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Information technology — Open Systems Interconnection — Systems Management: Summarization Function

Technologies de l'information — Interconnexion de systèmes ouverts (OSI) — Gestion-systèmes: Fonction de résumé

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Contents

Foreword

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

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 10164-13 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 21, *Open Systems Interconnection, data management and open distributed processing*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.738.

ISO/IEC 10164 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Systems Management*:

- *Part 1: Object management function*
- *Part 2: State management function*
- *Part 3: Attributes for representing relationships*
- *Part 4: Alarm reporting function*
- *Part 5: Event report management function*
- *Part 6: Log control function*
- *Part 7: Security alarm reporting function*
- *Part 8: Security audit trail function*
- *Part 9: Objects and attributes for access control*
- *Part 10: Accounting metering function*
- *Part 11: Metric objects and attributes*
- *Part 12: Test management function*
- *Part 13: Summarization function*
- *Part 14: Confidence and diagnostic test categories*
- *Part 15: Scheduling function*
- *Part 16: Management knowledge management function*

Annex A forms an integral part of this part of ISO/IEC 10164.

Introduction

ISO/IEC 10164 is a multipart standard developed according to ISO 7498 and ISO/IEC 7498-4. ISO/IEC 10164 is related to the following International Standards:

— 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 10165, *Information technology — Open Systems Interconnection — Structure of management information.*

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ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – SYSTEMS MANAGEMENT: SUMMARIZATION FUNCTION

1 Scope

This Recommendation | International Standard defines the Summarization Function. The Summarization Function is a Systems Management function which may be used by an application process in a centralised or decentralised management environment to interact for the purpose of systems management, as defined by the OSI Management Framework, CCITT Rec. X.700 | ISO/IEC 7498-4. This Recommendation | International Standard defines a function which consists of generic definitions and services. This function is positioned in the application layer of the OSI reference model (CCITT Rec. X.200 | ISO 7498) and is defined according to the model provided by ISO 9545. The role of systems management functions is described by CCITT Rec. X.701 | ISO/IEC 10040. The Summarization Function specifies methods to observe and report attribute values. It also specifies methods for reporting statistics based on attribute values, all observed at the same time. These attribute values and statistics provide summary information concerning a set of managed objects and their attributes at one or more distinct points in time. The statistics are calculated across managed objects, not over time.

This Recommendation | International Standard

- identifies the set of requirements satisfied by the function;
- provides a model for the behaviour of the summarization objects;
- specifies the management requirements of the function and how these are realised by specification of managed objects and their behaviour;
- specifies the mapping of these services onto the CMIS services; and
- specifies the abstract syntax of the parameters of the MAPDUs that will be used to refer to managed objects and their characteristics.

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- does not define the nature of any implementation intended to provide the Summarization function;
- does not specify the manner in which management is to be accomplished by the user of the Summarization function;
- does not define the nature of any interactions which result in the use of the Summarization function;
- does not specify the services necessary for the establishment, normal and abnormal release of a management association;
- does not define the interactions which result by the simultaneous use of several management functions;
- does not define connection establishment or authorisation requirements for the use of these functions or for any associated activity; and
- does not preclude the definition of further metric object classes to provide measurements for inclusion in the function.

2 Normative references

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

2.1 Identical Recommendations | International Standards

- CCITT Recommendation X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview.*
- CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *Information technology – Open Systems Interconnection – Structure of management information: Management information model.*
- CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information.*
- CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects.*
- CCITT Recommendation X.730 (1992) | ISO/IEC 10164-1:1993, *Information technology – Open Systems Interconnection – Systems Management: Object management function.*
- CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2:1993, *Information technology – Open Systems Interconnection – Systems Management: State management function.*
- CCITT Recommendation X.733 (1992) | ISO/IEC 10164-4:1992, *Information technology – Open Systems Interconnection – Systems Management: Alarm reporting function.*
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems Management: Event report management function.*
- CCITT Recommendation X.735 (1992) | ISO/IEC 10164-6:1993, *Information technology – Open Systems Interconnection – Systems Management: Log control function.*
- ITU-T Recommendation X.739 (1993) | ISO/IEC 10164-11:1994, *Information technology – Open Systems Interconnection – Systems Management: Metric objects and attributes.*

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.200 (1989), *Reference model of Open Systems Interconnection for CCITT Applications.*

  ISO 7498:1984, *Information processing systems – Open Systems Interconnection – Basic Reference Model.*
- CCITT Recommendation X.209 (1988), *Specification of Basic Encoding Rules for abstract syntax notation.*

  ISO 8825:1990, *Information technology – Open Systems Interconnection – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).*
- CCITT Recommendation X.210 (1988), *Open Systems Interconnection layer service definition conventions.*

  ISO/TR 8509:1987, *Information processing systems – Open Systems Interconnection – Service conventions.*
- CCITT Recommendation X.700 (1989), *Management framework definition for Open Systems Interconnection (OSI) for CCITT applications.*

  ISO 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework.*
- CCITT Recommendation X.710 (1991), *Common management information service definition for CCITT applications.*

  ISO/IEC 9595:1991, *Information technology – Open Systems Interconnection – Common management information service definition.*
- CCITT Recommendation X.711 (1991), *Common management information protocol specification for CCITT applications.*

  ISO/IEC 9596-1:1991, *Information technology – Open Systems Interconnection – Common management information protocol – Part 1: Specification.*
- CCITT Recommendation X.290 (1991), *OSI conformance testing methodology and framework for protocol recommendations for CCITT applications.*

  ISO/IEC 9646-1:1991, *Information technology – OSI conformance testing methodology and framework – Part 1: General concepts.*

2.3 Additional references

- ISO/IEC 3534-1:1993, *Statistics – Vocabulary and symbols – Part 1: Probability and general statistical terms.*
- ISO/IEC 9545:1989, *Information processing systems – Open Systems Interconnection – Application Layer structure.*
- CCITT Recommendation M.3100 (1992), *Generic Network Information Model.*

3 Definitions

For the purposes of this Recommendation | International Standard the following definitions apply.

3.1 Basic reference model definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.200 | ISO 7498:

a) open system;

b) systems management.

3.2 Management framework definitions

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

a) managed object;

b) management information.

3.3 Systems management overview definitions

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

a) agent;

b) agent role;

c) dependent conformance;

d) general conformance;

e) generic definitions;

f) managed system;

g) management operation;

h) manager;

i) manager role;

j) managing system;

k) notification;

l) systems management functional unit.

3.4 CMIS definitions

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

a) attribute;

b) common management information service.

3.5 Metric objects and attributes definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.739 | ISO/IEC 10164-11:

a) capacity;
b) granularity period;
c) metric algorithm;
d) metric attribute;
e) metric object;
f) observed attribute;
g) observed object;
h) percentile;
i) scan.

3.6 Standard definitions of statistics

This Recommendation | International Standard makes use of the following terms defined in ISO 3534-1:1993.

a) fractile of a probability distribution;
b) frequency distribution;
c) mean of a random variable;
d) range;
e) relative frequency;
f) variance.

3.7 Alarm reporting function definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.733 | ISO/IEC 10164-4:

– alarm.

3.8 OSI conformance testing definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.290 | ISO/IEC 9646-1.

– system conformance statement.

3.9 Additional definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.9.1 aggregation: The process of combining observed attribute values.

3.9.2 ensemble statistic: A statistic derived from observed attributes across managed objects at a specified point in time.

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

3.9.4 report period: The time between emitting notifications containing the reports of the collected aggregate values or statistical information. The report period begins and ends on granularity period boundaries, and therefore consists of one or more granularity periods.

3.9.5 summarization: The process of aggregating and optionally applying algorithms to obtained observed attribute values to produce summary information.

3.9.6 summarization object: A managed object which provides summary reports of multiple observations of the attribute values of many managed objects.

3.9.7 summary report: A notification or action reply that contains the results of aggregations of values of observed attributes.

4 Abbreviations

ASN.1	Abstract Syntax Notation One
CMIP	Common management information protocol
CMIS	Common management information service
Conf	Confirmation
GP	Granularity period
Ind	Indication
Id	Identifier
MAPDU	Management application protocol data unit
max	Maximum
min	Minimum
MOCS	Managed object conformance statement
PICS	Protocol implementation conformance statement
Req	Request
Rsp	Response
RP	Report period
SMAPM	System management application protocol machine

5 Conventions

This Specification defines services for the Summarization function following the descriptive conventions defined in CCITT Rec. X.210 | ISO/TR 8509.

The following notation is used in the service parameter tables:

M	The parameter is mandatory.
C	The parameter is conditional. The condition(s) are defined by the text which describes the parameter.
(=)	The value of the parameter is identical to the corresponding parameter in the interaction described by the preceding related service primitive.
U	The use of the parameter is a service-user option.
–	The parameter is not present in the interaction described by the primitive concerned.
P	The parameter is subject to the constraints imposed by CCITT Rec. X.710	ISO/IEC 9595.

NOTE – The parameters which are marked "P" in service tables of this Specification are mapped directly onto the corresponding parameters of the CMIS service primitive, without changing the semantics or syntax of the parameters. The remaining parameters are used to construct an MAPDU.

6 Requirements

Summarization provides the ability to aggregate observed attribute values and/or provide ensemble statistical information about observed attribute values.

The Summarization Function shall provide for:

- The ability for a managing system to request summarization of attribute values.
- The ability to summarize values on:
  a) a single attribute type of a single managed object;
  b) multiple attribute types of a single managed object;
  c) a single attribute type of multiple managed objects;
  d) multiple attribute types of multiple managed objects.
- The ability to provide summarized information gathered:
  a) at a single point in time, prescheduled or on-demand;
  b) over a specified interval of time;

c) periodically over specific intervals of time.

- The scheduling of summarization activity over a specified period of time.
- The aggregation of observed attribute values on a single managed system.
- The identification of the managed objects and their attributes to be summarized.
- A mechanism for the selection of managed objects which have the same set of attributes to be summarized.
- The ability to specify the selection criteria for managed objects to be observed and their attributes to be summarized, at any point in time.
- The ability to provide ensemble statistics of the information gathered.
- The ability for a managed system to send event reports to a managing system to notify:
  a) the results of the summarization;
  b) the identification of the units of measure of the results;
  c) the identification of the sources of the attribute samples used in the summary;
  d) the identification of the start time of the summary period;
  e) the parameters of the algorithm used for calculating statistical measures;
  f) the identification of any missing samples in the summary;
  g) the identification of any samples in the summary whose values are suspected of being incomplete or incorrect;
  h) optionally, the timestamping of the observed values;
  i) the ability to report an incomplete scan.
- The concise reporting of large quantities of summarized information.

7 Model

7.1 Summarization model

7.1.1 Introduction to the model

Summarization is the process of aggregating and optionally applying algorithms to observed attribute values to produce summary information.

Information is obtained by observing the attributes of a managed object. The managed objects from which information may be obtained include, for example:

a) managed objects representing a management view of an underlying resource;

b) management support objects (e.g. metric objects, log record objects).

These managed objects may be described generically as observed objects. That is, they have attributes, some of whose values are obtained by management operations and notifications.

Summarization objects obtain information, process such information to produce summary information, and issue summary report notifications.

A summarization object may have attributes to determine:

a) the identities of the managed objects which it is observing;

b) the identities of the attributes which it is observing;

c) the contents of the summary reports; and

d) the timing and frequency of observations.

Information obtained from observed objects is processed according to the behaviour of the summarization object class. Such behaviour may include:

a) algorithms for calculating summary information; and

b) methods for identifying missing values.

Summary information is issued in the form of notifications or as replies to requests which are specified in the summarization object class definition. Such specifications may include:

a) the structure of information to be reported;

b) the circumstances which trigger the issuing of a notification; and

c) the state information related to the summarization object (e.g. operational state, administrative state, availability status).

7.1.2 Properties of summarization object classes

Figure 1 illustrates a summarization object observing attributes of observed managed objects. The summarization object generates summaries in the form of notifications, or as a result of a request. The notifications may be forwarded as event reports by event forwarding discriminators (as discussed in CCITT Rec. X.734 | ISO/IEC 10164-5). The notifications may also be logged (as discussed in CCITT Rec. X.735 | ISO/IEC 10164-6).

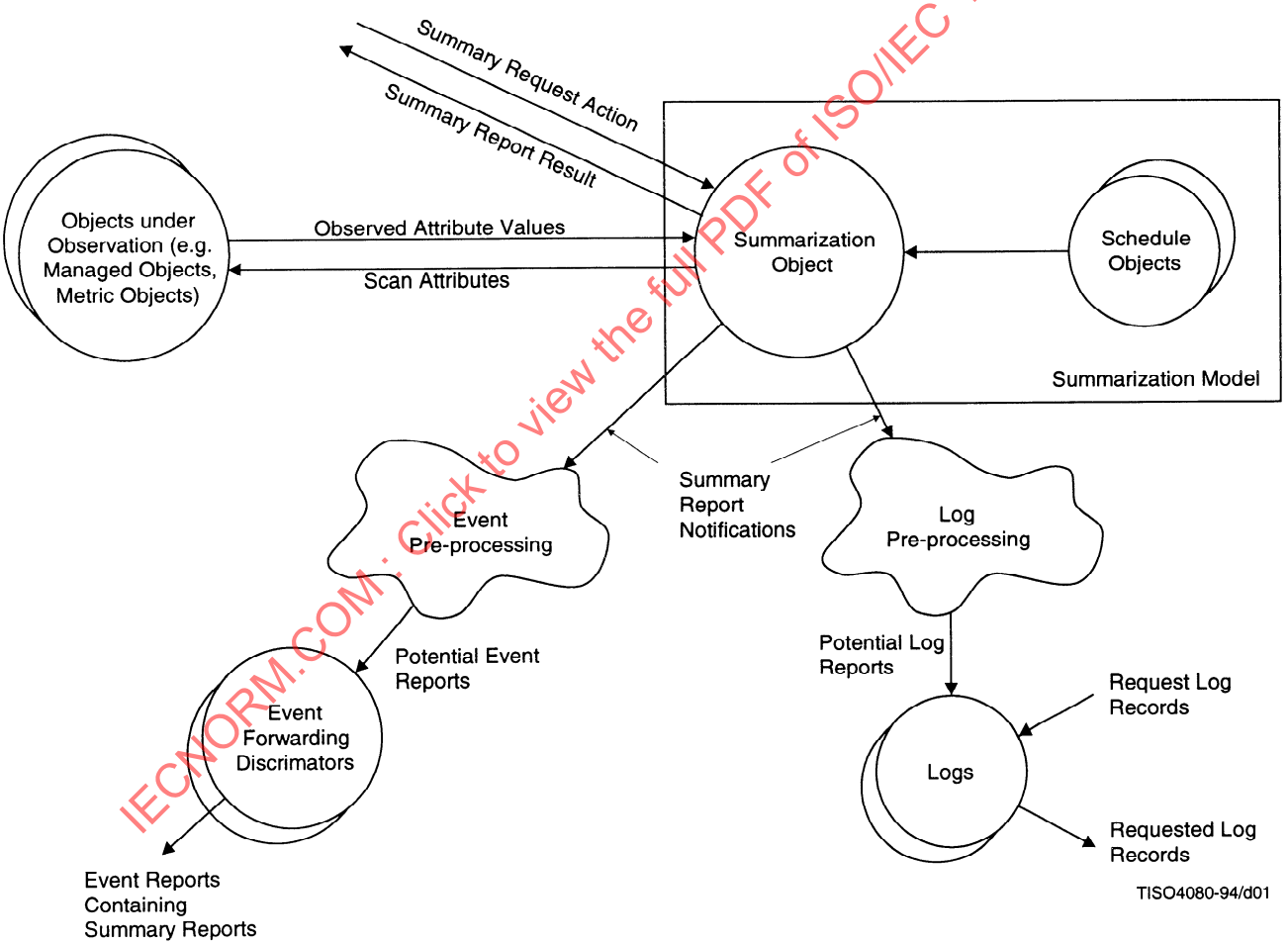


Figure 1 – Summarization model

A summarization object includes attributes for scheduling the underlying scanning and summary reporting processes, and various mechanisms to select observed objects and their attributes to be observed.

The following instantiable summarization managed object classes are defined for the Summarization Function. The instantiable classes are:

- *Simple scanner* – Scans the same set of attributes across a set of managed objects and generates reports of the observed attribute values at the end of each granularity period. The managed objects are selected using either a set of explicit names or using a scoping and filtering mechanism. The simple scanner may also return summary reports in an action reply when stimulated by an action.
- *Dynamic simple scanner* – Scans the same set of attributes across managed objects selected using the parameters specified in the information in the action request. It returns summary reports in an action reply. The term "dynamic" is used to indicate that the selection criteria are specified dynamically within each action.
- *Mean scanner* – Scans the same set of attributes across a set of managed objects and generates reports of the mean of the observed attribute values at the end of each granularity period. The managed objects are selected using either a set of explicit names or using a scoping and filtering mechanism. The mean scanner may also return summary reports in an action reply when stimulated by an action.
- *Mean variance scanner* – Scans the same set of attributes across a set of managed objects and generates reports of the mean and variance of the observed attribute values at the end of each granularity period. The managed objects are selected using either a set of explicit names or using a scoping and filtering mechanism. The mean variance scanner may also return summary reports in an action reply when stimulated by an action.
- *Min max scanner* – Scans the same set of attributes across a set of managed objects and generates reports of the minimum, maximum, and optionally the mean of the observed attribute values at the end of each granularity period. The managed objects are selected using either a set of explicit names or using a scoping and filtering mechanism. The min max scanner may also return summary reports in an action reply when stimulated by an action.
- *Percentile scanner* – Scans the same set of attributes across a set of managed objects and generates reports of the minimum, j^{th} percentile, median, $(100-j)^{th}$ percentile, maximum, and optionally the mean of the observed attribute values at the end of each granularity period. The managed objects are selected using either a set of explicit names or using a scoping and filtering mechanism. The percentile scanner may also return summary reports in an action reply when stimulated by an action.
- *Heterogeneous scanner* – Scans potentially different sets of attributes for a set of explicitly named observed objects and reports the results at the end of each granularity period. The heterogeneous scanner may also return summary reports in an action reply when stimulated by an action. The term "heterogeneous" is used to indicate that values of different attribute types for different managed objects can be included in the report.
- *Buffered scanner* – Similar to the heterogeneous scanner, but retains scanned values so that the results of multiple granularity periods can be reported together. In addition, at the time of reporting, it will scan a list of attributes of arbitrary type whose attribute values can be included in the report.

Diagram a) of Figure 2 illustrates the timing of the scanning process for non-buffered scanners. At the end of each granularity period, a scan is initiated, observed attribute values are collected, optionally statistics are calculated (in the case of statistical scanners only), and notifications are emitted. Diagram b) of Figure 2 illustrates the timing of the scanning process for buffered scanners. This process is similar to that used by the non-buffered scanners, except that buffered scanners retain collected data for one or more granularity periods before emitting notifications containing the collected data. All scanners also can produce summary information in action replies after being stimulated by action requests. Figures 2a and 2b do not apply to dynamic simple scanners where the summary reports are only produced as a result of actions. Scanner behaviour is discussed in further detail in 8.1.

7.2 Summarization scheduling

7.2.1 Scheduling of the scanner

To schedule scanning the summarization objects use the optional scheduling mechanisms defined in CCITT Rec. X.721 | ISO/IEC 10165-2 and in CCITT Rec. X.734 | ISO/IEC 10164-5. These mechanisms provide for daily scheduling, weekly scheduling, duration scheduling, and scheduling by an external scheduler.

Since scanning may be controlled by the scheduling of the scanner, the mechanisms that determine the scheduling of the scanner indirectly determine the scheduling of summary reports as well.

Since summarization objects and metric objects are both scheduled to observe attribute values, when summarization objects are observing metric objects the schedule of the objects should be coordinated to ensure reliable results.

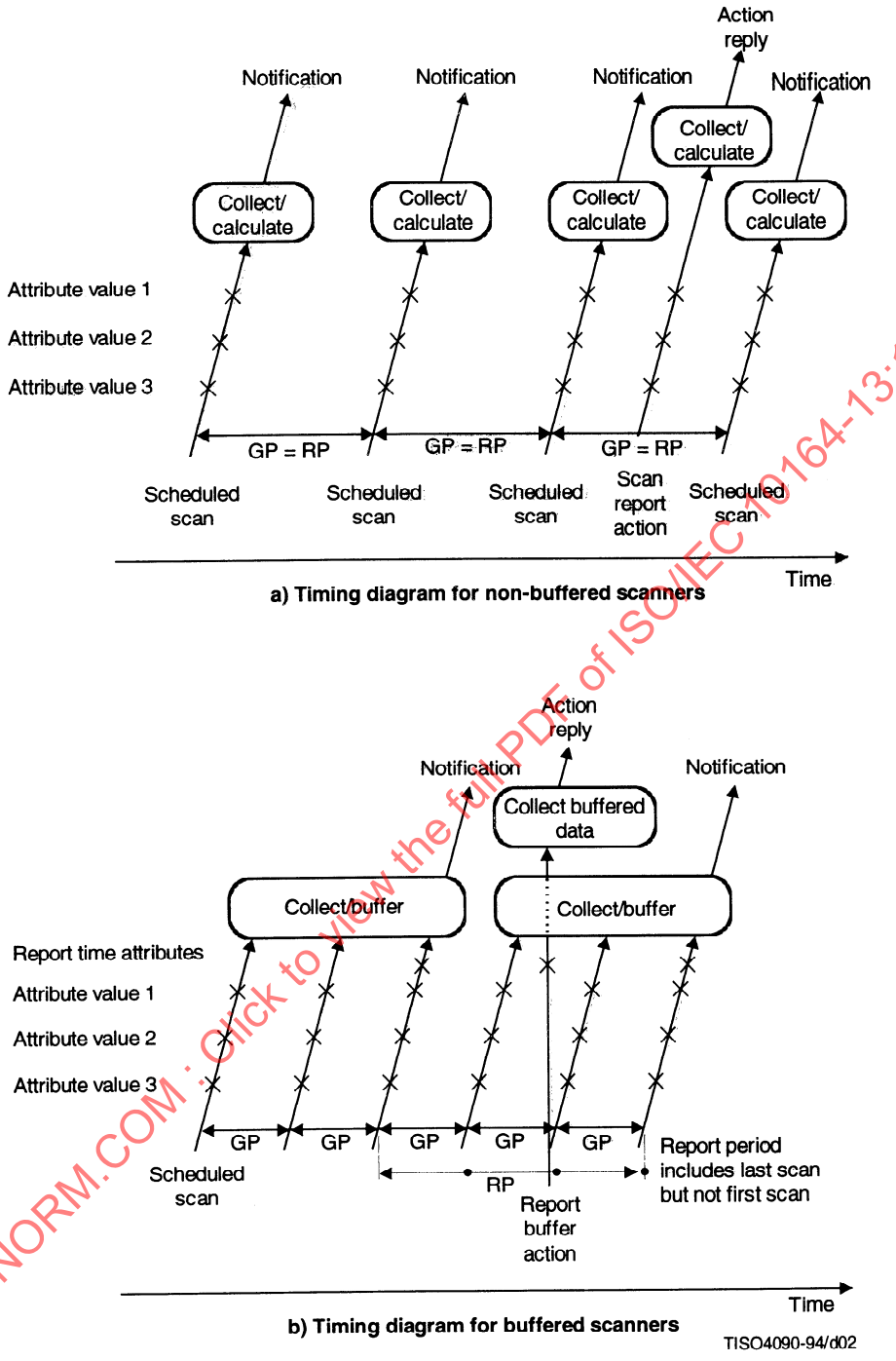


Figure 2

8 Generic definitions

8.1 Managed objects

This Specification defines a set of summarization managed object classes.The inheritance structure of these managed object classes is shown in Figure 3.

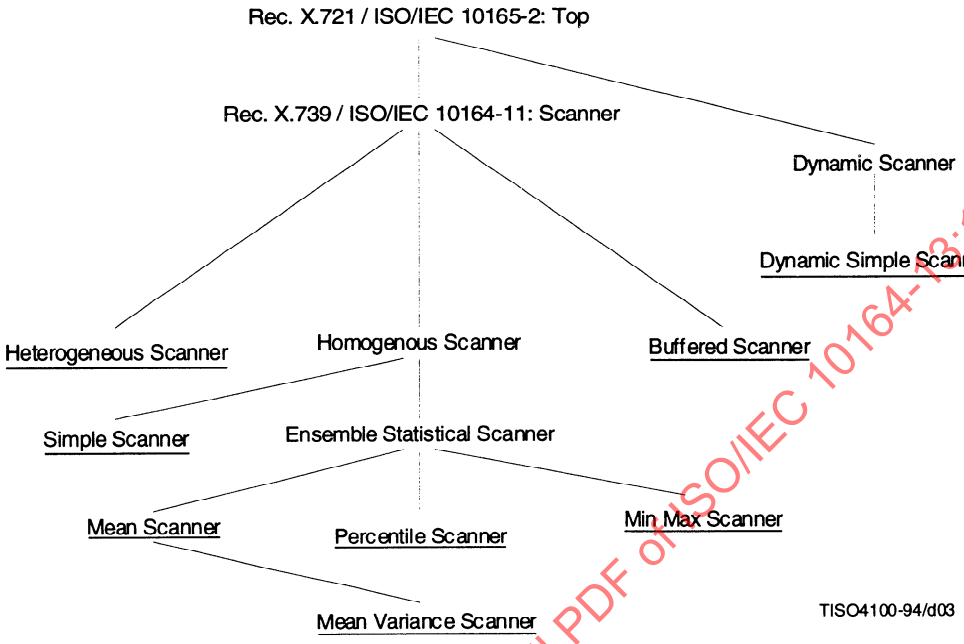


Figure 3 – Inheritance structure of summarization objects

NOTE – Instantiable summarization objects are underlined.

8.1.1 Homogeneous scanner

8.1.1.1 Overview

The homogeneous scanner selects a set of managed objects and observes the same set of attributes across these managed objects, and collects the observations. It is a subclass of the scanner managed object defined in ITU-T Rec. X.739 | ISO/IEC 10164-11. The homogeneous scanner is a non-instantiable superclass of periodic scanners which observe the same attributes across managed objects.

The homogeneous scanner can scope the set of managed objects that are eligible to be included in the summarization, and it may select managed objects using filtering criteria (similar to the concept of scoping and filtering as described in CCITT Rec. X.710 | ISO/IEC 9595). Alternatively, it can use an explicit list of managed object instances for scanning. The homogeneous scanner observes the values of the attributes of each selected managed object.

For each of the selected managed objects the attributes to be observed are specified using one or more attributes of the homogeneous scanner.

8.1.1.2 Attributes and packages of the homogeneous scanner

The homogeneous scanner has the following attribute, in addition to those inherited from scanner:

- *Scan attribute identifier list* – A set of attribute identifiers specifying attributes of any ASN.1 type, for which each attribute value is reported with its attribute identifier. The scan attribute identifier list may be empty.

The homogeneous scanner has the following conditional packages:

- scoped selection package (present if required and the managed object instance selection package is not present);
- timing selection package (present if required and the scoped selection package is present);
- managed object instance selection package (present if required and the scoped selection package is not present); and
- time stamp report package (present if time stamp reporting is required.)

Further description of these packages is contained in 8.1.12.

Either the scoped selection package or the managed object instance selection package shall be present in a homogeneous scanner. The timing selection package shall only be present if the scoped selection package is also present in a homogeneous scanner.

8.1.1.3 Behaviour of the homogeneous scanner

The administrative state and availability status attributes control the operation of the homogeneous scanner as described in 8.1.13.

The scan attribute identifier list attribute as well as attributes of the scoped selection package, of the timing selection package, of the managed object instance selection package, and of the time stamp report mode package may only be modified if the administrative state is "locked". If the attribute value change notification package is present, modification of these attributes shall result in an attribute value change notification.

If the managed object instance selection package is specified, the homogeneous scanner observes the managed object instances specified in the object list.

If the scoped selection package is specified, the homogeneous scanner uses the managed object identified in the base managed object attribute and checks all the managed objects within the levels indicated by the scope attribute by applying the criteria in the scanning filter attribute. The scoping and filtering is applied for each scan to select the managed objects to be observed. The scope attribute semantics are as described in 8.1.12.3. The scanning filter attribute semantics are the same as those for filter defined in CCITT Rec. X.720 | ISO/IEC 10165-1. The default value is true. If the timing selection package is also specified, a managed object is only selected if it satisfies both the selection criteria specified by the scoped selection package and the timing criterion specified by the timing selection package. The scanner checks whether the value of the time attribute is between current time minus begin offset time and current time minus end offset time. (See 8.1.12.5.) Managed objects that pass the selection criteria are observed in the scan.

If the time stamp report package is present, then its associated behaviour shall apply to summary reports emitted by subclasses of the homogeneous scanner. The default value for the time stamp report mode is time stamping off (i.e. no time stamps).

8.1.2 Simple scanner

8.1.2.1 Overview

The simple scanner is a subclass of the homogeneous scanner managed object class.

It reports the values of the scanned attributes from the scan attribute identifier list, reporting them with their attribute identifiers.

It includes a numeric attribute identifier array, which specifies numeric attributes to be reported without their attribute identifiers in summary reports.

8.1.2.2 Attributes and packages of the simple scanner

The simple scanner has the following attributes, in addition to those inherited from homogeneous scanner:

- *Numeric attribute identifier array* – An ordered sequence of numeric attribute identifiers specifying attributes of integer or real ASN.1 type, for which each attribute value is reported in the order in which its identifier appears in the array. The numeric attribute identifier array may be empty.
- *Suppress object instance* – A boolean value which, if true, causes the observed object instance parameter to be suppressed from all summary reports.

The simple scanner has the following conditional package:

- once report attribute Id list package (present if once report Id behaviour is required).

Further description of this package is contained in 8.1.12.

8.1.2.3 Behaviour of the simple scanner

The simple scanner makes observations of the same set of attributes across all managed object instances selected. If the simple scanner is scheduled, a scan that is initiated during an active scheduled period shall be completed normally and the notification emitted.

The simple scanner generates notifications. The notification includes the observed attribute values. Values for the attributes specified by the scan attribute identifier list are included in the notification paired with their attribute identifiers. Values of attributes specified by the numeric attribute identifier array are included in the notification without their attribute identifiers.

The simple scanner generates the scan report notification.

If either the scan attribute identifier list or the numeric attribute identifier array is empty, then the corresponding parameter is not included in the summary report.

The values of the numeric attribute identifier array, the suppress object instance, the once report attribute Id list, and the time stamp report mode attributes may only be modified if the administrative state attribute has a value of "locked". If the attribute value change notification package is present, modification of these attributes shall result in an attribute value change notification.

The attributes in the lists of attribute identifiers (scan attribute identifier list and numeric attribute identifier array) are scanned and included in the report. At least one of these lists shall always be specified. When the selected managed object does not have the attribute in the scan identifier list, the attribute value is absent in the result. If any attribute in the numeric attribute identifier array is absent, a value of NULL shall be present.

If the once report attribute Id list package is present, then its associated reporting behaviour is exhibited.

A scan report notification with the name of the observed objects and requested attribute values is emitted at the end of each scan. For the simple scanner the report period is equal to the granularity period.

If the suppress object instance attribute has a value of true, then the observed object instance parameter shall not be present in the summary report for any observed object. The value of the suppress object instance attribute shall be set to true only when either:

- identification of the observed managed object instance can be determined by other means (e.g. an attribute value which determines the managed object name); or
- identification of the observed managed object instance is not required by the receiving system (e.g. when statistics are to be calculated).

If all the summarized data cannot be sent, the parameter "incomplete scan" shall be included in the summary report.

Independently of periodic scans and subsequent notifications, the manager may also invoke an activate scan report action to request that the simple scanner initiate a scan and return the results of the scan in an action reply. Scanning and summary reports based on the granularity period of the scanner are not affected by the action request. If the administrative state is "locked", the simple scanner generates a scan action error if it receives an action request. Multiple replies may be issued for a single action request.

If the granularity period is zero, then scans are performed (and the results of the scan are returned) only when action requests are received.

The simple scanner exhibits state behaviour as described in 8.1.13.

8.1.3 Ensemble statistic scanner

8.1.3.1 Overview

The ensemble statistic scanner is a subclass of the homogeneous scanner managed object class. It is a non-instantiable superclass of the statistical scanners.

Statistical calculations for the same set of attributes are performed across the observed objects, and the calculated values are included in the summary report (notification or action reply).

As in the simple scanner, a set of attribute values can also be reported with attribute identifiers for each observed object.

The ensemble statistic scanner uses the statistical report notification. (See 9.3.2.)

8.1.3.2 Attributes and packages of the ensemble statistic scanner

The ensemble statistic scanner has the following attributes, in addition to those inherited from homogeneous scanner:

- *Numeric attribute identifier list* – A set of numeric attribute identifiers specifying attributes which have integer or real ASN.1 type, for which statistical calculations are carried out across all observed objects.
- *Suppress object instance* – A boolean value which, if true, causes the object instance parameter to be suppressed from all summary reports.

8.1.3.3 Behaviour of the ensemble statistic scanner

For the ensemble statistic scanner, a notification with the calculated values across observed objects for each attribute in the numeric attribute identifier list, is emitted at the end of each scan collection.

The values of the attributes identified by the scan attribute identifier list are scanned and included in the report for each observed object. When the selected managed object does not have the attribute in the scan identifier list, the attribute value is absent in the result.

The numeric attribute identifier list and suppress object instance attributes may only be modified if the administrative state is "locked". If the attribute value change package is present, modification of these attributes shall result in an attribute value change notification.

If the scan attribute identifier list is empty, then scanned attribute values shall not be present in the summary report. If the suppress object instance attribute is true, then observed object instance names shall not be present in the summary report. If neither object instance names nor observed attribute values are present in the summary report, then the observation report list parameter shall not be present in the summary report.

The value of the suppress object instance attribute shall be set to true only when either:

- identification of the observed managed object instance can be determined by other means (e.g. an attribute value which determines the managed object name); or
- identification of the observed managed object instance is not required by the receiving system (e.g. when statistics are to be calculated).

If any attribute in the numeric attribute identifier list is absent in an observed object, its value cannot be included in the calculation. The summary report includes a count of the number of managed objects which were included in the calculation for each numeric attribute.

If all the summarized data cannot be sent, the parameter incomplete scan shall be included in the summary report.

Independently of periodic scans and subsequent notifications, the manager may also invoke an activate statistical report action to request that the ensemble statistic scanner initiate a scan and return the results of the scan in an action reply. Scanning and summary reports based on the granularity period of the homogeneous scanner are not affected by the action request. If the administrative state is "locked", the ensemble statistic scanner generates a scan action error if it receives an action request. Multiple replies may be issued for a single action request.

If the granularity period is zero, then scans are performed (and the results of the scan are returned) only when action requests are received.

The ensemble statistic scanner exhibits state behaviour as described in 8.1.13.

8.1.4 Mean scanner

8.1.4.1 Overview

The mean scanner is a subclass of the ensemble statistic scanner, as defined in 8.1.3.2.

It has mean reporting behaviour, as well as mean calculation behaviour.

8.1.4.2 Mean reporting behaviour

The mean scanner makes observations of the same set of attributes across selected managed object instances. The attributes in the scan attribute identifier list are reported once for each selected managed object. For each attribute type specified in the numeric attribute identifier list, the number of samples is provided in the first element and the sample mean is provided in the second element of the algorithm outputs array.

8.1.4.3 Mean calculation behaviour

The sample mean, $\bar{X}$, is the arithmetic mean, defined as follows:

$$\bar{X} = \frac{\sum_{j=1}^{N} X_j}{N}$$

where X_j is the j^{th} sample attribute value, and N is the number of samples.

8.1.5 Mean variance scanner

8.1.5.1 Overview

The mean variance scanner is a subclass of the mean scanner, as defined in 8.1.4.

It has mean variance reporting behaviour, as well as calculation behaviour (see 8.1.4.3) and variance calculation behaviour.

8.1.5.2 Mean variance reporting behaviour

The mean variance scanner makes observations of the same set of attributes across selected managed object instances. The attributes in the scan attribute identifier list are reported once for each selected managed object. For each attribute type specified in the numeric attribute identifier list, the number of samples is provided in the first element, the sample mean is provided in the second element, and the sample variance is provided in the third element of the algorithm outputs array.

8.1.5.3 Variance calculation behaviour

The sample variance, S, is defined as:

$$S = \frac{\sum_{j=1}^{N} (X_j - \bar{X})^2}{N-1}$$

or equivalently as:

$$S = \frac{\sum_{j=1}^{N} X_j^2 - \frac{1}{N}\left(\sum_{j=1}^{N} X_j\right)^2}{N-1}$$

8.1.6 Percentile scanner

8.1.6.1 Overview

The percentile scanner is a subclass of the ensemble statistic scanner, as defined in 8.1.3.

In addition it includes the following attribute:

- *Configurable percentile* – An integer value between 1 and 49, as specified in ITU-T Rec. X.739 | ISO/IEC 10164-11.

It has percentile reporting behaviour, as well as the percentile calculation behaviour.

The percentile scanner may employ the mean calculation behaviour defined in 8.1.4.3.

8.1.6.2 Percentile reporting behaviour

The percentile scanner makes observations of the same set of attributes across selected managed object instances. The attributes in the scan attribute identifier list are reported once for each selected managed object.

For each attribute type specified in the numeric attribute identifier list, the number of samples is provided in the first element, the sample minimum is provided in the second element, the sample j^{th} percentile is provided in the third element, the sample median is provided in the fourth element, the sample $(100–j)^{th}$ percentile is provided in the fifth element, the sample maximum is provided in the sixth element, and the sample mean is conditionally provided in the seventh element of the algorithm outputs array if the mean calculation package is present. "j" is an integer between 1 and 49, and is specified by the configurable percentile attribute. The value of the algorithm parameter, "j", shall be provided in the first element of the algorithm parameters array.

The configurable percentile attribute may only be modified if the administrative state is "locked". If the attribute value change notification package is present, modification of this attribute shall result in an attribute value change notification.

8.1.6.3 Percentile calculation behaviour

The sample minimum is the smallest value of those collected.

The sample maximum is the largest value of those collected.

An estimate P_j of the j^{th} percentile is defined as follows:

If $\{X_1, X_2, \ldots X_N\}$ denotes the sequence of sample values, ordered from smallest to largest,

$$Q = \frac{j\,(N+1)}{100}, \text{ and}$$

q is the largest integer less than or equal to Q, then:

$P_j = X_1$, if $Q < 1$,

$P_j = X_N$, if $Q \geq N$,

$P_j = X_q + (X_{q+1} - X_q)\,(Q - q)$, otherwise.

The sample median is defined as an estimate of the 50^{th} percentile.

8.1.7 Min max scanner

8.1.7.1 Overview

The min max scanner is a subclass of the ensemble statistic scanner, as defined in 8.1.3.

It has min max reporting behaviour, as well as min max calculation behaviour.

The min max scanner may employ the mean calculation behaviour defined in 8.1.4.3.

8.1.7.2 Min max reporting behaviour

The min max scanner makes observations of the same set of attributes across selected managed object instances. The attributes in the scan attribute identifier list are reported once for each selected managed object. For each attribute type specified in the numeric attribute identifier array, the number of samples is provided in the first element, the sample minimum is provided in the second element, the sample maximum is provided in the third element, and the sample mean is conditionally provided in the fourth element of the algorithm outputs array if the mean calculation package is present.

8.1.7.3 Min max calculation behaviour

The sample minimum is the smallest value of those collected. The sample maximum is the largest value of those collected.

8.1.8 Heterogeneous scanner

8.1.8.1 Overview

The heterogeneous scanner managed object class is a subclass of the scanner managed object class. A heterogeneous scanner managed object is defined to report, at the end of each granularity period, the sampled values of a set of attributes collected from managed objects.

The heterogeneous scanner managed object uses an explicit list of managed object instances, and their associated possibly different attributes, for scanning.

8.1.8.2 Attributes and packages of the heterogeneous scanner

The heterogeneous scanner has the following attributes, in addition to those inherited from scanner:

- *Observation identifier list* – A set of managed object instances, and associated attribute identifiers. The attributes to be observed in each of the selected managed objects may be specified in either, or both, of two structures embedded in the observation identifier list. The structures used to identify the attributes are:

  a) The *scan attribute identifier list* – Provides the capability of specifying the reporting of values for arbitrary attribute types, where each attribute value reported is paired with its attribute identifier.

  b) The *numeric attribute identifier array* – Provides a way to request a more efficient reporting format for numeric attributes. The numeric attribute values are reported as a sequence in the order of the attributes specified in the numeric attribute identifier array, without the attribute identifiers.

- *Suppress object instance* – A boolean value which, if true, causes the observed object instance parameter to be suppressed from all summary reports.

The heterogeneous scanner has the following conditional packages:

- once report attribute Id list package (present if once report attribute Id list reporting is required); and
- time stamp report package (present if time stamp reporting is required).

Further description of these packages is contained in 8.1.12.

8.1.8.3 Behaviour of the heterogeneous scanner

The heterogeneous scanner scans possibly different sets of attributes for a set of explicitly named observed objects and reports the results at the end of each granularity period.

The observation identifier list and suppress object instance attributes, as well as attributes of the once report attribute Id list package and time stamp report package may only be modified if the administrative state is "locked". If the attribute value change notification package is present, modification of these attributes shall result in an attribute value change notification.

Every reported attribute value may be reported with a time stamp and a suspect flag. The time stamp is the time at which the attribute was observed. The suspect flag is set true when the integrity of the attribute value is in question.

Each scan retrieves all available attribute values as specified by the observation identifier list.

On completion of a scan, the scanner emits a scan report notification which includes all attribute values retrieved in the scan.

If the suppress object instance attribute is true, then observed object instance names shall not be present in the summary report. The value of the suppress object instance attribute shall be set to true only when either:

- identification of the observed managed object instance can be determined by other means (e.g. an attribute value which determines the managed object name); or
- identification of the observed managed object instance is not required by the receiving system (e.g. when statistics are to be calculated).

If all the summarized data cannot be sent, the parameter incomplete scan shall be included in the summary report.

Independently of periodic scans and subsequent notifications, the manager may also invoke an action to request that the heterogeneous scanner initiate a scan and return the results of the scan in an action reply. The operation of the scanner in selecting managed objects and applying algorithms in this case is the same as defined above. Scanning and summary reports based on the granularity period of the heterogeneous scanner are not affected by the action request. If the administrative state is "locked", the heterogeneous scanner generates a scan action error if it receives an action request. Multiple replies may be issued for a single action request.

If the granularity period is zero, then scans are performed (and the results of the scan are returned) only when action requests are received.

The heterogeneous scanner exhibits state behaviour as described in 8.1.13.

8.1.9 Buffered scanner

8.1.9.1 Overview

The buffered scanner managed object class is derived from the scanner managed object class. It has behaviour similar to the scanner, but instead of reporting at the end of each granularity period, it retains the scanned attribute values. The scanning and retention of observations is done according to the granularity period and scheduling attributes inherited from the scanner managed object class. Reporting of the retained results is performed according to a report period that is specified independently of the granularity period and scanner schedule.

8.1.9.2 Attributes and packages of the buffered scanner

The buffered scanner has the following attributes, in addition to those inherited from scanner:

- *Report period attribute* – The number of granularity periods (i.e. the number of scans) in a report period.
- *Buffered observation identifier list* – A list containing a set of information describing each managed object to be observed. For each instance of a managed object to be observed the following information is embedded in the buffered observation identifier list:
  a) *Observed object* – The name of the object instance to be observed.
  b) *Scan attribute identifier list* – A list which specifies attributes of the managed object are to be observed. The attribute values may be of any type.
  c) *Numeric attribute identifier array* – An array which specifies an ordered sequence of attributes to be observed which have only numeric values (i.e. integer or real). This array (an ordered list) provides for a more efficient formatting of results for multiple numeric type attributes.
  d) *Report time attribute identifier list* – A list which specifies a set of attributes of arbitrary types that are to be scanned at the end of each report period and is included only once in the report.

  Three types of attribute identifier lists may be specified. An attribute identifier may be present in more than one list.

  NOTE – An example of the possible use of the report time attribute identifier list is as follows. If the scanned observed objects are metric objects (see ITU-T Rec. X.739 | ISO/IEC 10164-11), the second list embedded within the buffered observation identifier list (the numeric attribute identifier array) would specify identifiers for attributes that contain outputs of metric algorithms. In this case, the third list embedded within the buffered observation identifier list (the report time attribute identifier list) will be used to report metric object attributes that identify the managed objects and attributes being monitored by the metric object.
- *Suppress object instance* – A boolean value which, if true, causes the object instance parameter to be suppressed from all summary reports.

The buffered scanner has the following conditional package:

- time stamp report package (present if time stamp reporting is required).

Further description of this package is contained in 8.1.12.

8.1.9.3 Behaviour of the buffered scanner

The values of attributes specified in the scan attribute identifier list, and the numeric attribute identifier array are observed and retained after each granularity period. At the end of each enabled report period, the retained values of the two lists are included in a notification. Also, the notification contains a count (suspect scans) which is the number of scans for which data are suspect or missing for at least one attribute. In addition, every reported attribute value may be reported with a time stamp, and a suspect flag. The time stamp is the time at which the attribute was observed. The suspect flag is set true when the integrity of the attribute value is in question. The values for the attributes in the third list (the report time attribute identifier list) are observed and included in the notification. After each scheduled notification is emitted, the retained values are cleared.

The buffered scanner will emit notifications at the end of each report period if the report schedule is active. If the granularity period is equal to zero, then the report period must also be zero, and therefore summary reports shall only be sent in the form of action replies in response to report buffer actions. The report period shall be an integral multiple of the granularity period and shall not be less than the granularity period.

It is also possible to explicitly request the buffered scanner to report previously scanned attribute values as a result of an action request. When results are reported using this mechanism, the previously scanned values are retained.

When a scanning schedule expires during an active scan, the buffered scanner should complete the scan normally and stop after the scan. Similarly, when a reporting schedule expires during an active scan, the buffered scanner should complete the scan normally and report the results.

Each scan retrieves all available attribute values as specified by the buffered observation identifier list.

The report period begins and ends on granularity period boundaries, and includes the scan which is initiated at the end of the report period, but not the scan which is initiated at the start of the report period.

On completion of the last scan in the report period, the scanner emits a buffered scan report notification which includes all attribute values retrieved in all scans in the report period. If all the summarized data cannot be sent, the parameter incomplete scan shall be included in the summary report.

The notification is emitted at the completion of the last scan in a report period. If the scanning function is in a suspended state as determined by the administrative state or by the schedule at the time that this last scan would be initiated, the notification is not emitted. If the scanning function is suspended for a part of a report period, but is active for the last scan in the report period, the notification that is emitted includes results of all scans that took place in the report period (including scans before the scanning function was suspended). After the notification is emitted the retained values are cleared.

The report buffer action initiates a scan of the attributes specified in the report time attribute identifier list. The retained values of the previously scanned attributes together with the results of this scan are returned in the action reply. All attribute values retrieved in that scan are returned in the action reply. The report buffer action has no effect on the scanning and subsequent notifications that occur at the end of a granularity period. In particular, the buffered scan results are not cleared. If the administrative state is "locked", the buffered scanner generates a scan action error if it receives an action request. Multiple replies may be issued for a single action request.

The buffered scanner exhibits state behaviour as described in 8.1.13.

The report period, buffered observation identifier list (and the information embedded in it, i.e. the observed object, the scan attribute identifier list, numeric attribute identifier array, and report time attribute identifier list), and suppress object instance attributes, as well as attributes of the time stamp report package may only be modified if the administrative state is "locked". If the attribute value change notification package is present, modification of these attributes shall result in an attribute value change notification.

The attribute values from a scan are included in the notification emitted at the end of the report period (if this notification is in fact emitted). Therefore, scanned attribute values should be stored until the end of the report period in which they were obtained. These values may be discarded at the following times: once the notification including them is emitted; when a "GP Ends" event occurs that would normally initiate the last scan in the RP, but the scan is not initiated because of scheduling; and when the value of the administrative state changes to "locked".

If the suppress object instance attribute is true, then observed object instance names shall not be present in the summary report. The value of the suppress object instance attribute shall be set to true only when either:

- identification of the observed managed object instance can be determined by other means (e.g. an attribute value which determines the managed object name); or
- identification of the observed managed object instance is not required by the receiving system (e.g. when statistics are to be calculated).

8.1.10 Dynamic scanner

8.1.10.1 Overview

Summarization managed object classes with the capability of dynamically specifying selection criteria are derived from the dynamic scanner. It is activated by an action to scan a set of attributes across managed objects selected according to the parameters specified in Action Information, and to return summary reports in an action reply. The dynamic scanner is a non-instantiable superclass from which other scanners that do not periodically scan are derived.

8.1.10.2 Attributes of the dynamic scanner

The dynamic scanner managed object class has the following attributes:

- scanner Id, whose value identifies an instance of the dynamic scanner managed object class;
- an operational state as defined in CCITT Rec. X.731 | ISO/IEC 10164-2; and
- an administrative state as defined in CCITT Rec. X.731 | ISO/IEC 10164-2.

8.1.10.3 Behaviour of the dynamic scanner

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

8.1.11 Dynamic simple scanner

8.1.11.1 Overview

The dynamic simple scanner managed object class is derived from the dynamic scanner managed object class. It selects managed object instances using the criteria specified by the parameters in action request information. It can scope and filter the naming tree to determine managed object instances to scan, or can use an explicit list of managed object instances for scanning.

The dynamic simple scanner observes the values of the same attributes of each selected managed object instances. For each of the selected instances the same attributes to be observed are specified in one or both of the scan attribute identifier list and the numeric attribute identifier array in action request information. It collects the observed attribute values and returns summary reports in action replies.

8.1.11.2 Attributes of the dynamic simple scanner

The dynamic simple scanner has the attributes inherited from the dynamic scanner.

8.1.11.3 Behaviour of the dynamic simple scanner

The dynamic simple scanner is activated by an activate dynamic simple scan report action to scan and report the requested attribute values across the selected managed object instances as long as its administrative state is "unlocked". It interprets the parameters specified in 8.3.1.

The administrative state attribute is used to suspend or resume the scanning and reporting. If the administrative state has the value "unlocked", the scanner is ready to perform the scanning and reporting. If the administrative state has the value "shutting down", a new action is not accepted, but any scanning that is in progress continues. If the administrative state has the value "locked", any scanning that is in progress is halted and a scan action error is returned.

The attributes specified in the scan attribute identifier list, the numeric attribute identifier array, and the once report attribute Id list are scanned. Values for the attributes specified by the scan attribute identifier list parameter are included in the action reply paired with their attribute identifiers. Values for the attributes specified by the numeric attribute identifier array parameter are included in the action reply without their attribute identifiers. If the once report attribute Id list parameter is specified, the values of the attributes are included only once in the action reply, if they are the same for each selected managed object. If any of the scan attribute identifier list, the numeric attribute identifier array, and the once report attribute Id list is not specified, then the corresponding values are not included in action replies. When the selected managed object does not have the attribute in the scan attribute identifier list parameter, the attribute value is absent in the action reply. If any attribute in the numeric attribute identifier array parameter is absent, a value of NULL shall be present in the action reply.

Either the scoped selection parameter or the object list parameter shall be specified, but not both. If the scoped selection parameter, composed of the base managed object, the scope and the scanning filter, is specified, the scanner uses the managed object instance specified in the base managed object parameter and observes all the instances within the levels indicated by the scope parameter which satisfy the criteria in the scanning filter parameter. If the object list parameter is specified, the scanner observes the managed object instances specified.

If the suppress object instance parameter is specified with the value of true, the names of the observed object instances are not included in the action reply.

When the time stamp report mode parameter is specified with a non-zero value, the action reply shall be time stamped in accordance with the specified mode.

If all the summarized data cannot be sent, the parameter incomplete scan shall be included in the action reply.

Multiple replies may be issued for a single action request.

8.1.12 Packages supporting summarization objects

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

8.1.12.1 Managed object instance selection package

8.1.12.1.1 Overview

The managed object instance selection package is used to explicitly identify managed objects with the same set of attributes to be observed.

8.1.12.1.2 Attributes of the managed object instance selection package

The managed object instance selection package contains the following attribute:

- *Object list* – A list which contains a set of managed object instance names which have the same set of attributes to be observed for the report.

8.1.12.1.3 Behaviour of the managed object instance selection package

The managed object instance selection package has no additional behaviour beyond the behaviour of the object list attribute.

8.1.12.2 Once report attribute Id list package

8.1.12.2.1 Overview

The once report attribute Id list package is used to suppress multiple reporting of attribute values when they are the same across selected managed objects.

8.1.12.2.2 Attributes of the once report attribute Id list package

The once report attribute Id list package includes the following attribute:

- *Once report attribute Id list* – A list which contains a set of attribute identifiers specifying attributes of any ASN.1 type. The value of the attributes identified shall be included only once in the summary report if they have the same value across all the observed objects.

8.1.12.2.3 Behaviour of the once report attribute Id list package

If the once report attribute Id list package is present, then the specified attributes shall be reported once in the report, if they are the same for each selected managed object. If the values for any one of the attributes specified in the once report attribute Id list are different or missing for any of the observed objects, then the attribute values for that attribute shall be reported separately for each observed object along with those specified in the scan attribute identifier list.

8.1.12.3 Scoped selection package

8.1.12.3.1 Overview

The scoped selection package is used to identify managed objects with the same set of attributes to be observed. The managed objects are selected using a scoping and filtering mechanism similar to that used by CMIS, as defined in CCITT Rec. 710 | ISO/IEC 9596.

8.1.12.3.2 Attributes of the scoped selection package

The scoped selection package contains the following attributes:

- *Base managed object* – The name of the base managed object instance used for scoping.
- *Scope* – The level(s) in the naming hierarchy which identify the instances that are to be selected using the scanning filter.
- *Scanning filter* – The criteria to be used for selecting managed objects.

8.1.12.3.3 Behaviour of the scoped selection package

The scoped selection package is used to identify managed objects using a scoping and filtering mechanism similar to that used by CMIS, as defined in CCITT Rec. 710 | ISO/IEC 9596. If the timing selection package is also specified, a managed object is only selected if it satisfies both the selection criteria specified by the scoped selection package and the timing criterion specified by the timing selection package. (See 8.1.12.5.) The same set of attributes are to be observed from the selected managed objects.

8.1.12.4 Time stamp report package

8.1.12.4.1 Overview

The time stamp report package provides a mechanism for specifying the inclusion of time stamps in summary reports.

8.1.12.4.2 Attributes of the time stamp report package

The time stamp report package has the following attribute:

- *Time stamp report mode* – An attribute which indicates the following time stamping reporting modes:

  a) *Time stamping off* – No time stamping in summary report;

  b) *Global time stamp only* – Only the scan initiation time is to be reported in the report; and

  c) *Individual time stamping* – The scan initiation time as well as the offset for each value is to be reported.

8.1.12.4.3 Behaviour of the time stamp report package

If the package is present, and the time stamp report mode attribute is not "time stamping off", then summary reports shall be time stamped in accordance with the time stamp report mode value, as follows:

- If the value is "global time stamp only", report only the scan initiation time in emitted summary reports.
- If the value is "individual time stamping", report the scan initiation time, as well as the time offset of each parameter's scan time relative to the scan initiation time, in emitted summary reports.

The default value for the time stamp report mode is "time stamping off".

8.1.12.5 Timing selection package

8.1.12.5.1 Overview

The timing selection package provides a mechanism for specifying timing selection criteria to be applied to managed objects to be observed. The scoped selection package shall also be present, and only those managed objects that satisfy the conditions imposed by both packages are selected for observation.

8.1.12.5.2 Attributes of the timing selection package

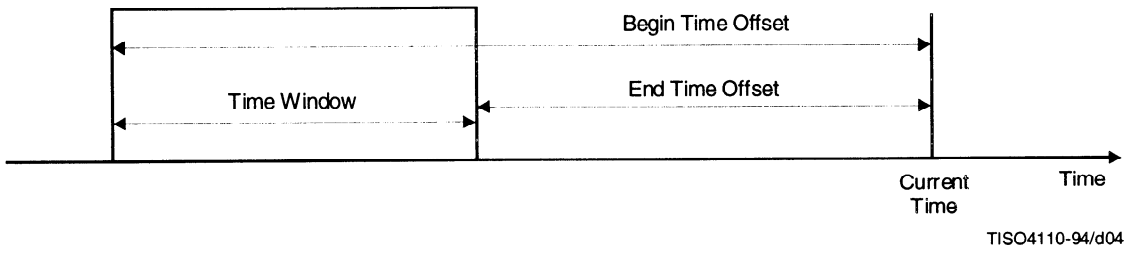
The timing selection package contains the following attributes:

- *Begin time offset* – Used together with the attribute end time offset to produce a time window relative to the current time for selecting managed objects. The value of the attribute is subtracted from the value of the current time to define the beginning of the current window. When examining a managed object for selection, if the value of the attribute identified by the time attribute identifier falls within the time window, that managed object is selected. The diagram below illustrates the time window.
- *End time offset* – Used together with the begin time offset attribute to produce a time window relative to the current time for selecting managed objects. The value of the attribute is subtracted from the value of the current time to define the end of the time window. The diagram below illustrates the time window.
- *Time attribute identifier* – Identifies the attribute whose value shall be used as part of the criteria for selecting the managed objects. The attribute identified shall have the syntax of ASN.1 type GeneralizedTime.

8.1.12.5.3 Behaviour of the timing selection package

In addition to the behaviour its attributes, the timing selection package has the following behaviour.

When examining a managed object for selection (e.g. selecting a log record object by its creation time), if the value of the attribute identified by the time attribute identifier falls within the time window, that managed object is selected. See the diagram below.



When this package is present the scoped selection package shall also be present. A managed object is only selected if it can satisfy the conditions specified by both packages.

8.1.13 State behaviour for summarization objects

Table 1 specifies aspects of the behaviour related to the administrative state attribute, availability status attribute, scheduling packages and action operations of summarization objects in the form of a state table. The table indicates the behaviour of the summarization object when certain events occur while it is in one of six specified states. The states in this table are formed as the combination of the values of the administrative state attribute and the "off-duty" value of the availability status attribute, as defined in CCITT Rec. X.731 | ISO/IEC 10164-2. This state table applies when the operational state attribute has the value enabled.

When the administrative state has the value "unlocked" (STA3 or STA6), there may or may not be a scan in progress. For non-buffered scanners, when the administrative state has the value "shutting down" (STA2 or STA5), there is a scan in progress, and when it completes, the administrative state will change to "locked" (unless it is changed to "unlocked" before the scan completes). For buffered scanners, when the administrative state has the value "shutting down" (STA2 or STA5), there may or may not be a scan in progress, and when the report period completes, the administrative state will change to "locked" (unless it is changed to unlocked before the report period completes). In the "locked" state (STA1 or STA4), there is no scan in progress, and scanning is inhibited.

When the availability status includes the value "off-duty", scan initiation is inhibited by the internal or external schedule for the summarization object. The absence of the "off-duty" value (indicated by "on-duty" in Table 1) indicates that scan initiation is not inhibited by the schedule.

The application of an action that is not defined for the summarization object class shall cause a CMIS "noSuchAction" error to be returned and the action shall otherwise be ignored.

The events that drive the summarization object are as follows:

- *Lock* – The administrative state is set to "locked".
- *Shut Down* – The administrative state is set to "shutting down".
- *Unlock* – The administrative state is set to "unlocked".
- *Schedule Off* – An "on" to "off" transition, as specified by the internal or external schedule.
- *Schedule On* – An "off" to "on" transition, as specified by the internal or external schedule.
- *GP Ends* – A granularity period ends.
- *Periodic Scan Completes* – A scan that was initiated as a result of a "GP Ends" event completes.
- *Scan Action Received* – An action to scan and report is received.
- *Action Scan Completes* – A scan that was initiated as a result of a "Scan Action Received" or "Report Buffer Action Received" event completes.
- *Report Buffer Action Received* – An action to report the buffered scanned attribute values is received.

Table 1 – State table for summarization scanners

		Current State					
		STA1 locked, off-duty	STA2 shutting down, off-duty	STA3 unlocked, off-duty	STA4 locked, on-duty	STA5 shutting down, on-duty	STA6 unlocked, on-duty
Event	Lock	STA1	p1: Halt scan p2: Halt scan; return scanActionError STA1	p1: Halt scan p2: Halt scan; return scanActionError STA1	STA4	p1: Halt scan p2: Halt scan; return scanActionError STA4	p1: Halt scan p2: Halt scan; return scanActionError STA4
	Shut Down	STA1	STA2	p1$^{\vee}$p2: STA2 ^p1&^p2: STA1	STA4	STA5	p1$^{\vee}$p2$^{\vee}$p4: STA5 ^(p1$^{\vee}$p2$^{\vee}$p4): STA4
	Unlock	STA3	STA3	STA3	STA6	STA6	STA6
	Schedule Off	STA1	STA2	STA3	STA1	STA2	STA3
	Schedule On	STA4	STA5	STA6	STA4	STA5	STA6
	GP Ends	STA1	STA2	STA3	STA4	STA5	Begin scan STA6
	Periodic Scan Completes	–	p3: Emit notification (include results of all scans in the RP) STA1	p3: Emit notification (include results of all scans in the RP) STA3	–	p3: Emit notification (include results of all scans in the RP) STA4	p3: Emit notification (include results of all scans in the RP) STA6
	Scan Action Received	Return scanAction Error STA1	Return scanAction Error STA2	Begin scan STA3	Return scanAction Error STA4	Return scanAction Error STA5	Begin scan STA6
	Action Scan Completes	–	Return action result (include results of the scan) STA1	Return action result (include results of the scan) STA3	–	Return action result (include results of the scan) STA4	Return action result (include results of the scan) STA6
	Report Buffer Action Received	Return scanAction Error STA1	Return scanAction Error STA2	Return action result (include all values from completed scans in this report period and report time attributes) STA3	Return scanAction Error STA4	Return scanAction Error STA5	Return action result (include all values from completed scans in this report period and report time attributes) STA6

The behaviour description in Table 1 makes use of the following predicates:

- *p1* – A scan that was initiated as a result of a "GP Ends" event is in progress.
- *p2* – A scan that was initiated as a result of a "Scan Action Received" or "Report Buffer Action Received" event is in progress.
- *p3* – The scan that has just completed is the last scan in the report period. (If the report period consists of one granularity period, this is the only scan in the report period.)
- *p4* – A report period of a buffered scanner is in progress.

NOTE – For the buffered scanner, the attribute values from a scan are included in the notification emitted at the end of the report period (if this notification is in fact emitted). Therefore, scanned attribute values should be stored until the end of the report period in which they were obtained. These values may be discarded at the following times: once the notification including them is emitted; when a "GP Ends" event occurs that would normally initiate the last scan in the RP, but the scan is not initiated; and when the last scan in the RP is halted.

Figure 4 is a diagrammatic representation of the key aspects of Table 1. It illustrates the primary state transitions, but does not represent the behaviour associated with actions.

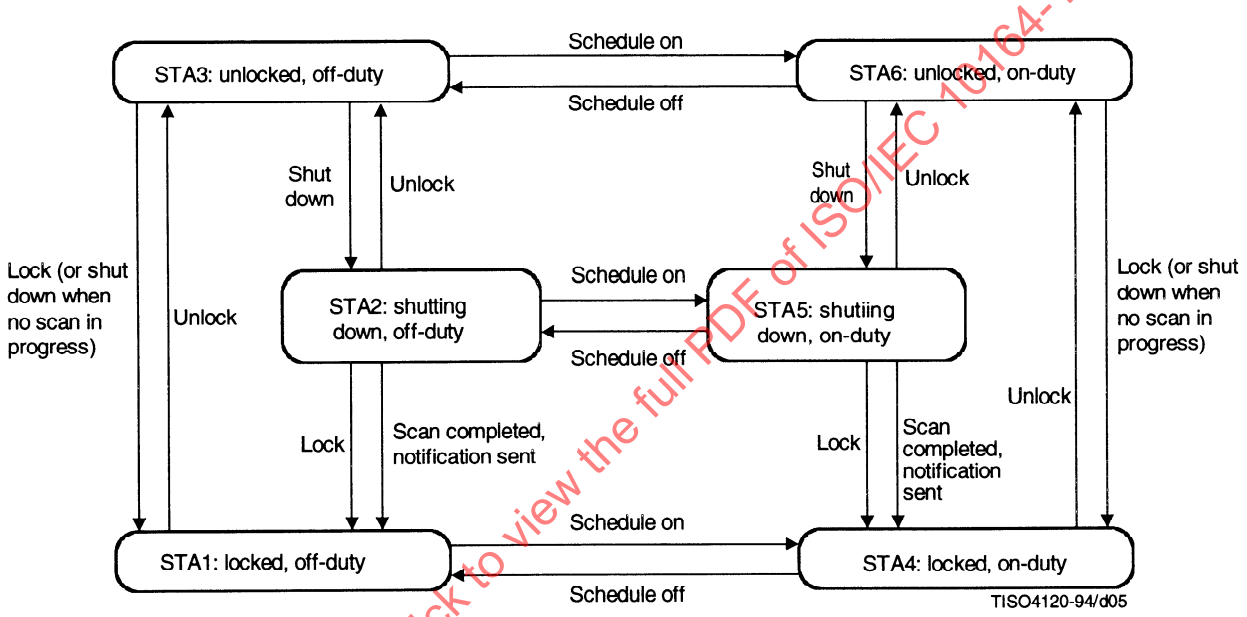


Figure 4 – State diagram for summarization scanners

8.2 Generic notifications

8.2.1 Event types

The following event types are defined within this Specification:

- *scan report* – Summary results from a single scan by a summarization object, reporting observed attribute values from one or more selected observed objects;
- *buffered scan report* – Summary results from multiple scans by a summarization object within a report period, reporting values obtained from each scan of observed attributes from one or more selected observed objects; and
- *statistical report* – Summary results from a single scan by a summarization object, reporting observed attribute values from one or more observed objects, and ensemble statistics derived from the same set of attributes across selected observed objects.

It is the role of the managed object class defined to fully detail the requirements that a managed object class has for generating one or more of the above notification types.

8.2.2 Event information

8.2.2.1 Parameters for the scan report notification, activate dynamic simple scan report action reply, and activate scan report reply

8.2.2.1.1 Scan initiation time

This parameter, when present, indicates the date and time at which the reported scan was initiated.

8.2.2.1.2 Once report attribute list

This parameter, when present, reports values of the attributes specified in the once report attribute Id list that are the same across all the observed object.

8.2.2.1.3 Observation scan list

A list, with one entry for each observed object. The entry for each managed object instance contains the following parameters:

- *Observed object instance* – When present indicates the name of an observed object.
- *Attribute measure list* – When present includes the list of scanned attribute values along with their attribute identifiers, each with an optional time stamp and an optional suspect flag. Attribute identifiers of missing attribute values are indicated.
- *Numeric value array* – When present includes the array of numeric attribute values, without the attribute identifier, each with an optional time stamp and an optional suspect flag. The attribute identifier can be determined by query on the numeric attribute identifier array of the scanner that emitted the notification. Missing values are indicated.

8.2.2.1.4 Incomplete scan

This parameter, when present, indicates that the scan is not complete. This parameter may take on one of the following values to indicate the reason that the scan could not be completed:

- *Size limit exceeded* – A pragmatic limit on the size of the summarized data was exceeded.
- *Scan time exceeded* – The beginning of a new scan has occurred before this scan could be completed.
- *Other* – There is another reason why this scan could not be completed.

8.2.2.2 Parameters for the statistical report notification and activate statistical report action reply

8.2.2.2.1 Scan initiation time

This parameter, when present, indicates the date and time at which the reported scan was initiated.

8.2.2.2.2 Observation report list

This parameter, when present, contains a list with one entry for each observed object. The entry for each managed object instance contains the following parameters:

- *Object instance* – When present indicates the name of an observed object.
- *Attribute values* – When present indicates the list of scanned attribute values along with their attribute identifiers, each with an optional time stamp and an optional suspect flag. Attribute identifiers of missing attribute values are indicated in the list.

8.2.2.2.3 Algorithm outputs

A list which has for each common numeric attribute the following parameters:

- attribute Id; and
- ordered array of numeric values, with the contents of each position determined by the statistical scanner managed object class (e.g. the number of samples in the first position, mean in second position, variance in the third position for the mean and variance scanner).

8.2.2.2.4 Algorithm parameters

This parameter, if present, indicates one or more algorithm parameters of a statistical algorithm that was applied to scanned attribute values. The parameters are contained in an ordered list. The managed object definition shall determine which algorithm parameters are contained in which positions in the ordered list.

8.2.2.2.5 Incomplete scan

See 8.2.2.1.4

8.2.2.2.6 Additional text

This parameter, when present, may be used for extensions to this notification as defined in Rec. X.733 | ISO/IEC 10164-4.

8.2.2.2.7 Additional information

This parameter, when present, may be used for extensions to this notification as defined in Rec. X.733 | ISO/IEC 10164 4.

8.2.2.3 Parameters for the buffered scan report notification and report buffer action reply

8.2.2.3.1 Granularity period

The time between successive scans, as defined in Rec. X.739 | ISO/IEC 10164-11.

8.2.2.3.2 First scan initiation time

This parameter, when present, indicates the start time of the first scan in the buffer.

8.2.2.3.3 Suspect intervals

This parameter, when present, indicates the number of scheduled scans which had any observed attribute value missing or suspect. The default value is zero.

8.2.2.3.4 Buffered observation list

A list, with one entry for each observed object. The entry for each managed object instance contains the following parameters:

- *Observed object instance name* – When present indicates the name of an observed object.
- *Report time attribute identifier list* – A list of attribute values along with their attribute identifiers scanned at the reporting time, each with an optional time stamp and an optional suspect flag. Attribute identifiers of missing attribute values are indicated.
- *Attributes buffer* – A set of attribute values along with their identifiers, ordered with respect to time of observation for each of the observed attributes of an observed object. For each value a time stamp and a suspect flag may optionally be specified. The absence of a value for an attribute indicates a missing value for that scan.
- *Numeric attributes buffer* – A collection of sequences of attribute values. Each sequence is ordered with respect to time of observation for each of the observed attributes of an observed object. The above sequences are placed in an outer sequence in the same order as the list of attributes specified in the numeric attribute identifier list attribute. For each value a time stamp and a suspect flag may optionally be specified. The absence of a value for an attribute indicates a missing value for that scan.

8.2.2.3.5 Incomplete scan

See 8.2.2.1.4.

8.2.2.3.6 Additional text

See 8.2.2.2.6.

8.2.2.3.7 Additional information

See 8.2.2.2.7.

8.3 Generic actions

The following action types are defined within this Specification:

- *Activate dynamic simple scan report* – Activate summary results from a single scan by a summarization object, reporting observed attribute values from one or more selected observed objects. The identification of managed object and attribute selection criteria is conveyed in the action argument information. The action reply information in the action response is identical to the event information in the scan report notification. See 8.2.2.1.

- *Activate scan report* – Activate summary results from a single scan by a summarization object, reporting observed attribute values from one or more selected observed objects. There is no argument information, and the action reply information in the action response is identical to the event information in the scan report notification information. See 8.2.2.1.
- *Report buffer* – Report the retained results of the scans in the current report period. The action may also result in a scan of the attributes specified by the report time attribute identifier list attribute. In this case the action reply information contains this last scan. There is no argument information, and the action reply information in the action response is identical to the event information in the buffered scan report notification. See 8.2.2.3.
- *Activate Statistical report* – Activate summary results from a single scan by a summarization object, reporting observed attribute values from one or more observed objects, and ensemble statistics derived from the same set of attributes across selected observed objects. There is no argument information, and the action reply information in the action response is identical to the event information in the statistical report notification. See 8.2.2.2.

It is the role of the managed object class defined to fully detail the requirements that a managed object class has for responding to one or more of the above action types.

8.3.1 Action information for the activate dynamic simple scan report action

The following parameters constitute the activate dynamic simple scan action information.

8.3.1.1 Scan attribute identifier list

See the definition of the attribute "scan attribute identifier list" in 8.1.1.2.

8.3.1.2 Numeric attribute identifier array

See the definition of the attribute "numeric attribute identifier array" in 8.1.2.2.

8.3.1.3 Base managed object

See the definition of the attribute "base managed object" in 8.1.12.3.

8.3.1.4 Scope

See the definition of the attribute "scope" in 8.1.12.3.

8.3.1.5 Scanning filter

See the definition of the attribute "scanning filter" in 8.1.12.3.

8.3.1.6 Object list

See the definition of the attribute "object list" in 8.1.12.1.

8.3.1.7 Suppress object instance

See the definition of the attribute "suppress object instance" in 8.1.2.2.

8.3.1.8 Once report attribute Id list

See the definition of the attribute "once report attribute Id list" in 8.1.12.2.

8.3.1.9 Time stamp report mode

See the definition of the attribute "time stamp report mode" in 8.1.12.4.

8.4 Parameter definitions

8.4.1 conflicting packages requested error parameter: This Specification defines the conflicting package requested error parameter to be returned in response to object creation requests either with attributes defined for conditional packages all of which shall not be present together or attributes of packages that must be present together but are not specified in the request.

8.4.2 scan action error parameter: This Specification defines the scan action error parameter to be returned when a scan action request to a summarization managed object was not performed because of one of the following reasons: administrative state is locked, administrative state is shutting down, scan is terminated because administrative state was set to locked when performing the scan action or an unspecified error occurred.

8.5 Compliance

Managed object class definitions may import the appropriate specification of managed objects, notifications, actions, and/or attribute types defined in this standard. This is achieved by reference to the templates defined in this Specification and in CCITT Rec. X.721 | ISO/IEC 10165-2. The reference mechanism is defined in CCITT Rec. X.722 | ISO/IEC 10165-4.

8.6 Generic definitions from the object management function

This Specification makes use of the following generic definitions in CCITT Rec. X.730 | ISO/IEC 10164-1:

- attribute value change notification;
- object creation notification; and
- object deletion notification.

8.7 Generic definitions from the state management function

This Specification makes use of the following generic definitions in CCITT Rec. X.731 | ISO/IEC 10164-2:

- administrative state;
- availability status;
- operational state; and
- state change notification.

8.8 Generic definitions from the event report management function

This Specification makes use of the following generic definitions in CCITT Rec. X.734 | ISO/IEC 10164-5:

- additional information;
- additional text;
- daily scheduling package;
- external scheduler scheduling package;
- start time;
- stop time;
- weekly scheduling package; and
- duration package.

8.9 Generic definitions from the generic network information model

This Specification makes use of the following generic definitions in CCITT Rec. M.3100:

- create delete notifications package;
- attribute value change notification package; and
- state change notification package;

8.10 Generic definitions from metric objects and attributes

This Specification makes use of the following generic definitions in ITU-T Rec. X.739 | ISO/IEC 10164-11:

- granularity period; and
- scanner.

8.11 Generic definitions from the alarm reporting function

This Specification makes use of the following generic definitions in CCITT Rec. X.733 | ISO/IEC 10164-4:

- additional information; and
- additional text.

9 Service definition

9.1 Introduction

The Summarization Function provides services to modify the operation of summarization objects. In particular, the operations required that can be applied to each instance of a summarization object are:

- creation of a summarization object;
- deletion of a summarization object; and
- modification of summarization attributes.

In addition to the above services to modify summarization instances, this function provides notification services, and actions to stimulate the generation of notifications from summarization object instances.

9.2 Initiation, termination, modification and retrieval services

The PT-CREATE, PT-DELETE, and PT-SET services can be used to create, delete, and modify summarization object instances.

The absence of scheduling attributes implies that the summarization object is always active.

The PT-GET service can be used to retrieve information pertaining to summarization object instances.

9.3 Notification services

9.3.1 Scan report service definition

This subclause specifies the scan report service, and maps it onto the CMIS M–EVENT–REPORT service (see Table 2).

9.3.2 Statistical report service definition

This subclause specifies the statistical report service, and maps it onto the CMIS M–EVENT–REPORT service (see Table 3).

9.3.3 Buffered scan report service definition

This subclause specifies the buffered scan report service, and maps it onto the CMIS M–EVENT–REPORT service (see Table 4).

9.4 Action services

The following four actions are defined:

- *Activate scan report* – Stimulates a scan and report;
- *Report buffer* – Stimulates reporting of retained values in a buffered scanner, without clearing the buffer;
- *Activate dynamic simple scan report* – Stimulates a dynamic simple scan and reply using the parameters of this action; and
- *Activate statistical report* – Stimulates a scan and statistical report.

9.4.1 Activate scan report action service definition

This subclause specifies the activate scan report action service, and maps it onto the CMIS M–ACTION service (see Table 5).

9.4.2 Report buffer action service definition

This subclause specifies the activate buffered report action service, and maps it onto the CMIS M–ACTION service (see Table 6).

9.4.3 Activate dynamic simple scan report action service definition

This subclause specifies the activate dynamic simple scan report action service, and maps it onto the CMIS M–ACTION service (see Table 7).

The activate dynamic simple scan report action service uses the parameters defined in 8.11.3 in addition to the general M-ACTION service parameters defined in CCITT Rec. X.710 | ISO/IEC 9595. Table 7 lists the parameters for this service.

9.4.4 Activate statistical report action service definition

This subclause specifies the activate statistical report action service, and maps it onto the CMIS M–ACTION service (see Table 8).

Table 2 – Scan report notification

Parameter name	Req./Ind.	Rsp./Conf.
Invoke identifier	P	P
Mode	P	–
Managed object class	P	P
Managed object instance	P	P
Event type	M	C2(=)
Event time	P	–
Event information		
Scan initiation time	U	–
Once report attribute list	U	–
Observation scan list	M	–
Observed object instance	U	–
Attribute measure list	U	–
Attribute Id	M	–
Attribute value	U	–
Time stamp	U	–
Suspect flag	U	–
Numeric value array	U	–
Missing data	C1	–
Value only	C1	–
Qualified value	C1	–
Value	M	–
Time stamp	C3	–
Suspect flag	C3	–
Incomplete scan	U	–
Additional text	U	–
Additional information	U	–
Current time	–	P
Event reply	–	P
Errors	–	P

C1 Only one of missing data, value only, and qualified value may be present in each element of the numeric value array.

C2 Condition defined in CCITT Rec. X.710 | ISO/IEC 9595.

C3 At least one of time stamp or suspect flag shall be present in qualified value.

NOTES

1 The parameter observed object instance shall be present if the value of the attribute suppress object instance is false.

2 The parameter incomplete scan shall be present if the scan could not be completed.

Table 3 – Statistical report notification

Parameter name	Req./Ind.	Rsp./Conf.
Invoke identifier	P	P
Mode	P	–
Managed object class	P	P
Managed object instance	P	P
Event type	M	C1(=)
Event time	P	–
Event information		
Scan initiation time	U	–
Observation report list	U	–
Object instance	U	–
Attribute values	U	–
Attribute Id	M	–
Attribute value	U	–
Time stamp	U	–
Suspect flag	U	–
Algorithm outputs	M	–
Attribute Id	M	–
Algorithm output	M	–
Algorithm parameters	U	–
Incomplete scan	U	–
Additional text	U	–
Additional information	U	–
Current time	–	P
Event reply	–	P
Errors	–	P

C1 Condition defined in CCITT Rec. X.710 | ISO/IEC 9595.

NOTES

1 If the observation report list is present and the value of the attribute suppress object instance is false, then the parameter object instance shall be present.

2 The parameter incomplete scan shall be present if the scan could not be completed.

Table 4 – Buffered scan report notification

Parameter name	Req./Ind.	Rsp./Conf.
Invoke identifier	P	P
Mode	P	–
Managed object class	P	P
Managed object instance	P	P
Event type	M	C3(=)
Event time	P	–
Event information		
Granularity period	M	–
First scan initiation time	U	–
Suspect intervals	U	–
Buffered observation list	M	–
Object instance	U	–
Report time attribute list	U	–
Attribute Id	M	–
Attribute value	U	–
Time stamp	U	–
Suspect flag	U	–
Attributes buffer	U	–
Attribute Id	M	–
Attribute value	U	–
Time stamp	U	–
Suspect flag	U	–
Numeric attributes buffer	U	–
Missing data	C2	–
Value only	C2	–
Qualified value	C2	–
Value	M	–
Time stamp	C1	–
Suspect flag	C1	–
Incomplete scan	U	–
Additional text	U	–
Additional information	U	–
Current time	–	P
Event reply	–	P
Errors	–	P

C1 At least one of time stamp or suspect flag shall be present in qualified value.

C2 Only one of missing data, value only, or qualified value may be present in each element of the numeric attributes buffer.

C3 Condition defined in CCITT Rec. X.710 | ISO/IEC 9595.

NOTES

1 The parameter object instance shall be present if the value of the attribute suppress object instance is false.

2 The parameter incomplete scan shall be present if the scan could not be completed.

Table 5 – Activate scan report action service

Parameter name	Req./Ind.	Rsp./Conf.
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	M(=)
Current time	–	P
Action reply	–	M
Scan initiation time	–	U
Once report attribute list	–	U
Observation scan list	–	M
Observed object instance	–	U
Attribute measure list	–	U
Attribute Id	–	M
Attribute value	–	U
Time stamp	–	U
Suspect flag	–	U
Numeric value array	–	U
Missing data	–	C1
Value only	–	C1
Qualified value	–	C1
Value	–	M
Time stamp	–	C2
Suspect flag	–	C2
Incomplete scan	–	U
Additional text	–	U
Additional information	–	U
Errors	–	U

C1 Only one of missing data, value only, and qualified value may be present in each element of the numeric value array.

C2 At least one of time stamp or suspect flag shall be present in qualified value.

NOTES

1 The parameter observed object instance shall be present if the value of the attribute suppress object instance is false.

2 The parameter incomplete scan shall be present if the scan could not be completed.

3 This Specification defines a specific error with syntax.

Table 6 – Report buffer action service

Parameter name	Req./Ind.	Rsp./Conf.
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	M(=)
Current time	–	P
Action reply	–	M
Granularity period	–	M
First scan initiation time	–	U
Suspect intervals	–	U
Buffered observation list	–	M
Object instance	–	U
Report time attribute list	–	U
Attribute Id	–	M
Attribute value	–	U
Time stamp	–	U
Suspect flag	–	U
Attributes buffer	–	U
Attribute Id	–	M
Attribute value	–	U
Time stamp	–	U
Suspect flag	–	U
Numeric attributes buffer	–	U
Missing data	–	C1
Value only	–	C1
Qualified value	–	C1
Value	–	M
Time stamp	–	C2
Suspect flag	–	C2
Incomplete scan	–	U
Additional text	–	U
Additional information	–	U
Errors	–	U

C1 Only one of missing data, value only, or qualified value may be present in each element of the numeric attributes buffer.

C2 At least one of time stamp or suspect flag shall be present in qualified value.

NOTES

1 The parameter object instance shall be present if the value of the attribute suppress object instance is false.

2 The parameter incomplete scan shall be present if the scan could not be completed.

3 This Specification defines a specific error with syntax.

Table 7 – Activate dynamic simple scan report action service

Parameter name	Req./Ind.	Rsp./Conf.
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	M(=)
Action Information	M	–
Scan attribute identifier list	U	–
Numeric attribute identifier array	U	–
Scoped selection	C2	–
Base managed object	U	–
Scope	U	–
Scanning filter	U	–
Object list	C2	–
Suppress object instance	U	–
Once report attribute Id list	U	–
Time stamp report mode	U	–
Current time	–	P
Action reply	–	M
Scan initiation time	–	U
Once report attribute list	–	U
Observation scan list		
Observed object instance	–	U
Attribute measure list	–	U
Attribute Id	–	M
Attribute value	–	U
Time stamp	–	U
Suspect flag	–	U
Numeric value array	–	U
Missing data	–	C1
Value only	–	C1
Qualified value	–	C1
Value	–	M
Time stamp	–	U
Suspect flag	–	U
Incomplete scan	–	U
Additional text	–	U
Additional information	–	U
Errors	–	U

C1 Only one of missing data, value only, and qualified value may be present in each element of the numeric value array.

C2 Either the scoped selection or the object list parameter (but not both) may be present in the ACTION request.

NOTES

1 The parameter observed object instance shall be present if the value of the attribute suppress object instance is false.

2 The parameter incomplete scan shall be present if the scan could not be completed.

3 This Specification defines a specific error with syntax.

Table 8 – Activate statistical report action service

Parameter name	Req./Ind.	Rsp./Conf.
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	M(=)
Current time	–	P
Action reply	–	M
Scan initiation time	–	U
Observation report list	–	U
Object instance	–	U
Attribute values	–	U
Attribute Id	–	M
Attribute value	–	U
Time stamp	–	U
Suspect flag	–	U
Algorithm outputs	–	U
Attribute Id	–	M
Algorithm output	–	M
Incomplete scan	–	U
Additional text	–	U
Additional information	–	U
Errors	–	U

NOTES

1 If the observation report list is present and the value of the attribute suppress object instance is false, then the parameter object instance shall be present.

2 The parameter incomplete scan shall be present if the scan could not be completed.

3 This Specification defines a specific error with syntax.

10 Systems management functional units

Two functional units are defined in this Specification for the management of Summarization object classes:

a) *Scan stimulation functional unit*

The scan stimulation functional unit requires the support of at least one of the summarization action services defined in this standard.

b) *Summarization event reporting functional unit*

The summarization event reporting functional unit requires the support of at least one of the summarization notification event report services defined in this standard.

The following functional units defined in CCITT Rec. X.730 | ISO/IEC 10164-1 may be negotiated for the purpose of managing summarization objects:

- control;
- monitor; and
- objectEvents.

The following functional unit defined in CCITT Rec. X.731 | ISO/IEC 10164-2 may be negotiated for the purpose of managing summarization objects:

- StateChangeReporting.

11 Protocol and abstract syntax

11.1 Scan report service elements of procedure

11.1.1 Agent role

11.1.1.1 Invocation

The scan report service procedures are initiated by the scan report service request primitive. On receipt of a scan report service request primitive, the SMAPM shall construct an MAPDU and issue a CMIS M-EVENT-REPORT request service primitive with parameters derived from the scan report service request primitive. In the non-confirmed mode, the procedure in 11.1.1.2 does not apply.

11.1.1.2 Receipt of response

On receipt of a CMIS M-EVENT-REPORT confirm service primitive containing an MAPDU responding to a scan report service notification, the SMAPM shall issue a scan report service confirmation primitive to the scan report service user with parameters derived from the CMIS M-EVENT-REPORT confirm service primitive, thus completing the scan report service procedure.

NOTE – The SMAPM shall ignore all errors in the received MAPDU. The scan report service user may ignore such errors, or abort the association as a consequence of such errors.

11.1.2 Manager role

11.1.2.1 Receipt of request

On receipt of a CMIS M-EVENT-REPORT indication service primitive containing an MAPDU requesting the scan report service, the SMAPM shall, if the MAPDU is well formed, issue a scan report service indication primitive to the scan report service user with parameters derived from the CMIS M-EVENT-REPORT indication service primitive. Otherwise, the SMAPM shall in the confirmed mode construct an appropriate MAPDU containing notification of the error, and shall issue a CMIS M-EVENT-REPORT response service primitive with an error parameter present. In the non-confirmed mode, the procedure in 11.1.2.2 does not apply.

11.1.2.2 Response

In the confirmed mode, the SMAPM shall accept an scan report service response primitive and shall construct an MAPDU confirming the notification and issue a CMIS M-EVENT-REPORT response service primitive with parameters derived from the scan report service response primitive.

11.2 Statistical report service elements of procedure

11.2.1 Agent role

11.2.1.1 Invocation

The statistical report service procedures are initiated by the statistical report service request primitive. On receipt of a statistical report service request primitive, the SMAPM shall construct an MAPDU and issue a CMIS M-EVENT-REPORT request service primitive with parameters derived from the statistical report service request primitive. In the non-confirmed mode, the procedure in 11.2.1.2 does not apply.

11.2.1.2 Receipt of response

On receipt of a CMIS M-EVENT-REPORT confirm service primitive containing an MAPDU responding to a statistical report service notification, the SMAPM shall issue a statistical report service confirmation primitive to the statistical report service user with parameters derived from the CMIS M-EVENT-REPORT confirm service primitive, thus completing the statistical report service procedure.

NOTE – The SMAPM shall ignore all errors in the received MAPDU. The statistical report service user may ignore such errors, or abort the association as a consequence of such errors.

11.2.2 Manager role

11.2.2.1 Receipt of request

On receipt of a CMIS M-EVENT-REPORT indication service primitive containing an MAPDU requesting the statistical report service, the SMAPM shall, if the MAPDU is well formed, issue a statistical report service indication primitive to the statistical report service user with parameters derived from the CMIS M-EVENT-REPORT indication service primitive. Otherwise, the SMAPM shall in the confirmed mode construct an appropriate MAPDU containing notification of the error, and shall issue a CMIS M-EVENT-REPORT response service primitive with an error parameter present. In the non-confirmed mode, the procedure in 11.2.2.2 does not apply.

11.2.2.2 Response

In the confirmed mode, the SMAPM shall accept an statistical report service response primitive and shall construct an MAPDU confirming the notification and issue a CMIS M-EVENT-REPORT response service primitive with parameters derived from the statistical report service response primitive.

11.3 Buffered scan report service elements of procedure

11.3.1 Agent role

11.3.1.1 Invocation

The buffered scan report service procedures are initiated by the buffered scan report service request primitive. On receipt of a buffered scan report service request primitive, the SMAPM shall construct an MAPDU and issue a CMIS M-EVENT-REPORT request service primitive with parameters derived from the buffered scan report service request primitive. In the non-confirmed mode, the procedure in 11.3.1.2 does not apply.

11.3.1.2 Receipt of response

On receipt of a CMIS M-EVENT-REPORT confirm service primitive containing an MAPDU responding to a buffered scan report service notification, the SMAPM shall issue a buffered scan report service confirmation primitive to the buffered scan report service user with parameters derived from the CMIS M-EVENT-REPORT confirm service primitive, thus completing the buffered scan report service procedure.

NOTE – The SMAPM shall ignore all errors in the received MAPDU. The buffered scan report service user may ignore such errors, or abort the association as a consequence of such errors.

11.3.2 Manager role

11.3.2.1 Receipt of request

On receipt of a CMIS M-EVENT-REPORT indication service primitive containing an MAPDU requesting the buffered scan report service, the SMAPM shall, if the MAPDU is well formed, issue a buffered scan report service indication primitive to the buffered scan report service user with parameters derived from the CMIS M-EVENT-REPORT indication service primitive. Otherwise, the SMAPM shall in the confirmed mode construct an appropriate MAPDU containing notification of the error, and shall issue a CMIS M-EVENT-REPORT response service primitive with an error parameter present. In the non-confirmed mode, the procedure in 11.3.2.2 does not apply.

11.3.2.2 Response

In the confirmed mode, the SMAPM shall accept an buffered scan report service response primitive and shall construct an MAPDU confirming the notification and issue a CMIS M-EVENT-REPORT response service primitive with parameters derived from the buffered scan report service response primitive.

11.4 Activate scan report elements of procedure

11.4.1 Manager role

11.4.1.1 Invocation

The activate scan report procedures are initiated by the activate scan report request primitive. On receipt of a activate scan report request primitive, the SMAPM shall construct an MAPDU and issue a CMIS M-ACTION request service primitive with parameters derived from the activate scan report request primitive.

11.4.1.2 Receipt of response

On receipt of a CMIS M-ACTION confirm service primitive containing an MAPDU responding to a activate scan report action, the SMAPM shall issue a activate scan report confirmation primitive to the activate scan report service user with parameters derived from the CMIS M-ACTION confirm service primitive, thus completing the activate scan report procedure.

NOTE – The SMAPM shall ignore all errors in the received MAPDU. The activate scan report service user may ignore such errors, or abort the association as a consequence of such errors.

11.4.2 Agent role

11.4.2.1 Receipt of request

On receipt of a CMIS M-ACTION indication service primitive containing an MAPDU requesting the activate scan report service, the SMAPM shall, if the MAPDU is well formed, issue a activate scan report indication primitive to the activate scan report service user with parameters derived from the CMIS M-ACTION indication service primitive. Otherwise, the SMAPM shall construct an appropriate MAPDU containing notification of the error, and shall issue a CMIS M-ACTION response service primitive with an error parameter present.

11.4.2.2 Response

The SMAPM shall accept an activate scan report response primitive and shall construct an MAPDU containing either the successful or an error reply to the action and issue a CMIS M-ACTION response service primitive with parameters derived from the activate scan report response primitive.

11.5 Report buffer elements of procedure

11.5.1 Manager role

11.5.1.1 Invocation

The report buffer procedures are initiated by the report buffer request primitive. On receipt of a report buffer request primitive, the SMAPM shall construct an MAPDU and issue a CMIS M-ACTION request service primitive with parameters derived from the report buffer request primitive.

11.5.1.2 Receipt of response

On receipt of a CMIS M-ACTION confirm service primitive containing an MAPDU responding to a report buffer action, the SMAPM shall issue a report buffer confirmation primitive to the report buffer service user with parameters derived from the CMIS M-ACTION confirm service primitive, thus completing the report buffer procedure.

NOTE – The SMAPM shall ignore all errors in the received MAPDU. The report buffer service user may ignore such errors, or abort the association as a consequence of such errors.

11.5.2 Agent role

11.5.2.1 Receipt of request

On receipt of a CMIS M-ACTION indication service primitive containing an MAPDU requesting the report buffer service, the SMAPM shall, if the MAPDU is well formed, issue a report buffer indication primitive to the report buffer service user with parameters derived from the CMIS M-ACTION indication service primitive. Otherwise, the SMAPM shall construct an appropriate MAPDU containing notification of the error, and shall issue a CMIS M-ACTION response service primitive with an error parameter present.

11.5.2.2 Response

The SMAPM shall accept an report buffer response primitive and shall construct an MAPDU containing either the successful or an error reply to the action and issue a CMIS M-ACTION response service primitive with parameters derived from the report buffer response primitive.

11.6 Activate dynamic simple scan elements of procedure

11.6.1 Manager role

11.6.1.1 Invocation

The activate dynamic simple scan procedures are initiated by the activate dynamic simple scan request primitive. On receipt of a activate dynamic simple scan request primitive, the SMAPM shall construct an MAPDU and issue a CMIS M-ACTION request service primitive with parameters derived from the activate dynamic simple scan request primitive.

11.6.1.2 Receipt of response

On receipt of a CMIS M-ACTION confirm service primitive containing an MAPDU responding to a activate dynamic simple scan action, the SMAPM shall issue a activate dynamic simple scan confirmation primitive to the activate dynamic simple scan service user with parameters derived from the CMIS M-ACTION confirm service primitive, thus completing the activate dynamic simple scan procedure.

NOTE – The SMAPM shall ignore all errors in the received MAPDU. The activate dynamic simple scan service user may ignore such errors, or abort the association as a consequence of such errors.

11.6.2 Agent role

11.6.2.1 Receipt of request

On receipt of a CMIS M-ACTION indication service primitive containing an MAPDU requesting the activate dynamic simple scan service, the SMAPM shall, if the MAPDU is well formed, issue a activate dynamic simple scan indication primitive to the activate dynamic simple scan service user with parameters derived from the CMIS M-ACTION indication service primitive. Otherwise, the SMAPM shall construct an appropriate MAPDU containing notification of the error, and shall issue a CMIS M-ACTION response service primitive with an error parameter present.

11.6.2.2 Response

The SMAPM shall accept an activate dynamic simple scan response primitive and shall construct an MAPDU containing either the successful or an error reply to the action and issue a CMIS M-ACTION response service primitive with parameters derived from the activate dynamic simple scan response primitive.

11.7 Activate statistical report elements of procedure

11.7.1 Manager role

11.7.1.1 Invocation

The activate statistical report procedures are initiated by the activate statistical report request primitive. On receipt of a activate statistical report request primitive, the SMAPM shall construct an MAPDU and issue a CMIS M-ACTION request service primitive with parameters derived from the activate statistical report request primitive.

11.7.1.2 Receipt of response

On receipt of a CMIS M-ACTION confirm service primitive containing an MAPDU responding to a activate statistical report action, the SMAPM shall issue a activate statistical report confirmation primitive to the activate statistical report service user with parameters derived from the CMIS M-ACTION confirm service primitive, thus completing the activate statistical report procedure.

NOTE – The SMAPM shall ignore all errors in the received MAPDU. The activate statistical report service user may ignore such errors, or abort the association as a consequence of such errors.

11.7.2 Agent role

11.7.2.1 Receipt of request

On receipt of a CMIS M-ACTION indication service primitive containing an MAPDU requesting the activate statistical report service, the SMAPM shall, if the MAPDU is well formed, issue a activate statistical report indication primitive to the activate statistical report service user with parameters derived from the CMIS M-ACTION indication service primitive. Otherwise, the SMAPM shall construct an appropriate MAPDU containing notification of the error, and shall issue a CMIS M-ACTION response service primitive with an error parameter present.

11.7.2.2 Response

The SMAPM shall accept an activate statistical report response primitive and shall construct an MAPDU containing either the successful or an error reply to the action and issue a CMIS M-ACTION response service primitive with parameters derived from the activate statistical report response primitive.

11.8 Abstract syntax

11.8.1 Managed objects

11.8.1.1 Referenced managed objects

This Specification references the following support managed objects for which the abstract syntax is specified in CCITT Rec. X.721 | ISO/IEC 10165-2:

a) eventLogRecord;

b) top; and

c) system.

11.8.1.2 Defined managed objects

Table 9 identifies the relationship between the managed objects defined in 8.1 and the managed object class specifications in Annex A.

Table 9 – Reference labels for managed objects defined in this Specification

Managed object name	Reference label
Buffered scanner	bufferedScanner
Buffered scan report record	bufferedScanReportRecord
Dynamic scanner	dynamicScanner
Dynamic simple scanner	dynamicSimpleScanner
Ensemble statistic scanner	ensembleStatisticScanner
Heterogeneous scanner	heterogeneousScanner
Homogeneous scanner	homogeneousScanner
Mean scanner	meanScanner
Mean variance scanner	meanVarianceScanner
Min max scanner	minMaxScanner
Percentile scanner	percentileScanner
Scan report record	scanReportRecord
Simple scanner	simpleScanner
Statistical report record	statisticalReportRecord

11.8.2 Attributes

11.8.2.1 Attributes imported from metric objects and attributes

This Specification references the following management attributes defined in ITU-T Rec. X.739 | ISO/IEC 10164-11:

a) configurablePCT;

b) granularityPeriod; and

c) scannerId.

11.8.2.2 Attributes imported from the definition of management information

This Specification references the following management attributes, the abstract syntax of which is specified in CCITT Rec. X.721 | ISO/IEC 10165-2:

a) additionalText;

b) additionalInformation;

c) administrativeState;

d) availabilityStatus; and

e) operationalState.

11.8.2.3 Attributes defined in this Specification

This Specification defines the following management attributes, the abstract syntax of which is specified in Annex A:

a) algorithmOutputs;

b) algorithmParameters;

c) baseManagedObject;

d) beginTimeOffset;

e) bufferedObservationIdList;

f) bufferedObservationList;

g) endTimeOffset;

h) firstScanInitiationTime;

i) incompleteScan;

j) numericAttributeIdArray;

k) numericAttributeIdList;

l) objectList;

m) observationIdList;

n) observationReportList;

o) observationScanList;

p) onceReportAttributeIdList;

q) onceReportAttributeList;

r) reportPeriod;

s) scanAttributeIdList;

t) scanInitiationTime;

u) scanningFilter;

v) scope;

w) suppressObjectInstance;

x) suspectIntervals;

y) timeAttributeIdentifier;

z) timeStampReportMode.

11.8.2.4 Parameter to attribute mapping

Table 10 identifies the relationship between the service parameters defined in 8.1 and 8.2 and the attribute type specifications in Annex A.

Table 10 – Parameter to attribute mapping

Parameter	Attribute Name
Algorithm outputs	algorithmOutputs
Algorithm parameters	algorithmParameters
Base managed object	baseManagedObject
Begin time offset	beginTimeOffset
Buffered observation identifier list	bufferedObservationIdList
Buffered observation list	bufferedObservationList
End time offset	endTimeOffset
First scan initiation time	firstScanInitiationTime
Incomplete scan	incompleteScan
Numeric attribute identifier array	numericAttributeIdArray
Numeric attribute identifier list	numericAttributeIdList
Object list	objectList
Observation identifier list	observationIdList
Observation report list	observationReportList
Observation scan list	observationScanList
Once report attribute Id list	onceReportAttributeIdList
Once report attribute list	onceReportAttributeList
Report period	reportPeriod
Scan attribute identifier list	scanAttributeIdList
Scan initiation time	scanInitiationTime
Scanning filter	scanningFilter
Scope	scope
Suppress object instance	suppressObjectInstance
Suspect intervals	suspectIntervals
Time attribute identifier	timeAttributeIdentifier
Time stamp report mode	timeStampReportMode

11.8.3 Actions

Table 11 identifies the relationship between the actions defined in 8.3 and the action reference label specifications in Annex A.

Table 11 – Actions

Action Name	Reference Label
Activate dynamic simple scan report	activateDynamicSimpleScanReport
Activate scan report	activateScanReport
Activate statistical report	activateStatisticalReport
Report buffer	reportBuffer

11.8.4 Notifications

11.8.4.1 Referenced notifications

This Specification references the following events defined in CCITT Rec. X.730 | ISO/IEC 10164-1:

a) attribute value change notification;

b) object creation notification; and

c) object deletion notification.

This Specification references the following event defined in CCITT Rec. X.731 | ISO/IEC 10164-2:

state change notification.

11.8.4.2 Notifications defined in this Specification

Table 12 identifies the relationship between the notifications defined in 8.2 and the notification type specifications in Annex A.

Table 12 – Notifications

Event type	Notification type
Buffered scan report	bufferedScanReport
Statistical report	statisticalReport
Scan report	scanReport

11.9 Negotiation of functional units

This Specification assigns the following object identifier value:

{ joint-iso-ccitt ms(9) function (2) part13(13) functionalUnitPackage(1) }

as a value of the ASN.1 type FunctionalUnitPackageId defined in CCITT Rec. X.701 | ISO/IEC 10040 for negotiating the availability of one of the following functional units:

0 Scan stimulation functional unit

1 Summarization event reporting functional unit

where the number identifies the bit positions in the BIT STRING assigned to the functional units, and the names referencing the functional units as defined in clause 10.

Within the Systems management application context, the mechanism for negotiating the functional units is described by CCITT Rec. X.701 | ISO/IEC 10040.

NOTE – The requirement to negotiate functional units is specified by the application context.

12 Relationships with other functions

The Summarization Function uses the services defined in CCITT Rec. X.731 | ISO/IEC 10164-2 for the notification of state changes, and the services defined in CCITT Rec. X.730 | ISO/IEC 10164-1 for the creation and deletion of managed objects, the retrieval of attributes and notifications of attribute value changes.

Control of the scan report service is provided by mechanisms specified in CCITT Rec. X.734 | ISO/IEC 10164-5. The scan report service may exist independently of the control mechanisms of CCITT Rec X.734 | ISO/IEC 10164-5.

Control of the statistical service is provided by mechanisms specified in CCITT Rec. X.734 | ISO/IEC 10164-5. The statistical report service may exist independently of the control mechanisms of CCITT Rec X.734 | ISO/IEC 10164-5.

Control of the buffered scan report service is provided by mechanisms specified in CCITT Rec. X.734 | ISO/IEC 10164-5. The buffered scan report service may exist independently of the control mechanisms of CCITT Rec X.734 | ISO/IEC 10164-5.

13 Conformance

There are two conformance classes: general conformance class and dependent conformance class. A system claiming to implement the elements of procedure for system management services referenced by this Specification shall comply with the requirements for either the general or the dependent conformance class as defined in the following subclauses. The supplier of the implementation shall state the class to which the conformance is claimed.

NOTE – The use of the two terms "general conformance class" and "dependent conformance class", is under review. However, this standard continues to use these terms in order to be consistent with CCITT Rec. X.701 | ISO/IEC 10040 and other standards under the general title *Information technology – Open Systems Interconnection – Systems Management*. When the review has been completed, it is intended to clarify and/or correct this conformance clause together with the related clauses in those other Recommendations | International Standards.

13.1 General conformance class requirements

A system claiming general conformance shall support this function for all managed object classes that import the management information defined in this Specification.

NOTE – This is applicable to all subclasses of the management support object classes defined in this Specification.

13.1.1 Static conformance

The system shall:

a) support the role of manager or agent or both, with respect to the scan stimulation functional unit (at least one of the action services referenced in 11.8.3) and the summarization event reporting functional unit (at least one of the notification services referenced in 11.8.4);

b) when acting in the agent role, support one or more instances of at least one of the summarization managed object classes or any of their subclasses;

c) for each supported managed object containing an action or notification referenced in 11.8.3 or 11.8.4 of this Specification, support the transfer syntax derived from the encoding rules specified in CCITT Rec. X.209 | ISO/IEC 8825 and named { joint-iso-ccitt asn1(1) basic-encoding(1) } for the purpose of generating and/or interpreting the MAPDUs defined by the abstract data type of that action or notification according to the role(s) supported.

13.1.2 Dynamic conformance

The system shall, in the role(s) for which conformance is claimed:

a) support the elements of procedure defined in:

- CCITT Rec. X.730 | ISO/IEC 10164-1 for the PT-GET, PT-CREATE, PT-DELETE, PT-SET services;
- CCITT Rec. X.730 | ISO/IEC 10164-1 for the Object creation reporting and Object deletion reporting, if the create delete notifications package is supported;
- CCITT Rec. X.730 | ISO/IEC 10164-1 for the Attribute value change reporting services, if the attribute value change notification package is supported;
- CCITT Rec. X.731 | ISO/IEC 10164-2 for the State change reporting service, if the state change notification package is supported;

b) support the elements of procedure defined in this Recommendation | International Standard for the following summarization event reporting and action services for which static conformance is claimed:

- scan report notification;
- statistical report notification;
- buffered scan report notification;
- activate scan report action;
- report buffer action;
- activate dynamic simple scan report action;
- activate statistical report action.

13.2 Dependent conformance class requirements

13.2.1 Static conformance

The system shall:

a) when acting in the agent role, support one or more instances of at least one of the summarization managed object classes or any of their subclasses;

b) for each supported managed object containing an action or notification referenced in 11.8.3 or 11.8.4, support the transfer syntax derived from the encoding rules specified in CCITT Rec. X.209 | ISO/IEC 8825 and named { joint-iso-ccitt asn1(1) basic-encoding(1) } for the purpose of generating and/or interpreting the MAPDUs defined by the abstract data type of that action or notification, as required by a referencing Specification according to the role(s) supported.

13.2.2 Dynamic conformance

The system shall support the elements of procedure defined in Specification, as required by a standardized use of this systems management function.

13.3 Conformance to support managed object definitions

The summarization objects supported by the open system shall comply with the behaviour specified in clause 8 and the syntax specified in Annex A.

Annex A

Summarization management support objects

(This annex forms an integral part of this Recommendation | International Standard)

A.1 Managed object class definitions

```
bufferedScanner MANAGED OBJECT CLASS
DERIVED FROM "ITU-T Rec. X.739 (1993) | ISO/IEC 10164-11:1994":scanner;
CHARACTERIZED BY
        bufferedScannerPackage PACKAGE
        BEHAVIOUR
        bufferedScannerBehaviour BEHAVIOUR
        DEFINED AS "See 8.1.9.3.";;
        ATTRIBUTES
        bufferedObservationIdList GET-REPLACE ADD-REMOVE,
        reportPeriod GET-REPLACE,
        suppressObjectInstance GET-REPLACE;
        ACTIONS
        reportBuffer scanActionError;
        NOTIFICATIONS
        bufferedScanReport;;;
CONDITIONAL PACKAGES
        timeStampReportPackage PRESENT IF "time stamping supported";
REGISTERED AS { summarizationManagedObjectClass 1 };

bufferedScanReportRecord MANAGED OBJECT CLASS
DERIVED FROM "CCITT Rec. X.721 (1992) | ISO/IEC 10165-2:1992":eventLogRecord;
CHARACTERIZED BY
bufferedScanReportPackage PACKAGE
        BEHAVIOUR
        bufferedScanReportRecordBehaviour       BEHAVIOUR
        DEFINED AS  "This managed object is used to represent logged information that resulted from buffered scan
                    report notifications or event reports.";;
        ATTRIBUTES
        "ITU-T Rec. X.739 (1993) | ISO/IEC 10164-11:1994":granularityPeriod GET,
        bufferedObservationList GET;;;
CONDITIONAL PACKAGES
        firstScanInitiationTimePackage PRESENT IF       "the firstScanInitiationTime parameter is present in
                                                        report", suspectIntervalsPackage PRESENT IF"the number
                                                        of suspect intervals is non-zero and therefore present in the
                                                        report.",
        incompleteScanPackage PRESENT IF                "the scan could not be completed.";
REGISTERED AS { summarizationManagedObjectClass 2 };

dynamicScanner MANAGED OBJECT CLASS
DERIVED FROM "CCITT Rec. X.721 (1992) | ISO/IEC 10165-2:1992":top;
CHARACTERIZED BY
        dynamicScannerPackage PACKAGE
        BEHAVIOUR
        dynamicScannerBehaviour BEHAVIOUR
        DEFINED AS "See 8.1.10.3.";;
        ATTRIBUTES
        "ITU-T Rec. X.739 (1993) | ISO/IEC 10164-11:1994":scannerId              GET,
        "CCITT Rec. X.721 (1992) | ISO/IEC 10165-2:1992":operationalState        GET,
        "CCITT Rec. X.721 (1992) | ISO/IEC 10165-2:1992":administrativeState     GET-REPLACE;;;
REGISTERED AS { summarizationManagedObjectClass 3 };

dynamicSimpleScanner MANAGED OBJECT CLASS
DERIVED FROM dynamicScanner;
CHARACTERIZED BY
        dynamicSimpleScannerPackage PACKAGE
        BEHAVIOUR
        dynamicSimpleScannerBehaviour BEHAVIOUR
```

```
        DEFINED AS "See 8.1.11.3.";;
        ACTIONS
        activateDynamicSimpleScanReport scanActionError;;;
REGISTERED AS { summarizationManagedObjectClass 4 };

ensembleStatisticScanner MANAGED OBJECT CLASS
DERIVED FROM homogeneousScanner;
CHARACTERIZED BY
        ensembleStatisticScannerPackage PACKAGE
        BEHAVIOUR
        ensembleBehaviour          BEHAVIOUR
        DEFINED AS "See 8.1.3.3.";;
        ATTRIBUTES
        numericAttributeIdList     GET-REPLACE ADD-REMOVE,
        suppressObjectInstance     GET-REPLACE;
        ACTIONS      activateStatisticalReport scanActionError;
        NOTIFICATIONS statisticalReport;;;
REGISTERED AS { summarizationManagedObjectClass 5 };

heterogeneousScanner MANAGED OBJECT CLASS
DERIVED FROM "ITU-T Rec. X.739 (1993) | ISO/IEC 10164-11:1994":scanner;
CHARACTERIZED BY
        heterogeneousScannerPackage PACKAGE
        BEHAVIOUR
        heterogeneousScannerBehaviour BEHAVIOUR
        DEFINED AS "See 8.1.8.3.";;
        ATTRIBUTES
        observationIdList GET-REPLACE ADD-REMOVE,
        suppressObjectInstance GET-REPLACE;
        ACTIONS
        activateScanReport scanActionError;
        NOTIFICATIONS
        scanReport;;;
CONDITIONAL PACKAGES
        timeStampReportPackage PRESENT IF "time stamping supported",
        onceReportAttributeIdListPackage PRESENT IF "the once report attribute Id list mechanism is supported";
REGISTERED AS { summarizationManagedObjectClass 6 };

homogeneousScanner MANAGED OBJECT CLASS
DERIVED FROM "ITU-T Rec. X.739 (1993) | ISO/IEC 10164-11:1994":scanner;
CHARACTERIZED BY
        homogeneousScannerPackage PACKAGE
        BEHAVIOUR
        homogeneousScannerBehaviour BEHAVIOUR
        DEFINED AS "See 8.1.1.3.";;
        ATTRIBUTES
        scanAttributeIdList GET-REPLACE ADD-REMOVE;;; -- this may be empty
        CONDITIONAL PACKAGES
        timeStampReportPackage PRESENT IF      "time stamping supported",
        scopedSelectionPackage PRESENT IF      "the managedObjectInstanceSelectionPackage is not present in an
                                               instance",
        timingSelectionPackage PRESENT IF      "timing attributes present",
        managedObjectInstanceSelectionPackage PRESENT IF        "the scopedSelectionPackage is not present in an
                                                                instance";
REGISTERED AS { summarizationManagedObjectClass 7 };

meanScanner MANAGED OBJECT CLASS
DERIVED FROMensembleStatisticScanner;
CHARACTERIZED BY
        meanScannerPackage PACKAGE
        BEHAVIOUR
        meanScannerBehaviour BEHAVIOUR
        DEFINED AS "See 8.1.4. 2and 8.1.4.3.";;;;
REGISTERED AS { summarizationManagedObjectClass 8 };

meanVarianceScannerMANAGED OBJECT CLASS
DERIVED FROMmeanScanner;
CHARACTERIZED BY
        meanVarianceScannerPackage PACKAGE
        BEHAVIOUR
```