast Track procedures or via the cooperative working procedures described in this technical report.

2 References

NOTE A revised numbering scheme was introduced in 1993 to provide alignment with the numbering scheme used by the IEEE for their LAN/MAN Standards and the basis for this numbering scheme is shown in Annex A.

ISO 7498-3:1997, *Information technology — Open Systems Interconnection — Basic Reference Model: Naming and addressing*

ISO/IEC 8802-2:1998, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 2: Logical link control*

ISO/IEC 8802-3:2000, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ISO/IEC 8802-5:1998, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 5: Token ring access method and physical layer specifications*

ISO/IEC 8802-6:1994, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 6: Distributed Queue Dual Bus (DQDB) access method and physical layer specifications*

ISO/IEC 8802-11:1999, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications*

ISO/IEC 8802-11:1999/Amd.1:2000, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications — Amendment 1: High-speed Physical Layer in the 5 GHz band*

ISO/IEC 8802-12:1998, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 12: Demand-Priority access method, physical layer and repeater specifications*

ISO/IEC 8886:1996 | ITU-T Recommendation X.212, *Information technology — Open Systems Interconnection — Data link service definition*

ISO 9314-1:1989, *Information processing systems — Fibre Distributed Data Interface (FDDI) — Part 1: Token Ring Physical Layer Protocol (PHY)*

ISO 9314-2:1989, *Information processing systems — Fibre Distributed Data Interface (FDDI) — Part 2: Token Ring Media Access Control (MAC)*

ISO/IEC 9314-3:1990, *Information processing systems — Fibre Distributed Data Interface (FDDI) — Part 3: Physical Layer Medium Dependent (PMD)*

ISO/IEC 9314-6:1998, *Information technology — Fibre Distributed Data Interface (FDDI) — Part 6: Station Management (SMT)*

ISO/IEC TR 9577:1999, *Information technology — Protocol identification in the network layer*

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

ISO/IEC 10742:1994, *Information technology — Telecommunications and information exchange between systems — Elements of management information related to OSI Data Link Layer standards*

ISO/IEC 11575:1995, *Information technology — Telecommunications and information exchange between systems — Protocol mappings for the OSI Data Link service*

ISO/IEC 11801:2000, *Information technology — Generic cabling for customer premises*

ISO/IEC TR 11802-1:1997, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Technical reports and guidelines — Part 1: The structure and coding of Logical Link Control addresses in Local Area Networks*

ISO/IEC TR 11802-2:1999, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Part 2: Standard Group MAC Addresses*

ISO/IEC TR 11802-5:1997, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Technical reports and guidelines — Part 5: Media Access Control (MAC) Bridging of Ethernet V2.0 in Local Area Networks*

ISO/IEC 15802-1:1995, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Common specifications — Part 1: Medium Access Control (MAC) service definition*

ISO/IEC 15802-3:1998, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Common specifications — Part 3: Media Access Control (MAC) Bridges*

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*

ISO/IEC 15802-5:1998, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Common specifications — Part 5: Remote Media Access Control (MAC) bridging*

3 Abbreviations

The following abbreviations are used in this Technical Report.

CSMA/CD	Carrier Sense Multiple Access with Collision Detection
DLS	Data Link Service
DQDB	Distributed Queue Dual Bus
DSAP	Destination Service Access Point
FDDI	Fibre-Distributed Data Interface
LAN	Local Area Network
LLC	Logical Link Control
MAC	Media Access Control
MAN	Metropolitan Area Network
MCS	Management Conformance Summary
MICS	Management Information Conformance Statement
MOCS	Managed Object Conformance Statement
MRCS	Managed Relationship Conformance Statement
PHY	Physical Layer
PICS	Protocol Implementation Conformance Statement
PMD	Physical Layer Medium Dependent
SMT	Station Management
SNAP	Sub-network Access Protocol
SSAP	Source Service Access Point

4 ISO/IEC JTC 1 SC 6 WG 1 and IEEE 802 LMSC Co-operative Work

4.1 Introduction

The association between ISO/IEC JTC 1 SC 6 WG 1 and IEEE 802 has over the years been most successful with the development of International Standards for local and metropolitan area networks. This technical report provides an overview of this family of standards together with a full reference list of published International Standards in this area.

However it was recognised that, in its original form, the joint processes of ISO/IEC JTC 1 SC 6 and IEEE 802 introduced a number of additional, and at times, difficult hurdles to be overcome in the production joint ISO/IEC and IEEE 802 Standards. This largely arose because the two organisations quite reasonably operated with differing timetables which inevitably introduced delay into the publication process and whilst technical discussion was complete the entire process to publication was not finished. This, combined with the undoubted standing of IEEE 802 as the international body that makes LAN standards, led to the debate within the IEEE 802 as to the value of the additional processing of their standards through ISO/IEC.

The main value of making use of ISO/IEC in the development cycle is to benefit from the wider audience that ISO/IEC JTC 1 SC 6 National Body participation is able to offer to the review process. This ensures that in addition to the usual rigorous technical appraisal carried out by the IEEE 802, the opportunity exists for account to be taken of regional and national perspectives which may otherwise be missed. The end result is a specification about which there is overwhelming, indeed global, consensus. To lose this element of the development process would be significant and to some extent would diminish the final product.

4.2 The Cooperative Process

Nominated representatives from ISO/IEC JTC 1 SC 6 National Bodies have been invited by IEEE 802 Working Groups (WG) to participate in their activities as International Observers in their ballot process to review and to comment on draft materials. Any comments received from such a source would then be addressed in the normal way as a part of the 802 WG ballot resolution process.

A liaison will be sent to ISO/IEC JTC 1 SC 6 WG 1 providing the necessary status information and inviting ISO/IEC JTC 1 SC 6 WG 1 to respond as a part of their ballot process when an IEEE 802 WG draft standard progresses to Sponsor ballot, that is, when the IEEE 802 WG has completed its technical work. This provides the opportunity for ISO/IEC JTC 1 SC 6 WG 1 formally to contribute to the work, and through this technical report to record its involvement in the standardisation process.

Additionally, and not withstanding issues of IEEE 802 LMSC permission and of copyright, the opportunity exists for ISO/IEC JTC 1 SC 6 National Bodies, where it is considered appropriate, to make use of ISO/IEC JTC 1 Fast track procedures for IEEE 802 work. However it is to be hoped that in the majority of cases this technical report will be of sufficient weight to record the involvement and endorsement of ISO/IEC JTC 1 SC 6 National Bodies in the standards making process.

Therefore in the general case this technical report will catalogue both those IEEE 802 standards already published as ISO/IEC International Standards, together with any International Standards approved via the Fast track procedures of ISO/IEC [Clause 2, References] as well as any IEEE 802 standards endorsed via the mechanism of cooperative working described here [Annex B]. New editions of this technical report will record successive endorsements by ISO/IEC of IEEE 802 standards published under these cooperative arrangements together with any commentary agreed by ISO/IEC JTC 1 National Bodies.

4.3 Catalogue of Endorsed Standards

Annex B of this technical report lists those standards that have been developed as a part of the cooperative agreement with the IEEE 802 LMSC together with any agreed commentary. Clause 2 of this technical report provides a full reference list for this endorsed material.

5 Local Area Network Technologies

5.1 Introduction

The local area network MAC technologies considered in this Technical Report are shown in Table 1.

Table 1 — Local area network MAC technologies and their related International Standards

LAN Technology	Data Transmission Rate	International Standard
CSMA/CD	10Mbit/s / 100Mbit/s / 1000Mbit/s	ISO/IEC 8802-3
Token-passing Ring	4Mbit/s / 16Mbit/s	ISO/IEC 8802-5
DQDB	no upper limit defined	ISO/IEC 8802-6
Wireless LAN	up to 54Mbit/s	ISO/IEC 8802-11
Demand Priority	100Mbit/s	ISO/IEC 8802-12
FDDI	100Mbit/s	ISO/IEC 9314 -1 -2 -3 (-6)

These International Standards are organised along the architectural lines of the OSI Basic Reference model, and in the case of the 8802 LANs into the medium-dependent aspects of the Physical Layer (PHY) and the formats and protocols used by the particular media access control sublayer (MAC).

Figure 1 shows the relationship and dependencies of the various technologies within this overall architecture. This family of International Standards deals with the physical and data link layers as defined by the Open Systems Interconnection Reference Model. It comprises a set of medium access control technologies and associated physical media, each appropriate for particular applications or system objectives.

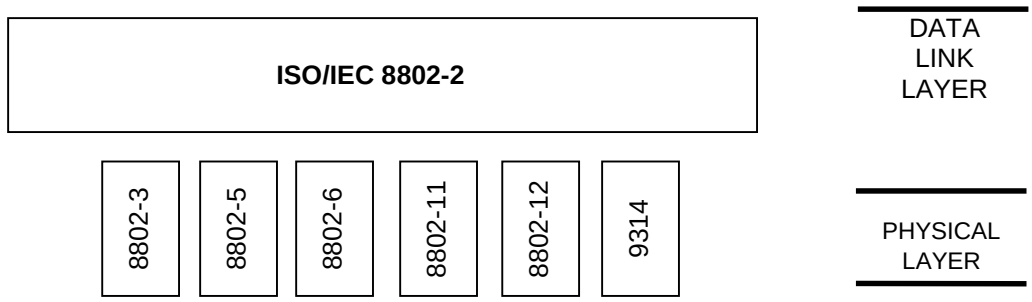

Figure 1 — Relationship of family of International Standards for Local Area Networks

5.2 The LAN Technologies

LANs cover a wide variety of Physical Layer International Standards, physical media, and methods of media access control. The following is a brief synopsis for each of the LAN technologies identified in Table 1, however the reader is referred to the International Standard documents (see Clause 2) for the precise detail for each of the LAN technologies.

5.2.1 CSMA/CD

This form of LAN technology provides two distinct modes of operation, namely half duplex and full duplex, and a given instantiation operates in either half or full duplex mode at any one time.

In half duplex mode Carrier Sense Multiple Access with Collision Detection controls access to the medium by means by which two or more stations share a common transmission medium. To transmit, a station waits (defers) for a quiet period on the medium (that is, no other station is transmitting) and then sends the intended message in bit-serial form. If, after initiating a transmission, the message collides with that of another station, then each transmitting station intentionally sends a few additional bytes to ensure propagation of the collision throughout the system. The station then remains silent for a random amount of time (backoff) before attempting to transmit again.

Full duplex operation allows simultaneous communication between a pair of stations using point-to-point media. It does not require that transmitters defer, nor do they monitor or react to receive activity, as there is no contention for a shared medium in this mode. In this respect, the multiple access (i.e., CSMA/CD) algorithms are unnecessary. Full duplex mode can only be used when all of the following are true; the physical medium is capable of supporting simultaneous transmission and reception without interference; there are exactly two stations connected with a full duplex point-to-point link; and both stations on the LAN are capable of, and have been configured to use, full duplex operation. The most common configuration envisioned for full duplex operation consists of a centralised bridge (or switch) [9.1] with a dedicated LAN connecting each bridge port to a single device; such an architecture being described in ISO/IEC 11801

The CSMA/CD LAN technology is defined for use on 50 ohm coaxial cable (10BASE5 and 10BASE2), on unshielded twisted pair (10BASE-T), and on fibre optic cable (FOIRL and 10BASE-F).

100BASE-T couples the ISO/IEC 8802-3 CSMA/CD MAC with a family of 100 Mbit/s physical layers. While the MAC is readily scaled to these performance levels, specific physical layer standards are required for 100 Mbit/s operation and these include 100BASE-T4, 100BASE-TX and 100BASE-FX.

1000BASE-T provides the ISO/IEC 8802-3 CSMA/CD MAC with a set of 1000 Mbit/s physical layers. As with 100BASE-T, the MAC is readily scaled to these performance levels, the specific physical layer standards of 1000BASE-SX and 1000BASE-LX are required for 1 000 Mbit/s operation.

5.2.2 Token-passing Ring

In a token-passing ring, stations are serially connected to form a logical ring over which data and control information is transmitted and received.

Access to this ring is controlled by a signalling sequence referred to as the “token” which circulates around the ring from station to station.

A station desiring to transmit waits until it receives a token. The station changes the token to a start-of-message, transmits its message and, upon completion of the message, releases a new token for use by other stations on the ring.

Token ring is defined for operation on shielded and unshielded twisted pair medium at data rates of 4 and 16 Mbits/s. In addition, token ring may operate using fibre optic cable.

5.2.3 Distributed Queue Dual Bus

DQDB is defined to have the capability to work over the local area and to interoperate with the other local area network technologies. In particular DQDB has the capability to use the 48-bit MAC address format and for that reason it is included in this Overview.

However, DQDB is more often encountered in the Metropolitan Area and it introduces the concept of the Metropolitan Area Network (MAN) where the development of a high speed technology to support connectionless data services is required. Because of the differing environments in which the DQDB MAN will be utilised, a variety of Physical Layer protocols are required. Physical Layer protocols which make use of existing underlying transmission standards have been defined. However it is intended that all Physical Layer specifications (PHY) will be based upon a common framework.

5.2.4 Wireless LAN

This form of LAN technology, Carrier Sense Multiple Access with Collision Avoidance, controls access to the medium by means by which many stations share a common transmission medium. As in CSMA/CD, a station waits to transmit (defers) until a quiet period occurs on the medium, i.e., when the station hears no other station transmitting on the medium. When a quiet period is detected, the station then sends the intended message. As this technology is used in ISO/IEC 8802-11, the station is not able to detect transmissions of other stations once its own transmission has begun. In addition, because of the nature of electromagnetic propagation, it may not be possible for every station to hear the transmissions of every other station. For these reasons, the MAC protocol of ISO/IEC 8802-11 distributes information about the duration of transmissions that allow stations to create a virtual sense of the activity on the medium and, thus, avoid transmitting when other stations will be using the medium. Should a station be required to transmit while the medium is determined to be in use, either from a physical or virtual sensing of that activity, a collision is determined to have occurred, causing the colliding station to delay its transmission for a random amount of time (backoff). Similarly, if the MAC protocol fails to deliver an acknowledgement for a transmission, a physical collision is determined to have occurred and the station will attempt it transmission again, after a random delay.

The CSMA/CA LAN technology is defined for use on wireless media. ISO/IEC 8802-11 couples the CSMA/CA MAC with three physical layers providing 1 and 2 Mb/s, a baseband infrared physical layer, a frequency hopping spread spectrum physical layer in the 2.4 GHz band, and a direct sequence spread spectrum physical layer in the 2.4 GHz band. The CSMA/CA MAC is also coupled with a higher speed direct sequence spread spectrum physical layer in the 2.4 GHz band that provides up to 11 Mb/s and is compatible with the original direct sequence and frequency hopping physical layers. In the 5 GHz Unlicensed National Information Infrastructure (UNII) band, the CSMA/CA MAC is coupled with an orthogonal frequency division multiplexing (OFDM) physical layer providing up to 54 Mb/s.

5.2.5 Demand Priority

A Demand Priority LAN comprises three principal components; the end nodes, the repeaters, and the network links. End nodes are typically personal or larger computers but may be special devices, for example bridges. Repeaters are the network controllers which manage the Demand Priority Access Method. The link segments provide the interconnection between a repeater and its connected end nodes or other repeaters.

Demand priority access is a priority-based, round-robin arbitration method where the central network controller (the repeater) regularly polls its connected ports to determine which have transmission requests pending, and whether the transmission request is normal priority (e.g. for data files) or high priority (e.g. for real time voice, video or data).

The medium access protocol provides a means by which stations (end nodes) can communicate with each other over a centrally controlled LAN that offers a choice of several different link media including 100 Ohm balanced cable (4-UTP and 2-TP), 150 Ohm shielded balanced cable (STP), and optical fibre.

5.2.6 Fibre Distributed Data Interface

The Physical Medium Dependent (PMD) provides the digital baseband channel for point to point communication between nodes on the FDDI network. It provides all services necessary to transport a suitably coded digital bit stream. The specific definition and characterisation may be found in ISO/IEC 9314-3.

The Physical Layer Protocol (PHY) provides the connection between the PMD and the MAC sublayer in the Data Link Layer. It provides clock synchronisation with the upstream data stream and provides the encoding and decoding of symbols, and the delineation of symbol boundaries as required for the transmission of information to or from higher layers. The specific definitions and characterisations may be found in ISO 9314-1.

5.3 Cabling Aspects

For the implementation of the LAN applications summarised in Table 1, an application independent solution has been developed in ISO/IEC 11801. This document describes the generic cabling of customer premises, supporting all major applications. Specific cabling definitions and characterisations may be found in this document. However for completeness reference should also be made to the appropriate clause of the specific International Standard for the LAN technology of interest to ensure cabling characteristics meet any particular requirements.

6 Data Link Layer

6.1 Introduction

For the specification of ISO/IEC 8802 Local Area Networks, the separation of the Data Link Layer of the OSI Basic Reference Model into two sublayers is of benefit. The Data Link Layer is therefore refined to show a Medium Access Control Sublayer and a Logical Link Control Sublayer.

6.2 Provision and Support of the Data Link Layer Service

ISO/IEC 8886 | ITU-T Recommendation X.212 contains the generic Data Link Service (DLS) definition for OSI and, as such, the elements of service definition within LLC can be regarded as a subset of this generic service definition. The OSI DLS definition describes the properties of individual instances of Data Link communication between pairs of DLS users. It is expressed abstractly in terms of primitives and parameters exchanged, at the Data Link service access points, between each DLS user and a single DLS provider. In this respect the service definition contained in LLC is no different.

ISO/IEC 11575 seeks to unify the generic DLS definition with the specific instances of Data Link layer service, e.g. LLC, and includes mapping the OSI DLS for LLC Types 1 and 2. The fundamental objective is to achieve such a mapping without requiring any change to the protocols themselves; further it is specifically not the intent to restrict the development of new protocols. It accepts that the service definitions contained in ISO/IEC 8802-2 for LLC Types 1 and 2 while performing a similar function to the OSI DLS differ in some points of detail. It attempts to identify places where there is a possible impact of mapping the DLS to the text of ISO/IEC 8802-2 and to indicate how the text would need to change if the DLS mapping were to be incorporated into ISO/IEC 8802-2 as a replacement for the existing LLC service definition.

7 Medium Access Control Sublayer

7.1 Introduction

The development of the concepts associated with the MAC sublayer have been intimately related to the development of the different LAN technologies. Indeed each LAN Standard describes the MAC Service interface for its particular requirements. A great deal of commonality exists in these definitions, to the extent that a definition of a single generic MAC Service description was considered appropriate and has been standardised as ISO/IEC 15802-1.

7.2 Provision and Support of the MAC Service

7.2.1 Connectionless-mode Service

ISO/IEC 15802-1 defines the MAC Service (the connectionless-mode service) found in local area network architecture. This service is defined in terms of the primitive actions and events of the service together with the parameters associated with each primitive action and event, their inter-relationship and valid sequences. Its intent is to specify the characteristics of a conceptual service and to provide guidance for the development of MAC protocols and OSI protocols that make use of the MAC Service.

The MAC Service provides for the transparent transfer of data between MAC service users and makes invisible the way in which supporting communications resources are utilised. In particular the MAC Service provides independence of the underlying MAC and Physical Layer to the MAC Service user and transparency of transferred information by providing no restriction on the content, format or coding of the information beyond the maximum number of octets of MAC Service user data that can be supplied in a user/provider interaction.

ISO/IEC 15802-1 introduces and discusses the quality of this service and classifies the parameters in terms of MAC Service performance and other MAC service characteristics. Within each class examples of the quality of service parameters are given and defined. These include,

— transit delay;
— residual error rate;
— probability of lost information;
— priority.

The subject of the quality of the MAC Service is more fully discussed in ISO/IEC 15802-3 and includes those parameters listed above together with the following additional parameters,

— service availability;
— frame mis-ordering;
— frame duplication;
— frame lifetime;
— maximum service data unit size supported;
— throughput.

Taken together this provides an exhaustive examination of the parameters of quality of the MAC Service within the context of quality of service maintenance.

7.3 48-Bit MAC Address Format

The network technologies described in this Technical Report all make use of the 48-bit MAC address format. Such addresses are universally applicable and provide unique identification. The registration authority for the Universally administered address is the American National Standards Institute Accredited Standards Committee, IEEE Standards Board.

The precise detail of address format and usage together with the definition of their representation in hexadecimal is described within ISO/IEC 15802-1. The Hexadecimal Representation of the 48-bit MAC address is used at the MAC service boundary to de-couple the specific requirements of the various MAC technologies.

The 48 bits are divided into two parts; the first 24 bits correspond to the Organisationally Unique Identifier as assigned by the IEEE Standards Board[1)], excepting that the assignee may choose between group addressing or individual addressing by modification of the Individual/Group Address bit. The second 24 bits of the address is administered locally by the assignee to provide uniqueness.

The address format additionally allows for local administration of addresses by modification of the Universally/Locally Administered Address bit.

1) IEEE Registration Authority, Standards Department, 445 Hoes Lane, P.O. Box 1331, Piscataway NJ 08855-1331, USA.

7.4 Standard Group MAC Addresses

Group MAC addresses which form a part of the operation of a published International Standard protocol exist (e.g. ISO/IEC 15802-3 spanning tree bridge protocol data units; ISO/IEC 10589 All Level 1 Intermediate Systems Address). It was realised that there would be benefit if such group addresses were allocated from an approved, assigned group MAC address block. ISO/IEC TR 11802-2 provides a record of the approved assignments from this Standard group MAC address block and a record of group MAC addresses in use in International Standards which are not part of the Standard group MAC address block.

NOTE Group MAC addresses for vendor specific proprietary protocols are not covered by this Technical Report; such addresses should be assigned out of the vendor's universally administered address block.

8 Logical Link Control Sublayer

8.1 Provision and Support of the LLC Services

ISO/IEC 8802-2 (LLC) contains both the service description and the elements of protocol which realise the functions, features, protocol and services of the Logical Link Control sublayer. This sublayer definition exists between the MAC sublayer of the Data Link layer and the Network layer. The service definition is provided in terms of primitives that represent the logical exchange of information and control, in an abstract manner. It provides a description of the peer-to-peer protocol procedures that are defined for the transfer of information and control between any pair of data link layer service access points. These procedures are independent of the particular MAC technology of the LAN as they themselves make use of the underlying generic MAC Service.

LLC Types 1 and 2 provide services which map well to the generic OSI Data Link Service (ISO/IEC 8886). LLC Type 3 provides the ability to submit data units for eventual transmission if and when requested by the remote end station; this service definition is currently absent from the OSI Data Link Service.

In their turn the protocol data units exchanged by LLC make use of the MAC sublayer service. LLC Types 1 and 2 map directly to the connectionless-mode MAC Service defined in ISO/IEC 15802-1. LLC Type 3 is able to make use of local acknowledgement, a service currently not described in ISO/IEC 15802-1.

8.1.1 LLC Type 1 Connectionless-mode Operation

LLC Type 1 provides a data link connectionless-mode service with the minimum of protocol complexity, so that any required recovery mechanism or sequencing services must be provided elsewhere in the higher layer protocols. With this type of service there can be no guarantee of delivery of each transmitted data link layer frame. This style of operation exists without the need to establish a data link connection and there are no acknowledgement mechanisms, flow control or error recovery procedures provided by this service.

8.1.2 LLC Type 2 Connection-mode Operation

LLC Type 2 provides a data link connection-mode service across a LAN and is comparable to existing non-LAN data link control procedures (e.g. ISO/IEC 7776, LAPB). The service includes support of sequenced delivery together with a comprehensive set of data link layer error recovery techniques. With this operation, a data link connection is established prior to the exchange of information. Whilst information is being exchanged in both directions, frames acknowledging receipt are passed in the opposite direction.

8.1.3 LLC Type 3 Acknowledged Connectionless-mode Operation

LLC Type 3 provides acknowledgement of transmitted information while retaining the simplicity of protocol of LLC Type 1. The acknowledgement scheme allows only the acknowledgement of a single frame at a time; mechanisms for ensuring sequencing are minimal, and a basic mechanism for re-transmission is provided. Additionally Type 3 operations allow one end system to poll another for data.

8.2 Logical Link Control Addresses

LLC protocol data units contain addressing information which comprise the Destination Service Access Point (DSAP) and the Source Service Access Point (SSAP). Each of these fields is further sub-divided; the DSAP into

the *address type designation bit* and the *actual address* and the SSAP into the *command/response identifier bit* and the *actual address* . In the general case, an individual *actual address* identifies a protocol or set of protocols operating above the LLC sublayer.

The addressing terminology and conventions of LLC are introduced and defined in ISO/IEC 8802-2. ISO/IEC TR 11802-1 deals comprehensively with the subject and includes a tabulation of current LLC address assignments for both individual and group address values. Private and proprietary protocols do not qualify for inclusion within ISO/IEC TR 11802-1 but, within the LAN environment, the use of SNAP encoding is recognised and it is described within an Annex to that Technical Report.

In the case of the Network Layer protocols operating in the environment above the LLC sublayer, complete protocol identification may require the application of ISO/IEC TR 9577 which comprehensively deals with the subject of protocol identification in the Network Layer.

9 Internetworking

9.1 Transparent Bridging

ISO/IEC 15802-3 describes and defines the mechanisms whereby 8802 LANs of all type may be connected together with MAC bridges. Each LAN has its own independent MAC, however the use of bridges allows the interconnection of end systems attached to separate LANs, that is to say access domains, as if they were attached to a single LAN.

Where a MAC bridge interconnects considerably more than two access domains, it is usually referred to as a switch. Some switches are used to interconnect access domains each containing a very small number of end systems (often, a single end system). Others interconnect multiple access domains containing principally other bridges, thus forming a backbone for the bridged LAN. Bridged LAN configurations involving these kinds of interconnection have now become widespread allowing the construction of networks with much larger numbers of end systems and much higher aggregate throughput than was previously achievable.

A bridge operates below the MAC Service boundary and is transparent to protocols operating above this boundary. A bridge is not directly addressed by communicating end systems, except by an end system for the purposes of management. Within the LAN environment frames transmitted between end systems carry the MAC address of the peer-end system in their Destination address field, not the MAC address of the bridge.

The operation of a bridge is dependent upon the existence and operation of an internal sublayer service provided by each MAC entity to the central MAC relay entity within the bridge. The bridge will observe the appropriate MAC procedures and protocol for each LAN to which it is connected. A mapping of the internal sublayer service to the specific MAC procedures of each of the 8802 MAC types and the FDDI MAC type is defined.

A bridge has three principal elements of operation; the ability to relay and filter frames, the maintenance of information required to make frame filtering and relaying decisions and the provision of management of the above.

In addition the provision of expedited traffic capabilities, to support the transmission of time-critical information in a LAN environment; and the provision of filtering services that support the dynamic definition and establishment of Groups in a LAN environment, and the filtering of frames by bridges such that frames addressed to a given Group are forwarded only on those LAN segments that are required in order to reach the members of that Group, are both supported.

ISO/IEC TR 11802-5 describes the problems of interoperability between end systems that exist in mixed environments that include Ethernet V2.0 in addition to ISO/IEC 8802-3 conformant end systems and any other OSI-based LAN technology, and in addition provides the accepted solution.

ISO/IEC 15802-5 describes the operation of the Remote MAC bridge. The Remote MAC bridge is defined to interconnect a locally bridged local area network and the non-LAN communications equipment of one or more remotely bridged local area networks. In addition it provides MAC sublayer interworking between end stations attached to any of the LANs within this configuration.