

IEEE Standards for Local and Metropolitan Area Networks:

Common Definitions and Procedures for IEEE 802 Management Information

Sponsor

**Technical Committee on Computer Communications
of the
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Abstract: Management information and procedures applicable across the entire family of IEEE 802 LAN/MAN standards within the architectural framework for LAN/MAN Management specified in IEEE Std 802-1990 are identified. Common management information, such as attributes to represent MAC address and managed objects to represent configurable gauges, are specified. The need of developers of LAN/MAN management specifications for common procedures to develop, describe, and register management information is addressed.

Keywords: local area networks, management; metropolitan area networks, management

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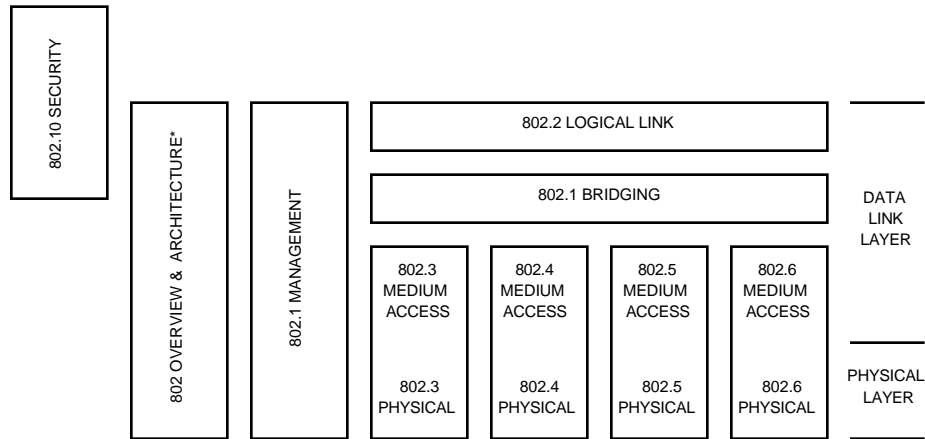
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Introduction

(This introduction is not a part of IEEE Std 802.1F-1993, IEEE Standards for Local and Metropolitan Area Networks: Common Definitions and Procedures for IEEE 802 Management Information.)

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



* Formerly IEEE Std 802.1A.

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

The standards defining these technologies are as follows:

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

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

- ISO 8802-2 [ANSI/IEEE Std 802.2]: Logical Link Control
- ISO/IEC 8802-3 [ANSI/IEEE Std 802.3]: CSMA/CD Access Method and Physical Layer Specifications
- ISO/IEC 8802-4 [ANSI/IEEE Std 802.4]: Token Bus Access Method and Physical Layer Specifications
- ISO/IEC 8802-5 [ANSI/IEEE Std 802.5]: Token Ring Access Method and Physical Layer Specifications
- IEEE Std 802.6 [ISO/IEC DIS 8802-6]: Metropolitan Area Network Access Method and Physical Layer Specifications
- IEEE Std 802.10: Interoperable Local Area Network (LAN) Security, *Currently Contains* Secure Data Exchange (SDE)

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

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

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

Conformance test methodology

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

802.1F-1993

This standard defines common management information types and procedures. It also provides guidance to developers of standards for management information related to IEEE 802 LAN/MAN technologies with respect to the appropriate techniques and notational conventions that should be applied when defining such information for use with ISO/IEC 15802-2 [ANSI/IEEE Std 802.1B-1992 and IEEE Std 802.1k-1993], LAN/MAN Management, or ISO/IEC 9596-1 : 1991, Common Management Information Protocol (CMIP).

This standard contains state-of-the-art material. The area covered by this standard is undergoing rapid evolution; revisions are anticipated to this standard within the next two years to clarify existing material and to incorporate new related material. Information on the current revision state of this standard may be obtained from

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IEEE Standards for Local and Metropolitan Area Networks: Common Definitions and Procedures for IEEE 802 Management Information

1. Overview

This standard identifies management information and procedures applicable across the entire family of IEEE 802 LAN/MAN standards within the architectural framework for LAN/MAN Management specified in IEEE Std 802-1990.¹ It specifies common management information, such as attributes to represent MAC addresses and managed objects to represent configurable gauges. It also addresses the need of developers of LAN/MAN management specifications for common procedures to develop, describe, and register management information.

Development of management specifications that permit remote management of resources in a communications environment involves coordinated activity of many independent developers, in international standards bodies, implementors' workshops, vendor organizations, etc. There is a danger that this will result in specifications that are inconsistent, incomplete, and inefficient. The goal of this document is therefore to provide both common definitions and common procedures to avoid inconsistency and duplication of effort in IEEE 802 LAN/MAN standards.

IEEE 802 LAN/MAN management information is based upon the following:

- a) The architectural framework for LAN/MAN management as described in IEEE Std 802-1990 (See Note below), and further refined in ISO/IEC DIS 15802-2;

NOTE—Current work is under way to refine the description of the management architecture for the IEEE 802 family of standards that is contained in IEEE Std 802-1990.

- b) Managed objects and management information as described in ISO/IEC 10165-1 : 1992;
- c) Notational techniques for defining managed objects as described in ISO/IEC 10165-4 : 1992; and
- d) The generic definitions contained in ISO/IEC 10165-2 : 1992.

To this base material, this standard adds common definitions and procedures that apply to development of managed object definitions in the LAN/MAN environment.

¹Information on references can be found in clause 3.

2. Scope

This standard provides the following two types of information to the developers of layer-, sublayer-, or resource-specific management specifications:

- a) Definition of common management information such as attributes, managed object classes, packages, behaviours, and encodings of information used by LAN/MAN Management.
- b) Common procedures required for specification of LAN/MAN Management, such as relationships to other common management information specifications and methods for registering management information within IEEE 802 standards.

This standard provides assistance and guidance to the developers of LAN/MAN management specifications that will

- Reduce duplication of effort by identifying commonly useful definitions and procedures.
- Encourage consistency between such specifications.
- Encourage the development of such specifications in a manner that will ensure compatibility with LAN/MAN Management specifications (ISO/IEC DIS 15802-2, ISO/IEC 8802-3 Amendment 11, and ISO 7498 : 1984) and with ISO/IEC 9595 : 1991 and 9596-1 : 1991.

To this end, this standard specifies the following:

- A set of definitions of commonly useful managed object and attribute types that build upon the generic definitions contained in DMI.
- The use of the Structure of Management Information (SMI) standards (ISO/IEC 10165-1 : 1992, 10165-2 : 1992, and 10165-4 : 1992) as the basis for the definition of management information and managed objects in a LAN/MAN environment.
- Procedures to be used in defining and registering management information within IEEE 802 LAN/MAN standards.

An informative annex is also included with guidelines toward recommended common approaches to be used for the documentation of LAN/MAN Management specifications.

This standard does not constrain the development of layer-specific management specifications.

This standard is applicable to the development of IEEE 802 management specifications that define the following:

- Management information that is to be transferred or manipulated by means of management protocol, in particular, that which is specified in ISO/IEC 15802-2 and ISO/IEC 9596-1 : 1991.
- The managed objects to which that information relates.

NOTE—Although the target audience for this standard is developers of managed object definitions relevant to LAN/MAN technologies, the information contained herein may also be of relevance to members of other communities.

3. References

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

ANSI ISSB990, Procedures for Registering Names for American National Standards Notation One (ASN.1).²

IEEE Std 802-1990, IEEE Standards for Local and Metropolitan Area Networks: Overview and Architecture (ANSI).³

ISO 7498 : 1984, Information processing systems—Open Systems Interconnection—Basic Reference Model.⁴

ISO/IEC 7498-4 : 1989, Information processing systems—Open Systems Interconnection—Basic Reference Model—Part 4: Management Framework.

ISO/IEC 8802-3 Amendment 11 [ANSI/IEEE Std 802.3k-1992], Information technology—Local and metropolitan area networks—Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications—Layer management for 10 Mbit/s baseband repeaters.

ISO/IEC DIS 8802-6...⁵ [ANSI/IEEE Std 802.6-1990], Information technology—Local and metropolitan area networks—Part 6: Distributed queue dual bus (DQDB) subnetwork of a metropolitan area network (MAN).

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

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

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

ISO/IEC 10040 : 1992, Information technology—Open Systems Interconnection—Systems management overview.

ISO/IEC 10164-1 : 1992, Information technology—Open Systems Interconnection—Systems management—Part 1: Object Management Function.

ISO/IEC 10164-2 : 1992, Information technology—Open Systems Interconnection—Systems management—Part 2: State Management Function.

²ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036-8002, USA.

³IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

⁴ISO and ISO/IEC publications are available from the ISO Central Secretariat, 1 rue de Varembé, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse.

⁵Presently at state of draft International standard.

ISO/IEC 10164-3 : 1992, Information technology—Open Systems Interconnection—Systems management—Part 3: Attributes for Representing Relationships.

ISO/IEC 10164-4 : 1992, Information technology—Open Systems Interconnection—Systems management—Part 4: Alarm Reporting Function.

ISO/IEC 10164-5 : 1992, Information technology—Open Systems Interconnection—Systems management—Part 5: Event Report Management Function.

ISO/IEC 10164-6 : 1992, Information technology—Open Systems Interconnection—Systems management—Part 6: Log Control Function.

ISO/IEC 10164-7 : 1992, Information technology—Open Systems Interconnection—Systems management—Part 7: Security Alarm Reporting Function.

ISO/IEC 10164-8 : 1993, Information technology—Open Systems Interconnection—Systems management—Part 8: Security Audit Trail Function.

ISO/IEC DIS 10164-9..., Information technology—Open Systems Interconnection—Systems management—Part 9: Objects and Attributes for Access Control.

ISO/IEC DIS 10164-10..., Information technology—Open Systems Interconnection—Systems management—Part 10: Accounting Meter Function.

ISO/IEC DIS 10164-11..., Information technology—Open Systems Interconnection—Systems management—Part 11: Workload Monitoring Function.

ISO/IEC DIS 10164-13..., Information technology—Open Systems Interconnection—Systems management—Part 13: Summarization Function.

ISO/IEC 10165-1 : 1992, Information technology—Open Systems Interconnection—Management information services—Structure of management information—Part 1: Management Information Model.

ISO/IEC 10165-2 : 1992, Information technology—Open Systems Interconnection—Management information services—Structure of management information—Part 2: Definition of management information.

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

ISO/IEC DIS 15802-2... [ANSI/IEEE Std 802.1B-1992 and IEEE Std 802.1k-1993], Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Common specifications—Part 2: LAN/MAN management, service and protocol.

4. Definitions

4.1 Basic Reference Model definitions

This standard makes use of the following terms defined in ISO 7498 : 1984:

- a) (N)-connection
- b) (N)-entity
- c) (N)-layer
- d) (N)-protocol
- e) (N)-sap
- f) open system
- g) systems management

4.2 Management Framework definition

This standard makes use of the following term defined in ISO/IEC 7498-4 : 1989:

- a) managed object

4.3 Systems Management Overview definitions

This standard makes use of the following terms defined in ISO/IEC 10040 : 1992:

- a) agent
- b) layer management protocol
- c) managed object class
- d) management information
- e) manager
- f) notification
- g) notification type
- h) (systems management) operation
- i) system managed object
- j) systems management protocol

4.4 Structure of Management Information (SMI) Information Model definitions

This standard makes use of the following terms defined in ISO/IEC 10165-1 : 1992:

- a) abstract datatype
- b) attribute type
- c) behaviour
- d) containment
- e) encapsulation
- f) inheritance
- g) inheritance hierarchy
- h) managed object boundary
- i) name binding
- j) (conditional) package
- k) subclass
- l) subordinate object

- m) superclass
- n) superior object

4.5 Common Management Information Service (CMIS) definitions

This standard makes use of the following terms defined in ISO/IEC 9595 : 1991:

- a) attribute
- b) Common Management Information Services

4.6 Abstract Syntax Notation One (ASN.1) definitions

This standard makes use of the following terms defined in ISO/IEC 8824 : 1990:

- a) object identifier
- b) type

4.7 Guidelines for the Definition of Managed Objects (GDMO) definitions

This standard makes use of the following terms defined in ISO/IEC 10165-4 : 1992:

- a) managed object class definition
- b) template

4.8 LAN/MAN Management definitions

This standard makes use of the following terms defined in ISO/IEC DIS 15802-2, ISO/IEC 8802-3 Amendment 11, and ISO 7498 : 1984:

- a) LAN/MAN Management

4.9 Exponentially Weighted Moving Average (EWMA) metric monitor definitions

This standard defines the following terms for use in the EWMA metric monitor managed object definition:

4.9.1 granularity period: As defined in ISO/IEC DIS 10164-11, the time between observations. For this standard, it is the time between two successive scans and is denoted by the symbol “GP.”

4.9.2 numeric attribute: An attribute whose value may be either integer or real.

4.9.3 observed attribute: An attribute of a managed object whose value is being observed by an EWMA metric managed object.

4.9.4 observed managed object: A managed object with one or more observed attributes.

NOTE—In this standard, only a single attribute is ever observed.

4.9.5 scan: A sampling process of observing attribute values at a specified point in time.

NOTE—In this standard, only a single attribute value is ever scanned.

4.9.6 metric: A value calculated from observed attribute values.

4.9.7 metric attribute: An attribute of a metric managed object whose value is either used as a parameter of one or more metric algorithms or whose value represents the output of such an algorithm.

4.9.8 metric algorithm: The behaviour of a metric managed object that models a formalized process to calculate specified results.

4.9.9 metric managed object: A managed object that contains at least one metric attribute whose value is calculated from values of attributes observed in managed objects.

4.9.10 monitoring: That aspect of performance management concerned with tracking the system activities in order to gather the appropriate data for determining performance.

4.9.11 rate: The change in a value over a specified period of time.

NOTE—Instantaneous rate is the derivative of the value with respect to time and cannot generally be measured. The measured rate approaches the instantaneous rate as the specified period of time approaches zero.

4.9.12 derived gauge: The computed difference between values of a counter type attribute sampled in successive scan intervals.

4.9.13 EWMA (exponentially weighted moving average) algorithm: A specific metric algorithm whose behaviour emphasizes recent observation values and that can also, depending upon initialization, transparently pass through the behaviour of the observed gauge or derived gauge type attribute.

NOTE—The EWMA algorithm specified by this standard is defined in annex A, A.7.

4.10 Abbreviations and acronyms

The following acronyms and abbreviations are used in this standard:

ASN.1	Abstract Syntax Notation One
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CPDU	Convergence Protocol Data Unit
DIS	Draft International Standard
DMI	Definition of Management Information
EWMA	Exponentially Weighted Moving Average
GDMO	Guidelines for the Definition of Managed Objects
LAN	Local Area Network
LLC	Logical Link Control
MAC	Media Access Control
MAN	Metropolitan Area Network
OSI	Open Systems Interconnection
OUI	Organizationally Unique Identifier
PDU	Protocol Data Unit
QOS	Quality of Service
SMI	Structure of Management Information

5. Concepts of management information and managed objects

This standard assumes the concepts of management information and managed objects as expressed in ISO/IEC 10165-1 : 1992 and ISO/IEC 10165-4 : 1992.

6. Common models

6.1 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; however, the information is provided by the manufacturer and is read-only.

6.1.1 Containment of resource type managed object

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

NOTE—This standard defines a name binding that permits an instance of the resource type managed object class to be contained within instances of “ISO/IEC 10165-2”:system.

6.2 MAC address attribute

A common representation for MAC address attributes is specified by this standard. Consistent with 5.2.2 of IEEE Std 802-1990, 48-bit MAC addresses have a fixed length of 6 octets.

Consistent with 6.5.1.2.1.2 of ISO/IEC DIS 8802-6, 60-bit MAC addresses have a fixed length of 8 octets. For purposes of this standard, a hexadecimal display representation is defined for 60-bit addresses, AB-CD-EF-GH-IJ-KL-MN-OP. Each symbol, “A,” “B,” etc., represents a 4-bit hexadecimal digit. The leftmost hexadecimal digit, “A,” represents the 4-bit address type field. The remaining 15 hexadecimal digits, “B” through “P,” represent the 60-bit MAC address, as defined in ISO/IEC DIS 8802-6.

NOTE—As in the 48-bit display representation used in IEEE Std 802-1990, this 60-bit display representation is not the form of the MAC address attribute, but is used only to map the 4-bit hexadecimal digits of the 60-bit MAC address to the bits of the MAC address attribute.

Since the MAC address attribute is represented by a fixed length octet string, the MAC address type (48 bit vs. 60 bit) can be determined by examining the attribute value. 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.

6.3 EWMA metric monitor managed object

The EWMA metric monitor managed object can be used within IEEE 802 LAN/MAN managed systems. This managed object is used to observe any attribute that 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 equal 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 notifica-

tion 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.

6.3.1 Model for EWMA metric monitor

The EWMA metric monitor monitors 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. In any case, the observed attribute is not affected and may still be used independently. 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 : 1992).

6.3.2 Properties of EWMA metric monitor managed objects

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

- a) The identification of the EWMA metric monitor managed object;
- b) The identification of a managed object to be monitored and its attribute to be observed;
- c) The frequency of observations;
- d) The indication of the result value of the observations; and
- e) 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.

6.3.3 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 8.4.2 of ISO/IEC 10165-2 : 1992. 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 notifyHigh and notifyLow switch, which can be used to implement hysteresis. The threshold can be set up 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.”

6.3.4 Relationship of EWMA metric monitor managed objects to other managed objects

6.3.4.1 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 object 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.

6.3.4.2 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.

NOTE—This standard defines a name binding that permits instances of the EWMA metric monitor managed object class to be contained within instances of “ISO/IEC 10165-2”:system.

7. Generic definitions

7.1 Managed objects

NOTE—The convention used for assigning GDMO labels for management information defined by this standard, e.g., oResourceTypeID, is given in annex D, D.2.4.9.

7.1.1 Resource Type ID managed object class (oResourceTypeID)

The Resource Type ID 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; however, the information is provided by the manufacturer and is read-only. No restrictions are placed upon the containment hierarchy for this class.

7.1.1.1 Resource Type ID behaviour

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

7.1.1.2 Attributes of Resource Type ID

7.1.1.2.1 Resource Type ID name (aResourceTypeIDName)

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

7.1.1.2.2 Resource info (aResourceInfo)

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

7.1.2 Scanner managed object class (oScanner)

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:

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

NOTE—The scanner managed object has been retained as a separate class in this standard in order to provide consistency with the scanner managed object defined in ISO/IEC DIS 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.

7.1.2.1 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 1—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 the administrative state has the value "unlocked," the scanner is ready to perform scans. If the 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.

NOTE 2—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.

NOTE 3—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.

7.1.2.2 Attributes of scanner

7.1.2.2.1 Scanner ID (aScannerID)

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

7.1.2.2.2 Operational state (operationalState)

This attribute defines the operational state of the managed object as defined in ISO/IEC 10164-2 : 1992.

7.1.2.2.3 Administrative state (administrativeState)

This attribute represents the administrative state of the metric managed object as defined in ISO/IEC 10164-2 : 1992. 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.

7.1.2.2.4 Granularity period (aGranularityPeriod)

This attribute represents the time between scans.

7.1.3 EWMA metric monitor managed object class (oEWMAMetricMonitor)

To report events, the EWMA metric monitor managed object uses the Alarm Reporting Service defined in ISO/IEC 10164-4 : 1992.

Attribute values of managed objects can be read or modified in accordance with the operations described in ISO/IEC 10165-1 : 1992.

The EWMA metric monitor managed object class is defined as a subclass of the scanner managed object class.

The EWMA metric monitor managed object class monitors the values of a gauge or counter type attribute of an observed managed object. The presence or absence 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.

7.1.3.1 EWMA metric monitor behaviour

An attribute to be observed is specified by the `aObservedAttributeID` of the managed object identified by `aObservedManagedObjectInstance`.

This observed attribute is monitored at intervals specified by the `granularityPeriod`. 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 is 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 are 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* four messages per minute.

An estimate of the mean of the derived gauge attribute (`estimateOfMean`) is calculated using the 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 be 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:

- a) The scanner ID, observed managed object instance, observed attribute ID.
- b) The granularity period (i.e., time between observations of the observed attribute).
- c) 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).

- d) The moving time period required by the EWMA algorithm.
- e) 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 and the 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 administrative 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.

7.1.3.2 Attributes of EWMA metric monitor

7.1.3.2.1 Observed managed object instance (aObservedManagedObjectInstance)

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

7.1.3.2.2 Observed attribute identifier (aObservedAttributeIdentifier)

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

7.1.3.2.3 Derived gauge (`aDerivedGauge`)

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 the value of this attribute is the difference between successive observations of the observed attribute.

7.1.3.2.4 Estimate of mean (`aEstimateOfMean`)

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 initializing the algorithm. The attribute may be modified after creation of the managed object in order to reinitialize the EWMA algorithm.

7.1.3.2.5 Severity indicating gauge threshold (`aSeverityIndicatingGaugeThreshold`)

This attribute contains the threshold levels that are to be applied to the estimate of mean attribute. It shall be initialized when the managed object is created and may be modified.

7.1.3.2.6 Moving time period (`aMovingTimePeriod`)

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

NOTE—The choice of time units for moving time period may 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.

7.2 Packages

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

7.2.1 Counter difference package (`pCounterDifference`)

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 that 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.

7.2.1.1 Counter difference behaviour

See annex A for detailed behaviour definition.

7.2.1.2 Counter difference attributes

7.2.1.2.1 Counter T minus GP (aCounterTMinusGP)

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 initialized upon creation if the observed attribute is a counter.

7.2.2 Configuration events reporting package (pConfigEventsReporting)

The configuration events reporting package contains no attributes.

This package contains the following notifications:

- a) State change,
- b) Attribute value change,
- c) Object creation, and
- d) Object deletion.

7.2.2.1 Configuration events reporting behaviour

If the scanner managed object (or any subclass that is derived from scanner) is created or deleted, a notification shall be generated. If a change is detected in the administrative state (in this specification 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.

7.2.2.2 Configuration events reporting attributes

The configuration events reporting package has no attributes.

7.2.3 Counter overflow package (pCounterOverflow)

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

7.2.3.1 Counter overflow attributes

The counter overflow package contains the following attribute.

7.2.3.1.1 Counter modulus (aCounterModulus)

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

7.2.3.2 Counter overflow behaviour

See annex A for detailed behaviour definition.

7.3 Use of quality of service (QOS) alarm notification

Parameters corresponding to alarm information in the Alarm Reporting Service (see ISO/IEC 10164-4 : 1992) and their semantics are presented in table 1. These parameters shall be present in the notification unless otherwise stated.

Table 1—Alarm reporting service

Parameter	Semantic
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.

Annex A Common managed objects

(normative)

This annex provides the definitive statement of registration values as required by annex C, C.4.3.

A.1 Managed object class definitions

```
oResourceTypeID MANAGED OBJECT CLASS
  DERIVED FROM "ISO/IEC 10165-2":top ;
  CHARACTERIZED BY
    pResourceTypeID PACKAGE
      ATTRIBUTES
        aResourceTypeIDName    GET,
        aResourceInfo          GET;
      ;
;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) managedObjectClass(3)
  resourcetypid(0)};

oScanner MANAGED OBJECT CLASS
  DERIVED FROM "ISO/IEC 10165-2":top;
  CHARACTERIZED BY
    pScanner PACKAGE
      BEHAVIOUR
        bScanner BEHAVIOUR
          DEFINED AS "See 7.1.2.1, Scanner behaviour";
      ATTRIBUTES
        aScannerID              GET,
        "ISO/IEC 10165-2":administrativeState GET-REPLACE,
        aGranularityPeriod      GET-REPLACE,
        "ISO/IEC 10165-2":operationalState   GET;;
  CONDITIONAL PACKAGES
    pConfigEventsReporting
      PRESENT IF "configuration event reporting is supported"
;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) managedObjectClass(3)
  scanner(1)};

oEWMAMetricMonitor MANAGED OBJECT CLASS
  DERIVED FROM oScanner;
  CHARACTERIZED BY
    pEWMAMetricMonitor PACKAGE
      BEHAVIOUR bEWMAMetricMonitor;
      ATTRIBUTES
        aObservedManagedObjectInstance GET-REPLACE,
        aObservedAttributeID GET-REPLACE,
        aDerivedGauge GET-REPLACE pDerivedGaugeNotCurrent,
        aEstimateOfMean GET-REPLACE,
        aMovingTimePeriod GET-REPLACE,
        aSeverityIndicatingThreshold GET-REPLACE ADD-REMOVE
      ;
      NOTIFICATIONS
        "ISO/IEC 10165-2" : qualityOfServiceAlarm;
;
;
  CONDITIONAL PACKAGES
    pCounterDifference    PRESENT IF "counter to gauge conversion is
      requested",
    pCounterOverflow      PRESENT IF "the pCounterDifference package is present
      and modulo arithmetic is required to calculate the new value of the derived gauge
      on counter overflow"
;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) managedObjectClass(3)
  ewmametricmonitor(2)};
```

A.2 Parameters

pDerivedGaugeNotCurrent PARAMETER

```
CONTEXT SPECIFIC-ERROR;
WITH SYNTAX IEEE802CommonDefinitions.DerivedGaugeNotCurrentType;
BEHAVIOUR
  bDerivedGaugeNotCurrent 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 ref-
      erenced by the Set operation.";
```

```
;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) parameter(5)
  derivedgaugecurrent(0)};
```

A.3 Name bindings

nbResourceTypeID-system NAME BINDING

```
SUBORDINATE OBJECT CLASS oResourceTypeID AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS
  "ISO/IEC 10165-2":system;
WITH ATTRIBUTE aResourceTypeIDName;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) nameBinding(6)
  resourcetypeid-system(0)};
```

nbEWMAMetricMonitor-system NAME BINDING

```
SUBORDINATE OBJECT CLASS oEWMAMetricMonitor AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS
  "ISO/IEC 10165-2":system;
WITH ATTRIBUTE aScannerID;
BEHAVIOUR
  bNBewmaMetricMonitor BEHAVIOUR
    DEFINED AS "See 7.1.2.1, Scanner behaviour, and 7.1.3.1, EWMA metric
    monintor behaviour";;
CREATE
  WITH-REFERENCE-OBJECT,
  WITH-AUTOMATIC-INSTANCE-NAMING;
DELETE
  ONLY-IF-NO-CONTAINED-OBJECTS;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) nameBinding(6)
  ewmametricmonitor-system(1)};
```

A.4 Package definitions

pCounterDifference PACKAGE

```
BEHAVIOUR bCounterDifference;
ATTRIBUTES
  aCounterTMinusGP GET-REPLACE;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) package(4)
  counterdifference(0)};
```

pConfigEventsReporting PACKAGE

```
BEHAVIOUR
  bConfigChangeReport BEHAVIOUR DEFINED AS "see 7.2.2.1, Configuration events
  reporting behaviour";;
NOTIFICATIONS
  "ISO/IEC 10165-2":stateChange,
  "ISO/IEC 10165-2":attributeValueChange,
  "ISO/IEC 10165-2":objectCreation,
  "ISO/IEC 10165-2":objectDeletion;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) package(4)
  configchangereport(1)};
```

```
pCounterOverflow PACKAGE
    BEHAVIOUR bCounterOverflow;
    ATTRIBUTES
        aCounterModulus      GET-REPLACE;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) package(4)
    countermodulus(2)};
```

A.5 Attribute definitions

```
aMacAddress ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.MACAddress;
    MATCHES FOR EQUALITY, ORDERING;
    BEHAVIOUR
        bMacAddress          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 6.2, MAC address
                            attribute, for further behaviour
                            definition.;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
    macaddress(0)};
```

```
aResourceTypeIDName ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.ResourceTypeIDName;
    MATCHES FOR EQUALITY;
    BEHAVIOUR bResourceTypeID          BEHAVIOUR
            DEFINED AS      Contains the name of the Resource Type
                            ID managed object. The attribute is
                            read-only and always contains the value
                            "RTID." This attribute value shall not
                            be used as a naming attribute for any
                            other managed object class;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
    restypeidname(1)};
```

```
aResourceInfo ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.ResourceInfo;
    MATCHES FOR EQUALITY;
    BEHAVIOUR
        bResourceInfo        BEHAVIOUR
            DEFINED AS      A structured attribute that specifies:

                            ManufacturerOUI. This takes the value of a valid instance of the organiza-
                            tionally unique identifier described in 5.1 of IEEE Std 802-1990.

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

                            ManufacturerProductName. This is the manufacturer-defined product name.

                            ManufacturerProductVersion. This is the manufacturer-defined product revi-
                            sion designation.;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
    resourceinfo(2)};
```

```
aScannerID ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.ScannerID;
```

```
MATCHES FOR EQUALITY ;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               scannerid(3)};
```

```
aCounterTMinusGP          ATTRIBUTE
    DERIVED FROM "ISO/IEC 10165-2":counter;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               counterminusgp(4)};
```

```
aCounterModulus          ATTRIBUTE
    DERIVED FROM "ISO/IEC 10165-2":counter;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               countermodulus(5)};
```

```
aDerivedGauge            ATTRIBUTE
    DERIVED FROM "ISO/IEC 10165-2":gauge;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               derivedgauge(6)};
```

```
aEstimateOfMean          ATTRIBUTE
    DERIVED FROM "ISO/IEC 10165-2":gauge;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               estimateofmean(7)};
```

```
aGranularityPeriod       ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.TimePeriod;
    MATCHES FOR EQUALITY, ORDERING;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               granularityperiod(8)};
```

```
aObservedAttributeID     ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.AttributeID;
    MATCHES FOR EQUALITY;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               observedattributeid(9)};
```

```
aObservedManagedObjectInstance  ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.ObjectInstance;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               observedmanagedobjectinstance(10)};
```

```
aSeverityIndicatingThreshold  ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.SeverityIndGaugeThreshold ;
    MATCHES FOR EQUALITY ;
    BEHAVIOUR bSeverityIndicatingThreshold;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               severityindicatingthreshold(11)};
```

```
aMovingTimePeriod        ATTRIBUTE
    WITH ATTRIBUTE SYNTAX IEEE802CommonDefinitions.TimePeriod;
    MATCHES FOR EQUALITY, ORDERING;
REGISTERED AS {iso(1)member-body(2) us(840) ieee802dot1partF(10011) attribute(7)
               movingtimeperiod(12)};
```

A.6 Behaviour definitions

bEWMAmetricMonitor BEHAVIOUR
DEFINED AS

See 7.1.3.1, EWMA metric monitor behaviour, 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 1.

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.

;

bCounterDifference 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
```

;

bSeverityIndicatingThreshold BEHAVIOUR
DEFINED AS

This attribute type has all the behaviour of a gauge-threshold attribute type, as defined in 8.4.2 of ISO/IEC 10165-2 : 1992. 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 notifyHigh's switch is on, the notifyHigh's severityIndication value shall be reported in the perceivedSeverity parameter of any notification triggered by the gauge value crossing the notifyHigh's gaugeThreshold value in the positive going direction.
- If the notifyLow's switch is on, the notifyLow's severityIndication value shall be reported in the perceivedSeverity parameter of any notification triggered by the gauge value crossing the notifyLow'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."

;

bCounterOverflow 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.

;

A.7 ASN.1 productions

```

IEEE802CommonDefinitions
    {iso(1) member-body(2) us(840) ieee802dot1partF(10011) asn1Module(2)
      commondefinitions(0) version1(0)} DEFINITIONS IMPLICIT TAGS ::=
BEGIN
    IMPORTS SetInfoStatus FROM CMIP-1 {joint-iso-ccitt ms(9) cmip(1) modules(0)
      protocol(3)};

-- EXPORTS everything

MACAddress      ::= OCTETSTRING      -- Minimum length 6 octets

-- If the MAC address is a 48-bit address the length of the octet string shall be 6 octets.
-- If the MAC address is a 60-bit address the length of the octet string shall be 8 octets.
-- The octet encoding is derived from the hexadecimal display representation order for the
-- MAC address. AB-CD-EF-GH-IJ-KL for the 48-bit address format; AB-CD-EF-GH-IJ-KL-MN-OP
-- for the 60-bit address format. The octets are encoded as follows: The first pair of
-- hexadecimal digits, AB, are encoded in the first octet. The second pair, CD, is encoded
-- in the second octet, etc. (See 6.2, MAC address attribute, for definition of
-- 60-bit hexadecimal display format.)

ResourceInfo    ::= SEQUENCE {
    manufacturerOUI           [0] ManufacturerOUI           OPTIONAL,
    manufacturerName         [1] ManufacturerName          OPTIONAL,
    manufacturerProductName   [2] ManufacturerProductName   OPTIONAL,
    manufacturerProductVersion [3] ManufacturerProductVersion OPTIONAL }

-- ResourceInfo provides a means of indicating, in data readable
-- from a managed object, information that identifies the source of the
-- implementation.

ManufacturerOUI      ::= OCTETSTRING

-- ManufacturerOUI takes the value of an organizationally unique
-- identifier, as defined in 5.1 of IEEE Std 802-1990.
-- When encoded as an OCTETSTRING, the encoding of
-- the value field of the OCTETSTRING shall comply with
-- the representation defined in 5.1.2 of IEEE Std 802-1990.
-- 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    ::= PRINTABLE STRING

-- ManufacturerName is a printable string used to identify the
-- manufacturer of the resource. Global assignment of unique name
-- strings is outside the scope of this standard. Maximum string
-- length is 128 octets.

ManufacturerProductName ::= PRINTABLE STRING

-- ManufacturerProductName is a printable string used to identify the
-- manufacturer's product name of the resource. Maximum string
-- length is 128 octets.

ManufacturerProductVersion ::= PRINTABLE STRING

-- ManufacturerProductVersion is a printable string used to identify the
-- manufacturer's product version of the resource. Maximum string
-- length is 128 octets.

ResourceTypeIDName ::= GRAPHIC STRING {"RTID"}

SeverityIndGaugeThreshold ::= SET OF SEQUENCE {
    severityIndNotifyLow SeverityIndThreshold,
    severityIndNotifyHigh SeverityIndThreshold
}

```



```
SeverityIndThreshold ::= SEQUENCE {
    threshold
    notifyonoff
    severityIndication
}
-- shall be present if notifyonoff is TRUE
```

```
ScannerID ::= GraphicString
```

```
-- A range of time period units from picoseconds to days. No implication
-- is to be inferred as to the degree of resolution required within the implementation of
-- an attribute that is to be represented as a time period. Likewise, no restriction is
-- imposed on the method (i.e., time period units) by which time period is represented
-- within the implementation of a managed object. Implementations are not required to
-- support all time period values.
```

```
TimePeriod ::= CHOICE {
    days          [0] IMPLICIT INTEGER,
    hours         [1] IMPLICIT INTEGER,
    minutes       [2] IMPLICIT INTEGER,
    seconds       [3] IMPLICIT INTEGER,
    millisecs     [4] IMPLICIT INTEGER,
    microsecs     [5] IMPLICIT INTEGER,
    nanosecs      [6] IMPLICIT INTEGER,
    picosecs      [7] IMPLICIT INTEGER
}
```

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

```
END
```

Annex B

Allocation of managed object identifier values for IEEE Std 802.1F-1993

(normative)

B.1 Introduction

This annex contains a summary of all managed object identifier values that have been allocated by this standard, both in this revision and in previous revisions.

Each table shows allocations related to a specific category of information object. The heading of the table identifies the category of information object, and shows the invariant part of the object identifier value allocated to the entries in the table. In cases of discrepancy between an identifier value in an allocation table and in the REGISTERED AS construct of a GDMO template, the template value takes precedence. The column labeled *Arc* shows the value allocated to the arc subsequent to the invariant part, which completes the object identifier value allocated. The column labeled *Purpose* contains a text description of the information object, and, in the case of current allocations, a reference to the location of the definition of the information object in the standard. The column labeled *Status* shows the status of the allocated values, using the following convention:

- R *Reserved.* The object identifier value is reserved for future use by this standard.
- C *Current.* The object identifier value has been allocated to an information object that is defined within the current revision of the standard.
- D *Deprecated.* The object identifier value has been allocated to an information object that was defined in a previous revision of the standard, and whose use is now deprecated.

B.2 Allocation tables

Allocations for standard-specific extension types. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) standardSpecificExtensions (0)}		
ARC	PURPOSE	STATUS
None allocated	N/A	N/A

Allocations for ASN.1 module identifiers. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) asn1Module(2)}		
ARC	PURPOSE	STATUS
commondefinitions(0)version1(0)	ASN.1 definitions for IEEE 802	C

Allocations for Managed object classes. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) managedObjectClass(3)}		
ARC	PURPOSE	STATUS
resourcetypeid(0)	Resource identification	C
scanner(1)	Superclass for scanner functions	C
ewmametricmonitor(2)	EWMA gauge with threshold notifications	C

Allocations for Package identifiers. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) packages (4)}		
ARC	PURPOSE	STATUS
counterdifference(0)	Generate derived values for gauges	C
configchangereport(1)	Configuration change reports	C
countermodulus(2)	Counter overflow modulus	C

Allocations for Parameter Identifiers. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) parameter(5)}		
ARC	PURPOSE	STATUS
derivedgauenotcurrent(0)	Value of derived gauge not current	C

Allocations for Name binding identifiers. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) nameBinding(6)}		
ARC	PURPOSE	STATUS
resourcetypeid-system(0)	Binding for resource type	C
ewmametricmonitor-system(1)	Binding for ewmaMetricMonitor	C

Allocations for Attribute Identifiers. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) attribute(7)}		
ARC	PURPOSE	STATUS
macaddress(0)	IEEE 802 MAC address	C
resourcetypeidname(1)	Name of resourceID managed object	C
resourceinfo(2)	Manufacturer information	C
scannerid(3)	Unique identifier for scanner	C
countertminusgp(4)	Difference counter	C
countermodulus(5)	Counter overflow modulus	C
derivedgauge(6)	Derived gauge	C
estimateofmean(7)	Mean estimate of derived gauge	C
granularityperiod(8)	Time between scans	C
observedattributeid(9)	Identifier for observed attribute	C
observedmanagedobjectinstance(10)	Identifier for observed object	C
severityindicatingthreshold(11)	Threshold information	C
movingtimeperiod(12)	Time period for estimate of mean	C

Allocations for Attribute Group types. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) attributeGroup (8)}		
ARC	PURPOSE	STATUS
None allocated	N/A	N/A

Allocations for Action types. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) action(9)}		
ARC	PURPOSE	STATUS
None allocated	N/A	N/A

Allocations for Notification types. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dot1partF(10011) notification(10)}		
ARC	PURPOSE	STATUS
None allocated	N/A	N/A

Annex C

Registration of information objects within IEEE 802 standards

(informative)

This annex describes an IEEE 802 operating procedure, the details of which may be changed from time to time by IEEE 802.

C.1 Registration requirements

The standardization effort within IEEE 802 is resulting in the definition of standard information objects. These objects are to be identified uniquely on a global basis. Information objects may represent a variety of real objects, such as standards documents, or virtual objects, such as managed object identifiers and attribute types.

The International Organization for Standardization (ISO) and the Telecommunication Standardization Bureau (TSB) (formerly CCITT) of the International Telecommunication Union (ITU) have defined a tree-structured naming hierarchy and have delegated administration of the names to various naming and registration authorities. Each information object is uniquely identified by constructing names from each level of registration authority under which the information object is registered. Each component in the hierarchical path has both a name and a number. All information types within American National Standards registered under the American National Standards Institute (ANSI) are identified under the following path:

{iso(1) member-body(2) us(840) standard-name(n)}

Individual standards can create additional hierarchial substructure beneath their containing naming hierarchy.

The following defines a process by which IEEE 802 working groups may obtain, administer, organize, and publish standard information type identifiers.

NOTE—This process has been adopted as an operating policy within IEEE 802.

C.2 Registration procedure overview

The registration and administration process, except for initial allocation of a branch in the ISO tree, is self-administered within each IEEE 802 working group and self-documented within the appropriate standards documents and supplements or amendments.

Since all standards defined within IEEE 802 are American National Standards, ANSI is used as the registration authority. Each working group is allocated a new arc in the registration hierarchy for each standard to be published, using a procedure (defined below) involving application to the IEEE 802 Executive Committee and subsequent processing through ANSI. Each working group then administers and documents its information objects subject to the IEEE 802 procedures defined below.

The procedures identified in this annex are intended for use in the allocation of object identifiers to standardized information objects defined in IEEE 802 standards. It is not the intent to use these procedures to establish registration services offered to bodies external to IEEE 802.

C.3 Obtaining information object identifiers for new standards

A prerequisite for the allocation of information object identifiers is that an object identifier arc under ANSI is obtained for the standard within which the allocation will be made.

A unique arc under ANSI is required for each American National Standard. Each IEEE 802 working group determines the mapping of its own work to standards. For example, IEEE Std 802.3 [ISO/IEC 8802-3], CSMA/CD defines a single standard, but 802.1 HiLi defines multiple standards—ISO/IEC DIS 15802-2, LAN/MAN Management; IEEE Std 802.1D [ISO/IEC 10038], MAC Bridging; etc.

NOTE—An arc for a standard is required only if that standard contains information objects. Standards such as IEEE Std 802-1990 may require no information object identifiers.

When a need for an arc for an IEEE 802 standard or draft standard is determined, the working group associated with that standard creates a request, formatted in conformance with current ANSI ISSB990 and IEEE 802 requirements. This request is then forwarded for approval by the IEEE 802 Executive Committee. The Executive Committee then processes the request through ANSI. Once the new identifier is allocated, the Executive Committee forwards it to the working group.

The only administrative requirement placed on the Executive Committee subsequently is to maintain a centralized file of top-level identifiers allocated for each standard, containing the information detailed in ISSB990, Section 7. This file takes the form of a standing document, maintained by the IEEE 802 Recording Secretary, which is revised and reissued when each additional arc is allocated by ANSI. All further suballocations below these arcs are performed and administered by the working groups.

C.4 Administrative guidelines for information object identifiers

Information object identifiers are locally administered by each IEEE 802 working group. However, to maintain consistency within IEEE 802 across working groups and also to follow common practices concerning administration of object identifiers, certain procedures are defined.

C.4.1 Rules on use/deprecation of identifiers

Several rules on the assignment and deprecation of object identifiers are required in order to maintain integrity across multiple systems and multiple versions of protocols as well as to conform to common practices.

C.4.1.1 First-come, first-served allocation

It is strongly recommended that no meaning be inferred from the encoding structure of object identifiers, e.g., an assumption that particular numeric ranges correspond to certain types of attributes. Therefore, a first-come, first-served allocation shall be used for each arc, starting with the numeric value zero. As each new information type is needed, the next available identifier is selected in numeric sequence.

C.4.1.2 Object identifiers are never reused

Once an identifier is chosen for a specific information type, it shall not be reused for any other. This requirement has several side effects. First, if the definition for the information type changes in any way that affects interoperability, then a new identifier is allocated. Second, if a new identifier is allocated for the updated information type, then the use of the old identifier is deprecated and its value never reused. A permanent record is maintained of both current and deprecated information object identifiers, as detailed in the following subclauses.

C.4.2 Guidelines for naming substructure

It is recommended that a standard substructure be used across all working groups. This substructure ensures consistency and understandability for allocation of the object identifier space.

NOTE—The current substructure is identified for management-related information types. Guidelines for other information types will be added to these procedures as the need arises.

If a working group is developing a single standard, but that standard is to be developed and published as a series of distinct sections (as is the case with 802.3, for example), an arc immediately below the arc allocated to the standard by ANSI should be used to identify the section or clause of the document within which the allocations are being made. If the working group is developing multiple, independent standards (as is the case with 802.1, for example), the use of a section or clause identifier may not be necessary.

Beneath the arc allocated for each standard, or each section or clause thereof, the following substructure should be created:

Arc	Allocation purpose
standardSpecificExtension(0)	Standard-specific extensions
asn1Module(2)	ASN.1 module identifiers
managedObjectClass(3)	Managed object class identifiers
package(4)	Package identifiers
parameter(5)	Parameter identifiers
nameBinding(6)	Name binding identifiers
attribute(7)	Attribute identifiers
attributeGroup(8)	Attribute group identifiers
action(9)	Action types
notification(10)	Notification types

Within each standard, arcs may be allocated below this level (e.g., to allocate particular attribute identifiers), as required by the standard.

NOTE—Allocation of information substructure helps keep it understandable. However, the complexity of the information substructure below these arcs may affect the size of the identifier string length as it appears in protocol data units. This substructure has no significance in protocol, i.e., once an object identifier value has been allocated to an information object, the value is significant only as a unique identifier for the information object.

The following examples illustrate the structure of object identifier values that might be allocated within two hypothetical standards defined within IEEE 802. In the first, the developers of the standard have chosen to assign all management information values directly beneath the arc corresponding to their working group (e.g., IEEE 802.1 has developed standards using this style). In the second, the developers have chosen to suballocate management information values under subordinate arcs (e.g., 802.3 has developed standards using this style). In each case, the first four arcs are those allocated to the standard by ANSI, and the remaining values are completely arbitrary and hypothetical.

Example with arc = IEEE 802.1001A standard identifier 9998 (a hypothetical value)

```
{iso(1) member-body(2) us(840) ieee802dot1001partA(9998) attribute(7) password(1)}
```

Example with arc = IEEE 802.1003B standard identifier 9999, subsection identifier 1 (a hypothetical value)

```
{iso(1) member-body(2) us(840) ieee802dot1003partB(9999) thingMgt(1) attribute(7) systemTime(1)}
```

C.4.3 Publication guidelines for identifiers

Identifiers are documented in the appropriate standards document that contains them. Each standards document shall contain a section or clause with the current (at time of adoption) allocation of all information object identifiers defined and contained within the standard. All identifiers that have been allocated during the lifetime of the standard shall be listed, whether in current use or deprecated. This section or clause is separate from the registration definitions contained within the GDMO templates.

Documents that extend an existing standard shall also contain an updated version of this section or clause.

The format of this boilerplate is shown on the facing page. It is divided into a number of tables, each of which identifies the allocations made under each category. Where a category is unused in a given standard, an empty table for that category should still be included.

[begin boilerplate]

Annex X Allocation of object identifier values

(normative)

X.1 Introduction

This annex contains a summary of all object identifier values that have been allocated by this standard, both in this revision and in previous revisions.

Each table shows allocations related to a specific category of information object. The heading of the table identifies the category of information object, and shows the invariant part of the object identifier value allocated to the entries in the table. In cases of discrepancy between an identifier value in an allocation table and in the REGISTERED AS construct of a GDMO template, the template value takes precedence. The column labeled *Arc* shows the value allocated to the arc subsequent to the invariant part, which completes the object identifier value allocated. The column labeled *Purpose* contains a text description of the information object, and, in the case of current allocations, a reference to the location of the definition of the information object in the standard. The column labeled *Status* shows the status of the allocated values, using the following convention:

- R *Reserved.* The object identifier value is reserved for future use by this standard.
- C *Current.* The object identifier value has been allocated to an information object that is defined within the current revision of the standard.
- D *Deprecated.* The object identifier value has been allocated to an information object that was defined in a previous revision of the standard, and whose use is now deprecated.

X.2 Allocation tables

<Tables for categories 0 (standard-specific extensions) through 10 (notification types)>

Allocations for <information type>. Invariant part of object identifier value = {iso(1) member-body(2) us(840) ieee802dotn(assigned number) <information_type>(<X>)}		
ARC	PURPOSE	STATUS
<Arc allocated> ...	<Short description of purpose> ...	<Code> ...

Annex D

Guidelines for developers of LAN/MAN standards

(informative)

This annex suggests guidelines for the development and documentation of network management information within LAN/MAN standards. Common formats and methodologies will result in better consistency and easier understanding for the reader of management information. These guidelines apply to both LAN/MAN layer standards such as 802.3 MAC, as well as related efforts, such as the 802.1 MAC Bridges and 802.3 Repeater specification.

D.1 Notation for managed object definitions

Managed object definers are recommended to make use of the notational tools (templates) defined in ISO/IEC 10165-4 : 1992⁶ as the means of defining managed objects, their behaviour, operations, notifications, and attributes. This approach will lead naturally to a layer management specification that is compatible with ISO/IEC 9596-1 : 1991, complete with the ASN.1 definitions that are necessary to represent attribute values, names, etc. As ISO/IEC DIS 15802-2 makes use of the CMIP PDU formats for the exchange of management information, this will result in a specification that is also compatible with the ISO/IEC DIS 15802-2 LAN/MAN Management protocol.

D.2 Content of definitions

This subclause identifies some of the major elements that are necessary in order to construct a management specification, and techniques that may be useful for their documentation.

D.2.1 Overview and scope

It is important to summarize, in an overview of the document, what approach has been taken to the development of the management specification, the facilities that it provides, what those facilities may be useful for, any terminology that the specification uses, and what conformance requirements are imposed by the specification.

The approach taken in developing the specification might be described in terms of the following:

- a) The general intent of the specification, e.g., what the overall purpose of the management specification is, and what the overall design philosophy was;
- b) The documentation techniques that have been employed, e.g., use of GDMO templates;
- c) The target management protocols with which the specification may be used.

The facilities that the specification provides for management purposes should be summarized, along with a commentary on what aspects of management each facility addresses. One way of achieving this is to relate the facilities to the management functional areas (Fault, Configuration, Performance, Accounting, Security) or particular systems management functions (ISO/IEC 10164-1 : 1992) to which the managed objects defined in the specification pertain. It is likely to be the case that uses other than those specified will emerge in future application of the managed objects defined in the specification; however, the identification of particular uses serves as a requirements specification that may help to identify definitions of dubious worth.

⁶Information on references can be found in clause 3.

The document should clearly identify conformance requirements that apply to the specifications it contains, and any dependencies that exist with respect to other specifications or standards.

D.2.2 Definitions

A clause should be included to define new terms needed for understanding of the specification as well as terms referenced in other specifications.

D.2.3 Model

A clause should be included to describe the overall model of operation. For example, this standard describes the model used for scanners and metric monitoring, including options for generating alarms based upon thresholds. The model is needed for understanding of the managed objects of the specification, but does not contain detailed object class, attribute, behaviour, or encoding definitions.

D.2.4 Generic definitions

Managed object definitions should be developed in a manner that is, as far as possible, independent of the protocol that will be used to convey operations and values related to the managed objects. A suitable approach here is to base them upon the conventions identified in ISO/IEC 10165-1 : 1992 for defining managed object classes, operations, attributes, containment, etc.

D.2.4.1 Managed object class definition

Each managed object class requires a complete definition in terms of operations, containment relationships etc. The managed object class definition should specify the relationship between its behaviour and that of the resource or protocol machine to which it relates; for example, if a managed object contains a counter, it is necessary to specify what events in the protocol state machine it counts. Other aspects of the managed object class, such as containment relationships, operations etc., shall also be specified. The Managed Object Class and Package templates defined in ISO/IEC 10165-4 : 1992 provide the appropriate notation to achieve this definition.

D.2.4.2 Relationships with other managed objects

It is necessary to specify which managed objects may be contained within this managed object. The Name Binding template defined in ISO/IEC 10165-4 : 1992 provides the appropriate notation to achieve this definition.

D.2.4.3 Attributes

It is necessary that the specification of attributes relate the definition of the attributes to the behaviour of the managed object as a whole, and also to the behaviour of the resource to which the managed object relates. The attribute types are chosen, where possible, from those identified in ISO/IEC 10165-2 : 1992. Where it is necessary to define additional attribute types, the Attribute and Attribute Group templates defined in ISO/IEC 10165-4 : 1992 provide the appropriate notation to achieve this definition.

D.2.4.4 Definitions of actions and notifications

Actions that may be performed upon the managed object are defined in terms of any parameters that are required by the actions, and the results of the actions in terms of values returned and the effect upon the managed object and its attributes. Any notifications that may be generated by the managed object are also specified, along with the circumstances under which they are generated, and the information associated with

them. The Action and Notification templates defined in ISO/IEC 10165-4 : 1992 provide the appropriate notation to achieve this definition.

D.2.4.5 Definition of error handling

Any error conditions that can occur when any of the operations identified in the specification are performed upon the managed object, and the consequences in terms of the result of the operation shall be specified. The Parameter template defined in ISO/IEC 10165-4 : 1992 provide the appropriate notation to achieve this definition.

D.2.4.6 Definitions of other relationships

Other types of relationships between a managed object class and other managed object classes, for example, usage relationships or inheritance relationships as described in ISO/IEC 10165-1 : 1992, should be described.

D.2.4.7 Encodings

The encodings that are necessary in order to complete the protocol specification should be included. These encodings should include identifiers, values, operation types, event types, error codes, etc., as required by the protocol elements being used. In the case of the LAN/MAN Management protocol (ISO/IEC DIS 15802-2, ISO/IEC 8802-3 Amendment 11, and ISO 7498 : 1984) or CMIP (ISO/IEC 9596-1 : 1991), this will require the specification of these elements within an ASN.1 module, as indicated in GDMO (ISO/IEC 10165-4 : 1992).

D.2.4.8 Object identifier registration

A section or clause is required that summarizes all defined object identifiers for the specification (used, reserved, or deprecated). This section or clause is required in order to manage the assignment of identifiers and in order to prevent the redundant assignment of identifiers in future revisions of the specification.

D.2.4.9 Label naming conventions

For ease of readability, the convention shown in table D-1 is recommended for labeling of management information in LAN/MAN standards. Individual words should each be capitalized. Information types should be given a prefix that identifies the type of information being defined. As an example, the GDMO label for a managed object class for refrigerators might be named oRefrigerator. The attribute for ice cubes produced might be aIceCubesProduced, etc.

Table D-1—Label naming conventions

Prefix	Information type
a	Attribute
b	Behaviour
nb	Name Binding
n	Notification
ac	Action
p	Package
pa	Parameter
ag	Attribute Group
o	Object Class

D.2.4.10 Implications of PDU size

Given that the CMIP-based 802.1 LAN/MAN Management protocol (ISO/IEC DIS 15802-2, ISO/IEC 8802-3 Amendment 11, and ISO 7498 : 1984) utilizes LLC Type 1 services for PDU encoding, inherent size limitations may exist on attributes, actions, parameters, and notifications defined within LAN/MAN standards. While no practical restriction is expected in most cases, a section or clause is required that defines whether or not any such restrictions exist. No attribute, action, parameter, or notification shall be defined that, when encoded in an 802.1 LAN/MAN CPDU, exceeds the minimum CPDU size.

D.3 Aspects of conformance

This subclause discusses conformance issues that should be addressed in other standards; it does not of itself define conformance requirements placed on open systems by this standard. The ISO/IEC Systems Management Overview (ISO/IEC 10040 : 1992) provides further guidance with respect to conformance issues in Systems Management and their implications for managed object definitions.

D.3.1 General aspects of conformance

In order to allow conformance to be claimed to 802.1 LAN/MAN Management (ISO/IEC DIS 15802-2, ISO/IEC 8802-3 Amendment 11, and ISO 7498 : 1984), a conformance clause is included in that standard. ISO/IEC DIS 15802-2, LAN/MAN Management, states that a product claiming conformance shall implement

- a) A defined subset of the 802.1 LAN/MAN Management protocol;
- b) The set of managed objects that are defined as mandatory in all 802 standards to which conformance is claimed within a station (i.e., 802.1 plus the appropriate MAC and LLC standards).

D.3.2 Optional managed objects

As stated in ISO/IEC 10165-1 : 1992, managed objects can be defined that contain other managed objects in a hierarchical containment structure, and managed object class definitions may contain conditional packages.

The definition of the managed object class shall state clearly the circumstances under which conditional packages are present. Claims of conformance to such a specification can be made only if all the mandatory elements identified in the specification are supported under the set of conditions that apply.

The definition of the name bindings that apply to the managed object classes define the possible containment relationships that may exist. Claims of conformance shall indicate which name bindings are supported by the implementation.

D.3.3 Conformance statements

The conformance statement associated with a layer management section shall

- a) State that conformance to ISO/IEC DIS 15802-2 is necessary to claim “802 Management” conformance;
- b) List the mandatory managed objects and operations for the defined managed objects, and any mandatory name bindings.

D.4 Bit ordering

When specifying management information that will be exchanged between systems in management protocol, it is essential to define the encoding of that information in a manner that is unambiguous. Failure to do this will result in problems of the kind that have been encountered as a consequence of the bit ordering differences in the existing LAN technologies.

The requirement is quite simply stated (as stated in ISO 8822 : 1988, Information processing systems—Open Systems Interconnection—Connection-oriented presentation service definition and ISO 8823 : 1988, Information processing systems—Open Systems Interconnection—Connection-oriented presentation protocol specification), that when transferring information from one station to another, the internal (local) representation of a piece of information in one station shall be converted into a recognized encoded form for transmission (known as a transfer syntax in ISO 8822 : 1988 and ISO 8823 : 1988) such that the data value can be unambiguously converted back to the internal form recognized by the receiving station.

In this standard, the encoding of MAC addresses and OUIs is specified in an unambiguous way, based upon the rules for representation of these data values that are defined in Section 5 of IEEE Std 802-1990. It is strongly recommended that the same approach be taken by all other management standards that permit transmission of this kind of address information as data.

D.5 Units of measurement of time

Whenever attributes of managed objects are used to represent time-based measurement, the ASN.1 representation must allow a range of time unit bases for measurement, ranging from picoseconds to days, as it does in this standard. If the definition of a managed object requires that granularity of measurement be constrained in some way, this restriction should be so stated within the managed object definition. No inferences should be made as to timer granularity or accuracy or other constraints based upon the time units chosen for the representation of the attribute within the managed object.

D.6 Relevance of definitions

When developing standards for layer-managed objects, it is advisable that the purpose and utility of the managed objects, attributes etc., being defined are clearly identified, and that definitions are carefully scrutinized to determine their relevance. With a rigorous approach to identifying the real requirements for each definition, it should be possible to minimize the number of options available in the standard and also to minimize the costs in terms of implementation.

It should also be borne in mind that the managed object definitions are the means by which a Manager is provided with a view of some “real” piece of protocol machinery. Mechanisms defined for the purposes of management should therefore not be such that the operation of the underlying protocol machine is modified in a way that causes it to deviate from the base standard.

D.7 Usage of Resource Type ID managed object class

The Resource Type ID managed object class provides useful information for identification of type and manufacturer of devices implementing functions derived from LAN/MAN standards. Designers of LAN/MAN standards should identify an appropriate point(s) in their managed object definitions for incorporation of the Resource Type ID managed object class. In this standard, a name binding has been defined that allows an instance of the Resource Type ID managed object class to be contained within “ISO/IEC 10165-2”:system. Other name bindings should be considered as appropriate by developers of LAN/MAN standards.

Because the Resource Type ID managed object class is of significant benefit in the multivendor environment of LAN/MAN systems, it is strongly recommended that this managed object class be made mandatory where appropriate in each standard derived from these guidelines.

D.8 Extensions to management developments in 802

In addition to the layer management specifications directly related to the existing 802.*n* standards, it is apparent that other aspects of LAN and MAN technology are legitimate subjects of management-related standardization, for example, Repeater Management as developed within 802.3.

When developing further management standards within 802 layer groups, there are a number of existing tools that may be used as appropriate:

- a) 802.1 standards (layer management guidelines, LAN/MAN Management protocol, load protocol);
- b) 802.*n* layer management standards;
- c) ISO Management standards (CMIS/CMIP, SMI, Systems Management Functions, etc.).

In terms of where particular standards should be developed, it is important to bear in mind whether the standard is specific to a particular LAN or MAN technology or whether it has wider applicability. In general, the choice of where such work should be developed and documented should be determined by the following criteria:

- Management should be defined only for elements that are applicable to (and defined in) the standard to which the management specification relates.
- Layer management standards in 802.*n* should be extended where the solution requires technology-specific mechanisms. This will generally be achieved by means of managed object specifications.
- Common mechanisms should be defined in 802.1 where the solution requires technology-independent but LAN-specific mechanisms. This will generally be achieved by protocol and/or managed object specifications.
- Issues should be delegated to ISO/IEC JTC1 SC21 or SC6 (e.g., to the Configuration Management group) via X3T5.4 or X3S3 when the solution is not LAN specific.