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Information technology — Telecommunications and information exchange between systems — Elements of management information related to OSI Data Link Layer standards

Technologies de l'information — Télécommunications et échange d'information entre systèmes — Éléments de l'information de gestion liés aux normes de la couche de liaison de données OSI

Contents

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. 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.

International Standard ISO/IEC 10742 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

Annexes A and B form an integral part of this International Standard. Annexes C and D are for information only.

Introduction

This document is intended to become one of a set of International Standards produced to facilitate the interconnection of open systems. The set of International Standards covers the services, protocols and management information required to achieve such interconnection.

This International Standard is positioned with respect to other related Specifications by the layers defined in the *Reference Model for Open System Interconnection* (ISO 7498). In particular, it is concerned with the definition of Data Link Layer management information.

Information technology — Telecommunications and information exchange between systems — Elements of management information related to OSI Data Link Layer standards

1 Scope

This International Standard provides the specification of management information within an Open System related to those operations of the OSI Data Link Layer specified by the specifications in this document. Specifics on how Data Link layer management is accomplished is beyond the scope of this International Standard. Data Link Layer management is defined by specifying:

- the managed object class definition of Data Link Layer Managed Objects following guidelines put forth by the *Structure of Management Information* (ISO/IEC 10165)

- the relationship of the Managed Objects and attributes to both the operation of the layer and to other objects and attributes of the layer, and

- the action type operations on the attributes of Data Link Layer Managed Objects that are available to OSI Systems Management.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation I International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation I International Standard are encouraged to investigate the possibility of applying the most recent editions of the Recommendations and Standards listed below. Members of IEC and ISO maintain Registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of the currently valid ITU-T Recommendations.

2.1 Identical Recommendations I International Standards

- ITU-T Recommendation X.200(1993) | ISO 7498-1: 1994, *Information technology - Open Systems Interconnection Reference Model: Basic Reference Model.*

- CCITT Recommendation X.701(1992) I ISO/IEC 10040: 1992, *Information technology - Open Systems Interconnection - Systems management overview.*

- CCITT Recommendation X.720(1992) I ISO/IEC 10165-1: 1993, *Information technology - Open Systems Interconnection - Structure of management information: Management Information Model.*

- CCITT Recommendation X.721(1992) I ISO/IEC 10165-2: 1992, *Information technology - Open Systems Interconnection - Structure of management information: Definition of Management Information.*

- CCITT Recommendation X.722(1992) I ISO/IEC 10165-4: 1992, *Information technology - Open Systems Interconnection - Structure of management information: Guidelines for the definition of managed objects.*

- ITU-T Recommendation X.723(1993) I ISO/IEC 10165-5:1994, *Information technology - Open Systems Interconnection -Structure of Management Information: Generic management information.*

- CCITT Recommendation X.730(1992) I ISO/IEC 10164-1: 1993, *Information technology - Open Systems Interconnection - Systems management: Object management function.*

- CCITT Recommendation X.731(1992) I ISO/IEC 10164-2: 1993, *Information technology - Open Systems Interconnection - Systems management: State management function.*

- CCITT Recommendation X.732(1992) I ISO/IEC 10164-3: 1993, *Information technology - Open Systems Interconnection - Systems management: Attributes for representing relationships.*

- CCITT Recommendation X.733(1992) I ISO/IEC /10164-4: 1992, *Information technology - Open Systems Interconnection - Systems management: Alarm reporting function.*

- CCITT Recommendation X.734(1992) I ISO/IEC 10164-5: 1993, *Information technology - Open Systems Interconnection - Systems management: Event report management function.*

- CCITT Recommendation X.735(1992) I ISO/IEC 10164-6: 1993, *Information technology -Open Systems Interconnection - Systems management: Log control function.*

2.2 Paired Recommendations I International Standards equivalent in technical content

- CCITT Recommendation X.700 (1992), *Management Framework for Open Systems Interconnection (OSI) for CCITT Applications.*

 ISO 7498 - 4: 1989, *Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Management framework.*

- CCITT Recommendation X.212(1988), *Data link service definition for open systems interconnection for CCITT applications.*

 ISO/IEC 8886: 1992, *Information technology - Telecommunications and information exchange between systems - Data link service definition for Open Systems Interconnection.*

- CCITT Recommendation X.208(1988), *Specification of abstract syntax notation one (ASN.1).*

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

- CCITT Recommendation X.710 (1991), *Common Management Information Service Definition for CCITT Applications.*

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

- CCITT Recommendation X.711 (1991), *Common Management Information Protocol Specification for CCITT Applications.*

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

2.3 Additional references

- ITU-T Recommendation X.25 (1993), *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.*

ISO 7776: 1986, *Information processing Systems - Data communications - High-level data link control procedures - Description of the X.25 LAPB-compatible DTE data link procedures.*

- ISO 8802-2: 1989, *Information processing systems - Local area networks - Logical link control.*

- ISO/IEC 8802-3: 1993, *Information technology - Local and metropolitan area networks - Carrier Sence multiple access with collision detection (CSMA/CD) access method and physical layer specifications.*

- ISO/IEC 11575, *Information Technology - Telecommunications and Information Exchange Between Systems - Protocol Mappings for the OSI Data Link Service.*

3 Definitions

3.1 Basic reference model

This International Standard makes use of the following terms defined in ITU-T Rec X.200 | ISO/IEC 7498-1

a) Data Link Layer

b) open system

c) (N)-entity

d) (N)-protocol

e) (N)-service access point

3.2 Management framework

This International Standard makes use of the following terms defined in CCITT Rec X.700 | ISO/IEC 7498-4

a) Managed object

3.3 Systems Management Overview

This International Standard makes use of the following terms defined in CCITT Rec X.701 | ISO/IEC 10040.

a) Managed object class

b) Notification

3.4 Common Management Information Service Definition

This International Standard makes use of the following terms defined in CCITT Rec X.710 | ISO/IEC 9595.

a) Attribute

3.5 Information Model

This International Standard makes use of the following terms defined in CCITT Rec X.720 | ISO/IEC 10165-1.

a) Attribute Type

b) Behaviour

c) Containment

d)   Distinguished Name

e)   Inheritance

f)   Name Binding

g)   Package

h)   Parameter

i)   Relative Distinguished Name

j)   Subclass

k)   Superclass

3.6 GDMO

This International Standard makes use of the following terms defined in CCITT Rec X.722 | ISO/IEC 10165-4

a)   Managed Object Class Definition

b)   Template

4 Abbreviations

Within the Managed Object definitions and GDMO templates the following abbreviations are used in the standard-name element of a document-identifier when making references to other documents.

DMI   CCITT Rec. X.721 | ISO/IEC 10165-2
GMI   CCITT Rec. X.723 | ISO/IEC 10165-5

This International Standard makes use of the following symbols and abbreviations.

CSMA/CD   Carrier sense multiple access with collision detection
DL   Data Link
DLE   Data Link Entity
DLL   Data Link Layer
DLM   Data Link Management
DLSAP   Data Link Service Access Point
DMI   Definition of Management Information
EWMA   Exponentially Weighted Moving Average
GDMO   Guidelines for the Definition of Managed Objects
GMI   Generic Management Information
IVMO   Initial Value Managed Object
LLC   Logical Link Control
MAC   Media Access Control
MLP   Multi Link Protocol
MO   Managed Object
NSAP   Network Service Access Point
PLE   Packet Level Entity
SAP   Service Access Point
SLP   Single Link Protocol

5 Elements of Data Link Layer Management Information

5.1 Managed Object Hierarchy

5.1.1 Summary of managed objects

The following set of common managed objects are defined in this International Standard for the OSI Data Link Layer:

a)   The Data Link Subsystem managed object (datalinkSubsystem) (see 5.3, page 9).

b)   The Data Link Entity managed object (datalinkEntity) (see 5.4, page 10). (This managed object is never instantiated.)

c)   The Data Link Service Access Point managed object (dLSAP) (see 5.5, page 11).

d)   The LAPB Data Link Entity managed object (lAPBDLE) (see 5.6, page 12).

e)   The LAPB Single Link Protocol Machine managed object (sLPPM) (see 5.7, page 14).

f)   The LAPB Single Link Protocol Connection managed object (sLPConnection) (see 5.8, page 15).

g)   The LAPB Single Link Protocol Connection Initial Values managed object (sLPConnectionIVMO) (see 5.9, page 22).

h)   The Mac Data Link Entity managed object (mACDLE) (see 5.10, page 23).

i)   The MAC managed object /mAC) (see 5.11, page 24). (This managed object is never instantiated.)

j)   The LLC Data Link Entity managed object (lLCDLE) (see 5.12, page 27).

k)   The LLC Connectionless Protocol Machine managed object (lLCCLPM) (see 5.13, page 28). (This managed object is never instantiated.)

l)   The LLC Connection-mode Protocol Machine managed object (lLCCOPM) (see 5.14, page 29). (This managed object is never instantiated.)

m)   The Resource TypeId managed object (resourceTypeId) (see annex B)

n)   The Scanner managed object (scanner) (see annex B)(This managed object is never instantiated.)

o)   The Exponentially Weighted Moving Average Metric Monitor managed object (eWMAMetricMonitor) (see annex B)

These Managed Objects represent OSI Management's view of those elements of an Open System which support the OSI Data Link Service subject to OSI management operations. Other MOs may be defined under Data Link Subsystem using these generic specifications.

5.1.2 Containment hierarchy

The containment hierarchy is illustrated in figure 1. Managed objects which can have multiple instances are illustrated by shadowed (multiple) boxes. These objects are defined in detail in the following clauses of this International Standard.
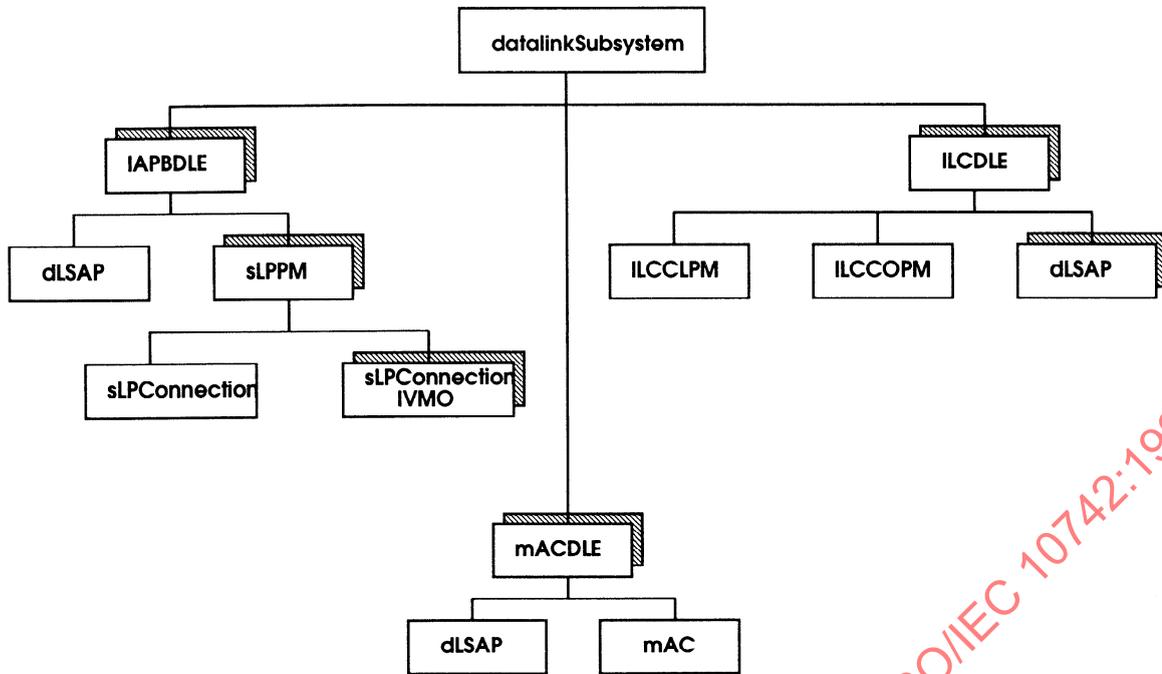
Figure 1 - Data Link Layer Containment Hierarchy

The datalink subsystem MO is subordinate to the system MO. The LAPB DLE, MAC DLE and LLC DLE MOs represent protocol- and media-specific communication entities.

The SLP PM MO represents the operation of the protocol machine for the single-link procedures specified in ISO 7776. The MAC, LLC CL PM and LLC CO PM MOs are generic managed objects from which MAC-specific and LLC-specific protocol machine managed objects can be derived, e.g. for CSMA/CD MAC specified in ISO/IEC 8802-3, and for LLC Type 1 and LLC Type 2 protocol operation specified in ISO 8802-2. The SLP Connection MO represent the management view of connections established using the SLP.

5.1.3 Relationships

5.1.3.1 General

The use of relationship attributes is illustrated by examples in annex D. The following describes the individual relationships in more detail.

5.1.3.2 DLE

There is a relationship between a 'DLE' MO (i.e. an LAPB, LLC and MAC DLE MO) and the MO representing the underlying service provider. This is represented by the attribute providerEntityNames inherited from the generic datalinkEntity MO. This is a read-write attribute which allows a manager to configure which entities are to be used to provide services to this entity. For example, a LAPB DLE MO might be configured with the local distinguished name of a Ph-Entity MO or an LLC DLE MO with the name of a MAC DLE MO (e.g. one containing a CSMA/CD MAC MO).

Additionally, a 'DLE' MO has a localSapNames attribute inherited from GMI:communicationsEntity. This is a read-only attribute which contains the local distinguished name(s) of SAP MO(s), representing the point at which services are provided to the entity. For example, in a LAPB DLE MO localSapNames might contain the name of a Ph-SAP MO or, in an LLC DLE MO, the name of a dLSAP MO contained in a MAC DLE MO.

The sN-ServiceProvider attribute of the Network layer Linkage and X25PLE-DTE MOs contains the local distinguished name of a 'DLE' MO.

5.1.3.3 dlSAP

There is a relationship between a dlSAP MO and the managed objects that represent the (Network layer) user entities that are using the SAP. This is represented by the userEntityNames attribute inherited from GMI:sap1. For example, in an dlSAP MO contained in an LAPB DLE MO, userEntityNames might contain the distinguished name of an X25PLE-DTE MO.

The sN-SAP attribute of the Network layer Linkage and X25PLE-DTE MOs contains the distinguished name of a dlSAP MO.

5.1.3.4 sLPConnection

There is a relationship between an sLPConnection MO and the MO representing the underlying Ph-Connection. This represented by the attribute underlyingConnectionNames inherited from GMI:singlePeerConnection.

5.1.4 Minimum Event Filtering Capabilities

The Data Link Layer management definitions embodied in this International Standard imply the frequent, and possibly excessive, generation of notifications during regular layer operation. These notifications are especially useful for effective fault management, where they facilitate the tracing and pinpointing of error situations. To avoid the excessive dissemination of these event reports under normal operating conditions, it is advisable for a managed system to have, as a minimum, the capability to perform discrimination based upon:

a)   The source managed object class.
b)   The object identifier values in the probable cause and specific problems field of communication alarms.

5.1.5 Use of Optional Fields

Where reference is made in this International Standard to ASN.1 syntax defined in DMI or GMI, only the following fields shall be employed.

1) Those which are not OPTIONAL in the ASN.1 syntax.

2) Those which are OPTIONAL, but whose use is explicitly required by this International Standard.

3) Those which are OPTIONAL, but whose ASN.1 type is SET OF ManagementExtension.

The use of any other fields is prohibited.

5.2 Common Data Link Layer GDMO definitions

-- **Behaviours**

commonCreationDeletion-B BEHAVIOUR
DEFINED AS
    Managed object class imports the ISO/IEC 10165-2 objectCreation
    and/or objectDeletion notifications. Used as follows:

      objectCreation - Generated whenever an instance of the managed
      object class is created. Implementations may optionally
      include the sourceIndicator parameter in the notification.
      If creation occured as a result of internal operation of
      the resource, the value 'resourceOperation' is used. If
      creation occured in response to a management operation, the
      value 'managementOperation' is used. A value of 'unknown'
      may be returned if it is not possible to determine the source
      of the operation. None of the other optional parameters are
      used.

      objectDeletion - Generated whenever an instance of the managed
      object class is deleted. Implementations may optionally
      include the sourceIndicator parameter in the notification.
      If deletion occured as a result of internal operation of
      the resource, the value 'resourceOperation' is used. If
      deletion occured in response to a management operation, the
      value 'managementOperation' is used. A value of 'unknown'
      may be returned if it is not possible to determine the source
      of the operation. None of the other optional parameters are
      used.;

commonStateChange-B BEHAVIOUR
DEFINED AS
    Managed object class imports the ISO/IEC 10165-2 stateChange
    notification. Used to report the changes to the operationalState
    attribute, and where present, the administrativeState attribute. A
    single parameter set is included in the State change definition field.
    Only the (mandatory) attributeId and (optional) newAttributeValue
    parameters are used.;

-- **Attribute Groups**

timers ATTRIBUTE GROUP
-- Empty group definition. Timer attributes are added to the group in
-- package definitions.
DESCRIPTION The group of all timer attributes;
REGISTERED AS {DLM.agoi timers(1)};

5.3 The Data Link Subsystem managed object

-- There shall be exactly one of these managed objects within a system.
-- It exists to provide a container for all managed objects in a system
-- that relate to the operation of the Datalink layer.
--
-- The datalinkSubsystem managed object can not be created or deleted
-- explicitly by management operation. It exists inherently in a system;
-- created and deleted as part of system operation.

```
datalinkSubsystem MANAGED OBJECT CLASS
DERIVED FROM "GMI":subsystem;
CHARACTERIZED BY datalinkSubsystem-P PACKAGE
   ATTRIBUTES
      "GMI":subsystemId
         INITIAL VALUE DLM.datalinkSubsystemId-Value
         GET;;;
REGISTERED AS {DLM.moi datalinkSubsystem(1)};
```

-- **Name Bindings**

-- IMPORT "GMI":subsystem-system NAME BINDING

5.4 The Data Link Entity managed object

-- The generic DLE MO from which protocol- and media-specific DLE MOs
-- may be derived.

```
datalinkEntity MANAGED OBJECT CLASS
DERIVED FROM "GMI":communicationsEntity;
CHARACTERIZED BY datalinkEntity-P PACKAGE
   BEHAVIOUR
      commonCreationDeletion-B,
      commonStateChange-B;
   ATTRIBUTES
      providerEntityNames REPLACE-WITH-DEFAULT
         GET-REPLACE;
   ATTRIBUTE GROUPS
      "DMI":state
         "DMI":operationalState;
   NOTIFICATIONS
      "DMI":objectCreation,
      "DMI":objectDeletion,
      "DMI":stateChange;;;
REGISTERED AS {DLM.moi datalinkEntity(2)};
```

-- **Name Bindings**

-- IMPORT "GMI":communicationsEntity-subsystem NAME BINDING

```
datalinkEntity-datalinkSubsystem-Management NAME BINDING
SUBORDINATE OBJECT CLASS datalinkEntity AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS datalinkSubsystem AND SUBCLASSES;
WITH ATTRIBUTE "GMI":communicationsEntityId;
BEHAVIOUR datalinkEntity-datalinkSubsystem-Management-B BEHAVIOUR
   DEFINED AS
      The name binding which applies when a datalinkEntity managed object (or
      an instance of a subclass of the datalinkEntity MO class) can be created by
      management as a subordinate object of the datalinkSubsystem
      managed object (or subclass), and deleted by management.;;
CREATE;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi datalinkEntity-datalinkSubsystem-Management(1)};
```

-- **Attributes**

```
providerEntityNames ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.GroupObjects;
MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;
BEHAVIOUR providerEntityNames-B BEHAVIOUR
  DEFINED AS
     The distinguished names of provider entity managed objects.
     The managed objects that represent the entities to be used to
     provide services to this entity.;;
REGISTERED AS {DLM.aoi providerEntityNames(11)};
```

5.5 The Data Link Service Access Point managed object

-- The dLSAP managed object class is used to represent a service access
-- point at which services are provided by a DLE to the user entity.
-- Instances of the dLSAP managed object class are contained within
-- instances of subclasses derived from the datalinkEntity managed object
-- class. Constraints on the number of contained dLSAP MOs and any
-- specific semantics of the attributes are given as part of the definition
-- of the containing DLE managed object class.
--
-- A dLSAP managed object may be created and deleted explicitly by
-- management operation or created and deleted automatically as part of
-- system operation, e.g. when a user of the Data Link layer service
-- requests and is granted use of the service. The mechanism by which
-- this happens is a local matter and not subject to OSI standardisation.

dLSAP MANAGED OBJECT CLASS
DERIVED FROM "GMI":sap1;
REGISTERED AS {DLM.moi dLSAP(13)};

-- **Name Bindings**

-- IMPORT "GMI":sap1-communicationsEntity NAME BINDING

dLSAP-datalinkEntity-Management NAME BINDING
SUBORDINATE OBJECT CLASS dLSAP AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS datalinkEntity AND SUBCLASSES;
WITH ATTRIBUTE "GMI":sapId;
BEHAVIOUR dLSAP-datalinkEntity-Management-B BEHAVIOUR
  DEFINED AS
      The name binding which applies when a dLSAP managed object (or
      an instance of a subclass of the dLSAP MO class) can be created
      by management as a subordinate object of a datalinkEntity managed
      object (or subclass), and deleted by management.;;
CREATE;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi dLSAP-datalinkEntity-Management(2)};

5.6 The LAPB Data Link Entity managed object

-- There may be multiple instances of the IAPBDLE managed object in a
-- system. Systems not supporting the LAPB Data Link procedures defined
-- in IS 7776 are not required to support the IAPBDLE and contained
---.managed objects.
--
-- The IAPBDLE managed object has a conditional mlp Package. There may
-- be multiple instances of IAPBDLE MO in a system, both with and without
-- the mlp Package. For those instances in which the package is absent,
-- the mlp procedures do not apply and the IAPBDLE MO may contain at
-- most one sLPPM MO. For those instances in which the package is
-- present, the mlp procedures do apply and the IAPBDLE MO may contain
-- multiple instances of sLPPM MO.
--
-- A IAPBDLE MO may contain at most one dLSAP MO. The value of the
-- sap1Address attribute is of no significance. The cardinality of the
-- userEntityNames attribute is limited to one.
--
-- A IAPBDLE MO may be created and deleted explicitly by
-- management operation or created and deleted automatically as
-- part of system operation.
--
-- When the IAPBDLE MO is operable, the operationalState shall
-- have the value 'enabled'; otherwise it shall have the value 'disabled'.
-- Transitions of operationalState shall be reported using the
-- stateChange notification.

```
IAPBDLE MANAGED OBJECT CLASS
DERIVED FROM datalinkEntity;
CONDITIONAL PACKAGES
   mLP-P PRESENT IF IAPBDLE supports mlp procedures,
   mT2-P PRESENT IF IAPBDLE supports mlp procedures and mT2 timer.;
REGISTERED AS {DLM.moi IAPBDLE(3)};
```

-- **Packages**

```
mLP-P PACKAGE
BEHAVIOUR mLP-P-B BEHAVIOUR
   DEFINED AS
      Additional properties of an IAPBDLE MO, present when mlp procedures supported.;;
ATTRIBUTES
   mT1Timer REPLACE-WITH-DEFAULT
      GET-REPLACE,
   mT3Timer REPLACE-WITH-DEFAULT
      GET-REPLACE;
ATTRIBUTE GROUPS
   timers
      mT1Timer
      mT3Timer;
REGISTERED AS {DLM.poi mLP-P(1)};

mT2-P PACKAGE
BEHAVIOUR mT2-P-B BEHAVIOUR
   DEFINED AS
      Additional properties present when mT2 timer is supported.;;
ATTRIBUTES
   mT2Timer REPLACE-WITH-DEFAULT
      GET-REPLACE;
ATTRIBUTE GROUPS
   timers
      mT2Timer;
REGISTERED AS {DLM.poi mT2-P(5)};
```

-- Attributes

mT1Timer ATTRIBUTE
DERIVED FROM "GMI":timer;
BEHAVIOUR mT1Timer-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter MT1 (lost frame timer).
     Unit is seconds.;;
REGISTERED AS {DLM.aoi mT1Timer(12)};

mT2Timer ATTRIBUTE
DERIVED FROM "GMI":timer;
BEHAVIOUR mT2Timer-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter MT2 (group busy timer).
     Unit is seconds.;;
REGISTERED AS {DLM.aoi mT2Timer(13)};

mT3Timer ATTRIBUTE
DERIVED FROM "GMI":timer;
BEHAVIOUR mT3Timer-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter MT3 (mlp reset confirmation
     timer). Unit is seconds.;;
REGISTERED AS {DLM.aoi mT3Timer(14)};

5.7 The LAPB Single Link Protocol Machine managed object

-- The sLPPM managed object represents the operation of the LAPB Data
-- Link layer protocol machine described in IS 7776 over a single physical
-- link. An sLPPM managed object may contain at most one sLPConnection
-- MO and one or more sLPConnectionIVMO.
--
-- An sLPPM MO may be created and deleted explicitly by
-- management operation or created and deleted automatically as
-- part of system operation.
--
-- When the sLPPM MO is operable, the operationalState shall
-- have the value 'enabled'; otherwise it shall have the value 'disabled'.
-- Transitions of operationalState shall be reported using the
-- stateChange notification.

sLPPM MANAGED OBJECT CLASS
DERIVED FROM "GMI":coProtocolMachine;
CHARACTERIZED BY sLPPM-P PACKAGE
    BEHAVIOUR
        commonCreationDeletion-B,
        commonStateChange-B;
    ATTRIBUTE GROUPS
        "DMI":state
            "DMI":operationalState;
    ACTIONS
        "GMI":activate,
        "GMI":deactivate;
    NOTIFICATIONS
        "DMI":objectCreation,
        "DMI":objectDeletion,
        "DMI":stateChange;;;
REGISTERED AS {DLM.moi sLPPM(4)};

-- Name Bindings

-- IMPORT "GMI":coProtocolMachine-entity NAME BINDING

sLPPM-IAPBDLE-Management NAME BINDING
SUBORDINATE OBJECT CLASS sLPPM AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS IAPBDLE AND SUBCLASSES;
WITH ATTRIBUTE "GMI":coProtocolMachineId;
BEHAVIOUR sLPPM-IAPBDLE-Management-B BEHAVIOUR
    DEFINED AS
        The name binding which applies when a sLPPM managed object (or
        an instance of a subclass of the sLPPM MO class) can be created
        by management as a subordinate object of a IAPBDLE managed
        object (or subclass), and deleted by management.;;
CREATE;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi sLPPM-IAPBDLE-Management(3)};

5.8 The LAPB Single Link Protocol Connection managed object

-- The sLPConnection managed object represents the local view of a
-- connection between LAPB DLEs over a single physical link.

-- An sLPConnection MO is created automatically as part of system
-- operation.
-- An sLPConnection MO may be deleted automatically as part of system
-- operation or may be deleted as a result of the deactivate or delete
-- management
-- operations. An sLPConnectionIVMO may be used as the source of
-- initial values of attributes of an slpConnection MO.

sLPConnection MANAGED OBJECT CLASS
DERIVED FROM "GMI":singlePeerConnection;
CHARACTERIZED BY
   commonSLPConnection-P,
   sLPConnection-P;
CONDITIONAL PACKAGES
   t3-P PRESENT IF Optional Timer T3 of ISO 7776 is supported.;
REGISTERED AS {DLM.moi sLPConnection(5)};

-- **Packages**

commonSLPConnection-P PACKAGE
BEHAVIOUR
   commonCreationDeletion-B;
ATTRIBUTES
   interfaceType REPLACE-WITH-DEFAULT
      DEFAULT VALUE DLM.interfaceTypeDefault -- dTE
      GET-REPLACE,
   k REPLACE-WITH-DEFAULT
      GET-REPLACE,
   n1 REPLACE-WITH-DEFAULT
      GET-REPLACE,
   n2 REPLACE-WITH-DEFAULT
      GET-REPLACE,
   sequenceModulus REPLACE-WITH-DEFAULT
      GET-REPLACE,
   t1Timer REPLACE-WITH-DEFAULT
      GET-REPLACE,
   t2Timer REPLACE-WITH-DEFAULT
      GET-REPLACE,
   t4Timer REPLACE-WITH-DEFAULT
      GET-REPLACE;
ATTRIBUTE GROUPS
   timers
      t1Timer
      t2Timer
      t4Timer;
NOTIFICATIONS
   "DMI":objectCreation,
   "DMI":objectDeletion;
; -- not registered

sLPConnection-P PACKAGE
BEHAVIOUR
   commonDeactivateConnection-B,
   commonStateChange-B,
   fRMRReceivedCommunicationsAlarm-B;
ATTRIBUTES
   fCSErrorsReceived GET,
   fRMRsReceived GET,

```
        fRMRsSent  GET,
        iFrameDataOctetsReceived GET,
        iFrameDataOctetsSent GET,
        iFramesReceived GET,
        iFramesSent GET,
        pollsReceived GET,
        rEJsReceived GET,
        rEJsSent GET,
        rNRsReceived GET,
        rNRsSent GET,
        sABMsReceived GET,
        sABMsSent GET,
        sLPProtocolState GET,
        timesT1Expired GET;
    ATTRIBUTE GROUPS
        "GMI":counters
            fCSErrorsReceived
            fRMRsReceived
            fRMRsSent
            iFrameDataOctetsReceived
            iFrameDataOctetsSent
            iFramesReceived
            iFramesSent
            pollsReceived
            rEJsReceived
            rEJsSent
            rNRsReceived
            rNRsSent
            sABMsReceived
            sABMsSent
            timesT1Expired,
        "DMI":state
            sLPProtocolState;
    ACTIONS
        "GMI":deactivate;
    NOTIFICATIONS
        "DMI":communicationsAlarm
            fRMR;
            -- Note: The fRMR parameter is carried
            -- as additionalInformation in the communicationsAlarm.
    ; -- not registered


t3-P PACKAGE
BEHAVIOUR t3-P-B BEHAVIOUR
    DEFINED AS
        Present if the optional Timer T3 is supported.;;
    ATTRIBUTES
        t3Timer REPLACE-WITH-DEFAULT
            GET-REPLACE,
        timesT3Expired
            GET;
    ATTRIBUTE GROUPS
        "GMI":counters
            timesT3Expired,
        timers
            t3Timer;
REGISTERED AS {DLM.poi t3-P(2)};


-- Behaviours

commonDeactivateConnection-B BEHAVIOUR
DEFINED AS
    Managed object class imports the ISO/IEC 10165-5 deactivate
```

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action. The deactivate action causes the connection to be terminated.
The termination should occur as rapidly as practical, but no particular
time constraints are implied. Typically, this action simulates a disconnect
request received across the service interface. If a more rapid means for
terminating the connection exists, then this should be used.
The termination shall occur in conformance to the protocol standard.
The Managed Object remains in existence after completion of
the deactivate action. It is subsequently deleted when the connection is
terminated, in the same way as if the connection had been terminated by
other means. A deactivate action may fail (with the ProcessingFailure
response) if it is temporarily not possible to terminate the connection.;

fRMRReceivedCommunicationsAlarm-B BEHAVIOUR
DEFINED AS
    Managed object imports the ISO/IEC 10165-2 communicationsAlarm
    notification. Used to report the following conditions:

    fRMRReceived - A FRMR frame is received. The received
    FRMR frame is reported as additionalInformation in the
    notification, using the fRMR parameter. The significance
    subparameter shall be set as described above.

    The probableCause parameter is set to the value
    communicationsProtocolError.

    The value DLM.fRMRReceived shall be reported in the
    specificProblems parameter. In addition, the reason why the frame
    was sent is also returned in specificProblems. Values are specified
    in the DLM ASN.1 module for
    controlFieldUndefinedOrUnimplemented,
    infoFieldLengthGreaterThanMaximum, invalidNR, formatError,
    and nonSpecific.

    The perceivedSeverity parameter is set to the value Minor. A
    subsequent communicationsAlarm with a perceivedSeverity value of
    Cleared is not generated. No other parameters are used.;

sLPConnection-sLPPM-Automatic-B BEHAVIOUR
    DEFINED AS
        The name binding which applies when an sLPConnection managed
        object (or an instance of a subclass of the sLPConnection MO class)
        is created automatically by the operation of the system as a
        subordinate object of an sLPPM managed object
        (or subclass), and deleted automatically.

        The creation of an instance of an sLPConnection MO (or subclass)
        using this name binding may reference an instance of the
        sLPConnectionIVMO (or subclass). The means by which an instance
        (if any) of the sLPConnectionIVMO are identified are a local matter.
        When this occurs, some of the initial values of the attributes of the
        instance of the sLPConnection MO may be supplied by the values of
        the attributes in the specified instance of sLPConnectionIVMO.
        However any such value may be overridden by a value supplied by
        local means (for example across an internal interface). Where values
        are supplied by the IVMO, the initial value of an attribute of the
        sLPConnection MO shall be the value of the corresponding attribute
        in the sLPConnectionIVMO (that is, which has the same attribute
        template label). The naming attribute of the sLPConnection MO is
        assigned a value according to local mechanisms.;

sLPConnection-sLPPM-Management-B BEHAVIOUR
    DEFINED AS
        The name binding which applies when an sLPConnection managed

object (or an instance of a subclass of the sLPConnection MO class)
which is a subordinate object of an sLPPM managed object (or
subclass), can be deleted by management.;

-- Name Bindings

sLPConnection-sLPPM-Automatic NAME BINDING
SUBORDINATE OBJECT CLASS sLPConnection AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS sLPPM AND SUBCLASSES;
WITH ATTRIBUTE "GMI":connectionId;
BEHAVIOUR sLPConnection-sLPPM-Automatic-B;
REGISTERED AS {DLM.nboi sLPConnection-sLPPM-Automatic(4)};

sLPConnection-sLPPM-Management NAME BINDING
SUBORDINATE OBJECT CLASS sLPConnection AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS sLPPM AND SUBCLASSES;
WITH ATTRIBUTE "GMI":connectionId;
BEHAVIOUR
    sLPConnection-sLPPM-Automatic-B,
    sLPConnection-sLPPM-Management-B;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi sLPConnection-sLPPM-Management(5)};

-- Attributes

fCSErrorsReceived ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR fCSErrorsReceived-B BEHAVIOUR
    DEFINED AS
      Counter. Total number of frames received with a bad frame
      check.;;
REGISTERED AS {DLM.aoi fCSErrorsReceived(15)};

fRMRsReceived ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR fRMRsReceived-B BEHAVIOUR
    DEFINED AS
      Counter. Total number of FRMR frames received.;;
REGISTERED AS {DLM.aoi fRMRsReceived(1)};

fRMRsSent ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR fRMRsSent-B BEHAVIOUR
    DEFINED AS
      Counter. Total number of FRMR frames sent.;;
REGISTERED AS {DLM.aoi fRMRsSent(2)};

iFrameDataOctetsReceived ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR iFrameDataOctetsReceived-B BEHAVIOUR
    DEFINED AS
      Counter. Total number of data octets received in I frames.
      Only data octets in new I frames are counted, i.e. retransmitted
      frames that are received do not cause the counter to be
      incremented.;;
REGISTERED AS {DLM.aoi iFrameDataOctetsReceived(16)};

iFrameDataOctetsSent ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR iFrameDataOctetsSent-B BEHAVIOUR
    DEFINED AS

Counter. Total number of data octets sent in I frames.
Only data octets in new I frames are counted, i.e. retransmitted
frames that are sent do not cause the counter to be incremented.;;
REGISTERED AS {DLM.aoi iFrameDataOctetsSent(17)};

iFramesReceived ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR iFramesReceived-B BEHAVIOUR
   DEFINED AS
     Counter. Total number of I frames received.
     Only new I frames are counted, i.e. retransmitted frames that
     are received do not cause the counter to be incremented.;;
REGISTERED AS {DLM.aoi iFramesReceived(3)};

iFramesSent ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR iFramesSent-B BEHAVIOUR
   DEFINED AS
     Counter. Total number of I frames sent.
     Only new I frames are counted, i.e. retransmitted frames that
     are sent do not cause the counter to be incremented.;;
REGISTERED AS {DLM.aoi iFramesSent(4)};

interfaceType ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.InterfaceType;
MATCHES FOR EQUALITY;
BEHAVIOUR interfaceType-B BEHAVIOUR
   DEFINED AS
     Determines the address mode used by the local DTE.;;
REGISTERED AS {DLM.aoi interfaceType(18)};

k ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.WindowSize;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR k-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter k.
     The maximum number of sequentially numbered I frames that a DTE
     may have outstanding (i.e. unacknowledged) at any given time.;;
REGISTERED AS {DLM.aoi k(19)};

n1 ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.MaximumIFrameSize;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR n1-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter N1.
     The maximum number of bits in an I frame (excluding flags and
     "0" bits inserted for transparency).;;
REGISTERED AS {DLM.aoi n1(20)};

n2 ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.Integer;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR n2-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter N2.
     The maximum number of attempts that shall be made to complete
     the successful transmission of a frame.;;
REGISTERED AS {DLM.aoi n2(21)};

pollsReceived ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR pollsReceived-B BEHAVIOUR
   DEFINED AS
      Counter. Total number of command frames received with P-bit set.;;
REGISTERED AS {DLM.aoi pollsReceived(22)};

rEJsReceived ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR rEJsReceived-B BEHAVIOUR
   DEFINED AS
      Counter. Total number of REJ frames received.;;
REGISTERED AS {DLM.aoi rEJsReceived(5)};

rEJsSent ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR rEJsSent-B BEHAVIOUR
   DEFINED AS
      Counter. Total number of REJ frames sent.;;
REGISTERED AS {DLM.aoi rEJsSent(6)};

rNRsReceived ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR rNRsReceived-B BEHAVIOUR
   DEFINED AS
      Counter. Total number of RNR frames received.;;
REGISTERED AS {DLM.aoi rNRsReceived(7)};

rNRsSent ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR rNRsSent-B BEHAVIOUR
   DEFINED AS
      Counter. Total number of RNR frames sent.;;
REGISTERED AS {DLM.aoi rNRsSent(8)};

sABMsReceived ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR sABMsReceived-B BEHAVIOUR
   DEFINED AS
      Counter. Total number of SABM frames received.;;
REGISTERED AS {DLM.aoi sABMsReceived(9)};

sABMsSent ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR sABMsSent-B BEHAVIOUR
   DEFINED AS
      Counter. Total number of SABM frames sent.;;
REGISTERED AS {DLM.aoi sABMsSent(10)};

sLPProtocolState ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.SLPProtocolState;
MATCHES FOR EQUALITY;
BEHAVIOUR sLPProtocolState-B BEHAVIOUR
   DEFINED AS
      Local state of a LAPB (SLP) connection.;;
REGISTERED AS {DLM.aoi sLPProtocolState(23)};

sequenceModulus ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.SequenceModulus;
MATCHES FOR EQUALITY;
BEHAVIOUR sequenceModulus-B BEHAVIOUR
   DEFINED AS
      Determines basic (modulo 8) or extended (modulo 128) operation.;;
REGISTERED AS {DLM.aoi sequenceModulus(24)};

t1Timer ATTRIBUTE
DERIVED FROM "GMI":timer;
BEHAVIOUR t1Timer-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter Timer T1.
     Unit is hundreds of milliseconds.;;
REGISTERED AS {DLM.aoi t1Timer(25)};

t2Timer ATTRIBUTE
DERIVED FROM "GMI":timer;
BEHAVIOUR t2Timer-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter T2.
     Unit is hundreds of milliseconds.;;
REGISTERED AS {DLM.aoi t2Timer(26)};

t3Timer ATTRIBUTE
DERIVED FROM "GMI":timer;
BEHAVIOUR t3Timer-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 optional parameter T3.
     Unit is seconds.;;
REGISTERED AS {DLM.aoi t3Timer(27)};

t4Timer ATTRIBUTE
DERIVED FROM "GMI":timer;
BEHAVIOUR t4Timer-B BEHAVIOUR
   DEFINED AS
     Value of the ISO 7776 parameter T4.
     The maximum time a DTE will allow without frames being
     exchanged on the data link. Unit is seconds.;;
REGISTERED AS {DLM.aoi t4Timer(28)};

timesT1Expired ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR timesT1Expired-B BEHAVIOUR
   DEFINED AS
     Counter. Total number of times the local Timer T1 expired.;;
REGISTERED AS {DLM.aoi timesT1Expired(29)};

timesT3Expired ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR timesT3Expired-B BEHAVIOUR
   DEFINED AS
     Counter. Total number of times local Timer T3 expired.;;
REGISTERED AS {DLM.aoi timesT3Expired(30)};

-- Parameters

fRMR PARAMETER
CONTEXT EVENT-INFO;
WITH SYNTAX DLM.FRMRSyntax;
BEHAVIOUR fRMR-B BEHAVIOUR
   DEFINED AS
     FRMR frame.
     Returned as additionalInformation in a communicationsAlarm notification
     when specificProblems has the value DLM.fRMRReceived.;;
REGISTERED AS {DLM.proi fRMR(1)};

5.9 The LAPB Single Link Protocol Connection Initial Values managed object

-- An sLPConnectionIVMO may be used to supply initial values for the
-- attributes of sLPConnection MOs. Different instances of sLPConnectionIVMO may
-- contain different initial values.
--
-- An sLPConnectionIVMO may be created and deleted explicitly by management operation.

sLPConnectionIVMO MANAGED OBJECT CLASS
DERIVED FROM "DMI":top;
CHARACTERIZED BY
    commonSLPConnection-P,
    sLPConnectionIVMO-P;
CONDITIONAL PACKAGES
    t3IVMO-P PRESENT IF optional Timer T3 of ISO 7776 is supported.;
REGISTERED AS {DLM.moi sLPConnectionIVMO(6)};

-- Packages

sLPConnectionIVMO-P PACKAGE
ATTRIBUTES
    sLPConnectionIVMOId GET;
; -- not registered

t3IVMO-P PACKAGE
BEHAVIOUR t3IVMO-P-B BEHAVIOUR
    DEFINED AS
        Present if the optional Timer T3 is supported.;;
ATTRIBUTES
    t3Timer REPLACE-WITH-DEFAULT
        GET-REPLACE;
ATTRIBUTE GROUPS
    timers
        t3Timer;
REGISTERED AS {DLM.poi t3IVMO-P(3)};

-- Name Bindings

sLPConnectionIVMO-sLPPM-Management NAME BINDING
SUBORDINATE OBJECT CLASS sLPConnectionIVMO AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS sLPPM AND SUBCLASSES;
WITH ATTRIBUTE sLPConnectionIVMOId;
BEHAVIOUR sLPConnectionIVMO-sLPPM-B BEHAVIOUR
    DEFINED AS
        The name binding which applies when an sLPConnectionIVMO
        managed object (or an instance of a subclass of the
        sLPConnectionIVMO MO class) can be created by
        management as a subordinate object of a sLPPM managed object
        (or subclass), and deleted by management.;;
CREATE;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi sLPConnectionIVMO-sLPPM-Management(6)};

-- Attributes

sLPConnectionIVMOId ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.NamingString;
MATCHES FOR EQUALITY;
BEHAVIOUR sLPConnectionIMVOId-B BEHAVIOUR
    DEFINED AS
        Naming attribute for the sLPConnectionIVMO managed object.;;
REGISTERED AS {DLM.aoi sLPConnectionIVMOId(31)};

5.10 The MAC Data Link Entity managed object

-- There may be multiple instances of the mACDLE managed object in a
-- system. Systems not supporting connections to LAN media are not
-- required to support the mACDLE and contained managed objects.
--
-- A mACDLE managed object may contain at most one instance of a
-- mac-specific MO derived from the generic mAC MO. A mACDLE MO
-- may contain at most one dLSAP MO. The value of the
-- sap1Address attribute is of no significance. The cardinality of the
-- userEntityNames attribute is limited to one.
--
-- A mACDLE MO may be created and deleted explicitly by
-- management operation or created and deleted automatically as
-- part of system operation.
--
-- When the mACDLE MO is operable, the operationalState shall
-- have the value 'enabled'; otherwise it shall have the value 'disabled'.
-- Transitions of operationalState shall be reported using the
-- stateChange notification.

mACDLE MANAGED OBJECT CLASS
DERIVED FROM datalinkEntity;
REGISTERED AS {DLM.moi mACDLE(7)};

-- **Name Bindings**

-- IMPORT "GMI":communicationsEntity-subsystem NAME BINDING
-- datalinkEntity-datalinkSubsystem-Management NAME BINDING

5.11 The MAC managed object

-- The generic MAC MO from which media-specific MAC MOs may be derived.

mAC MANAGED OBJECT CLASS
DERIVED FROM "DMI":top;
CHARACTERIZED BY mAC-P PACKAGE
  BEHAVIOUR
    commonCreationDeletion-B,
    commonStateChange-B;
  ATTRIBUTES
    "DMI":operationalState GET,
    mACId GET;
  ATTRIBUTE GROUPS
    "DMI":state
      "DMI":operationalState,
    "GMI":counters;
  ACTIONS
    "GMI":activate,
    "GMI":deactivate;
  NOTIFICATIONS
    "DMI":objectCreation,
    "DMI":objectDeletion,
    "DMI":stateChange;;;
REGISTERED AS {DLM.moi mAC(8)};

-- **Name Bindings**

mAC-mACDLE-Automatic NAME BINDING
SUBORDINATE OBJECT CLASS mAC AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS mACDLE AND SUBCLASSES;
WITH ATTRIBUTE mACId;
BEHAVIOUR mAC-mACDLE-Automatic-B BEHAVIOUR
  DEFINED AS
    The name binding which applies when a mAC managed object (or
    an instance of a subclass of the mAC MO class) is created
    automatically by the operation of the system as a subordinate object
    of a mACDLE managed object (or subclass), and deleted
    automatically.;;
REGISTERED AS {DLM.nboi mAC-mACDLE-Automatic(7)};

mAC-mACDLE-Management NAME BINDING
SUBORDINATE OBJECT CLASS mAC AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS mACDLE AND SUBCLASSES;
WITH ATTRIBUTE mACId;
BEHAVIOUR mAC-mACDLE-Management-B BEHAVIOUR
  DEFINED AS
    The name binding which applies when a mAC managed object (or
    an instance of a subclass of the mAC MO class) can be created by
    management as a subordinate object of a mACDLE managed object
    (or subclass), and deleted by management.;;
CREATE;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi mAC-mACDLE-Management(8)};

-- **Attributes**

framesReceivedOK ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR framesReceivedOK-B BEHAVIOUR
  DEFINED AS

Counter. Total number of frames sucessfully received.
These are frames that passed address and protocol type filtering
and include multicast frames. This provides a gross measurement
of incoming MAC usage by the local system and
information that can be used in conjunction with other counters
to determine the ratio of error conditions to successful receives
or to approximate average receive frame size.;;
REGISTERED AS {DLM.aoi framesReceivedOK(32)};

framesTransmittedOK ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR framesTransmittedOK-B BEHAVIOUR
    DEFINED AS
        Counter. Total number of frames sucessfully transmitted.
        This provides a gross measurement of outgoing MAC
        usage by the local system and information that can be used in
        conjunction with other counters to determine the ratio of error
        conditions to successful transmits or to approximate average
        transmit frame size.;;
REGISTERED AS {DLM.aoi framesTransmittedOK(33)};

localMACAddresses ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.MACAddresses;
MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;
BEHAVIOUR localMACAddresses-B BEHAVIOUR
    DEFINED AS
        MAC address(es) of the local system.;;
REGISTERED AS {DLM.aoi localMACAddresses(34)};

mACAddress ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.MACAddress;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR mACAddress-B BEHAVIOUR
    DEFINED AS
        Octet string of fixed length of 6 octets (48 bit MAC address) or 8
        octets (60 bit 802.6 MAC address). Used to represent a MAC
        address of a LAN or MAN station. This attribute is readable,
        and may also be writable if the specific use to which it is put
        permits modification of its contents. See Annex B, MACAddress
        Attribute for further behaviour definition.;;
REGISTERED AS {IEEE 802.CommonDefinitions.partf attribute(7) macaddress(0)};

mACId ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.NamingString;
MATCHES FOR EQUALITY;
BEHAVIOUR mACId-B BEHAVIOUR
  DEFINED AS The naming attribute for the mAC MO.;;
REGISTERED AS {DLM.aoi mACId(36)};

multicastFramesReceivedOK ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR multicastFramesReceivedOK-B BEHAVIOUR
    DEFINED AS
        Counter. Number of multicast frames successfully received.
        In conjunction with total frames received, it provides a gross
        percentage of the MAC medium usage for multicast frames
        received by the local system.;;
REGISTERED AS {DLM.aoi multicastFramesReceivedOK(37)};

multicastFramesTransmittedOK ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR multicastFramesTransmittedOK-B BEHAVIOUR
    DEFINED AS

Counter. Number of multicast frames transmitted.
It is a subset of the framesSent counter. In conjunction with
total frames sent, it provides a gross percentage of the MAC
medium usage for multicast frames transmitted by the local
system.;;
REGISTERED AS {DLM.aoi multicastFramesTransmittedOK(38)};

octetsReceivedOK ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR octetsReceivedOK-B BEHAVIOUR
  DEFINED AS
    Counter. Total number of MAC user octets sucessfully received.
    This does not include MAC headers. These are the octets from
    frames that passed address and protocol type filtering for both
    individual and multicast MAC addresses. When the framesReceived
    counter is used to calculate protocol overhead, the overhead plus
    octetsReceived provides a measurement of the amount of MAC
    bandwidth consumed by frames received by the local system.;;
REGISTERED AS {DLM.aoi octetsReceivedOK(39)};

octetsTransmittedOK ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR octetsTransmittedOK-B BEHAVIOUR
  DEFINED AS
    Counter. Total number of MAC user octets sucessfully transmitted.
    This does not include MAC headers. When the number of frames
    sent is used to calculate protocol overhead, the overhead plus
    octetsSent provides a measurement of the amount of MAC
    bandwidth (over time) consumed by frames sent by the local
    system. The counter is not incremented until a frame has been
    successfull transmitted.;;
REGISTERED AS {DLM.aoi octetsTransmittedOK(40)};

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5.12 The LLC Data Link Entity managed object

-- There may be multiple instances of the ILCDLE managed object in a
-- system. Systems not supporting LLC procedures are not required
-- to support the ILCDLE and contained managed objects.
--
-- An ILCDLE managed object may contain instances of
-- llc-specific connectionless and connection-mode protocol machine
-- MOs derived from the generic ILCCOPM and ILCCLPM MO. An
-- ILCDLE MO may contain multiple dLSAP MOs. The cardinality of the
-- userEntityNames attribute is limited to one.
--
-- An ILCDLE MO may be created and deleted explicitly by
-- management operation or created and deleted automatically as
-- part of system operation.
--
-- When the ILCDLE MO is operable, the operationalState shall
-- have the value 'enabled'; otherwise it shall have the value 'disabled'.
-- Transitions of operationalState shall be reported using the
-- stateChange notification.

ILCDLE MANAGED OBJECT CLASS
DERIVED FROM datalinkEntity;
REGISTERED AS {DLM.moi ILCDLE(9)};

-- **Name Bindings**

-- IMPORT "GMI":communicationsEntity-subsystem NAME BINDING
-- datalinkEntity-datalinkSubsystem-Management NAME BINDING

5.13 The LLC Connectionless Protocol Machine managed object

-- The generic LLC Connectionless PM MO from which protocol-specific LLC
-- PM MOs may be derived.

ILCCLPM MANAGED OBJECT CLASS
DERIVED FROM "GMI":clProtocolMachine;
CHARACTERIZED BY ILCCLPM-P PACKAGE
   BEHAVIOUR
     commonCreationDeletion-B,
     commonStateChange-B;
   ATTRIBUTE GROUPS
     "DMI":state
       "DMI":operationalState;
   ACTIONS
     "GMI":activate,
     "GMI":deactivate;
   NOTIFICATIONS
     "DMI":objectCreation,
     "DMI":objectDeletion,
     "DMI":stateChange;;;
REGISTERED AS {DLM.moi ILCCLPM(10)};

-- **Name Bindings**

-- IMPORT "GMI":clProtocolMachine-entity NAME BINDING

ILCCLPM-ILCDLE-Management NAME BINDING
SUBORDINATE OBJECT CLASS ILCCLPM AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS ILCDLE AND SUBCLASSES;
WITH ATTRIBUTE "GMI":clProtocolMachineId;
BEHAVIOUR ILCCLPM-ILCDLE-Management-B BEHAVIOUR
  DEFINED AS
    The name binding which applies when an ILCCLPM managed object
    (or an instance of a subclass of the ILCCLPM MO class) can be
    created by management as a subordinate object of an ILCDLE
    managed object (or subclass), and deleted by management.;;
CREATE;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi ILCCLPM-ILCDLE-Management(9)};

5.14 The LLC Connection-mode Protocol Machine managed object

-- The generic LLC Connection-mode PM MO from which protocol-specific
-- LLC PM MOs may be derived.

```
ILCCOPM MANAGED OBJECT CLASS
DERIVED FROM "GMI":coProtocolMachine;
CHARACTERIZED BY ILCCOPM-P PACKAGE
    BEHAVIOUR
        commonCreationDeletion-B,
        commonStateChange-B;
    ATTRIBUTE GROUPS
        "DMI":state
            "DMI":operationalState;
    ACTIONS
        "GMI":activate,
        "GMI":deactivate;
    NOTIFICATIONS
        "DMI":objectCreation,
        "DMI":objectDeletion,
        "DMI":stateChange;;;
REGISTERED AS {DLM.moi ILCCOPM(11)};
```

-- **Name Bindings**

-- IMPORT "GMI":coProtocolMachine-entity NAME BINDING

```
ILCCOPM-ILCDLE-Management NAME BINDING
SUBORDINATE OBJECT CLASS ILCCOPM AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS ILCDLE AND SUBCLASSES;
WITH ATTRIBUTE "GMI":coProtocolMachineId;
BEHAVIOUR ILCCOPM-ILCDLE-Management-B BEHAVIOUR
    DEFINED AS
        The name binding which applies when a ILCCOPM managed object
        (or an instance of a subclass of the ILCCOPM MO class) can be
        created by management as a subordinate object of a ILCDLE
        managed object (or subclass), and deleted by management.;;
CREATE;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi ILCCOPM-ILCDLE-Management(10)};
```

6 ASN.1 module

```
DLM {joint-iso-itu datalink-layer(15) management(0) asn1Module(2) 0}
DEFINITIONS IMPLICIT TAGS ::= BEGIN

IMPORTS
    GroupObjects, ObservedValue, PerceivedSeverity
        FROM Attribute-ASN1Module {joint-iso-itu ms(9) smi(3) part2(2) asn1Module(2) 1}
    SetInfoStatus, AttributeId, ObjectInstance
        FROM CMIP-1 {joint-iso-itu ms(9) cmip(1) modules(0) protocol(3)};

-- Note: In this standard, the identifier joint-iso-itu is used as a synonym for the identifier joint-iso-ccitt and has
-- the same value (2), defined in ISO/IEC 8824.

-- "infrastructure" object identifier definitions

datalink-layer OBJECT IDENTIFIER ::= {joint-iso-itu datalink-layer(15)}

dloi OBJECT IDENTIFIER ::= {datalink-layer management(0)}

sseoi OBJECT IDENTIFIER ::= {dloi standardSpecificExtension(0)}
moi OBJECT IDENTIFIER ::= {dloi objectClass (3)}
poi OBJECT IDENTIFIER ::= {dloi package (4)}
proi OBJECT IDENTIFIER ::= {dloi parameter (5)}
nboi OBJECT IDENTIFIER ::= {dloi nameBinding (6)}
aoi OBJECT IDENTIFIER ::= {dloi attribute (7)}
agoi OBJECT IDENTIFIER ::= {dloi attributeGroup (8)}
acoi OBJECT IDENTIFIER ::= {dloi action (9)}
noi OBJECT IDENTIFIER ::= {dloi notification (10)}


--
-- value assignments for Data Link layer specificProblems
--

fRMRReceived OBJECT IDENTIFIER ::=
    {sseoi specificProblems(11) fRMRReceived(5)}

fRMRReasons OBJECT IDENTIFIER ::=
    {sseoi specificProblems(11) fRMRReasons(6)}

fRMRReasonsControlFieldUndefinedOrUnimplemented OBJECT IDENTIFIER ::=
    {sseoi specificProblems(11) fRMRReasons(6)
     controlFieldUndefinedOrUnimplemented(1)}

fRMRReasonsFormatError OBJECT IDENTIFIER ::=
    {sseoi specificProblems(11) fRMRReasons(6) formatError(2)}

fRMRReasonsInfoFieldLengthGreaterThanMaximum OBJECT IDENTIFIER ::=
    {sseoi specificProblems(11) fRMRReasons(6)
     infoFieldLengthGreaterThanMaximum(3)}

fRMRReasonsInvalidNR OBJECT IDENTIFIER ::=
    {sseoi specificProblems(11) fRMRReasons(6) invalidNR(4)}

fRMRReasonsNonSpecific OBJECT IDENTIFIER ::=
    {sseoi specificProblems(11) fRMRReasons(6) nonSpecific(5)}
```

--
-- value assignments for Data Link layer specific errorIds for activate action processingFailure errors.
--

activateFailure OBJECT IDENTIFIER ::=
    {sseoi action(9) activate(1) errors(1) processingFailure(1)}

activateFailureInsufficientResources OBJECT IDENTIFIER ::=
    {activateFailure insufficientResources(1)}

activateFailureProviderDoesNotExist OBJECT IDENTIFIER ::=
    {activateFailure providerDoesNotExist(2)}

activateFailureProviderNotAvailable OBJECT IDENTIFIER ::=
    {activateFailure providerNotAvailable(3)}

activateFailureRequiredServiceNotAvailable OBJECT IDENTIFIER ::=
    {activateFailure requiredServiceNotAvailable(4)}

activateFailureSystemSpecific OBJECT IDENTIFIER ::=
    {activateFailure systemSpecific(5)}

--
-- other definitions
--

datalinkSubsystemId-Value GraphicString ::= "datalinkSubsystem"

FRMRSyntax ::= OCTET STRING
NamingString ::= GraphicString
Integer ::= INTEGER

InterfaceType ::= ENUMERATED{
    dTE(0),
    dCE(1)}

interfaceTypeDefault InterfaceType ::= dTE

MACAddress ::= OCTET STRING -- Minimum length 6 octets

-- If the MAC address is a 48-bit address the minimum length of the octet string shall be 6 octets.
-- If the MAC address is a 60-bit address the minimum length of the octet string shall be 8 octets.
-- The octet encoding is derived from the hexidecimal display representation order for the MAC -- address,
-- AB-CD-EF-GH-IJ-KL for the 48-bit address; AB-CD-EF-GH-IJ-KL-MN-OP for the 60-bit -- address format.
-- The octets are encoded as follows:
-- The first pair of hexidecimal digits, AB, are encoded in the first octet.
-- The second pair, CD, is encoded in the second octet, etc. (See Annex D, clause D.1.2
-- "MACAddress Attribute" for definition of 60-bit hexidecimal display format)

MACAddresses ::= SET OF MACAddress

MaximumlFrameSize ::= INTEGER
    -- in bits, 1080 (135 octets) minimum

Octet ::= OCTET STRING(SIZE(1))
OctetString ::= OCTET STRING

SequenceModulus ::= Integer

SLPProtocolState ::= ENUMERATED{
    disconnectedPhase(0),
    linkdisconnection-phase(1),
    link-setup-phase(2),

```
        information-Transfer-phase(3),
        frame-Reject-condition(4),
        busy-condition(5),
        sent-Reject-condition(6),
        system-Parameters-and-error-recovery(7)}

WindowSize ::= CHOICE{
    modulo8ws     [0] INTEGER(1..7),     -- for modulo 8
    modulo128ws  [1] INTEGER(1..127)} -- for modulo 128

END
```

7 Conformance

7.1 Conformance requirements to ISO/IEC 10742

An implementation for which conformance to this International Standard as a managed implementation is claimed shall

a) support the datalinkSubsystem MO;
b) for each supported MO, support at least one name binding defined in this International Standard, for which the MO is the subordinate.

7.2 Protocol specific conformance requirements

7.2.1 An implementation claiming conformance to the management operation of ISO 7776 as a managed implementation shall:

a) conform to ISO/IEC 10742 as defined in 7.1;
b) support the x25DLE MO, the dLSAP MO, the sLPPM MO and the sLPConnection MO.

7.2.2 An implementation claiming conformance to the management operation of an ISO/IEC 8802-2 connectionless-mode LLC as a managed implementation shall:

a) conform to ISO/IEC 10742 as defined in 7.1;
b) support the ILCDLE MO, the dLSAP MO and at least one class derived from the ILCCLPM MO.

7.2.3 An implementation claiming conformance to the management operation of an ISO/IEC 8802-2 connection-mode LLC as a managed implementation shall:

a) conform to ISO/IEC 10742 as defined in 7.1;
b) support the ILCDLE MO, the dLSAP MO and at least one class derived from the ILCCOPM MO.

7.2.4 An implementation claiming conformance to the management operation of a ISO 8802 MAC as a managed implementation shall:

a) conform to ISO/IEC 10742 as defined in 7.1;
b) support the mACDLE MO, the dLSAP MO and at least one class derived from the mAC MO.

NOTE — Behaviour clauses defined in this standard may not always be testable. Care should be exercised when defining behaviour test suites in order not to impose additional constraints to those defined in this standard for implementations.

Annex A
(normative)

Allocation of Object Identifiers

The following Object Identifiers have been allocated by the normative main body of this International Standard.

```
joint-iso-itu
    datalink-layer (15)
        management (0)
            standardSpecificExtension (0)
                action (9)
                    activate (1)
                        errors (1)
                            processingFailure (1)
                                insufficientResources (1)
                                providerDoesNotExist (2)
                                providerNotAvailable (3)
                                requiredServiceNotAvailable (4)
                                systemSpecific (5)
                specificProblems (11)
                    alignmentError (1)
                    carrierCheckFailure (2)
                    frameTooLong (4)
                    fRMRReceived (5)
                    fRMRReasons (6)
                        controlFieldUndefinedOrUnimplemented (1)
                        formatError (2)
                        infoFieldLengthGreaterThanMaximum (3)
                        invalidNR (4)
                        nonSpecific (5)
                asn1Module (2)
                    (0)
                objectClass (3)
                    datalinkSubsystem (1)
                    datalinkEntity (2)
                    x25DLE (3)
                    sLPPM (4)
                    sLPConnection (5)
                    sLPConnectionIVMO (6)
                    mACDLE (7)
                    mAC (8)
                    lLCDLE (9)
                    lLCCLPM (10)
                    lLCCOPM (11)
                    dLSAP (13)
                package (4)
                    mLP-P (1)
                    t3-P (2)
                    t3IVMO-P (3)
                    mT2-P (5)
                parameter (5)
                    fRMR (1)
                nameBinding (6)
                    datalinkEntity-datalinkSubsystem-Management (1)
                    dLSAP-datalinkEntity-Management (2)
                    sLPPM-x25DLE-Management (3)
                    sLPConnection-sLPPM-Automatic (4)
                    sLPConnection-sLPPM-Management (5)
                    sLPConnectionIVMO-sLPPM-Management (6)
```

mAC-mACDLE-Automatic (7)
mAC-mACDLE-Management (8)
ILCCLPM-ILCDLE-Management (9)
ILCCOPM-ILCDLE-Management (10)
resourceTypeId-mACDLE-Automatic(12) (In Annex B)
resourceTypeId-mACDLE-Automatic(13) (In Annex B)
eWMAMetricMonitor-ILLCDLE-Management(13)(In Annex B)
eWMAMetricMonitor-ILLCDLE-Management(14)(In Annex B)
attribute (7)
fRMRsReceived (1)
fRMRsSent (2)
iFramesReceived (3)
iFramesSent (4)
rEJsReceived (5)
rEJsSent (6)
rNRsReceived (7)
rNRsSent (8)
sABMsReceived (9)
sABMsSent (10)
providerEntityNames (11)
mT1Timer (12)
mT2Timer (13)
mT3Timer (14)
fCSErrorsReceived (15)
iFrameDataOctetsReceived (16)
iFrameDataOctetsSent (17)
interfaceType (18)
k (19)
n1 (20)
n2 (21)
pollsReceived (22)
sLPProtocolState (23)
sequenceModulus (24)
t1Timer (25)
t2Timer (26)
t3Timer (27)
t4Timer (28)
timesT1Expired (29)
timesT3Expired (30)
sLPConnectionIVMOId (31)
framesReceivedOK (32)
framesTransmittedOK (33)
localMACAddresses (34)
mACId (36)
multicastFramesReceivedOK (37)
multicastFramesTransmittedOK (38)
octetsReceivedOK (39)
octetsTransmittedOK (40)
attributeGroup (8)
timers (1)
action (9)
notification (10)

Annex B

(normative)

IEEE 802.1F Common Models and Generic Definitions

B.1 Introduction

This Annex identifies management information and procedures developed for IEEE 802 LAN/MAN Standards. It is applicable across the entire family of IEEE LAN/MAN standards but is also applicable for other SC6 standards.

NOTE — The information in Annex B is taken out of IEEE 802.1F/D13.

B.2 Common Models

Note: Clause B.2 is only informative

B.2.1 Resource Type Managed Object

The resource type managed object class is used within IEEE 802 LAN/MAN resources to identify information about the managed system such as resource name, manufacturer name, manufacturer OUI, and manufacturer product version. This managed object is used to identify any resource within a LAN/MAN system. The information is provided by the manufacturer, however, and is read-only.

B.2.1.1 Containment of Resource Type Managed Object

A single instance of the resource type managed object may be contained within any managed object which represents a resource.

B.2.2 MACAddress Attribute

A common representation for MAC address attributes is specified by this tandard. Consistent with section 5.2.2 of the 802.1 Overview and Architecture, 48-bit MAC addresses have a fixed length of 6 octets.

Consistent with section 6.5.1.2.1.2 of the 802.6 DQDB specification, 60 bit MAC addresses have a fixed length of 8 octets. For purposes of this International Standard a hexidecimal display representation is defined for 60 bit addresses, AB-CD-EF-GH-IJ-KL-MN-OP, similar to 48-bit addresses. The left-most hexidecimal digit represents the 4 bit address type field. The remaining fifteen hexidecimal digits, "B" through "P", represent the 60 bit MAC address, as defined in ANSI/IEEE Standard 802.6-1990.

NOTE — As in the 48-bit display representation used in IEEE 802-1990, this 60-bit display representation is not the form of the MAC Address attribute, but is used only to map the four bit hexadecimal digits of the 60-bit MAC address attribute.

Since the MAC address address attribute is represented by a fixed length octet string, the attribute type (48 bit vs. 60 bit) can be determined by examining the attribute length. An attribute value 6 octets in length is a 48 bit MAC address; an attribute value 8 octets in length is a 60 bit MAC address.

B.2.3 EWMA Metric Monitor Managed Object

The Exponentially Weighted Moving Average (EWMA) metric monitor managed object can be used within IEEE 802 LAN/MAN managed systems. This managed object is used to observe any attribute which behaves like a counter (which can be used as input for a derived gauge) or gauge. If the observed attribute is a counter the EWMA metric monitor managed object may derive a gauge value from the counter. In this case the derived gauge value is the difference between successive observations of the counter. If the observed attribute is a gauge the derived gauge value will be qual to the observed attribute at the time of each observation. The EWMA metric monitor managed object may have a severity indicating gauge-threshold applied to the gauge attribute.

The managed object may emit a quality of service alarm notification whenever the threshold value is crossed. The alarm notification can be generated on either increasing or decreasing threshold crossings (with hysteresis). Observed data is smoothed by the EWMA smoothing algorithm. Depending upon the initialization of attributes, this summarization function can be used to provide either an exponentially weighted behaviour or a simple difference (between scans) behaviour.

B.2.3.1 Model for EWMA Metric Monitor

The EWMA metric monitor values of an attribute in an observed managed object. The observed attribute is monitored at intervals specified by the granularity period. A gauge value (derived gauge) is derived from the values of the observed attribute. The value of the derived gauge attribute shall remain the same until the next observation.

The observed attribute can be monitored either as a counter or as a gauge. If the counter difference package is present the observed attribute is treated as a counter and the counter difference algorithm is applied to derive the gauge value.If the counter difference package is absent the observed attribute is treated as a gauge value. No other knowledge is assumed regarding the characteristics of the observed attribute.

An estimate of the mean of the derived gauge is calculated. A threshold is applied to the estimate of the mean value. If the threshold value is exceeded (subject to hysteresis) an alarm notification shall be generated (ISO/IEC 10164-7).

B.2.3.2 Properties of EWMA Metric Monitor Managed Objects

The EWMA metric monitor managed object type defined in this International Standard has attributes for

- the identification of the EWMA metric monitor managed object;
- the identification of a managed object to be monitored and its attribute to be observed;
- the frequency of observations;
- the indication of the result value of the observations, and;
- the threshold value(s) at which to report increasing/decreasing alarms;

EWMA metric monitor managed objects may be created as they are needed. If more than one observation is to be made, then a separate EWMA metric monitor managed object shall be created for each such observation. If the managed system creates an EWMA metric monitor managed object, a notification indicating that an object was created may be emitted.

The EWMA metric monitor managed object shall have an attribute to identify the managed object under observation and an attribute to identify the observed attribute.

The EWMA metric monitor managed object shall have an attribute indicating the value of the observed attribute (actual or derived) and an attribute that indicates the value of the results of the EWMA algorithm.

The lifetime of the EWMA metric monitor managed object may be controlled by the managing system by requesting the managed system to delete the EWMA metric monitor managed object. If the managed system deletes an EWMA metric monitor managed object, a notification indicating object deletion may be emitted.

B.2.3.3 Threshold Model

The EWMA metric monitor managed object is used to summarize the value of either a derived or an actual gauge within an IEEE 802 managed system. The summarized value may be compared to threshold level values in order to trigger the generation of notifications when threshold level values are crossed. Thresholds generated in this manner are termed severity indicating thresholds.

The severity indicating threshold attribute type has all the behaviour of a gauge-threshold attribute type, as defined in clause 8.4.2 of ISO/IEC 10165-2. As an enhancement to the syntax of the gauge-threshold attribute type it adds an optional severity indication parameter to the syntax of both the notifyHigh and notifyLow submembers within each threshold level member.

The EWMA metric monitor managed object may have zero, one, or more threshold levels. Each of these threshold levels may be triggered on either increasing or decreasing values. Each threshold level has a notify-high and notify-low switch, which can be used to implement hysteresis. The threshold can be setup to generate

notifications when the mean of the observed value crosses either switch-boundary (with one notification being "clear" if both boundaries are selected).

NOTE — Alarm notifications will not be emitted if the granularity period is set to zero or if all threshold level attributes are removed. Alarm notifications will not be emitted if the administrative state is set to "locked".

B.2.3.4 Relationship of EWMA Metric Monitor Managed Objects to other Managed Objects

Relationship Attributes

The managed system uses internal mechanisms for conveying the observed attribute values to the metric monitor managed object.

The EWMA metric monitor managed object has a relationship attribute to allow the identification of the observed managed objects and its attribute to be observed. The value of this relationship attribute shall be read-write and is initialized at the time of EWMA metric monitor managed object creation. The relationship of an EWMA metric monitor managed object with an observed managed object is a one-way asymmetric relationship.

Containment Relationships

The EWMA metric monitor managed object may either be contained within the observed managed object or within some other managed object. Multiple instances of the managed object may be contained within any other managed object.

B.3 Generic Definitions

NOTE — Clause B.3 is only informative.

B.3.1 Managed Objects

B.3.1.1 resourceTypeId managed object class

The Resource TypeId managed object class can be used within IEEE 802 LAN/MAN resources to identify information about the managed system. This managed object can be used to identify any resource within a LAN/MAN system. The information is provided by the manufacturer, however, and is read-only. No restrictions are placed upon the containment hierarchy for this class.

resourceTypeId Behaviour

The attributes of this managed object class are read-only.

Attributes of resourceTypeId

resourceTypeIdName

This attribute is used to contain the name of the resourceTypeId managed object. This contains a fixed value, "RTID".

resourceInfo

This attribute is used to describe the resource. The attribute is structured and contains ManufacturerOUI, ManufacturerName, ManufacturerProductName, and ManufacturerProductVersion.

B.3.1.2 scanner managed object class

The scanner managed object class is a superclass from which the ewmaMetricMonitor managed object class is derived. It defines the facilities for periodically sampling the value of a specified attribute within a specified object. The scanner managed object class is never instantiated.

The scanner managed object class has a single conditional package:

-       configuration events reporting package (present only if configuration events reporting is supported).

NOTE — The scanner object has been retained as a separate class in this International Standard in order to provide consistency with the scanner object defined in ISO/IEC 10164-13. This definition of scanner does not support all of the packages defined in the ISO version. In particular, scheduling is not supported. Also, while the scope of monitoring allowed by scanner is very flexible, the EWMA metric monitor managed object class limits the scope to a single gauge or derived-gauge attribute in a single managed object.

scanner Behaviour

A managed object of this class represents the ability to retrieve values of some attribute of some other managed object and produce summary information from those values. This summary information may be made available in attributes, notifications, action results, or some combination of these. Summary information may consist of observed attribute values or statistics calculated from these values.

Observed attribute values are retrieved during a 'scan', which is initiated periodically, at the end of each granularity period.

The granularity period attribute indicates the length of the granularity period. The granularity period in the scanner managed object class shall not be set unless the administrative state is set to locked.

NOTE — A system does not need to support all time unit values for time-based attributes. If an agent does not support a specific time unit, it can respond with the CMIS inappropriate attribute value indication.

The administrative state attribute is used to suspend or resume the scanning function. If administrative state has the value 'unlocked', the scanner is ready to perform scans. If administrative state has the value 'locked', the scanner is administratively prohibited from performing scans.

The operational state attribute represents the operational capability of the scanner to perform its functions.

If the configuration events reporting package is present, then changes to the granularity period shall cause attribute value change notifications to be emitted, and changes to operational state or administrative state shall cause state change notifications to be emitted. Such notifications shall include a report of all scanner attribute values.

NOTES

1 — It is recommended that the observed attribute be scanned within the granularity period. If a new scan is initiated when another scan is in progress, then it is a local issue to resolve the conflict. The outcome is not deterministic.

2 — The scan may occur at slightly different times for each observed attribute, but the time skew between the start of a scan and the scan time for a given attribute in the scan should be approximately equal between successive scans.

The scanner begins the collection of data immediately upon its creation. The scanner verifies that the granularity period has elapsed since the last scan. If the granularity period has elapsed, the scanner observes and collects the current attribute values of the specified managed objects and attributes to be observed. The scanner continues to scan at the end of each granularity period until it is deleted.

If the granularity period is zero, then the scanner will not emit notifications on a periodic basis.

Attributes of scanner

scannerId

This attribute is used to name the scanner managed object class (used for naming).

operationalState

This attribute defines the operational state of the managed object as defined in ISO/IEC 10164-2;

administrativeState

This attribute represents the administrative state of the metric managed object as defined in ISO/IEC 10164-2. The following AdministrativeState values are defined:

a) Unlocked - the metric managed object is ready to monitor;

b) Locked - the monitoring process in the metric managed object is stopped.

granularityPeriod

This attribute represents the time between scans.

B.3.1.3 eWMAMetricMonitor managed object class

To report events the eWMAMetricMonitor managed object uses the Alarm Report Service defined in ISO/IEC 10164-4.

Attribute values of managed objects can be read or modified in accordance with the operations described in ISO/IEC 10165-1.

The eWMAMetricMonitor managed object class is defined as a subclass of the scanner managed object class.

The eWMAMetricMonitor managed object class monitors the values of a gauge or counter type attribute of an observed managed object. The presence or absense of the counter difference package determines how the output of the data conversion process is derived from the observed attribute. If the counter difference package is not present, the derived gauge attribute value contains the last observed value of the observed attribute. If the package is present the derived gauge value contains the value of the difference between two successive observations of observed attribute values.

An estimate of the mean of the derived gauge is calculated using the EWMA algorithm. The EWMA algorithm has the property that, given the proper choice of attributes, both exponential smoothing and simple difference gauges can be implemented. A threshold is applied to the estimate of the mean for the purpose of generating alarm notifications of type quality of service. The relationship attributes for the gauge monitor metric managed object are observed managed object instance and observed attribute id.

eWMAMetricMonitor Behaviour

An attribute to be observed is specified by the observedAttributeId of the managd object identified by observedManagedObjectInstance. This observed attribute is monitored at intervals specified by the granularity period. A gauge value (derivedGauge) is derived from the values of the observed attribute. The value of the derived gauge attribute shall remain the same until the next observation.

The calculation of the derived gauge attribute value depends on the type of the observed attribute. If the observed attribute is of gauge type, the derived gauge attribute contains the last observed value of the observed attribute. If the observed attribute is a counter, the derived gauge contains the value of the counter difference between two successive observations of the counter.

The presence of the counter difference package determines how the output of the data conversion process is derived from the observed attribute. If the package is present, the observed attribute is considered a counter; otherwise it a considered a gauge.

If the observed attribute is a gauge, the units of the derived gauge are the same as the units of the observed gauge.

If the observed attribute is a counter, the units of the derived gauge is related to the interval between observations (granularityPeriod). For example, if the derived gauge value is for a counter of messages observed over 15 minutes and the derived gauge has a value of 60, then the derived gauge value represents 60 messages per 15 minutes, and not 4 messages per minute.

An estimate of the mean of the derived gauge attribute (estimateOfMean) is calculated using the exponentially weighted moving average (EWMA) algorithm. The value of the estimate of mean remains the same until the next observation. The estimate of mean is updated using subsequent scanned values of the derived gauge attribute, taken over a period specified by the value of the moving time period.

This managed object class also contains a severity indicating gauge threshold, with its associated behaviour. Threshold crossing notifications are triggered by the estimate of mean attribute value crossing a severity indicating gauge threshold level. As a result of a threshold crossing, a QOS Alarm Report is generated with

probable cause threshold crossing, and with the perceived severity parameter having the value stored in the severity indicator attribute value.

NOTE — There is no requirement that the moving time period and granularity period have the same units. Choice of a common time unit base may more efficient in some implementations, but is not required by this standard.

The severity indicating gauge threshold is applied to the estimate of mean attribute.

When an EWMA metric monitor managed object instance is created, the following shall be specified

—The scanner id, observed managed object instance, observed attribute id;

—The granularity period (i.e., time between observations of the observed attribute);

—The severity indicating gauge threshold (i.e., the threshold levels to be applied to the estimate of mean attribute value for generation of quality of service alarm types).

—The moving time period required by the EWMA algorithm.

—The initial value for the estimate of mean.

If the counter difference package is absent, the observed attribute is treated as a gauge.;

If the counter difference package is present, then the data capture process is derived by the counter difference package behaviour. Before the metric managed object instance can enter the on-duty condition, it shall ensure that counter[T-GP] is initialized.;

If the counter overflow package is present, then the metric object shall ensure that the value of the modulus value attribute is initialized before entering the on-duty condition.;

If the observed attribute id references an attribute that is not of gauge or counter type, the creation shall fail andthe CMIS error "invalid attribute value" shall be returned.

The state change notification shall be applied to the administrative state, operational state, and availability status if the configuration events reporting package is present.

The lifetime of the metric object may be controlled by the managing system by requesting the managed system to delete the metric object.

If the managed system deletes a metric object and the configuration events reporting package is present, a notification indicating managed object deletion is emitted. The notification shall include the values of the attributes of the metric object at the time of deletion.

All attributes of the EWMA Metric Monitor managed object class, including optional attributes of the counter difference and counter overflow packages may only be modified if the adminstrative state is locked. If the configuration events reporting package is present, modifications of these attributes shall result in an attribute value change notification. All attributes shall be reported when such notifications are emitted.

NOTE — It is the responsibility of the manager to assure that the estimate of mean is reinitialized if the scan interval is changed.

The managed object will emit a quality of service alarm (QOS) notification whenever the value of the estimate of the mean attribute triggers the corresponding threshold. This notification will contain the following attributes:

—the estimate of mean attribute will be reported in the observed value element;

—the observed managed object instance and observed attribute identifier will be reported in the monitored attributes parameter.

Attributes of EWMA metric Monitor

observedManagedObjectInstance

This attribute is used to identify the instance of the managed object that contains the observed attribute.

observedAttributeIdentifier

This attribute is used to identify the observed attribute of the observed managed object.

derivedGauge

This attribute contains the gauge value derived from the values of the observed attribute. If the observed attribute is a gauge then this attribute contains the value of the latest observation. If the counter difference package is present, then this attribute's value is the difference between successive observations of the observed attribute.

estimateOfMean

This attribute contains the estimate of the mean calculated by the EWMA algorithm. The initial value of this attribute shall be supplied upon creation of the managed object for use in initialising the algorithm. The attribute may be modified after creation of the managed object in order to re-initialise the EWMA algorithm.

severityIndicatingGaugeThreshold

This attribute contains the threshold levels which are to be applied to the Estimate of the Mean attribute. It shall be initialised when the managed object is created and may be modified.

movingTimePeriod

This attribute contains the effective time period over which values are scanned to calculate an estimate of the mean. This attribute shall be initialised when the managed object is created and may be subsequently modified.

NOTE — Choice of time units for moving time period is not constrained by the choice of time units for granularity period. It is recommended that the same time units be chosen for efficiency within agent systems. If the value of the moving time period is greater than the value specified for the granularity period attribute, the output of the EWMA algorithm will not be useful.

B.3.2 Packages

The conditional packages which are present are determined at the time of creation, and they are used to control the behaviour of managed object instances.

B.3.2.1 Counter Difference Package

This package defines the behaviour for deriving a gauge value from an observed attribute that is a wrap counter. The gauge value derived is the difference between the observed counter values for two successive observations. If this package is included, the observed attribute shall be interpreted to be a counter. When the counter difference package is present, the first scan interval subsequent to either creation or transition from unlocked to locked state is treated in a special way. Since the value of the derived gauge does not become valid until the completion of the first scan interval, any attempt to read the derived gauge during this period will receive an error indication. Likewise, if the difference between successive observations is negative, any attempt to read the derived gauge will receive an error indication. The observed value retained by the metric monitor managed object is to be used in calculating the next difference.

NOTE — It is recommended that a gauge not be derived from a resettable counter which may be reset frequently. The resetting of a counter during a granularity period will result in an invalid gauge value for that granularity period. Therefore, gauges should only be derived from resettable counters if the time between resets is significantly greater than the granularity period.

Counter Difference Behaviour

See clause B.4 for detailed behaviour.

Counter Difference Attributes

counterTMinusGP

This attribute is used in calculating counter differences for counters. It contains the value of the counter captured by the latest observation. This value shall be initialised upon creation if the observed attribute is a counter.

B.3.2.2 Configuration Events Reporting Package

The configuration events reporting package contains no attributes.

This package contains the following notifications:
- state change,
- attribute value change,
- object creation, and
- object deletion

Configuration Events Reporting Behaviour

If the scanner managed object (or any subclass which is derived from scanner) is created or deleted, a notification shall be generated. If a change is detected in administrative state (in this International Standard changes can only be generated for internal causes), a state change notification shall be emitted. If changes occur to the granularity period, attribute value change notifications shall be emitted. This package is most likely required in multiple manager environments.

Configuration Events Reporting Attributes

The configuration events reporting package has no attributes.

B.3.2.3 Counter Overflow Package

This package defines the modulus value attribute which is used when an observed counter overflows and counter differences are to be calculated. The package contains an attribute which specifies the value to be used when the modulus of the difference between counter values is required on counter overflow.

Counter Overflow Attributes

The counter overflow package contains the following attribute:

counterModulus

This attribute holds the value to be used as the modulus value when an observed counter overflows.

Counter Overflow Behaviour

See clause B.4 for detailed behaviour definition.

B.3.3 Use of Quality Of Service (QOS) Alarm Notification

Parameters corresponding to Alarm information in the Alarm Reporting Service (See ISO/IEC 10164-4) and their semantics are presented below. These parameters shall be present in the notification unless otherwise stated.

Alarm type:	Quality of service
Probable cause:	Threshold crossed
Perceived severity:	The values related to the severe and early warning thresholds are defined on a managed object instance basis. The value "Cleared" indicates crossing either of the two values associated with the severe clear and early warning clear. The values related to additional threshold levels are also to be defined on a managed object instance basis.

Threshold information: The threshold information is used for the estimate of the mean threshold.

Monitored attributes: Attribute identifiers and values of the observed managed object instance and the observed attribute identifier. Other attributes of the metric may also be included in this parameter.

State change: Optionally used to indicate an operational state change has occurred associated with the alarm reported.

B.4 Common Managed Objects

In this clause the following Managed Objects are defined:

the Resource TypeId managed object;
the Scanner managed object;
the Exponentially Weighted Moving Average Metric Monitor managed object.

The Parameters, Name Bindings, Packages, Attributes and Behaviours are defined together with the Managed Object.

NOTE — In IEEE 802.1F all the names of the Managed Objects, Packages, Behaviours, Attributes, Name Bindings and Parameters starts with o, p, b, a, nb and p respectively.

In IEEE 802.1F/D13 the Standards name "ISO/IEC 10165-2" is used for DMI.

The allocation of Object Identifiers are taken from IEEE 802.1F

B.4.1 The ResourceTypeId managed object

```
-- The resourceTypeId managed object class can be used within IEEE 802 LAN/MAN resources to
-- identify information about the managed system. This managed object can be used to identify
-- any resource within a LAN/MAN system. The information is provided by the manufacturer,
-- however, and is read-only. Support of the resourceTypeId managed object is strongly recommended.

resourceTypeId MANAGED OBJECT CLASS
DERIVED FROM "DMI":top;
CHARACTERIZED BY resourceTypeId-P PACKAGE
    ATTRIBUTES
        resourceTypeIdName GET,
        resourceInfo GET;;;
REGISTERED AS {IEEE802CommonDefinitions.partf managedObjectClass(3) resourcetypeid(0)};
```

-- Name Bindings

```
resourceTypeId-ILCDLE-Automatic NAME BINDING
SUBORDINATE OBJECT CLASS resourceTypeId AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS ILCDLE AND SUBCLASSES;
WITH ATTRIBUTE resourceTypeIdName;
BEHAVIOUR resourceTypeId-ILCDLE-Automatic-B BEHAVIOUR
    DEFINED AS
        The name binding which applies when a resourceTypeId managed object (or
        an instance of a subclass of the resourceTypeId class) is created automatically
        by the operation of the system as a subordinate object of an ILCDLE
        managed object (or subclass), and deleted automatically.;;
REGISTERED AS {DLM.nboi resourceTypeId-ILCDLE-Automatic(11)};


resourceTypeId-mACDLE-Automatic NAME BINDING
SUBORDINATE OBJECT CLASS resourceTypeId AND SUBCLASSES;
NAMED BY
```

SUPERIOR OBJECT CLASS mACDLE AND SUBCLASSES;
WITH ATTRIBUTE resourceTypeIdName;
BEHAVIOUR resourceTypeId-mACDLE-Automatic-B BEHAVIOUR
   DEFINED AS
      The name binding which applies when a resourceTypeId managed object (or
      an instance of a subclass of the resourceTypeId class) is created automatically
      by the operation of the system as a subordinate object of a mACDLE
      managed object (or subclass), and deleted automatically.;;
REGISTERED AS {DLM.nboi resourceTypeId-mACDLE-Automatic(12)};

-- Note: In EEEEI 802.1F there is only one Name Binding,
-- REGISTERED AS {IEEE802CommonDefinitions.partf nameBinding(6) resourcetypeid-system(0)}.

--Attributes

resourceTypeIdName ATTRIBUTE
WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.ResourceTypeIdName;
MATCHES FOR EQUALITY;
BEHAVIOUR resourceTypeIdName-B BEHAVIOUR
   DEFINED AS
      Contains the name of the resourceTypeId managed object.
      The attribute is read-only and always contains the value "RTID".
      This attribute shall not be used as a naming attribute for any other managed object class.;;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) restypeidname(1)};

resourceInfo ATTRIBUTE
WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.ResourceInfo;
MATCHES FOR EQUALITY;
BEHAVIOUR resourceInfo-B BEHAVIOUR
   DEFINED AS
      Manufacturer-supplied info describing the resource.
      A structured attribute that specifies:

      ManufacturerOUI. This takes the value of a valid instance of the organisationally unique
      identifier described in section 5.1 of IEEE 802.1 Overview and Architecture.

      ManufacturerName. This identifies the manufacturer of the resource. Global assignment of
      unique strings is outside the scope of this standard.

      ManufacturerProductName. This is the manufacturer-defined product name.

      ManufacturerProductVersion. This is the manufacturer-defined product revision
      designation.;;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) resourceinfo(2)};

B.4.2 The Scanner managed object

-- The scanner managed object class is a superclass from which the eWMAMetricMonitor
-- managed object class is derived. It defines facilities for periodically sampling the value of a
-- specified attribute within a specified object. The scanner managed object class is never
-- instantiated.

scanner MANAGED OBJECT CLASS
DERIVED FROM "DMI":top;
CHARACTERIZED BY scanner-P PACKAGE
   BEHAVIOUR scanner-P-B BEHAVIOUR
      DEFINED AS See "scanner Behaviour".in clause B.3.1.2.;;
   ATTRIBUTES
      "DMI":administrativeState GET-REPLACE,
      "DMI":operationalState GET,
      granularityPeriod GET-REPLACE,
      scannerId GET;;;

CONDITIONAL PACKAGES
    configurationEventsReporting-P PRESENT IF configuration event reporting is supported.;
REGISTERED AS { IEEE802CommonDefinitions.partf managedObjectClass(3) scanner(1) };

-- Packages

configurationEventsReporting-P PACKAGE
BEHAVIOUR configurationEventsReporting-P-B BEHAVIOUR
    DEFINED AS See ,clause B.6.2.2."Configuration Events Reporting Package".;;
NOTIFICATIONS
    "DMI":attributeValueChange,
    "DMI":objectCreation,
    "DMI":objectDeletion,
    "DMI":stateChange;
REGISTERED AS {IEEE802CommonDefinitions.partf package(4) configchangereport(1) };

-- Attributes

granularityPeriod ATTRIBUTE
WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.TimePeriod;
MATCHES FOR EQUALITY, ORDERING;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) granularityperiod(8) };

scannerId ATTRIBUTE
WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.ScannerId;
MATCHES FOR EQUALITY ;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) scannerid(3) };

B.4.3 The Exponentially Weighted Moving Average Metric Monitor managed object

-- The eWMAMetricMonitor managed object class is defined as a subclass of the scanner
-- managed object class. Support of the eWMAMetricMonitor managed object is optional.

eWMAMetricMonitor MANAGED OBJECT CLASS
DERIVED FROM scanner;
CHARACTERIZED BY eWMAMetricMonitor-P PACKAGE
    BEHAVIOUR eWMAMetricMonitor-P-B;
    ATTRIBUTES
        derivedGauge GET-REPLACE derivedGaugeNotCurrent,
        estimateOfMean GET-REPLACE,
        movingTimePeriod GET-REPLACE,
        observedAttributeId GET-REPLACE,
        observedManagedObjectInstance GET-REPLACE,
        severityIndicatingThreshold GET-REPLACE ADD-REMOVE;
    NOTIFICATIONS
        "DMI":qualityofServiceAlarm;;;
CONDITIONAL PACKAGES
    counterDifference-P PRESENT IF "counter to gauge conversion is requested",
    counterOverflow-P PRESENT IF "the counterDifference-P package is present and modulo
        arithmetic is required to calculate the new value of the derived gauge on counter overflow";
REGISTERED AS {IEEE802CommonDefinitions.partf managedObjectClass(3) ewmametricmonitor(2) };

-- Packages

counterDifference-P PACKAGE
BEHAVIOUR counterDifference-P-B;
ATTRIBUTES
    counterTMinusGP GET-REPLACE;
REGISTERED AS {IEEE802CommonDefinitions.partf package(4) counterdifference(0) };

counterOverflow-P PACKAGE
BEHAVIOUR counterOverflow-P-B;

ATTRIBUTES
    counterModulus GET-REPLACE;
REGISTERED AS {IEEE802CommonDefinitions.partf package(4) countermodulus(2) };

-- Behaviours

eWMAMetricMonitor-P-B BEHAVIOUR
    DEFINED AS

See "EWMA Metric Monitor Behaviour" in clause B.3.1.3. for general behaviour of this object. The detailed smoothing algorithm for estimateOfMean is as follows:

The estimate of the mean (estimateOfMean), $\sim V(t)$, is defined to be a weighted moving average of a gauge, $V[t]$. The specified weighting is exponential. The algorithm has the property that more recent event occurrences in the moving time period are "weighted" more heavily than older occurrences. The exponentially weighted moving average (EWMA) is defined by the following recursive algorithm.

$$\sim V[t] = \sim V[t - GP] + GP * (V[t] - \sim V[t - GP]) / T1$$

where

t   is the current value of time,

V[t]   is the value of the gauge (derivedGauge) at time t,

$\sim V[t]$ is the estimate of the mean (estimateOfMean) of the gauge V[t] at time t,

$\sim V[t - GP]$ is the estimate of the mean of the gauge V[t] at time (t -GP), the last estimate of the mean,

GP   is the time between the last observation of V[t] and the current observation constrained to be a positive value larger than zero (granularityPeriod). It is sufficient to have a best effort to make GP a constant value.

T1   is the time constant of the exponentially weighted moving average with the same units as GP. T1 is defined by the equation T1 = (MTP + GP)/2.

MTP   is the moving time period (movingTimePeriod) over which the mean is estimated.

            MTP must be greater than or equal to GP. Therefore the value of T1 is greater than or equal to GP.

            When GP = MTP the calculated mean value for the gauge becomes the current gauge value, i.e. $\sim V[t] = V[t]$.

            Both GP and MTP can be reset by the managing system. The mean time period, T1, can be chosen to be integer multiples of the granularity period, GP.

            The initial condition (or reset condition) of the EWMA of the estimated mean is provided by setting the estimateOfMean attribute.

            The units of $\sim V[t]$ are the same as the units of the gauge to which the estimate of the mean is applied. ;

counterDifference-P-B BEHAVIOUR
    DEFINED AS

$$V[t] = [counter[t] - counter[t-GP]]$$

where

V[t]   is the difference between successive observations of the counter,

counter[t]   is the value of the counter at the current time t (not saved in any attribute),

counter[t-GP]   is the previous value of the counter at time t-GP (i.e., counterTMinusGP),

GP   is the sampling interval in units of time (Granularity Period),

The initial value of counter[t-GP] determines the initial difference value.

Whenever the metric object transitions from locked to unlocked status, the first scan is treated in a special manner.

    On first scan
        counter[t-GP] <- observed counter
        derivedGauge <- unspecified, if retrieved returns error parameter
pDerivedGaugeNotCurrent
        estimateOfMean <- either as initialized or value when last locked

    On second and subsequent scans
        read observed counter
        derivedGauge <- observed counter - counter[t-GP]
        counter[t-GP] <- observed counter
        estimate of mean <- results of EWMA summarization function;

severityIndicatingThreshold-B BEHAVIOUR
    DEFINED AS

This attribute type has all the behaviour of a gauge-threshold attribute type, as defined in clause 8.4.2 of ISO/IEC 10165-2. As an enhancement to the syntax of the gauge-Threshold attribute type it adds an optional severityIndication parameter to the syntax of both the notifyHigh and notifyLow submembers within each threshold level member. This attribute type has additional behaviour associated with these optional perceivedSeverity indication parameters, which is defined as follows:

- If the notify-high's switch is on, the notify-high's severityIndication value shall be reported in the perceivedSeverity parameter of any notification triggered by the gauge value crossing the notify-high's gaugeThreshold value in the positive going direction.

- If the notify-low's switch is on, the notify-low's severityIndication value shall be reported in the perceivedSeverity parameter of any notification triggered by the gauge value crossing the notify-low's gaugeThreshold value in the negative going direction.

If both switches are on for a single thresholdLevel, one of the severityIndication values shall be "clear".;

counterOverflow-P-B BEHAVIOUR
    DEFINED AS

The gauge value derived (V[t]) is calculated using the following method:

    If [counter[t] - counter[t-GP]] is positive

        V[t] is evaluated as defined in bCounterDifference behaviour

    If [counter[t] - counter[t-GP]] is negative

        V[t] = [counter[t] - counter[t-GP] + modulus value].

If the value of the modulus value attribute is zero the actual modulus value used to evaluate V[t] is a local matter.;

-- Name Bindings

eWMAMetricMonitor-ILCDLE-Management NAME BINDING
SUBORDINATE OBJECT CLASS eWMAMetricMonitor AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS ILCDLE AND SUBCLASSES;
WITH ATTRIBUTE scannerId;
BEHAVIOUR eWMAMetricMonitor-ILCDLE-Management-B BEHAVIOUR
   DEFINED AS See "scanner Behaviour" in clause B.3.1.2 and "eWMAMetricMonitor Behaviour" in
     clause B.3.1.3 ;;
CREATE
 WITH-REFERENCE-OBJECT,
 WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi eWMAMetricMonitor-ILLCDLE-Management(13)};

eWMAMetricMonitor-mACDLE-Management NAME BINDING
SUBORDINATE OBJECT CLASS eWMAMetricMonitor AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS mACDLE AND SUBCLASSES;
WITH ATTRIBUTE scannerId;
BEHAVIOUR eWMAMetricMonitor-mACDLE-Management-B BEHAVIOUR
   DEFINED AS See "scanner Behaviour" in clause B.3.1.2 and "eWMAMetricMonitor Behaviour" in
     clause B.3.1.3;;
CREATE
 WITH-REFERENCE-OBJECT,
 WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
 ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {DLM.nboi eWMAMetricMonitor-mACDLE-Management(14)};

-- Note: In IEEEE 802.1F there is only one Name Binding,
-- REGISTERED AS {IEEE802CommonDefinitions.partf nameBinding(6) ewmametricmonitor-system(1)}.

-- **Attributes**

counterTMinusGP ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) countertminusgp(4) };

-- Note: In IEEE 802.1F "DERIVED FROM" refers to "DMI: counter" instead.

counterModulus ATTRIBUTE
DERIVED FROM "GMI":nonWrapping64BitCounter;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) countermodulus(5) };

-- Note: In IEEE 802.1F "DERIVED FROM" refers to "DMI: counter" instead.

derivedGauge ATTRIBUTE
DERIVED FROM "DMI":gauge;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) derivedGauge(6) };

estimateOfMean ATTRIBUTE
DERIVED FROM "DMI":gauge;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) estimateofmean(7) };

observedAttributeId ATTRIBUTE
WITH ATTRIBUTE SYNTAX DLM.AttributeId;
MATCHES FOR EQUALITY;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) observedattributeid(9) };

-- Note: In IEEE 802.1F "WITH ATTRIBUTE SYNTAX" refers to "ISO/IEC 9596-1:1991,CMIP" instead.

observedManagedObjectInstance ATTRIBUTE

WITH ATTRIBUTE SYNTAX DLM.ObjectInstance;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) observedmanagedobjectinstance(10) };

-- Note: In IEEE 802.1F "WITH ATTRIBUTE SYNTAX" refers to "ISO/IEC 9596-1:1991,CMIP" instead.

severityIndicatingThreshold ATTRIBUTE
WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.SeverityIndGaugeThreshold ;
MATCHES FOR EQUALITY ;
BEHAVIOUR severityIndicatingThreshold-B;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) severityindicatingthreshold(11) };

movingTimePeriod ATTRIBUTE
WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.TimePeriod;
MATCHES FOR EQUALITY, ORDERING;
REGISTERED AS {IEEE802CommonDefinitions.partf attribute(7) movingtimeperiod(12) };

-- Parameters

derivedGaugeNotCurrent PARAMETER
CONTEXT SPECIFIC-ERROR;
WITH SYNTAX IEEE802CommonDefinitions.DerivedGaugeNotCurrentType;
BEHAVIOUR derivedGaugeNotCurrent-B BEHAVIOUR
    DEFINED AS
        Derived gauge set to an inconsistent value. May occur during the first scan interval after
        transitioning to the unlocked state or when the counter difference derives a negative value.
        The syntax of the parameter permits the recipient of the operation to return the values of all
        attributes referenced by the Set operation.;;
REGISTERED AS {IEEE802CommonDefinitions.partf parameter(5) derivedgaugenotcurrent(0) };

B.5 ASN.1 Module

IEEE802CommonDefinitions
{ iso(1) member-body(2) us(840) ieee802dot1partf(10011) asn1Module(2) commondefinitions(0) version1(0)}
DEFINITIONS IMPLICIT TAGS ::=
BEGIN
IMPORTS SetInfoStatus,AttributeId FROM CMIP-1 {joint-iso-itu ms(9) cmip(1) modules(0) protocol(3)}
            GroupObjects, ObservedValue,PerceivedSeverity FROM
Attribute-ASN1Module {joint-iso-itu ms(9) smi(3) part2(2) asn1Module(2) 1};

-- Note: In this standard, the identifier joint-iso-itu is used as a synonym for the identifier joint-iso-ccitt and has
-- the same value (2), defined in ISO/IEC 8824.

-- EXPORTS everything

-- Note: This clause includes ASN.1 definitions specific to Annex B.

DerivedGaugeNotCurrentType ::= SEQUENCE {
    currentTime   [5] IMPLICIT GeneralizedTime OPTIONAL,
    setInfoList   [6] IMPLICIT SET OF SetInfoStatus }

ManufacturerOUI ::= OCTET STRING

-- ManufacturerOUI takes the value of an Organisationally Unique Identifier, as defined in
-- section 5.1 of IEEE 802.1 Overview and Architecture. When encoded as an
-- OCTET STRING, the encoding of the value field of the OCTET STRING shall comply with
-- the representation defined in section 5.1.2 of the Overview and Architecture. Inasmuch as
-- multiple OUI assignments are possible for a given manufacturer and no public registry of
-- such assignments exists, methods for application of the OUI as a globally unique
-- manufacturer identifier is outside the scope of this standard.

ManufacturerName ::= PrintableString