

IEEE Std 802.6j-1995
[Supplement to ISO/IEC 8802-6:1994
(ANSI/IEEE Std 802.6, 1994 Edition)]

IEEE Standards for Local and Metropolitan Area Networks:

Supplement to Distributed Queue Dual Bus (DQDB) Access Method and Physical Layer Specifications

Connection-Oriented Service on a Distributed Queue Dual Bus (DQDB) Subnetwork of a Metropolitan Area Network (MAN)

Sponsor

**Technical Committee on Computer Communications
of the
IEEE Computer Society**

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Abstract: Enhanced Queued Arbitrated (QA) Functions, which can support applications requiring bandwidth guarantees and delay limits on a DQDB subnetwork, are specified. Connection-Oriented Convergence Functions (COCFs) using the enhanced QA Functions, which are necessary to support connection-oriented service, are also specified.

Keywords: Connection-Oriented Convergence Function (COCF), connection-oriented service, Distributed Queue Dual Bus (DQDB), Guaranteed Bandwidth (GBW), Queued Arbitrated (QA) Functions, Variable Bit Rate (VBR)

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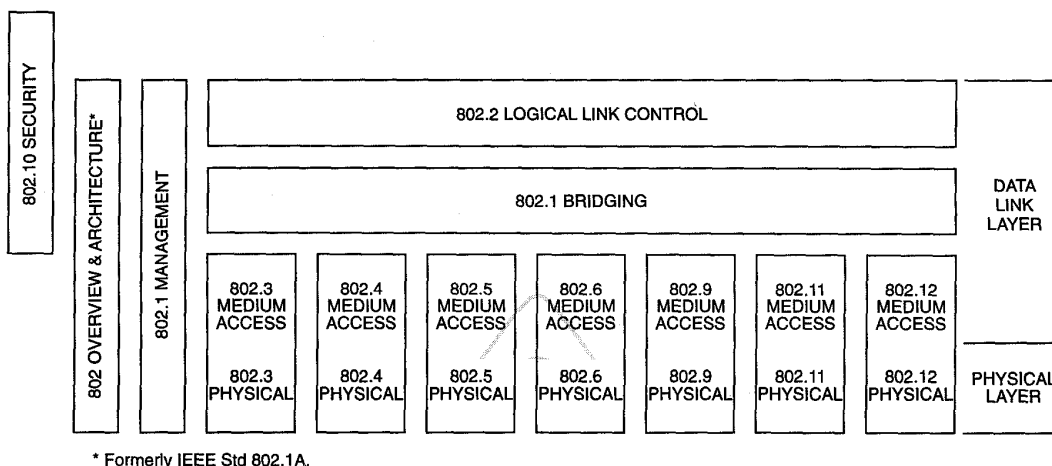
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Introduction

(This introduction is not part of IEEE Std 802.6j-1995.)

This standard is part of a family of standards for local and metropolitan area networks. The relationship between the standard and other members of the family is shown below. (The numbers in the figure refer to IEEE standard numbers.)



This family of standards deals with the Physical and Data Link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection Basic Reference Model (ISO 7498 : 1984). The access standards define several types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. Other types are under investigation.

The standards defining the technologies noted above are as follows:

- IEEE Std 802¹:
Overview and Architecture. This standard provides an overview to the family of IEEE 802 Standards. This document forms part of the 802.1 scope of work.
- ANSI/IEEE Std 802.1B [ISO/IEC 15802-2]:
LAN/MAN Management. Defines an Open Systems Interconnection (OSI) management-compatible architecture, and services and protocol elements for use in a LAN/MAN environment for performing remote management.
- ANSI/IEEE Std 802.1D [ISO/IEC 10038]:
MAC Bridging. Specifies an architecture and protocol for the interconnection of IEEE 802 LANs below the MAC service boundary.
- ANSI/IEEE Std 802.1E [ISO/IEC 15802-4]:
System Load Protocol. Specifies a set of services and protocol for those aspects of management concerned with the loading of systems on IEEE 802 LANs.

¹The 802 Architecture and Overview standard, originally known as IEEE Std 802.1A, has been renumbered as IEEE Std 802. This has been done to accommodate recognition of the base standard in a family of standards. References to IEEE Std 802.1A should be considered as references to IEEE Std 802.

- ANSI/IEEE Std 802.2 [ISO/IEC 8802-2]: Logical Link Control
- ANSI/IEEE Std 802.3 [ISO/IEC 8802-3]: CSMA/CD Access Method and Physical Layer Specifications
- ANSI/IEEE Std 802.4 [ISO/IEC 8802-4]: Token Bus Access Method and Physical Layer Specifications
- ANSI/IEEE Std 802.5 [ISO/IEC 8802-5]: Token Ring Access Method and Physical Layer Specifications
- ANSI/IEEE Std 802.6 [ISO/IEC 8802-6]: Distributed Queue Dual Bus Access Method and Physical Layer Specifications
- IEEE Std 802.9: Integrated Services (IS) LAN Interface at the Medium Access Control (MAC) and Physical (PHY) Layers
- IEEE Std 802.10: Interoperable LAN/MAN Security, *Currently approved*: Secure Data Exchange (SDE)
- IEEE Std 802.12: Demand Priority Access Method, Physical Layer and Repeater Specification for 100 Mb/s Operation

In addition to the family of standards, the following is a recommended practice for a common Physical Layer technology:

- IEEE Std 802.7: IEEE Recommended Practice for Broadband Local Area Networks

The following additional working groups have authorized standards projects under development:

- IEEE 802.11: Wireless LAN Medium Access Control (MAC) Sublayer and Physical Layer Specifications
- IEEE 802.14: Standard Protocol for Cable-TV Based Broadband Communication Network

The reader of this standard is urged to become familiar with the complete family of standards.

Conformance test methodology

An additional standards series, identified by the number 1802, has been established to identify the conformance test methodology documents for the 802 family of standards. Thus the conformance test documents for 802.3 are numbered 1802.3, the conformance test documents for 802.5 will be 1802.5, and so on. Similarly, ISO will use 18802 to number conformance test standards for 8802 standards.

IEEE Std 802.6j-1995

This standard is a supplement to ISO/IEC 8802-6: 1994 [ANSI/IEEE Std 802.6, 1994 Edition]. When approved by ISO and IEC, it will be incorporated into the base text of the standard and will no longer be available separately.

This standard contains state-of-the-art material. The area covered by this standard is undergoing evolution. Revisions are anticipated within the next few years to clarify existing material, to correct possible errors, and to incorporate new related material. Information on the current revision state of this and other IEEE 802 standards may be obtained from

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Supplement to Distributed Queue Dual Bus (DQDB) Access Method and Physical Layer Specifications

Connection-Oriented Service on a Distributed Queue Dual Bus (DQDB) Subnetwork of a Metropolitan Area Network (MAN)

Revisions to ISO/IEC 8802-6: 1994 [ANSI/IEEE Std 802.6, 1994 Edition]

The contents of this document will be incorporated into ISO/IEC 8802-6 in a future edition. The clauses of this document are ordered to parallel the order of clauses in the base standard. However, to maintain internal consistency within this document, subclauses will not correspond identically with subclauses of the base standard, and the base standard will have to be renumbered upon incorporation of this document by the Working Group. This supplement is intended to be used in conjunction with ISO/IEC 8802-6: 1994.

Editing instructions in this document are provided in ***bold italics***. It is noted whether a clause or subclause is an addition to ISO/IEC 8802-6: 1994 or replaces a clause or subclause of it in order to specify the provision of connection-oriented service.

1. Overview

1.1 Scope

This standard is a supplement to ISO/IEC 8802-6: 1994. Applications requiring bandwidth guarantees and delay limits are common and the need has been identified to support such applications on a DQDB subnetwork. Those requirements can be achieved by using either the Pre-Arbitrated (PA) functions (see IEEE Std 802.6h-1993¹) or the Queued Arbitrated (QA) functions. This standard focuses on the use of enhanced QA functions.

The Guaranteed Bandwidth (GBW) protocol is specified as an enhancement of the QA Functions block. Moreover, Connection-Oriented Convergence Functions (COCFs) using the enhanced QA functions are necessary to support connection-oriented service. Different COCFs optimized for different types of

¹Information on references can be found in 1.3.

applications are envisaged on top of the QA Functions block, using for example, AAL3/4 or AAL5. However, in this standard, only the COCF block using AAL3/4 is fully specified.

This standard does not specify procedures for establishing, maintaining, and releasing connections.

1.2 Organization

This standard in essence contains two parts, which are not explicitly separated:

- a) *Enhanced QA functions.* The enhanced QA functions are necessary for providing services with bandwidth guarantees and delay limits. The enhanced QA functions are compatible with the QA functions as defined in ISO/IEC 8802-6: 1994. Due to the layered approach, the enhanced QA functions can be used by different convergence functions.
- b) *COCFs.* The protocol functions and frame formats used to support different connection-oriented service types are defined. In this edition of the standard, only the Convergence Function block providing an AAL3/4 like service [ITU-T Recommendation I.363 (1993)] is fully specified.

1.3 Normative references

The following standards contain provisions which, through reference in this 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 indicated below. Members of ISO and IEC maintain registers of currently valid International Standards.

IEEE Std 802.6h-1993, IEEE Standards for Local and Metropolitan Area Networks—Supplement to Distributed Queue Dual Bus (DQDB) Access Method And Physical Layer Specifications—Isochronous Service on a Distributed Queue Dual Bus (DQDB) Subnetwork of a Metropolitan Area Network (MAN).²

ISO/IEC 11172: 1993, Information technology—Coding of moving pictures and associated audio for digital storage media up to about 1,5 Mbit/s.³

ITU-T Recommendation I.363 (1993), B-ISDN ATM Adaption Layer (AAL) Specification, Rev. 1.⁴

1.4 Abbreviations and acronyms

For this standard, the abbreviations and acronyms in ISO/IEC 8802-6: 1994 apply. In addition, the following abbreviations and acronyms are used within this standard.

CF	Convergence Function
COCF	Connection-Oriented Convergence Function
COCF3/4	Connection-Oriented Convergence Function Block using AAL3/4
COCF5	Connection-Oriented Convergence Function Block using AAL5

²This publication is packaged with IEEE Std 802.6c-1993 and this volume is available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

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

⁴ITU-T publications are available from the International Telecommunications Union, Sales Section, Place des Nations, CH-1211, Genève 20, Switzerland/Suisse. They are also available in the United States from the U.S. Department of Commerce, Technology Administration, National Technical Information Service (NTIS), Springfield, VA 22161, USA.

COCFx	Connection-Oriented Convergence Functions (Stream-based)
CODU	Connection-Oriented Service Data Unit
COSU	Connection-Oriented Service User
DCOPDU	Derived Connection-Oriented Service Protocol Data Unit
FIFO	First In First Out
GBW	Guaranteed Bandwidth
ICOPDU	Initial Connection-Oriented Service Protocol Data Unit
MV	Maximum Value
PICS	Protocol Implementation Conformance Statement
PLCP	Physical Layer Convergence Procedure
TSSM	Traffic Shaping State Machine
VBR	Variable Bit Rate

2. Overview of the connection-oriented service

Add the following subclauses to ISO/IEC 8802-6: 1994.

This clause provides an overview of the connection-oriented service. Although only video applications are described in more detail, other applications such as time-critical data communication or frame relay interworking are not precluded. Several applications are described that can use the Variable Bit Rate (VBR) connection-oriented service defined in this standard. The design objectives used in the development of this standard are also described. Finally, the properties of the different connection-oriented service types envisaged in this standard are described.

This standard complements the base standard, ISO/IEC 8802-6: 1994 [IEEE Std 802.6, 1994 Edition], which provides for connectionless data transfer without realtime delivery constraints.

2.1 Compressed video applications

Applications that are expected to be supported by this service fall into the category of low to medium bandwidth compressed digital video, i.e., 348 kbit/s to 44.2097 Mbit/s. There are two types of compressed video information, namely constant bit rate/variable image quality and variable bit rate/constant image quality. These two types have different service requirements and hence may be supported by different services on a DQDB subnetwork. The requirements of the constant bit rate/variable quality users are met by the isochronous service described in IEEE Std 802.6h-1993. The connection-oriented service types defined in this standard, in particular the stream-oriented service, are intended to meet the requirements for variable bit rate/constant image quality users.

2.2 Multiservice support

Multiservice support refers to the ability to simultaneously support multiple services on the same subnetwork from any given station, e.g., video and bursty data. By meeting the requirements of all other services, this type of service can be automatically supported.

2.3 Multimedia application

Multimedia application requires the simultaneous, integrated use of two or more of the following: voice, video, text, and graphics. This results in generating signals that are a sequence of isochronous and bursty information, which may be carried in separate channels or may be multiplexed in one channel. They are in

specific timing relationships. These timing relationships are such that the information remains meaningful and intact, e.g., a voice describing a specific graphic image, or narrating a text, must be played while the image or text is on the screen. Another example is maintaining synchronization between a motion picture and a voice that accompanies it. However, when video and voice are multiplexed by the terminal into a single data stream—as is the case in ISO/IEC 11172: 1993—the network performance does not affect synchronization. When voice and video are carried in separate channels, the network performance has to be such that synchronization at the receiving end is possible whether it is carried out by the terminals or by the network. This implies that the differences in delay must be bounded.

2.4 Design objectives

The following design objectives are seen as the most important towards the definition of connection-oriented service capability on a DQDB subnetwork. Other design objectives may also apply.

2.4.1 Support of variable data rates

Connection-oriented service capability is desirable for several applications. In the near future, many likely applications are expected to use variable data rates. The connection-oriented service as defined in this standard supports any peak data rate by specific setting of system parameters.

2.4.2 Bounded delay, guaranteed throughput

The connection-oriented service shall be able to provide a bounded delay and/or a guaranteed throughput for transmission of Connection-Oriented Service Data Units (CODUs). This feature is ensured by the GBW protocol. A formula for calculating the maximum delay of a segment is provided in B.2.

The GBW protocol makes use of higher priorities and requires peak rate shaping. The peak rate shaping is located in the QA Functions block. Additionally, it supports mean rate shaping as a supplement to the peak rate shaping of the GBW protocol.

2.4.3 Conservation of bandwidth

The connection-oriented service shall not waste bandwidth that was reserved at connection setup but is not needed due to variable bit rates generated by the Connection-Oriented Service User (COSU). This will support statistical multiplexing and efficient network utilization. The GBW protocol ensures this feature since each slot used for transmission must be reserved individually.

2.4.4 Support of point-to-multipoint connections

In addition to point-to-point connections, the connection-oriented service shall be able to provide point-to-multipoint connections that may be used in a distribution service.

2.4.5 Compatibility with base standard

These enhancements of the QA functions are compatible with the QA functions of ISO/IEC 8802-6: 1994 (i.e., a node sending at priority level 0, implementing either the base standard or enhanced QA functions, can communicate with any other node).

2.5 Properties of the connection-oriented service types

Different service types are optimized for different applications. For example, data communication will prefer to use a packet-oriented, connection-oriented service type based on AAL3/4 or AAL5. The AAL3/4 like service (COCF3/4) conveys information regarding packet start and end points with error checking on

each slot transmitted as well as an optional 32-bit Cyclic Redundancy Check (CRC) on the whole packet. The AAL5 compatible service (COCF5) uses 48 bytes payload in each slot as well as packet delimitation and error checking with a 32-bit CRC. Other applications (e.g., video applications) will prefer to use the Stream-Oriented Service (COCFx), which is also a connection-oriented service but does not expect the information stream to be demarked into packets, and which does not provide explicit error checking. Of course, the application can provide its own error checking and correcting facilities if desired.

2.6 Characteristics of priority levels

Priority level 2. This priority level guarantees its user a certain throughput and a maximum delay.

Priority level 1. This priority level guarantees its user a certain throughput.

Priority level 0. There are no throughput guarantees for this priority level.

3. Connection-oriented service definition

This clause replaces 3.3 of ISO/IEC 8802-6: 1994.

The connection-oriented service supports the transfer of CODUs between a pair of COSUs over an already established connection.⁵ The size of a CODU depends on the chosen connection-oriented service type.

Note that it is intended that all connection-oriented service types described in this standard use the CO-DATArequest/indication primitives. However, since the COCF5 and COCFx are under study, different primitives for those service types may be defined if needed.

The abstract description does not constrain an implementation in any way. For example, a primitive may be implemented such that several primitive calls are necessary to forward one CODU to a Convergence Function block. This would allow pipelining.

The primitives used to describe the service are

CO-DATArequest
CO-DATAindication

3.1 CO-DATArequest

Function:

This primitive requests the transfer of a CODU over an established connection.

Semantics of the service primitive:

```
CO-DATArequest  (
                  CODU
                  )
```

The CODU parameter conveys a single CODU.

When generated:

This primitive is generated by a COSU whenever a CODU must be transferred.

⁵The procedures for establishing, maintaining, and releasing a connection are outside the scope of this standard, but will be specified by other standards. (See annex B of ISO/IEC 8802-6: 1994.)

Effect on receipt:

The receipt of this primitive by the DQDB Layer results in the DQDB Layer attempting to transfer the CODU over the established connection. CODUs are transferred in the same order in which they are submitted by the COSU.

Additional comments:

None.

3.2 CO-DATAindication

Function:

This primitive indicates the arrival of a CODU over an established connection.

Semantics of the service primitive:

```
CO-DATAindication (
    CODU
)
```

The CODU parameter conveys a single CODU.

When generated:

This primitive is generated by the DQDB Layer to deliver a CODU that has arrived over an established connection.

Effect on receipt:

The effect of receipt of this primitive is dependent upon the COSU. CODUs shall be delivered to the receiving COSU in the same order that they were sent by the sending COSU.

Additional comments:

None.

4. Physical Layer service definitions

The Physical Layer service definition used in support of the connection-oriented service is as described in clause 4 of ISO/IEC 8802-6: 1994.

5. Functional architecture of a DQDB node supporting connection-oriented service

Figure 1 describes the general architecture of a DQDB node as found in ISO/IEC 8802-6: 1994. This clause defines the Convergence Function blocks used in support of connection-oriented service. Moreover, enhancements to the QA Functions block as defined in ISO/IEC 8802-6: 1994 are included. The new and enhanced blocks covered in this standard are marked in figure 1. The COCF blocks are defined in 5.1, the enhanced QA Functions block is described in 5.2, and the Common Function blocks are defined in 5.3.

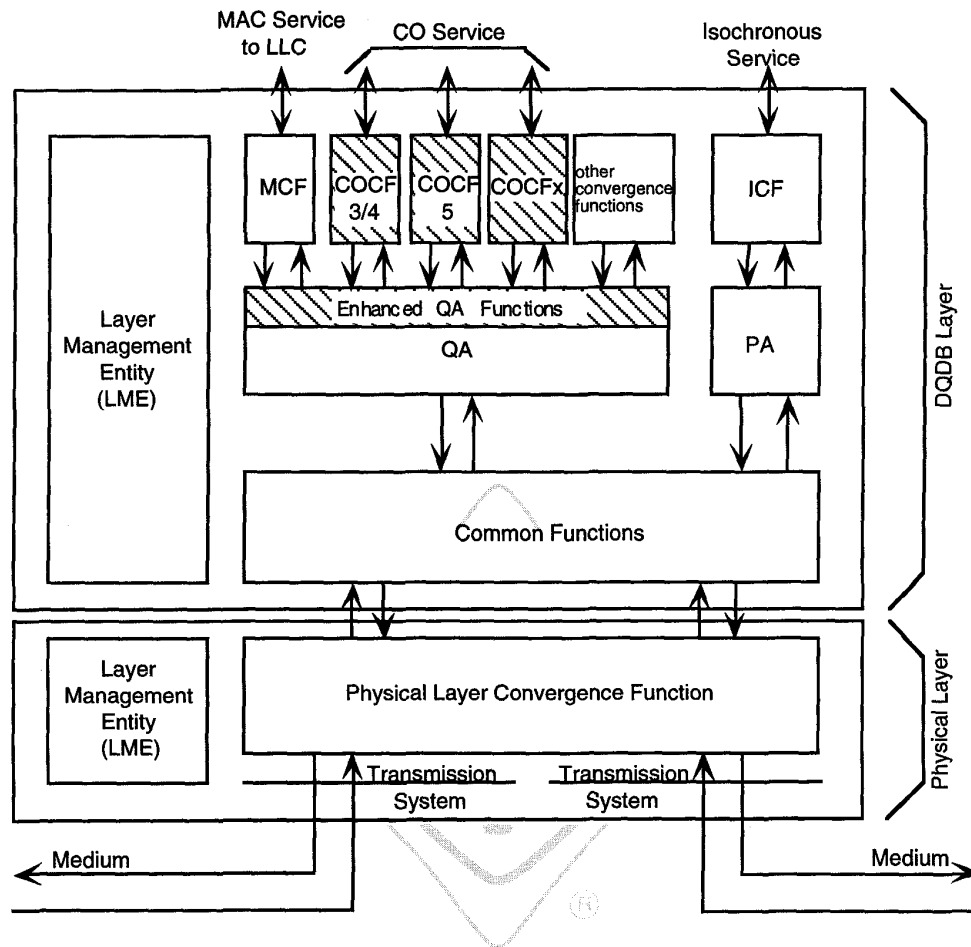


Figure 1— DQDB node architecture

5.1 COCF blocks

This subclause replaces 5.3.1 through 5.3.1.2.1 of ISO/IEC 8802-6: 1994.

Different COCFs described in this standard make use of the enhanced QA functions described in 5.2. Due to the independence of the Convergence Function blocks and the QA Functions block, other convergence functions may also use the service offered by the enhanced QA functions. The interface data unit exchanged between the convergence functions and the QA functions has a length of 48 octets.

The PDU of a connection-oriented service is received as the CODU in a CO-DATAindication, as defined in clause 3. Figure 2 summarizes the Transmit and Receive functions that are required of the COCF blocks and the QA Functions block to transfer a CODU between nodes. The CODU is delivered by each destination node in a CO-DATAindication, as defined in clause 3. (The bracketed numbers in the diagram refer to subclauses in this standard.)

5.1.1 COCF block using AAL3/4 (COCF3/4)

This subclause describes the functions performed by the DQDB Layer to support the transfer of a CODU from one DQDB node to one or more peer DQDB nodes. The protocol functions and frame formats are based on the AAL3/4 [ITU-T Recommendation I.363 (1993)].

The PDU of the connection-oriented service is received, either completely or in segmentation units of 44 octets, as the CODU in a CO-DATAindication, as defined in 3.1. Figure 2 summarizes the Transmit and Receive functions that are required of the COCF block using AAL3/4 and the QA Functions block to transfer a CODU between nodes. The CODU is delivered by each destination node in a CO-DATAindication, as defined in 3.2.

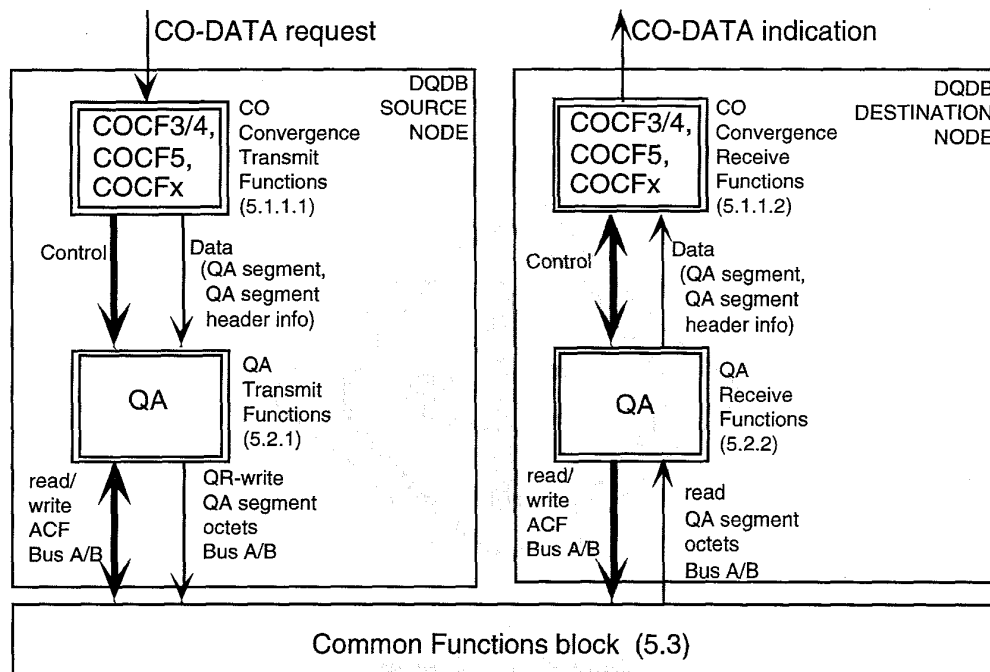


Figure 2—DQDB Layer functions to support connection-oriented service

5.1.1.1 COCF3/4 Transmit functions

This subclause specifies the functions performed by the COCF3/4 block upon the receipt of a single CODU in a CO-DATArequest, as depicted in figure 3.

The creation of an Initial Connection-Oriented Service Protocol Data Unit (ICOPDU) by addition of protocol control information to the CODU is specified in 5.1.1.1.1. The segmentation of the ICOPDU into fixed length segmentation units is specified in 5.1.1.1.2. The creation of a Derived Connection-Oriented Service Protocol Data Unit (DCOPDU) by addition of protocol information to a segmentation unit is specified in 5.1.1.1.3. How the DCOPDU is passed to the QA Functions block as a QA segment payload, along with data needed by the QA Functions block to generate the QA segment header, and other control information needed to transfer the DCOPDU, is specified in 5.1.1.1.4.

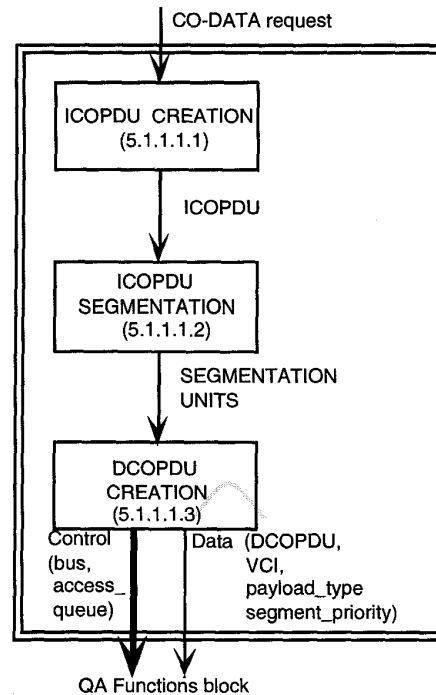


Figure 3—COCF3/4 Transmit functions

5.1.1.1.1 Creation of the ICOPDU

Upon receipt of a CO-DATArequest from the sublayer above DQDB, the COCF3/4 shall perform the following operations to create an ICOPDU from the data parameter contained in the CO-DATArequest, which is the CODU. The format of the ICOPDU is given in 6.1.1.1

Steps a) through c) are for the creation of the Common PDU header of the ICOPDU.

- a) Code the Reserved field of the Common PDU header to zero, according to 6.1.1.1.1.
- b) Select a Beginning-End tag (BETag) value and code the BETag field of the Common PDU header according to 6.1.1.1.2.

The BETag field value shall be incremented by one (modulo 256) for sequential ICOPDUs sent by the node.

- c) Code the Buffer Allocation size (BAsize) field of the Common PDU header to the number of octets contained in the CODU according to 6.1.1.1.3. If the CODU is not received completely in one CO-DATAindication by the COCF3/4, the BAsize shall be set to the maximum value (65535 octets).

Step d) is for the creation of the INFO field.

- d) Code the data parameter (CODU) received in the CO_DATArequest into the INFO field, according to 6.1.1.1.4.

Step e) is for the creation of the PAD field.

- e) Create the PAD field such that the length of the INFO field plus the PAD field is an integral multiple of four octets. The number of PAD octets is either 0, 1, 2, or 3, according to the following formula:

$$\text{Number_PAD_octets} = 3 - [(\text{Length of INFO field} + 3)(\text{mod } 4)]$$

Each PAD octet is coded as zero, according to 6.1.1.1.5.

Step f) is for the creation of the CRC32 field.

- f) If the CRC32_CO_TX_CONTROL flag (see 7.4.1) is set to OFF, then there is no CRC32 field used for this ICOPDU. If the CRC32_CO_TX_CONTROL flag is set to ON, then the CRC32 field is coded according to 6.1.1.1.6. [Note that the fields covered by the CRC32 field are those created in steps d) and e), i.e., the INFO field and the PAD field.]

Steps g) and h) are for the creation of the Common PDU trailer of the ICOPDU.

- g) Code the Reserved field of the Common PDU trailer to zero, according to 6.1.1.1.7.
- h) Code the Bntag field of the Common PDU trailer with the same value as contained in the Bntag field in the Common PDU header, as per step b) above.
- i) Code the Length field of the Common PDU trailer to the number of octets contained in the CODU according to 6.1.1.1.9. This value is lower than or equal to the value in the BAsize field in the Common PDU header, as per step c) above.

5.1.1.1.2 Segmentation of ICOPDUs

The segmentation of the ICOPDUs is like the segmentation of the Initial MAC Protocol Data Units (IMPDU).

Replace all instances of "IMPDU" with "ICOPDU" in 5.1.1.1.2 (and all of its subsequent subclauses) of ISO/IEC 8802-6: 1994.

5.1.1.1.3 Creation of DCOPDUs

The COCF3/4 creates a DCOPDU from each segmentation unit created as described in 5.1.1.1.2. The type of DCOPDU created depends upon the type of the segmentation unit, and is described in items a1) and a2) below. Each DCOPDU is passed to the QA Functions block as described in 5.1.1.1.4. The order of passing DCOPDUs shall preserve the order of octets in the original ICOPDU.

- a) DCOPDU from an ICOPDU of one segmentation unit

If segmentation of the ICOPDU generates a Single Segment Message (SSM) segmentation unit, as described in 5.1.1.1.2, the COCF3/4 shall add the following protocol information to the segmentation unit to create a DCOPDU. The format of the DCOPDU is given in 6.1.1.2.

- 1) Code the Segment_Type subfield of the SSM DCOPDU header with the binary value 11 (SSM), according to 6.1.1.2.
- 2) Take the current value of the TX_SEQUENCE_NUM counter (see 7.2.6 of ISO/IEC 8802-6: 1994) associated with the Message Identifier (MID) selected in item a3) below and the Virtual Channel Identifier (VCI) selected in 5.1.1.1.4, and code the Sequence_Number subfield of the SSM DCOPDU header with this value according to 6.1.1.2. The value of TX_SEQUENCE_NUM shall then be incremented by one (modulo 16) for use with the next DCOPDU to be sent by the node with the same MID value and using the same VCI.

- 3) Select an arbitrary MID value of the set allocated to that connection (or subconnection in case of multiplexing; see 6.1.1.2).⁶ Code the MID subfield of the DCOPDU header, according to 6.1.1.2.
- 4) Code the Payload_Length subfield of the DCOPDU trailer with the number of octets of the ICOPDU contained in the SSM segmentation unit, according to 6.1.1.2. The value of this subfield shall be any decimal number that is a multiple of 4 in the range of 12 to 44 inclusive.
- 5) Calculate the Payload_CRC subfield of the DCOPDU trailer, according to 6.1.1.2.

The SSM DCOPDU is then passed to the QA Functions block as described in 5.1.1.1.4.

b) DCOPDU from an ICOPDU of more than one segmentation unit

If segmentation of the ICOPDU generates more than one segmentation unit, as described in 5.1.1.1.2, the COCF3/4 shall add the following protocol control information to each segmentation unit to create a DCOPDU. The format of the DCOPDU is given in 6.1.1.2.

- 1) Code the Segment_Type subfield of the DCOPDU header with the appropriate binary value of either 10 for Beginning Of Message (BOM), 00 for Continuation Of Message (COM), or 01 for End Of Message (EOM), according to 6.1.1.2.
- 2) Take the current value of the TX_SEQUENCE_NUM counter (see 7.2.6 of ISO/IEC 8802-6:1994) associated with the MID selected in item b3) below and the VCI selected in 5.1.1.1.4, and code the Sequence_Number subfield of the DCOPDU header with this value according to 6.1.1.2. The value of TX_SEQUENCE_NUM shall then be incremented by one (modulo 16) for use with the next DCOPDU to be sent by the node with the same MID value and using the same VCI.
- 3) Select an arbitrary MID value of the set allocated to that connection (or subconnection in the case of multiplexing; see 6.1.1.2). Code the MID subfield of the DCOPDU header, according to 6.1.1.2 and subject to the following condition:

The MID value shall be the same for every DCOPDU derived from the same ICOPDU.
- 4) Code the Payload_Length subfield of the DCOPDU trailer with the number of octets of the ICOPDU contained in the segmentation unit, according to 6.1.1.2. For the BOM DCOPDU and any COM DCOPDU, the value of this subfield shall be decimal 44. For the EOM DCOPDU, the value of this subfield shall be any number that is a multiple of 4 in the range 4 to 44 inclusive.
- 5) Calculate the Payload_CRC subfield of the DCOPDU trailer according to 6.1.1.2.

The DCOPDU is then passed to the QA Functions block as described in 5.1.1.1.4.

5.1.1.1.4 Transmit interactions between COCF3/4 and the QA Functions block

The interaction between a COCF3/4 and the QA Functions block for the transfer of a QA segment payload is depicted in figure 4.

The TX_BUS_SIGNAL, ACCESS_QUEUE_SIGNAL, VCI_DATA, and SP_DATA are set to the values of TX_BUS, TX_ACCESS_QUEUE_PRIORITY, TX_VCI, AND TX_SEGMENT_PRIORITY, respectively, received in an OPEN_CE_ COCF3/4 action. The PT_DATA shall be set to 00 for all QA segments passed from the COCF3/4 to the QA Functions block.

⁶This message identifier fulfills the functionality of the AAL3/4 multiplexing identification. However, for consistency, only the term Message Identifier (MID) is used in this standard.