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(10/92)

MAINTENANCE: ISDN

MANAGEMENT OF THE D-CHANNEL – DATA LINK LAYER AND NETWORK LAYER

Recommendation M.3640

FOREWORD

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Recommendation M.3640 was prepared by Study Group IV and was approved under the Resolution No. 2 procedure on the 5th of October 1992.

CCITT NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized private operating agency.

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Recommendation M.3640

MANAGEMENT OF THE D-CHANNEL – DATA LINK LAYER AND NETWORK LAYER

(1992)

Abstract

This Recommendation contains a prosaic description of the management aspects of the data link layer and network layer of the access to ISDNs. Besides it also defines managed objects, by using OSI-management principles.

Keywords

– fault Management;
– performance management;
– management of ISDN D-channel;
– management of ISDN.

1 Introduction

The purpose of this Recommendation is to describe the management capabilities[1)] for the data link (layer 2) and the network (layer 3) layer associated with the access to Integrated Services Digital Networks (ISDNs). These management capabilities are specified as functions in the Exchange Termination (ET). These functions may either be visible to an TMN Operations System (OS) via a Q-interface or visible to local maintenance personnel via an F-interface. The principles of Recommendation M.20 [3] and M.3600 Series Recommendations [5], [6] are adhered.

This Recommendation pertains to management of the data link layer and network layer of the access-protocols between the exchange termination (ET) and subscriber installation (see Figure 1/M.3640). The management, as viewed only by the ET of the data link and network protocols, is specified.

Section 2 provides definitions of terms introduced in this Recommendation. Section 3 outlines a reference configuration for management of the data link layer and network layer. In section 4 a prosaic description is given of the capabilities for management of the data link layer and network layer. In section 5 a list of abbreviations is given.

In Appendix II, an informal description of the management information is given. Appendix III gives the semi-formal specification of the candidate managed objects for the data link layer and network layer of the D-channel. In Annex A, the management support functions are referenced.

Appendix I lists the management capabilities which are to be considered to be included in future versions of this Recommendation.

2 Definitions

2.1 autonomous management

The management operations which are local to the network element and which are not controlled by an external operations system or by a human operator. Autonomous management operations are supported by internal mechanisms which monitor a certain object and which decide by analysing the results of the monitoring which action should be implemented. The whole process is automated.

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1) Management capabilities refer to operation, maintenance and administration and also to e.g. configuration and performance management and possibly other management areas.

2.2 **human machine interface**

The management operations which are locally performed by a human operator. These operations are visible at the F-interface of TMN.

2.3 **management information**

Management information refers to the management view of resources. This management view consists of the management characteristics of the resources, the actions which may be performed upon the resources and the notifications which may be emitted, due to internal events.

2.4 **managed object**

See ISO/IEC 7498/4.

2.5 **attributes**

See Recommendation X.710.

2.6 **systems management operations**

See CCITT Rec. X.701 | ISO/IEC 10040.

2.7 **notification**

See CCITT Rec. X.701 | ISO/IEC 10040.

2.8 **invalid frame**

See § 2.9 of Recommendation Q.921.

3 Reference configuration for management of the access protocol

The ISDN-access protocols are defined between the ISDN and the user (see Figure 1/M.3640). The protocol entities of the data link layer and network layer are located in the exchange termination (ET) and in the subscriber installation (SI). The SI is composed of the terminal equipment (TE) and/or the network termination type 2 (NT2)[2]. The ET is part of an ISDN local exchange.

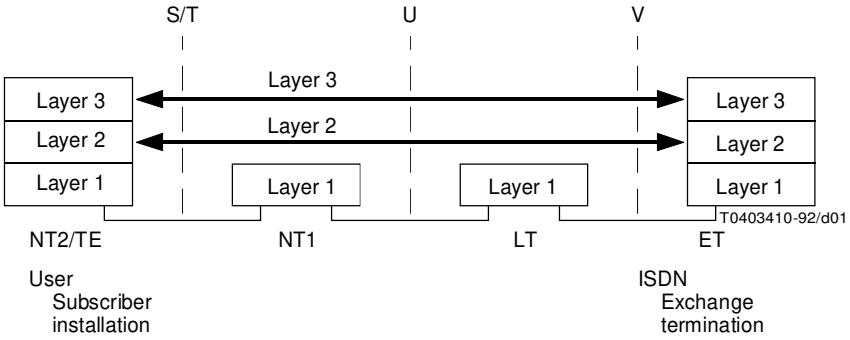

FIGURE 1/M.3640

Peer relationships between the exchange termination and subscriber installation

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[2] In the United States-standards the NT1 will also be part of the SI. However, this has no effect on this Recommendation.

In Figure 2/M.3640, a reference configuration for management of the access protocol is presented. This reference configuration is a refinement of Figure 9/M.3600 and is based upon the Telecommunication Management Network (TMN) concept (see Recommendation M.3010) [4]. TMN defines a structure which contains, among other things, Operations Systems (OSs) and Network Elements (NEs). In this Recommendation, the ISDN local exchange is considered to be the NE. The interface between the OS and NE is, in TMN-terminology, called the Q3-interface.

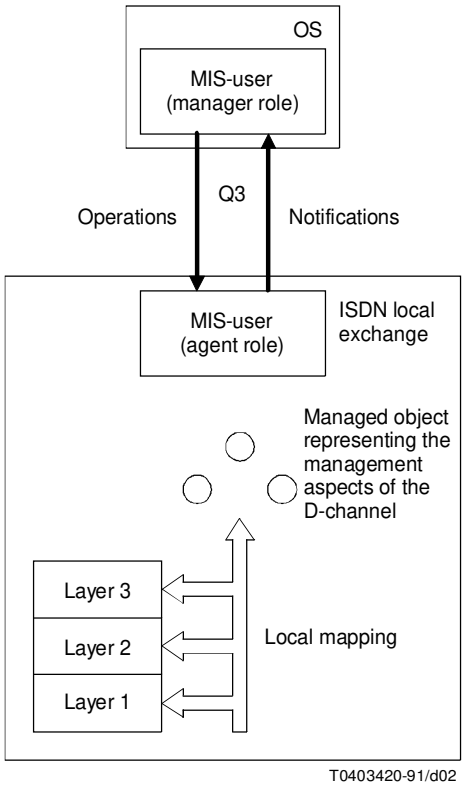


FIGURE 2/M.3640

Reference configuration for management of the access protocol

Management of a communication environment is an information processing application. Because the environment being managed is distributed, the individual components of the management activities are themselves distributed. The interactions which take place between management applications (manager and agent) are abstracted in terms of operations and notifications issued by one entity to the other. The management activities are effected through the manipulation of managed objects. These managed objects are the management view of a system resource that is subject to management, such as a data link layer entity. Thus, a managed object is the abstracted view of such a resource that represents its properties as seen by and for the purposes of management.

With the definition of managed objects the possible management activities are described.

The local mapping of the managed objects upon the resources they represent is a matter of implementation and is not subject to standardization.

For a more detailed description of the concepts of OSI-management and TMN, see CCITT Rec. X.701 | ISO/IEC DIS 10040 and Recommendation M.3010.

4 Prosaic description of management of the data link layer and network layer

This section provides a prosaic description of the management capabilities relevant to management of the data link layer and network layer of the D-channel.

The data link layer and network layer peer relationships considered here are the signalling data on the D-channel and packet data on the D-channel. The management capabilities include the following management functions:

– counts (with associated thresholds) for performance monitoring;

– counts (and associated thresholds) or logs for protocol abnormalities;

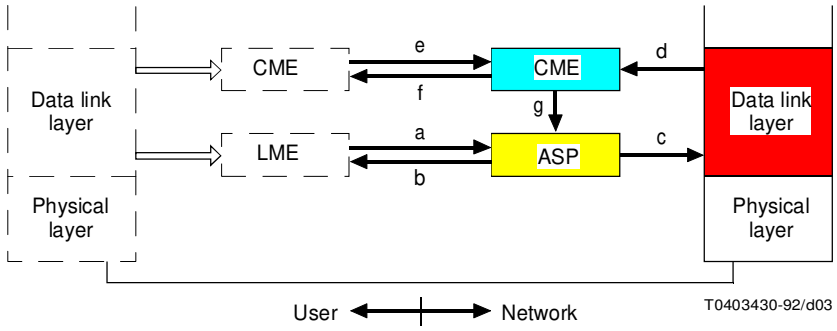
– an on-demand log of all protocol activity on a given D-channel over a specified time interval;

– the counters for the performance monitoring and protocol abnormality parameters shall be readable and resettable on demand;

– other support management functions are listed in Appendix III.

4.1 *Management information relating to the data link layer*

In the data link layer, several entities have been identified. See Figure 3/M.3640.



a ID request, ID verify request, ID check response
b ID assigned/denied, ID check request, ID remove
c MDL-ASSIGN-REQUEST, MDL-REMOVE-REQUEST
d MDL-ERROR indication
e MDL-XID command
f MDL-XID response
g request TEI removal/check procedure

Note – For abbreviations see § 5.

FIGURE 3/M.3640

Composition of layer 2

4.1.1 *Protocol error detection and logging*

The following data link layer errors shall be logged per D-channel:

1) the frames received with a control field that is undefined or not implemented;
2) the frames received with an information field that is not permitted;
3) the supervisory or unnumbered frame with incorrect length;
4) the frames received with an invalid receive sequence number [i.e. invalid N(R)];
5) the frames received with an information field that exceeds the maximum established length;
6) the Frame Reject (FRMR) frames received;
7) the Disconnect Mode (DM) frames in response to a Set Asynchronous Balanced Mode Extended (SABME) frame[3)];
8) the proper responses (i.e. unnumbered acknowledgement or disconnect mode frames) not received to establish or restore the link after N200 SABME frames were sent;
9) the DM frames sent in response to a SABME frame.

4.1.2 *Layer 2 performance monitoring*

The ET shall keep counts for the following layer 2 parameters for each D-channel (it is optionally possible to specify measurements for these counters, for which scheduling is allowed):

– the number of frames with Frame Check Sequence (FCS) errors at the ET;
– the total number of frames received at the ET;
– the number of frames retransmitted by the ET;
– the total number of frames transmitted by the ET.

The occurrence of invalid frames (see § 2.9 of Recommendation Q.921); except those with FCS-errors are counted per D-channel or logged. The unexpected frames (see Table 9/Q.921) are logged.

4.2 *Management information relating to Recommendation Q.931*

This subsection describes the management information of the basic call control function of the network layer. Both the opportunities and the requirements are listed here.

4.2.1 *Incorrect messages*

The messages defined for layer 3 in § 5.8 of Recommendation Q.931 should obey specified rules. The error conditions are handled by the protocol itself. In Recommendation Q.931 a number of message faults are defined. For instance, a message may contain an information element which represents an invalid bearer capability (or a missing bearer capability information element).

The following incorrect messages are defined in Recommendation Q.931:

– messages received containing a protocol discriminator coded other than "Q.931 user-network call control message" (see § 5.8.1 of Recommendation Q.931);
– messages which are too short to contain a complete message type (see § 5.8.2 of Recommendation Q.931);
– general information element errors (see § 5.8.5 of Recommendation Q.931);
– mandatory information element errors (see § 5.8.6 of Recommendation Q.931).

On occurrence of these incorrect messages a counter will be incremented. If the counter exceeds a certain threshold, the OS shall be notified. The OS may initiate a procedure to disconnect the connection with the subscriber installation or send a message to the user.

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3) The reception of this frame indicates that the exchange termination did not establish a link successfully.

4.2.2 *Call reference errors*

In the protocol a call reference is used to specify a call. If in a message the call reference value is not correct (see Table 1/M.3640), than a counter shall be raised or this message shall be logged. If the messages are being counted, the OS shall be informed after a threshold is crossed.

TABLE 1/M.3640

Messages with call reference errors

Messages	Call reference value
All messages except: SETUP, STATUS, RESUME	which is not relating to an active call or a call in progress
SET-UP, RESUME	which is not relating to an active call or a call in progress and with a call reference flag set to "1"
SET-UP	which is relating to an active call or a call in progress
All messages except: RESTART, RESTART ACK, STATUS	which is the global call reference

4.2.3 *Layer 3 performance monitoring and signalling abnormalities*

For the purpose of performance management and detection of signalling abnormalities the following message types will be counted per D-channel or logged:

- STATUS messages received;
- RESTART messages received;
- STATUS messages transmitted;
- RESTART messages transmitted.

The following messages will be logged:

- DISCONNECT, RELEASE and RELEASE COMPLETE messages received, with a cause value other than normal event;
- DISCONNECT, RELEASE and RELEASE COMPLETE messages transmitted, with a cause value other than normal event.

4.2.4 *Expiry of system timers*

Upon expiry of the following system timers, the OS should be informed by means of a notification:

- T308: After the second expiry the B-channel will be placed in a maintenance condition;
- T309: The data link failure has not been recovered;
- T316: After "n" expiries the OS shall be notified;
- T317: The restart procedure did not work, the OS shall be notified.

The following expiries of protocol timers will be counted. After exceeding the threshold associated with this counter the OS shall be informed:

- T303: After the second expiry (which implies that the user did not respond) management could be informed, because it indicates a faulty situation;
- T310: After reception of call proceeding, no response has reached the network.

4.3 *Logging mechanism*

In the ET a log shall be present to hold the protocol abnormalities, as are stated in the previous sections, for all D-channels in the ET. The log should be capable of storing log entries for at least 24 hours under normal operation. New log entries shall, if necessary, replace the oldest entries on a FIFO-basis. To prevent high rates of abnormalities from flooding the log, the ability to inhibit entries caused by specific subscriber accesses shall be provided. The ET shall provide an indication when the oldest entry is less then "n" hours old. The value of "n" is settable.

5 Abbreviations

ASP	assignment source point
CME	connection management entity
DLE	data link entity
ET	exchange termination
FIFO	first-in-first-out
LME	layer management entity
MDL-ERROR	management data link-error
NE	Network Element
OS	Operations System
OSI	open systems interconnection
SI	subscriber installation
TEI	terminal endpoint identifier
TMN	Telecommunication Management Network.

ANNEX A

(to Recommendation M.3640)

Support management functions

In this annex support management functions are listed.

A.1 *Top*

To be derived from the OSI-management standards.

A.2 *Discriminator*

The discriminator is a construct for selectively passing on notifications from any object to the OS. The selectivity may pertain to the object class, object instance, event type and event type specific attributes. The selectivity conditions specified by the discriminator are criteria for discrimination, identification of a scheduling package that determines when event forwarding will occur, the OSI-state of the discriminator, etc. (See CCITT Rec. X.734 | ISO/IEC DIS 10164-5 and CCITT Rec. X.721 | ISO/IEC DIS 10165-2.)

A.3 *Counters*

For counting events OSI-management has defined in ISO/IEC DP 10165-2 a counter attribute and a counter threshold attribute. These shall be used in the specification of the objects representing layer 2 and 3 of the D-channel.

It is recommended that, in case counters are used, they be read daily or that after a threshold exceeding a notification be transmitted.

Each counter may be optimized for each specific implementation.

A.4 *Measurements*

For measuring specific types of occurrences, OSI-management specifies in ISO/IEC JTC 1 SC 21 N4972 a model for measurement summarization. In this D-channel standard this function shall be used for defining the measurement functionality.

A.5 *Logging*

The log of OSI-management makes use of a discriminator-process to determine whether events are to be logged, forwarded to an OS or are to be discarded.

A.5.1 *Log*

In OSI-management a log control function is specified (see CCITT Rec. X.738 | ISO/IEC DP 10164-6). This function shall be used for management of layers 2 and 3 of the D-channel.

1) Logging a log-record depends on the state (the usage, operational and administrative – ISO/IEC DIS 10164-2 | X.731 –) and a discriminator construct of the log. With the construct it is possible, for example, to log only a specific type of record.

2) Two options can be used in case the log reaches the max log size:

   – Halt: New information will be discarded, in favour of old information;

   – Wrap: Old information will be discarded.

3) a) In case a settable attribute is modified an attribute-change indication is generated.

   b) In case a log administrative state is changed a state change notification will be emitted to the corresponding management system (these notifications may, depending on the state of a discriminator, be sent to the management system).

4) It is possible to control the period of time during which logging may occur.

5) The log may emit a capacity alarm threshold indication, in case the log exceeds a percentage of the max log size.

6) It is possible to delete records from the log.

A.5.2 *Log record*

All entries in the log shall contain the following information:

– date and time of abnormality;

– location information;

– the specific condition that occurred (e.g. type of frame message);

– the specific cause for that condition (e.g. message cause code); and

– the reason for any action taken by the ET.

Whenever the message contains diagnostic codes (in addition to the cause codes) these codes shall also be included as part of the log entry.

APPENDIX I

(to Recommendation M.3640)

Optional management capabilities for the D-channel

It is requested to consider the mentioned capabilities and contribute on them.

I.1 *Management of the data link layer*

I.1.1 *Management of TEI management procedures*

Management of TEI-management procedures considers the following aspects:

1) The situation of exhausted TEI information/resources will occur when

   a) the number of unused TEI values gets too high [see item 2)]: the network will eventually run out of free TEI values;

   b) too many data links are requested by the users.

   When the situation of exhaustion of TEI information/resources is approaching, this should be notified to the OS. The OS should be able to start the TEI check procedure for all (or a set of the) TEI values (e.g. as part of a maintenance activity); the unused TEI values will then be detected.

2) An unused TEI value (i.e. reserved at the network side but not used by a terminal) is possible when

   a) the request for a TEI value crosses the assignment of a TEI value for another entity using the same Ri value: this will result in one unused TEI value and one double TEI value. The probability that this will happen is very small (same Ri value (probability 1/65536) and simultaneous request at the same time!);

   b) the user has removed his TEI value, without notifying the network side [e.g. when the (optional) TEI verify procedure is not implemented by the network and/or the user];

   c) two ID remove messages in succession or an ID assigned message have been lost (low performance of lower layers).

3) Multiple assignment of TEI values is possible when

   a) see item 2), a);

   b) two non-automatic terminals have the same TEI value (probability 1/64).

As probability is small that these situations occur, management capabilities should be optional. The preferred way of dealing with these kind of situations would be the following.

To provide full flexibility to the OS, it should be possible to log the preceding information when the need for this arises. In Appendix III, a logging concept has been described which will provide the OS with functionality to schedule the logging activity of a certain item of information in a flexible way.

Furthermore, the OS should be able to change and read lists of free and assigned TEI values; exhaustion of the list of free TEI values should be notified to the OS.

I.1.2 *Protocol parameters*

Within Recommendation Q.921, a number of system parameters are used for use within the protocol. These system parameters will be renamed in this appendix to protocol parameters to avoid confusion on what the system is.

An OS may optionally want to reset these protocol parameters, e.g. in case of tuning the protocol:

– if the layer 2 implementation of either the network or the user side is too slow, reduce the upperbound on the maximum number of simultaneous active data links or put an upperbound on the number of data links operating in the multiple frame of operation state;

– if the error rate at the lower layers is too high, increase N200 and decrease T200; a corrupted frame will be detected faster this way (and more corrupted-missing-frames will be allowed);

– if the response time of the layer 2 and lower is too slow but the error rate is low, increase T200 and decrease N200 and (if possible) decrease the maximum number of outstanding I-frames.

If the OS is able to change these protocol parameters, then a procedure should be defined for the following situation. If the automatic peer-to-peer negotiation of the data link layer parameters (see Appendix IV of Recommendation Q.921) is present, then there are two ways of changing the protocol parameters. Which one has the priority?

I.1.3 *Layer 2 deactivation procedure*

It may be required (requirements are to be specified) to allow an OS to (de-)activate the data link layer. See also Appendix III of Recommendation Q.921.

I.2 *Management of the network layer*

I.2.1 *Status enquiry*

Whenever the OS wishes to check the correctness of a call state of a network layer entity in the SI, the OS may initiate a procedure in the network layer entity of the ET to send a STATUS ENQUIRY message. The SI receiving a status enquiry message shall return a STATUS message. In this message the state of the call in the entity of the SI will be reported. The OS shall either clear the call or take some other actions.

I.2.2 *System timers*

The following timers may be set and reset by the OS.

It is not quite clear if there is a specific need in real time operation of layer 3 to change these system timers. Most implementations only require an initial or a fixed setting.

– T301: ≥ 3 minutes;

– T303, T308: Depends on the value of N200 and T200 of layer 2;

– T306: Usage in cases announcements are provided for;

– T310: Depends on the characteristics of the attached private network.

I.3 *Management of the Recommendation X.31*

I.3.1 *Layer 3 packet abnormalities*

The following packet abnormalities shall be logged:

– the RESTART packets received with a local procedure error cause;

– the RESTART packets transmitted with a local procedure error cause;

– the RESET packets received with a local procedure error, incompatible destination or out of order cause (for permanent virtual circuit only);

– the RESET packets transmitted with a local procedure error, incompatible destination or out of order cause (for permanent virtual circuit only);

– the CLEAR packets received with an invalid facility request, access barred, local procedure error, not obtainable or Recognized Private Operating Agency out of order cause;

– the CLEAR packets received with an invalid facility request, access barred, local procedure error, not obtainable or Recognized Private Operating Agency out of order cause;

– the DIAGNOSTIC packets transmitted.

I.3.2 *Service disruptions due to layer 3 packet conditions*

Layer 3 packet service is disrupted when the threshold is exceeded for the combined total number of abnormal CLEAR INDICATION packets plus the RESET packets sent by the exchange termination.

APPENDIX II

(to Recommendation M.3640)

Definition of candidate managed objects for the data link and network layer

In this appendix the managed objects, representing the management view of the data link and network layer of the D-channel, are described. In Figure II-1/M.3640 the relationships between these objects are illustrated. One entity illustrating the managed object class representing the exchange is also indicated, because all D-channels are considered to be located within an exchange.

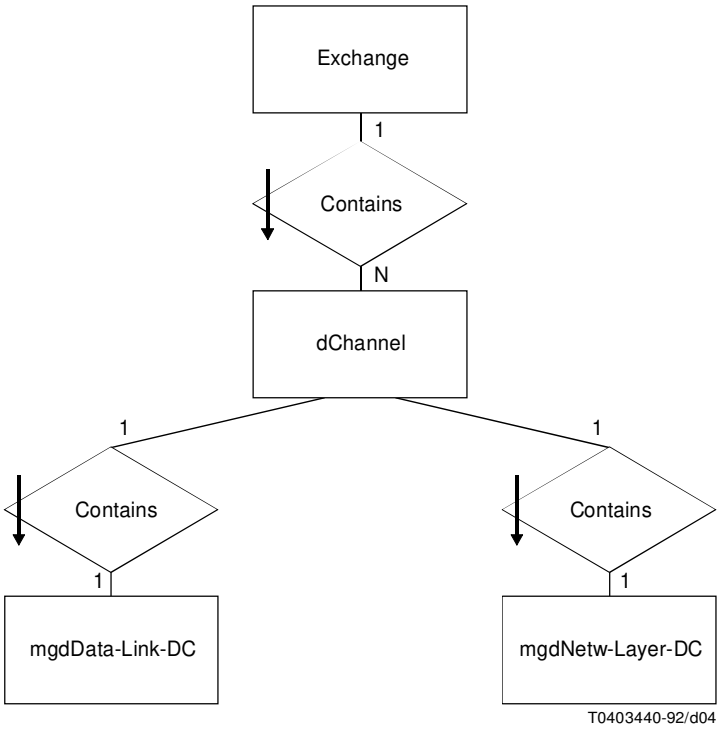

FIGURE II-1/M.3640

Entity-relationship diagram explaining the containment relationship between the managed objects relating to the data link layer and network layer

II.1 *mgdDChannel*

Managed object class	Attributes	Notifications	Actions
mgdDChannel	mgdDChannel-Id	for further study	for further study
	for further study		

Attributes

mgdDChannel-Id: This attribute is used for identification of this object class.

II.2 *mgdDatalink-DC*

This managed object class reflects the management information for the data link layer protocol. The major part of this information is for fault and performance management.

Managed object class	Attributes	Notifications	Actions
mgdDataLink-DC	mgdDataLink-DC-Id	thresholdExceeded	for further study
	operationalState	errorFrames	
	administrativeState	invalidFrames	
	usageState	unexpectedFrames	
	noOfFramesWithFCS		
	noOfFramesReceived		
	noOfFramesTransmitted		
	noOfFramesRetransmitted		

In § 4 at the moment there is no state required. For completeness it is, however, given here.

The following attributes are identified for the mgdDataLink-DC managed object class:

1) mgdDataLink-DC-Id: This attribute represents the identification of this object class (it is used for naming);

2) noOfFramesWithFCS: This attribute represents a counter for the number of frames received with FCS-error;

3) noOfFramesReceived: This attribute represents the total number of frames received;

4) noOfFramesTransmitted: This attribute represents the total number of frames transmitted;

5) noOfFramesRetransmitted: This attribute represents the total number of frames retransmitted.

The following notifications are identified:

1) errorFrames: This notification will contain one (in each instance) of the following messages:

   – framesWithBadInfoField;
   – framesWithBadControlField;
   – supervisoryFramesWithBadLength;
   – unnumberedFramesBadLength;
   – framesWithInvalidReceiveSeqNumber;
   – framesWithInfoFieldTooLong;
   – fRMRReceived;
   – dMFramesSendInResponseToSABME;
   – dMFramesReceivedInResponseToSABME;
   – invalidFrames;
   – unexpectedFrames.

2) invalidFrames: This notification contains an invalid frame (on reception of these frames this notification will be emitted).

3) unexpectedFrames: This notification contains an unexpected frame.

4) thresholdExceeded: This notification represents the exceeding of the thresholds associated with each counter.

II.3 *mgdNetwLayer-DC*

This object class represents the management view of the basic call control function in the network layer of the D-channel.

Managed object class	Attributes	Notifications	Action
mgdNetwLayer-DC	mgdNetwLayer-DC-Id	thresholdExceeded	disconnectCall
	operationalState	timerExpiryNetw	
	administrativeState	messageSequenceError	
	usageState	messageCallRefError	
	messageWithWrongPdi	messageReceived [a]	
	messagesTooShort		
	messagesWithGenInfoElemMissing		
	messagesWithMandInfoElemMissing		
	messageCallReferenceErrors		
	sTATUSMessagesReceived		
	sTATUSMessagesTransmitted		
	rESTARTMessagesTransmitted		
	rESTARTMessagesReceived		
	noOfT303Expiries		
	noOfT310Expiries		

[a] Either this notification is present or a counter is present.

Attributes

1) mgdNetwLayer-DC-Id: This attribute represents the identification of the object class. It is a read-only attribute;

2) operationalState: This attribute represents the operational state of OSI-management of Recommendation X.731 [12]. It is not mandatory;

3) administrativeState: This attribute represents the administrative state. It is not mandatory. It is read-writeable;

4) usageState: This attribute represents the usage state. It is not mandatory. It is read-only;

5) messageWithWrongPdi: This attribute represents a counter. This counter holds the number of messages with a protocol discriminator that is not valid. This counter has an associated threshold. The threshold may be read-writeable;

6) messagesTooShort: This attribute represents a counter. The number of messages which are too short. See also attribute in horizontal column 5 and for details on counters see § III.3;

7) messagesWithGenInfoElemMissing: This attribute represents a counter for counting the number of messages with general information elements missing. See attribute 5;

8) messagesWithMandInfoElemMissing: This attribute represents a counter for counting the number of messages with mandatory information elements missing. See attribute 5;

9) messageCallReferenceErrors: This attribute represents the number of messages with call reference errors;

10) sTATUSMessagesReceived: This attribute represents the number of STATUS messages received. This attribute is present or the notification messagesReceived is present;

11) sTATUSMessagesTransmitted: This attribute represents the number of STATUS messages transmitted;

12) rESTARTMessagesReceived: This attribute represents the number of RESTART messages received;

13) rESTARTMessagesTransmitted: This attribute represents the number of RESTART messages received;

14) noOfT303Expiries: This attribute represents the number of expiries of T303;

15) noOfT310Expiries: This attribute represents the number of expiries of T310.

The Notifications:

1) thresholdExceeded: This notification represents the exceeding of the threshold of each counter;

2) timerExpiry: This notification represents the expiry of the following timers:

   – T308;

   – T309;

   – T316;

   – T317.

3) messageSequenceError: This notification represents each occurrence of message sequence error;

4) messageCallRefError: Each message with a call reference error results in this notification;

5) messageReceived: This notification contains the following occurrences:

   – reception of a STATUS message;

   – transmission of a STATUS message;

   – reception of a RESTART message;

   – transmission of a RESTART message;

   – reception of a DISCONNECT, RELEASE OR RELEASE COMPLETE message;

   – transmission of a DISCONNECT, RELEASE OR RELEASE COMPLETE message.

APPENDIX III

(to Recommendation M.3640)

Semi-formal specification of candidate managed objects for the data link and network layer

In this appendix the semi-formal specification is given of the object classes from Appendix II. It should be noted that some definitions provided below are incomplete (listed as for further study) in particular regarding behaviour definitions and regarding alignment with generic and related capabilities.

```
ASN1TypeModule { ccitt (0) recommendation (0) m (13) M3640 (3640)
informationModel (0) asn1Module (2) asn1TypeModule (0) }

DEFINITIONS IMPLICIT TAGS ::=

BEGIN

informationModel OBJECT IDENTIFIER ::= { ccitt (0) recommendation (0) m (13)
M3640 (3640) informationModel (0) }

standardSpecificExtension OBJECT IDENTIFIER ::= { informationModel standardSpecificExtension (0) }
dSS1ManagedObjectClass OBJECT IDENTIFIER ::= { informationModel dSS1ManagedObjectClass (3) }
dSS1packageLabel OBJECT IDENTIFIER ::= { informationModel dSS1packageLabel (4) }
dSS1nameBinding OBJECT IDENTIFIER ::= { informationModel dSS1nameBinding (6) }
dSS1Attribute OBJECT IDENTIFIER ::= { informationModel dSS1Attribute (7) }
dSS1Notification OBJECT IDENTIFIER ::= { informationModel dSS1Notification (10) }
INTEGER ::= INTEGER
PrintableString ::= PrintableString
TimerExpiryNetwork ::= ENUMERATE
        { T308          (0),
        309             (1),
        316             (2),
        317             (3) }
MessageSequenceError ::= OCTETSTRING
MessageCallRefError ::= OCTETSTRING
SpecialMessageType ::= INTEGER
        { STATUSReceived                        (1),
        RESTARTReceived                         (2),
        STATUSTransmitted                       (3),
        RESTARTTransmitted                      (4),
        DISCONNECTReceived                      (5),
        RELEASETransmitted                      (6),
        RELEASECOMPLETETransmitted              (7),
        DISCONNECTTransmitted                   (8),
        RELEASEReceived                         (9),
        RELEASECOMPLETEReceived                 (10) }
        ErrorFrames ::= INTEGER
        { framesWithBadInfoField                (1),
        framesWithBadControlField               (2),
        supervisoryFramesWithBadLength          (3),
        unnumberedFramesBadLength               (4),
        framesWithInvalidReceiveSeqNumber       (5),
        framesWithInfoFieldTooLong              (6),
        fRMRReceived                            (7),
        dMFramesSendInResponseToSABME           (8),
        dMFramesReceivedInResponseToSABME       (9) }
        InvalidFrames ::= OCTETSTRING
        UnexpectedFrames ::= OCTETSTRING

        END
```

III.1 *Managed object classes*

III.1.1 *mgdDChannel*

```
mgdDChannel MANAGED OBJECT CLASS
        DERIVED FROM            "Rec. X.721:1992":top;
        CHARACTERIZED BY        mgdDChannel-package;
REGISTERED AS { dSS1ManagedObjectClass 1 };

mgdDChannel-package PACKAGE
        BEHAVIOUR DEFINITIONS                   -- for further study;
        ATTRIBUTES    mgdDChannel-Id            GET;
        NOTIFICATIONS                           -- for further study;
        ACTIONS                                 -- for further study;
REGISTERED AS { dSS1PackageLabel 1 };
```

III.1.2 *mgd-d-channel-datalink*

```
mgdDatalink-DC MANAGED OBJECT CLASS
        DERIVED FROM                            "Rec. X.721:1992":top;
        CHARACTERIZED BY mgdDatalink-package;
REGISTERED AS { dSS1ManagedObjectClass 2 };

mgdDataLink-package PACKAGE
        BEHAVIOUR DEFINITIONS -- for further study;
        ATTRIBUTES
                        mgdDataLink-DC-Id       GET,
                        noOfFramesWithFCS       GET,
                        noOfFramesReceived      GET,
                        noOfFramesTransmitted   GET,
                        noOfFramesRetransmitted GET;
        NOTIFICATIONS           "Rec. X.721:1992":qualityofServiceAlarm, errorFrames,
                                invalidFrames, unexpectedFrames;
REGISTERED AS { dSS1PackageLabel 2 };
```

III.1.3 *mgdNetwLayer-DC-Id*

This object class represents the management view of the basic call control function in the network layer of the D-channel.

```
mgdNetwLayer MANAGED OBJECT CLASS
        DERIVED FROM            "Rec. X.721:1992":top;
        CHARACTERIZED BY        mgdNetwLayer-package;
REGISTERED AS { dSS1ManagedObjectClass 3 };

        mgdNetwLayer-package PACKAGE
          BEHAVIOUR DEFINITIONS                                 -- for further study.
          ATTRIBUTES  mgdNetwLayer-DC-Id                        GET
                      "Rec. X.721:1992":operationalState        GET,
                      "Rec. X.721:1992":administrativeState     GET-REPLACE,
                      "Rec. X.721:1992":usageState              GET,
                      messageWithWrongPdi                       GET,
                      messagesTooShort                          GET,
                      messagesWithGenInfoElemMissing            GET,
                      messagesWithMandInfoElemMissing           GET,
                      messageCallReferenceErrors                GET,
                      sTATUSMessagesReceived                    GET,
                      sTATUS MessagesTransmitted                GET,
                      rESTARTMessagesReceived                   GET,
                      rESTARTMessagesTransmitted                GET,
                      noOfT303Expiries                          GET,
                      noOfT310Expiries                          GET;
            NOTIFICATIONS       "Rec. X.721:1992":qualityofServiceAlarm, timerExpiryNetwork,
                          messageSequenceError, messageCallRefError,
                            messageReceived;
REGISTERED AS { dSS1PackageLabel 3 };
```

III.2 *Naming*

Naming is specified by structure rules and name bindings. The structure rules define the distinguished names that the managed objects shall have and the ways in which the objects are related to one another in the Management Information Tree (MIT) (see Figure III.1/M.3640).

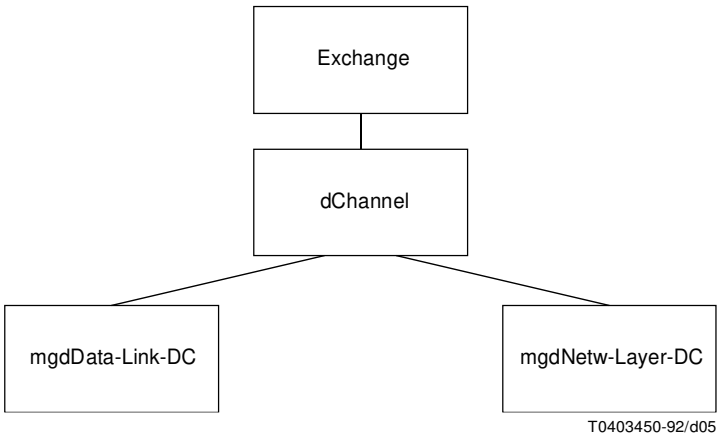

FIGURE III-1/M.3640

Specification of the management information tree

Each structure rule defines a sequence of name bindings. The name binding selects the attribute to be used in the relative distinguished name of an object. The structure rule herewith selects all the attributes to be used in the distinguished name of an object.

For naming the containment relationships from the entity-relationship model are used. For example mgd-ASP is named by mgdDataLink-DC.

The ASN.1 description of the structure rules for the DSS 1 MIT is given below:

```
DSS1 MITSchema ::= SET OF { MitStructureRule MiTStructureRule }
        {
        { exchange-d-channel },
        { exchange-d-channel,     d-channel-mgdDataLink-DC },
        { exchange-d-channel,     d-channel-mgdNetwLayer-DC },
        }
```

III.2.1 *d-channel-mgd-d-channel-datalink*

```
d-channel-mgdDataLink-DC NAME-BINDING
        SUBORDINATE OBJECT CLASS    mgdDatalink-DC;
        NAMED BY
        SUPERIOR OBJECT CLASS       d-channel;
        WITH ATTRIBUTE              mgdDatalink-DC-Id;
REGISTERED AS { dSS1NameBinding 1 };
```

III.2.2 *DChannel-mgdNetwLayer-DC*

```
d-channel-mgdNetwLayer-DC NAME-BINDING
        SUBORDINATE OBJECT CLASS    mgdNetwLayer-DC;
        NAMED BY
        SUPERIOR OBJECT CLASS       d-channel;
        WITH ATTRIBUTE              mgdNetwLayer-DC-Id;
REGISTERED AS { dSS1NameBinding 2 };
```

III.3 *Attributes*

III.3.1 *mgdDataLink-DC-Id*

```
mgdDataLink-DC-Id ATTRIBUTE
      WITH ATTRIBUTE SYNTAX         ASN1TypeModule.PrintableString;
      MATCHES FOR                   Equality;
REGISTERED { dSS1Attribute 1 }
```

III.3.2 *noOfFramesWithFCS*

```
noOfFramesWithFCS ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 2 }
```

III.3.3 *noOfFramesReceived*

```
noOfFramesReceived ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 3 }
```

III.3.4 *noOfFramesTransmitted*

```
noOfFramesTransmitted ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 4 }
```

III.3.5 *noOfFramesRetransmitted*

```
noOfFramesRetransmitted ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 5 }
```

III.3.6 *mgdNetwLayer-DC-Id*

```
mgdNetwLayer-DC-Id ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 6 }
```

III.3.7 *messageWithWrongPdi*

```
messageWithWrongPdi ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 7 }
```

III.3.8 *messagesTooShort*

```
messagesTooShort ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 8 }
```

III.3.9 *messagesWithGenInfoElemMissing*

```
messagesWithGenInfoElemMissing ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 9 }
```

III.3.10 *messagesWithMandInfoElemMissing*

```
messagesWithMandInfoElemMissing ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 10 }
```

III.3.11 *messageCallReferenceErrors*

```
messageCallReferenceErrors ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 11 }
```

III.3.12 *sTATUSMessagesReceived*

```
sTATUSMessagesReceived ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 12 }
```

III.3.13 *sTATUSMessagesTransmitted*

```
sTATUSMessagesTransmitted ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 13 }
```

III.3.14 *rESTARTMessagesReceived*

```
rESTARTMessagesReceived ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 14 }
```

III.3.15 *rESTARTMessagesTransmitted*

```
rESTARTMessagesTransmitted ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 15 }
```

III.3.16 *noOfT303Expiries*

```
noOfT303Expiries ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 16 }
```

III.3.17 *noOfT310Expiries*

```
noOfT310Expiries ATTRIBUTE
        WITH ATTRIBUTE SYNTAX       ASN1TypeModule.INTEGER;
        MATCHES FOR                 Equality;
REGISTERED { dSS1Attribute 17 }
```

III.4 *Notifications*

III.4.1 *timerExpiryNetwork*

```
timerExpiryNetwork NOTIFICATION
        BEHAVIOUR                   -- for further study.
        WITH INFORMATION SYNTAX     ASN1TypeModule.TimerExpiryNetwork;
REGISTERED AS { dSS1Notification 1 };
```

III.4.2 *messageSequenceError*

```
messageSequenceError NOTIFICATION
        BEHAVIOUR                   -- for further study.
        WITH INFORMATION SYNTAX     ASN1TypeModule.MessageSequenceError
REGISTERED AS { dSS1Notification 2 };
```

III.4.3 *messageCallRefError*

```
messageCallRefError NOTIFICATION
        BEHAVIOUR                   -- for further study.
        WITH INFORMATION SYNTAX     ASN1TypeModule.MessageCallRefError;
REGISTERED AS { dSS1Notification 3 };
```

III.4.4 *specialMessageType*

```
specialMessageType NOTIFICATION
        BEHAVIOUR                   -- for further study.
        WITH INFORMATION SYNTAX     ASN1TypeModule.SpecialMessageType;
REGISTERED AS { dSS1Notification 4 };
```

III.4.5 *errorFrames*

```
errorFrames NOTIFICATION
        BEHAVIOUR                   -- for further study.
        WITH INFORMATION SYNTAX     ASN1TypeModule.ErrorFrames
REGISTERED AS { dSS1Notification 5 };
```

III.4.6 *invalidFrames*

```
invalidFrames NOTIFICATION
        BEHAVIOUR                   -- for further study.
        WITH INFORMATION SYNTAX     ASN1TypeModule.InvalidFrames;
REGISTERED AS { dSS1Notification 6 };
```

III.4.7 *unexpectedFrames*

```
unexpectedFrames NOTIFICATION
        BEHAVIOUR                   -- for further study.
        WITH INFORMATION SYNTAX     ASN1TypeModule.UnexpectedFrames;
REGISTERED AS { dSS1Notification 7 };
```

References

[1] CCITT Recommendation Q.921 *ISDN user-network interface data link layer specification*.

[2] CCITT Recommendation Q.931 *ISDN user-network interface network layer specification*.

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[4] CCITT Recommendation M.3010 *Principles for a telecommunications management network*.

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[6] CCITT Recommendations M.3602 to M.3605 *Application of maintenance principles of ISDN-subscriber installations and access*.

[7] ISO/IEC 7498-4:1989 *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework*.

[8] CCITT Rec. X.701 | ISO/IEC DIS 10040:192 *Information processing systems – Open Systems Interconnection – System Management Overview*.

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[11] CCITT Recommendation X.722 *Guidelines for the definition of managed objects*.

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[13] CCITT Recommendation X.734 *Event report function*.

[14] CCITT Recommendation X.735 *Log control function*.

[15] CCITT Recommendation X.738 *Measurement summarization function*.