INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Q.821
(02/2000)

SERIES Q: SWITCHING AND SIGNALLING

Q3 interface

Stage 2 and stage 3 description for the Q3 interface – Alarm surveillance

ITU-T Recommendation Q.821

ITU-T Q-SERIES RECOMMENDATIONS

SWITCHING AND SIGNALLING

For further details, please refer to the list of ITU-T Recommendations.

ITU-T Recommendation Q.821

Stage 2 and stage 3 description for the Q3 interface – Alarm surveillance

Summary

This ITU-T Recommendation provides a Stage 2 and Stage 3 Description for the Q3 Interface in a Telecommunications Management Network. Its initial focus is Alarm Surveillance. Included in this Description are specifications of the functions, management information, services, functional units, and protocols related to Alarm Surveillance. Significant reuse of OSI Management specifications in the X.700-series Recommendations is described.

Because of the desirability for providing common TMN solutions, this ITU-T Recommendation is expected to be applicable to other TMN or TMN-related interfaces.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

© ITU 2001

CONTENTS

ITU-T Recommendation Q.821

**Stage 2 and stage 3 description for the Q3 interface –
Alarm surveillance**

1 Scope, purpose and application

1.1 Scope

This ITU-T Recommendation is part of a series of Recommendations that specify the Q3 interface requirements for communication between an Operations System (OS) and a Network Element (NE), between an OS and a Mediation Device (MD), between an OS and a Q Adaptor (QA), and between OSs in a Telecommunications Management Network (TMN) [1]. The current issue of this ITU-T Recommendation provides a Stage 2 and Stage 3 Description [19] for Alarm Surveillance to support the associated TMN management service component described in [3].

1.2 Purpose

Current telecommunications networks are populated by a large and increasing number of OSs and NEs supplied by different vendors. Both the number and variety of networks and services have grown, creating a diversity of management needs. This growth has resulted in the proliferation of unique communication interfaces between OSs and NEs. The telecommunications industry stands to benefit from the standardization of these interfaces, designed to achieve interoperability between a broad range of OSs and NE/QAs using MDs where appropriate, and between OSs.

The primary purpose of this ITU-T Recommendation is to provide a set of application messages and associated support objects for the support of communication across Q3 interfaces. Because of the desirability of providing common TMN solutions, these messages and support objects are expected to be applicable to other TMN or TMN-related interfaces.

1.3 Application

The minimum service and protocol requirements at the Session and Presentation Layers, and the supporting Application Service Elements for two types of OAM services at the Application Layer, are defined in [2]. The messages defined in this ITU-T Recommendation are part of the transaction-oriented type of OAM services as specified in [2]. These messages also require selected support object classes as defined in Annex A and in [9].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1]   ITU-T Recommendation M.3010 (2000), *Principles for a telecommunications management network.*

[2]   ITU-T Recommendation Q.812 (1993), *Upper layer protocol profiles for the Q3 interface.*

[3]   ITU-T Recommendation M.3200 (1997), *TMN management services and telecommunications managed areas: Overview.*

[4]   ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology − Open Systems Interconnection − Basic Reference Model: The basic model*.

[5]   CCITT Recommendation X.229 (1988), *Remote Operations: Protocol specification*.

        ISO/IEC 9072-2:1989, *Information processing systems − Text communication − Remote operations − Part 2: Protocol specification*.

[6]   ITU-T Recommendation X.710 (1997) | ISO/IEC 9595:1998, *Information technology − Open Systems Interconnection − Common Management Information Service*.

[7]   ITU-T Recommendation X.711 (1997) | ISO/IEC 9596-1:1998, *Information technology − Open Systems Interconnection − Common Management Information Protocol: Specification*.

[8]   ITU-T Recommendation X.217 (1995) | ISO/IEC 8649:1996, *Information technology − Open Systems Interconnection − Service definition for the Association Control Service Element*.

[9]   CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology − Open Systems Interconnection − Structure of management information: Definition of management information*.

[10]   CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1)*.

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

[11]   CCITT Recommendation X.733 (1992) | ISO/IEC 10164-4:1992, *Information technology − Open Systems Interconnection − Systems Management: Alarm reporting function*.

[12]   CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology − Open Systems Interconnection − Systems Management − Event Report Management Function*.

[13]   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*.

[14]   ITU-T Recommendation X.210 (1993) | ISO/IEC 10731:1994, *Information technology − Open Systems Interconnection − Basic Reference Model − Conventions for the definition of OSI services*.

[15]   CCITT Recommendation X.735 (1992) | ISO/IEC 10164-6:1993, *Information technology − Open Systems Interconnection − Systems Management: Log control function*.

[16]   CCITT Recommendation X.730 (1992) | ISO/IEC 10164-1:1993, *Information technology − Open Systems Interconnection − Systems Management: Object management function*.

[17]   CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2:1993, *Information technology − Open Systems Interconnection − Systems Management: State management function*.

[18]   ITU-T Recommendation M.3100 (1995), *Generic network information model*.

[19]   ITU-T Recommendation Q.68 (1993), *Overview of methodology for developing management services*.

[20]   ITU-T Recommendation X.701 (1997) | ISO/IEC 10040:1998, *Information technology − Open Systems Interconnection − Systems management overview*.

[21]   CCITT Recommendation X.209 (1988), *Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*.

ISO/IEC 8825:1990, *Information technology – Open Systems Interconnection – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*.

[22]   ITU-T Recommendation X.680 (1997) | ISO/IEC 8824-1:1998, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.

[23]   ITU-T Recommendation X.680 (1997)/Amd. 1 (1999) | ISO/IEC 8824-1:1998/Amd.1 (to be published), *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation – Amendment 1: Relative object identifiers*.

[24]   ITU-T Recommendation X.681 (1997) | ISO/IEC 8824-2:1998, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification*.

[25]   ITU-T Recommendation X.690 (1997) | ISO/IEC 8825-1:1998, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER), and Distinguished Encoding Rules (DER)*.

[26]   CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *Information technology – Open Systems Interconnection – Structure of management information: Management information model*.

[27]   ITU-T Recommendation X.738 (1993) | ISO/IEC 10164-13:1995, *Information technology – Open Systems Interconnection – Systems Management: Summarization function*.

[28]   ITU-T Recommendation X.792 (1999), *Configuration audit support function for ITU-T Applications*.

[29]   ITU-T Recommendation M.3400 (2000), *TMN Management Functions*.

3   Definitions and abbreviations

3.1   Definitions from other ITU-T Recommendations

Agent   [1]

Alarm   [11]

Alarm reporting   [11]

AlarmInfo   [9]

Correlated notifications   [11]

Element management layer   [1]

Fault management   [30]

Inheritance hierarchy   [26]

Management information model   [1]

Manager   [1]

Naming Tree   [26]

Network management layer   [1]

Notification identifier   [11]

Systems management functional unit   [20]

| Subordinate objects | [26] |
| Superior object | [26] |

3.2 Special definitions of this ITU-T Recommendation

This ITU-T Recommendation defines the following terms:

3.2.1 alarm event: An instantaneous occurrence that changes at least one of the attributes of the alarm status of an object. This status change may be persistent or temporary, thus allowing for surveillance, monitoring, and performance measurement functionality, etc. Alarm events may or may not generate alarm reports; they may trigger other events or may be triggered by one or more other events.

3.2.2 alarm surveillance: A set of functions that enables the monitoring or interrogation (or both) of the telecommunications network concerning alarm-related events or conditions.

3.2.3 alarm status: A set of attributes that describes the alarms currently defined for an object, for example, Perceived Severity. The alarm status of an object is a subset of the global status of that object.

3.2.4 alarm synchronization: The retrieval of alarm information for the purpose of synchronizing the manager to the agent's collection of Current Alarms.

3.2.5 current alarm: An agent's active alarm that has not yet been cleared.

3.3 Abbreviations

This ITU-T Recommendation uses the following abbreviations:

ASN.1	Abstract Syntax Notation One
CMIS	Common Management Information Service
Cnf	Confirm
DCN	Data Communications Network
EFD	Event Forwarding Discriminator
ET	Event Type
Ind	Indication
MAPDU	Management Application Protocol Data Unit
MD	Mediation Device
MOC	Managed Object Class
MOI	Managed Object Instance
NE	Network Element
OS	Operations System
OSI	Open Systems Interconnection
PC	Probable Cause
PDU	Protocol Data Unit
QA	Q Adaptor
RDN	Relative Distinguished Name
Req	Request

Rsp   Response

SMAP   System Management Application Protocol

SP   Specific Problems

TMN   Telecommunications Management Network

4   Conventions

The definition of several Alarm Surveillance services in this ITU-T Recommendation includes a table that lists the parameters of its primitives. For a given primitive, the presence of each parameter is described by one of the following values:

M   The parameter is mandatory.

(=)   The value of the parameter is equal to the value of the parameter in the column to the left.

U   Use of the parameter is a service-user option.

O   Optional. Optionality is subject to definition according to the Service Level Agreement or Contract between the manager and agent, i.e. a parameter listed as optional may be made mandatory by the Contract.

−   The parameter is not present in the interaction.

C   The parameter is conditionally present − the condition(s) are defined by the text that describes the parameter.

P   Subject to the constraints imposed on the parameter by [6].

The service definitions in clause 6 are described using the service definition conventions specified in [14].

The parameters which are marked "P" in the service tables of this ITU-T Recommendation 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 a MAPDU.

Except for OS-OS communications, the term managing system refers to the OS and the term managed system refers to either a NE, QA, or a MD. NEs may be exchanges, signalling systems, or other network resources as specified in other ITU-T Recommendations that reference this ITU-T Recommendation. For OS-OS communications, one OS is the managing system while the other is the managed system.

5   Alarm Surveillance

5.1   Alarm Surveillance Functions

Alarm Surveillance functions are used to monitor or interrogate NEs (or both) about events or conditions. Event data is generated by an NE upon the detection of an abnormal condition. Examples of such events are detection of transmission data errors, the violation of a performance threshold, and the detection of faulty equipment. Event data can be reported at the time of occurrence, logged for future access, or both. An event may also cause further management actions within the NE that lead to the generation of other management data. In the functions described below, the term NE refers to any of the TMN Q3 entities described above that are acting in the managed system role.

The management information related to Alarm Surveillance whose semantics is described includes managed object classes, support object classes, and their associated attributes.

5.1.1 Alarm Reporting Functions

This subclause describes the Alarm Reporting functions provided by the services specified in this Recommendation. Table 1 gives a mapping between these functions and the (one or more) services that support each function.

Table 1/Q.821 – Alarm Reporting Functions and Services

Function	Service
Report Alarm	Alarm Reporting
Route Alarm Report	Initiate Alarm Reporting
	Set Event Forwarding Discriminator
Request Alarm Report Route	Get Event Forwarding Discriminator
Condition Alarm Reporting	Initiate/Terminate Alarm Reporting
	Set Event Forwarding Discriminator
Request Alarm Report Control Condition	Get Event Forwarding Discriminator
Allow/Inhibit Alarm Reporting	Suspend/Resume Alarm Reporting
Request Alarm Report History	Alarm Report Retrieving
Delete Alarm Report History	Alarm Report Deleting

5.1.1.1 Report Alarm

NE notifies TMN of alarm information upon the occurrence of an alarm.

5.1.1.2 Route Alarm Report

TMN specifies to the NE the destination address(es) for a specified set of alarm reports.

5.1.1.3 Request Alarm Report Route

TMN requests NE to send the current assignment of the destination address(es) for a specified set of alarm reports; NE responds with the current assignment of destination address(es).

5.1.1.4 Condition Alarm Reporting

TMN instructs the NE to assign Event Forwarding Discriminator attributes as specified by the TMN.

5.1.1.5 Request Alarm Report Control Condition

TMN requests NE to send the current assignment of specified Event Forwarding Discriminator attributes; NE responds with the current assignment of the specified attributes.

5.1.1.6 Allow/Inhibit Alarm Reporting

TMN instructs the NE to allow/inhibit alarm reports to the TMN.

5.1.1.7 Request Alarm Report History

TMN requests the NE to send specified historical alarm information; NE responds with the specified information.

5.1.1.8 Delete Alarm Report History

TMN requests the NE to delete specified historical alarm information.

5.1.2   Alarm Summary Functions

This subclause describes the Alarm Summary functions provided by the services specified in this ITU-T Recommendation. Table 2 gives a mapping between these functions and the (one or more) services that support each function.

Table 2/Q.821 – Alarm Summary Functions and Services

Function	Service
Report Current Alarm Summary	Current Alarm Summary Reporting
Route Current Alarm Summary	Initiate/Set Management Operations Schedule
Request Current Alarm Summary Route	Get Management Operations Schedule
Schedule Current Alarm Summary	Initiate/Terminate/Set Current Alarm Summary Control
	Initiate/Terminate/Set Management Operations Schedule
Request Current Summary Schedule	Get Current Alarm Summary Control
	Get Management Operations Schedule
Allow/Inhibit Current Alarm Summary	Resume/Suspend Management Operations Schedule
Request Current Alarm Summary	Retrieve Current Alarm Summary

5.1.2.1   Report Current Alarm Summary

NE provides TMN (based on a pre-defined schedule) with a Current Alarm Summary.

5.1.2.2   Route Current Alarm Summary

TMN specifies to the NE the destination address(es) for a specified set of Current Alarm Summaries.

5.1.2.3   Request Current Alarm Summary Route

TMN requests NE to send the current assignment of the destination address(es) for a specified set of Current Alarm Summaries; NE responds with the current assignment of destination address(es).

5.1.2.4   Schedule Current Alarm Summary

TMN specifies a schedule for the NE to establish for the reporting of Current Alarm Summaries. The schedule information specifies when it should be reported.

5.1.2.5   Condition Current Alarm Summary

TMN specifies a condition for the NE to establish for the reporting of Current Alarm Summaries. The condition information specifies what should be reported.

5.1.2.6   Request Current Alarm Summary Schedule

TMN requests NE to send the current schedule information for Current Alarm Summary reporting; NE responds with the schedule information.

5.1.2.7   Request Current Alarm Summary Condition

TMN requests NE to send the current condition information for Current Alarm Summary reporting; NE responds with the condition information.

5.1.2.8   Allow/Inhibit Current Alarm Summary

TMN instructs NE to allow/inhibit reporting of the scheduled Current Alarm Summaries.

5.1.2.9   Request Current Alarm Summary

TMN requests the NE to send a Current Alarm Summary; NE responds with the summary.

5.1.3   Alarm Event Criteria Functions

This subclause describes the Alarm Event Criteria functions provided by the services specified in this ITU-T Recommendation. Table 3 gives a mapping between these functions and the (one or more) services that support each function.

Table 3/Q.821 – Alarm Event Criteria Functions and Services

Function	Service
Condition Alarm Event Criteria	Initiate/Terminate/Set Alarm Severity Assignment Profile
Request Alarm Event Criteria	Get Alarm Severity Assignment Profile

5.1.3.1   Condition Alarm Event Criteria

TMN instructs the NE to assign specified alarm attributes (e.g. thresholds, etc.) used by the NE to determine if an event is to be considered an alarm. This function is initially limited to alarm severity assignment.

5.1.3.2   Request Alarm Event Criteria

TMN requests NE to report the current assignments of specified attributes (e.g. thresholds, etc.) used to determine if an event is to be considered an alarm; NE responds with the current assignment of the requested attributes, modes, or thresholds. This function is initially limited to the alarm severity attribute.

5.1.4   Alarm Indication Management Functions

This subclause describes the Alarm Indication Management functions provided by the services specified in this ITU-T Recommendation. Table 4 gives a mapping between these functions and the (one or more) services that support each function.

Table 4/Q.821 – Alarm Indication Management Functions and Services

Function	Service
Inhibit/Allow Audible and Visual Alarm Indications	Inhibit/Allow Audible and Visual Local Alarms
Reset Audible Alarms	Reset Audible Alarms

5.1.4.1   Inhibit/Allow Audible and Visual Alarm Indications

TMN instructs the NE to inhibit/allow the operation of specified alarm indication/recording devices such as lamps, speakers, printers, etc.

5.1.4.2   Reset Audible Alarms

TMN instructs the NE to reset specified audible alarm indicator(s).

5.1.5   Log Control Functions

This subclause describes the Log Control functions provided by the services specified in this ITU-T Recommendation. Table 5 gives a mapping between these functions and the (one or more) services that support each function.

Table 5/Q.821 – Log Control Functions and Services

Function	Service
Inhibit/Allow Logging	Suspend/Resume Logging
Condition Logging	Initiate/Terminate Log
	Set Log
Request Log Condition	Get Log

5.1.5.1 Allow/Inhibit Logging

TMN instructs the NE to allow/inhibit logging of Log Records.

5.1.5.2 Condition Logging

TMN instructs the NE to assign Log attributes as specified by the TMN.

5.1.5.3 Request Log Condition

TMN requests NE to send the current assignment of specified Log attributes; NE responds with the current assignment of the specified attributes.

5.1.6 Other Alarm Surveillance Functional Information

Clauses 7 and 8 of [11], [12], and [15] are also applicable to this ITU-T Recommendation.

5.2 Alarm Surveillance Management Information

This subclause describes the semantics of management information related to Alarm Surveillance.

5.2.1 Managed Object Classes

The Alarm Surveillance Services specified below are applicable to the managed object classes of an information model specified in any other Recommendation if the proper references to this ITU-T Recommendation are made in the relevant managed object classes. In particular, these services are applicable to the managed object classes of the Generic Network Information Model [18].

5.2.2 Support Object Classes

The following support object classes (or their subclasses), defined in [9], support the Alarm Surveillance functions specified in this ITU-T Recommendation:

–   alarmRecord;

–   discriminator;

–   eventForwardingDiscriminator;

–   eventLogRecord;

–   log;

–   logRecord.

The following support object classes (or their subclasses), defined in Annex A and [18], support the Alarm Surveillance functions specified in this Recommendation:

–   alarmSeverityAssignmentProfile.

The containment relationships between these support object classes is defined in Annex A, [18] and [9]; they are shown in Figure 1 using the Entity-Relationship notation as in [18].
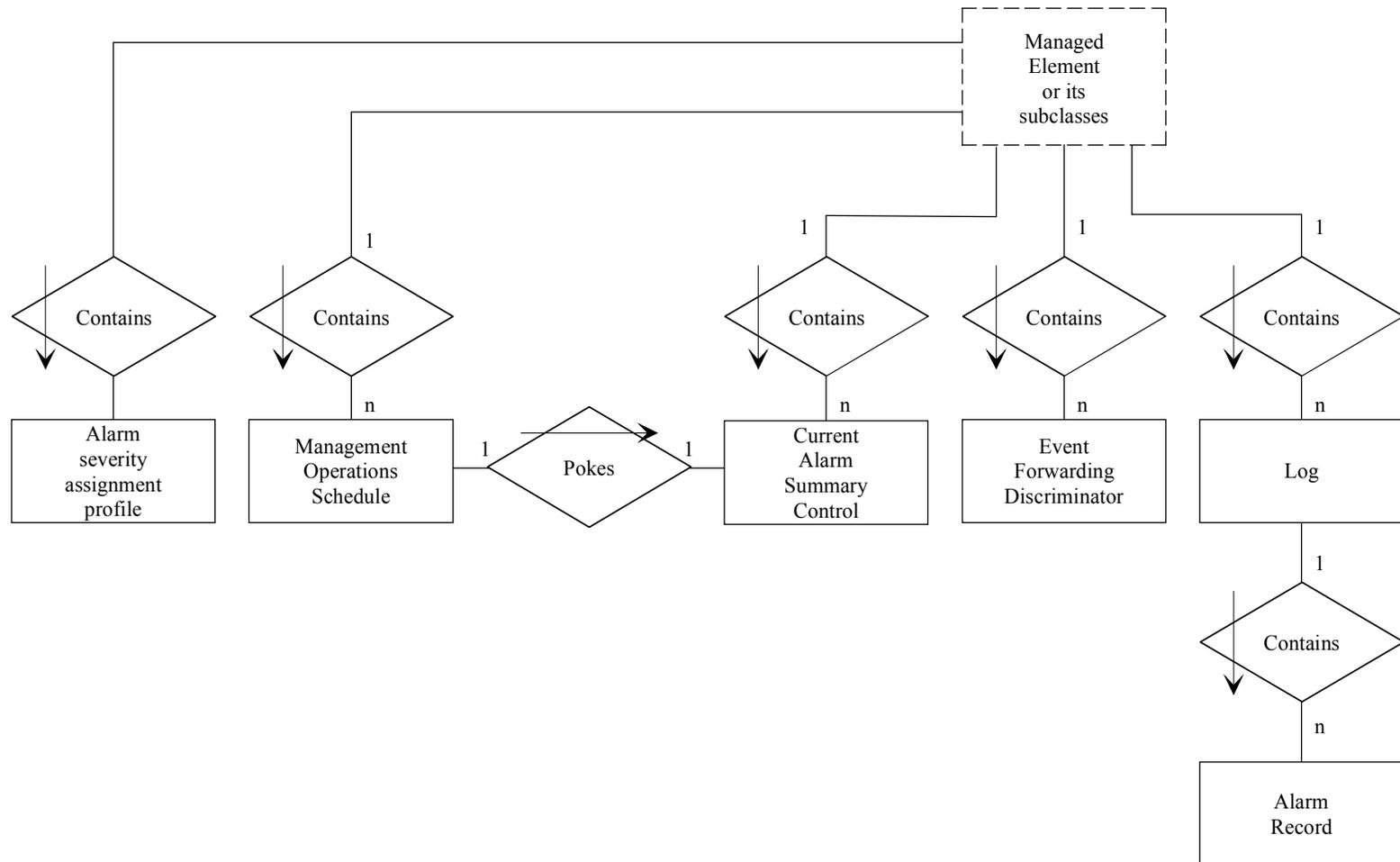
T1145640-92

Figure 1/Q.821 – Containment relationships between alarm surveillance support objects

5.2.2.1 Current Alarm Summary Control

The Current Alarm Summary Control object class is a class of support objects that provide the criteria for generation of current alarm summary reports. An object is included in a current alarm summary report if:

–   the object is included in the Object List, (if the list is non-empty);

–   the object has an Alarm Status that is present in the Alarm Status List (if the list is non-empty);

–   the object has an alarm (or potential alarm) with a Perceived Severity and Probable Cause matching members of the Perceived Severity List (if non-empty) and Probable Cause List (if non-empty), respectively.

If the Object List is empty then the criteria in the Current Alarm Summary Control are applied to all objects in the Managed System. If any of the other criteria are empty then they are not used in selecting objects that will appear in the current alarm summary report.

A single object may appear in a report multiple times if it has multiple outstanding alarm conditions that match the Perceived Severity List and Probable Cause List criteria.

This object class is a subclass of the Top object class.

The semantics of associated attributes are as follows:

a)   *Current Alarm Summary Control Id*

The Current Alarm Summary Control Id is an attribute type whose distinguished value can be used as an Relative Distinguished Name (RDN) when naming an instance of the Current Alarm Summary Control managed object class.

b)   *Alarm Status List*

The Alarm Status List attribute type describes criteria for inclusion in a current alarm summary report. The Alarm Status List consists of a set of possible Alarm Status. In order to be included in a current alarm summary report, an object shall have an Alarm Status that matches one of the states in the Alarm Status List.

If the Alarm Status List has null value, the Alarm Status of the objects in the Object List is not used as a criterion for inclusion in the current alarm summary report.

c)   *Object List*

The Object List attribute type describes a set of object instances.

d)   *Perceived Severity List*

The Perceived Severity List attribute type describes criteria for inclusion in a current alarm summary report. It consists of a set of possible Perceived Severities. In order to be included in a current alarm summary report, an object must have an outstanding alarm (or potential alarm) that has a Perceived Severity that matches one of the elements in the Perceived Severity List.

If the Perceived Severity List has null value, the Perceived Severity of the objects in the object list is not used as a criterion for inclusion in the current alarm summary report.

e)   *Probable Cause List*

The Probable Cause List attribute type describes criteria for inclusion in a current alarm summary report, consisting of a set of possible Probable Causes. In order to be included in a current alarm summary report, an object must have an outstanding alarm (or potential alarm) that has a Probable Cause that matches one of the elements in the Probable Cause List.

If the Probable Cause List has a null value, the Probable Cause of the objects in the object list is not used as a criterion for inclusion in the current alarm summary report.

5.2.2.2 Management Operations Schedule

The Management Operations Schedule object class is a class of support objects that provide the ability to schedule a management service to occur periodically. The period is specified by an Interval, with the first occurrence of the service (coinciding with the start of the first interval) specified as the Begin Time. The end of the time span during which the service can occur is defined by the End Time.

The object(s) that will supply the service are defined by the Affected Object Class and Affected Object Instances (e.g. the Current Alarm Summary Control object when providing the Current Alarm Summary Reporting Service). The Destination Address specifies the destination of the service. The Administrative State is used to allow/inhibit the operation of the schedule. The Operational State describes whether the object is capable of performing its function(s).

This object class is a subclass of the Top object class.

The semantics of associated attributes are as follows:

a) *Administrative State*

The semantics of the Administrative State attribute type is described in [17].

b) *Affected Object Class*

The Affected Object Class attribute type identifies the object class affected by a scheduled management operation.

c) *Affected Object Instances*

The Affected Object Instances attribute type identifies the object instances on which a scheduled management operation will be performed.

d) *Begin Time*

The Begin Time attribute type indicates the starting time for a management function.

e) *Destination Address*

The Destination Address attribute type identifies the destination to which selected event reports will be sent. The Destination Address may be an application entity title or a group address. If no Destination Address is specified in the request, the address of the invoker is assumed. This destinationAddress is not redundant with destinationAddress in EFD. It is used for the purpose of current alarm summary, to define the destination of the report containing the current alarm summary.

f) *End Time*

The End Time attribute type indicates the termination time of a management function.

g) *Interval*

The Interval attribute type indicates the time between occurrences of a given activity described by an instance of the Management Operations Schedule object class. The interval can be specified in seconds, minutes, hours, or days.

h) *Operational State*

The semantics of the Operational State attribute type is described in [17].

i) *Schedule Id*

The Schedule Id is an attribute type whose distinguished value can be used as an RDN when naming an instance of the Management Operations Schedule object class.

5.3 Alarm Surveillance Service Definition

This subclause defines the services needed to support the alarm surveillance functions specified in 5.1. Alarm surveillance involves the reporting of alarms and alarm summaries, which are specialized forms of event reporting, and the logging of this information. As such, it can make use of three System Management Functions from OSI Management: Alarm Reporting [11], Event Report Management [12], and Log Control [15].

The mapping of the following services to the confirmed or unconfirmed mode of the supporting CMIS services, except where specified, is a local implementation issue and is not specified in this ITU-T Recommendation.

The services defined to support the alarm surveillance functions specified in 5.1 have been grouped into several functional units to allow negotiation of their use on an association (during association establishment), and to allow referencing by other Recommendations. Functional unit negotiation shall be performed as described in [20]. The bit string defined in 5.4 shall be used to represent the alarm surveillance functional units. No TMN-specific user information is supplied during association release or aborts. Table 6 lists these functional units and their corresponding services.

Table 6/Q.821 – Alarm Surveillance FUs, Services, Object Classes and Functions

Functional unit	Service(s)	Object class(es)	Function(s)
Kernel	Alarm Reporting	Event Forwarding Discriminator	Report Alarm
Basic Alarm Report Control	Suspend/Resume Alarm Reporting	Event Forwarding Discriminator	Inhibit/Allow Alarm Reporting
Enhanced Alarm Report Control	Initiate/Terminate Alarm Reporting Set/Get Event Forwarding Discriminator	Event Forwarding Discriminator	Condition alarm Reporting Route Alarm Report Request Alarm Report Route Request Alarm Report Control Condition
Alarm Report Retrieval	Alarm Report Retrieving	Alarm Record	Request Alarm Report History
Alarm Report Deletion	Alarm Report Deleting	Alarm Record	Delete Alarm Report History
Current Alarm Summary Reporting	Current Alarm Summary Reporting	Management Operations Schedule Current Alarm Summary Control	Report Current Alarm Summary
Basic Management Operations Scheduling	Suspend/Resume Management Operations Schedule	Management Operations Schedule	Inhibit/Allow Current Alarm Summary

Table 6/Q.821 – Alarm Surveillance FUs, Services, Object Classes and Functions *(concluded)*

Functional unit	Service(s)	Object class(es)	Function(s)
Enhanced Management Operations Scheduling	Initiate/Terminate/ Set/Get Management Operations schedule	Management Operations Schedule	Schedule Current Alarm Summary Route Current Alarm Summary Request Current Alarm Summary Schedule Request Current Alarm Summary Route
Current Alarm Summary Reporting Control	Initiate/Terminate/ Set/Get Current Alarm Summary Control	Current Alarm Summary Control	Condition Current Alarm Summary Request Current Alarm Summary Condition
Current Alarm Summary Retrieval	Retrieve Current Alarm Summary	Current Alarm Summary Control	Request Current Alarm Summary
Alarm Event Criteria Management	Initiate/ Terminate/ Set/Get Alarm Severity Assignment Profile	Alarm Severity Assignment Profile	Condition Alarm Event Criteria Request Alarm Event Criteria
Alarm Indication Management	Inhibit/Allow Audible and Visual Local Alarms, Reset Audible Alarm	Managed Element or its subclasses	Inhibit/Allow Audible and Visual Local Alarms, Reset Audible Alarm
Basic Log Control	Suspend/Resume Logging	Log	Inhibit/Allow Logging
Enhanced Log Control	Initiate/ Terminate Log Set/Get Log	Log	Condition Logging Request Log Condition

5.3.1 Kernel Functional Unit

The Kernel functional unit contains only the Alarm Reporting service described below. Figure 2 shows the interactions between the managing and managed system for this functional unit. Note that the Event Forwarding Discriminator object shown in Figure 2 may be predefined.
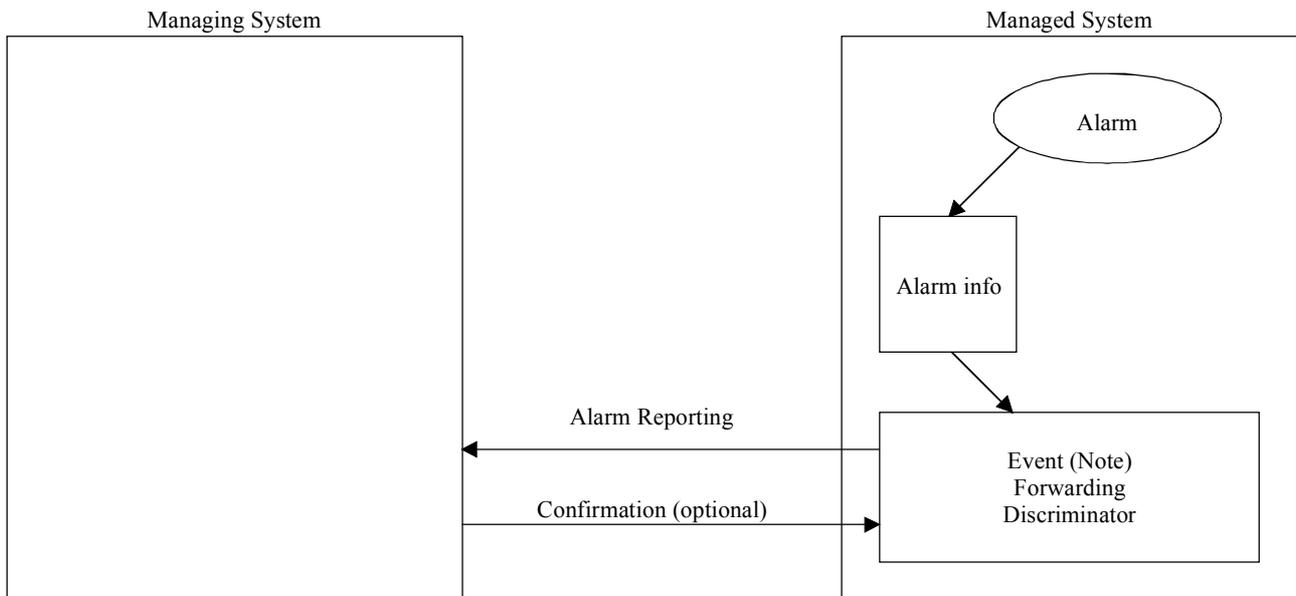
NOTE – The services associated with the Event Forwarding Discriminator object class are not provided in this Functional Unit.

Figure 2/Q.821 – Kernel FU

5.3.1.1 Alarm Reporting Service

The Alarm Reporting service allows a managed system to report the detection of an alarm condition for a managed object to its managing system(s). This service supports the Report Alarm function in 5.1.

For the service definition, see [11] except for the addition of three parameters. The semantics of the three parameters follows below. Their definitions are found in Annex A.

The Log Record Id is a parameter to be included in the Additional Information parameter of the Alarm Reporting service. The distinguished value can be used as an RDN when naming an instance of the Log Record managed object class or any of its subclasses.

The Correlated Record Name is a parameter to be included in the Additional Information parameter of the Alarm Reporting service. The distinguished value can be used as an RDN when naming an instance of the Log Record managed object class or any of its subclasses. This parameter indicates that an Alarm Report about a managed object is related to a previous Alarm Report about a (possibly different) managed object. The value of this attribute identifies the record of the (previous) Alarm Report to which it is related. The Correlated Record Name parameter may or may not be used in conjunction with the Trend Indication attribute. The exact criteria to be used for correlation is beyond the scope of this ITU-T Recommendation.

The Suspect Object List is a parameter to be included in the Additional Information parameter of the Alarm Reporting service. The Suspect Object List parameter identifies objects that may be responsible for an alarm condition. Each listed instance may optionally have a failure responsibility probability associated with it.

The clearing of alarms is done in accordance with the corrigenda of ITU-T X.733.

5.3.1.2 Other services

The inclusion of other services in the kernel functional unit is for further study.

5.3.2 Basic Alarm Report Control Functional Unit

The Basic Alarm Report Control functional unit contains the Suspend Alarm Reporting service and the Resume Alarm Reporting service. Figure 3 shows the interactions between the managing and managed system for this functional unit. Note that the Event Forwarding Discriminator object shown in Figure 3 may be predefined. In such cases, only the administrative state attribute is modifiable by the managing system.
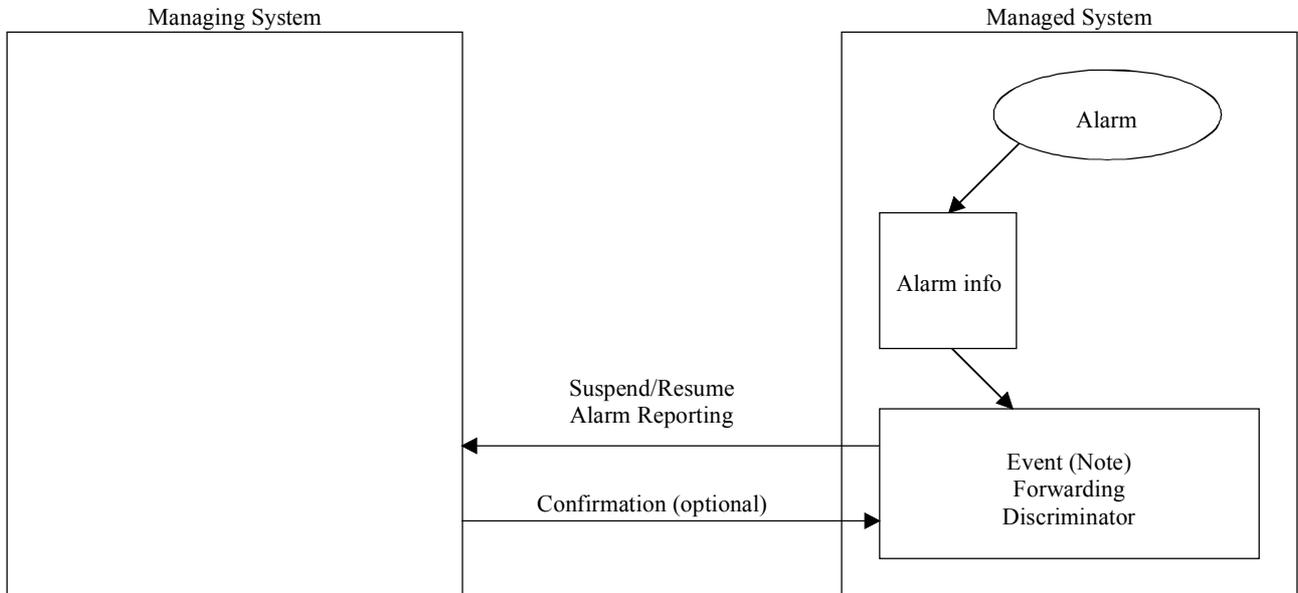
T1136750-91

NOTE – Some services associated with the Event Forwarding Discriminator object class are not provided in this Functional Unit.

Figure 3/Q.821 – Basic alarm report control FU

5.3.2.1 Suspend Alarm Reporting Service

The Suspend Alarm Reporting Service allows a managing system to inhibit the reporting of alarm information through an instance of the Event Forwarding Discriminator object class in a managed system. This service supports the Inhibit Alarm Reporting function identified in 5.1.

For the service definition, see [12] under Event Forwarding Discriminator Suspension.

5.3.2.2 Resume Alarm Reporting Service

The Resume Alarm Reporting Service allows a managing system to allow the reporting of alarm information through an existing instance of the Event Forwarding Discriminator object class in a managed system. This service supports the Allow Alarm Reporting function identified in 5.1.

For the service definition, see [12] under Event Forwarding Discriminator Resumption.

5.3.3 Enhanced Alarm Report Control Functional Unit

The Enhanced Alarm Report Control functional unit contains the Initiate Alarm Reporting service, the Terminate Alarm Reporting service, the Set Event Forwarding Discriminator service, and the Get Event Forwarding Discriminator service. Figure 4 shows the interactions between the managing and managed system for this functional unit.

If a bilateral agreement exists between two Alarm Reporting Service users, the Initiate and Terminate Alarm Reporting Services can be omitted. In this case, the Alarm Reporting Service starts automatically at system initialization.
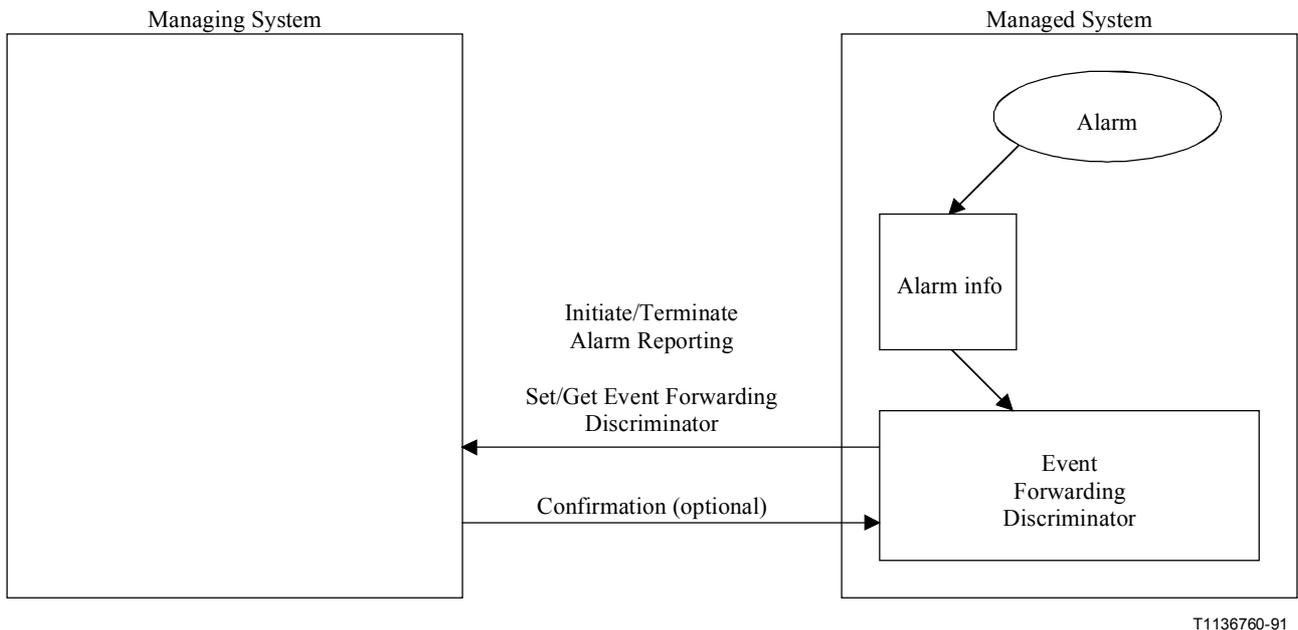
Figure 4/Q.821 – Enhanced alarm report control FU

5.3.3.1   Initiate Alarm Reporting Service

The Initiate Alarm Reporting Service allows a managing system to create an instance of the Event Forwarding Discriminator object class in a managed system. This service supports the Condition Alarm Reporting and the Route Alarm functions identified in 5.1.

For the service definition, see [12] under Initiation of Event Report Forwarding.

5.3.3.2   Terminate Alarm Reporting Service

The Terminate Alarm Reporting Service allows a managing system to delete an instance of the Event Forwarding Discriminator object class in a managed system. This service supports the Condition Alarm Reporting function identified in 5.1.

For the service definition, see [12] under Termination of Event Report Forwarding.

5.3.3.3   Set Event Forwarding Discriminator Service

The Set Event Forwarding Discriminator service is a service that allows a managing system to set the attribute values of a specified instance of an Event Forwarding Discriminator object, thus allowing it to alter the criteria used to determine those alarms that are reported. This service supports the Condition Alarm Reporting and Route Alarm Report functions identified in 5.1.

For the service definition, see [12] under Event Forwarding Discriminator Modification.

5.3.3.4   Get Event Forwarding Discriminator Service

The Get Event Forwarding Discriminator service allows a managing system to retrieve the values of given attributes of a specified instance of an Event Forwarding Discriminator object. This service supports the Request Alarm Report Control Condition and Request Alarm Report function identified in 5.1.

For the service definition, see [12] under Retrieval of Event Forwarding Discriminator Attributes.

5.3.4   Alarm Report Retrieval Functional Unit

The Alarm Report Retrieval functional unit contains only the Alarm Report Retrieving service described below. Figure 5 shows the interactions between the managing and managed system for this functional unit.

5.3.4.1   Alarm Report Retrieving Service

The Alarm Report Retrieving service is used to access the values of specified Alarm Record attributes. This service supports the Request Alarm Report History function identified in 5.1.

This service may be used to retrieve attribute values of a single Alarm Record by specifying the Alarm Record object class in the Base Object Class parameter. In this case, this service utilizes the PT-GET service and procedures defined in [16].

Alternatively, attributes for multiple Alarm Records may be retrieved by specifying the Log object class in the Base Object Class parameter and using the Scope and Filter parameters appropriately. This approach of course assumes the existence of one or more instances of the Log object class. Note that the multiple object selection functional unit of CMIS shall be selected to support the retrieval of attributes for multiple Alarm Records. For the service definition in this case, see [15] under Retrieval of Log Records.

5.3.4.2   Other services

The inclusion of other services in the Alarm Retrieval functional unit is for further study.

5.3.5   Alarm Report Deletion Functional Unit

This functional unit contains only the Alarm Report Deleting service. Figure 6 shows the interaction between the managing and managed systems for this functional unit.
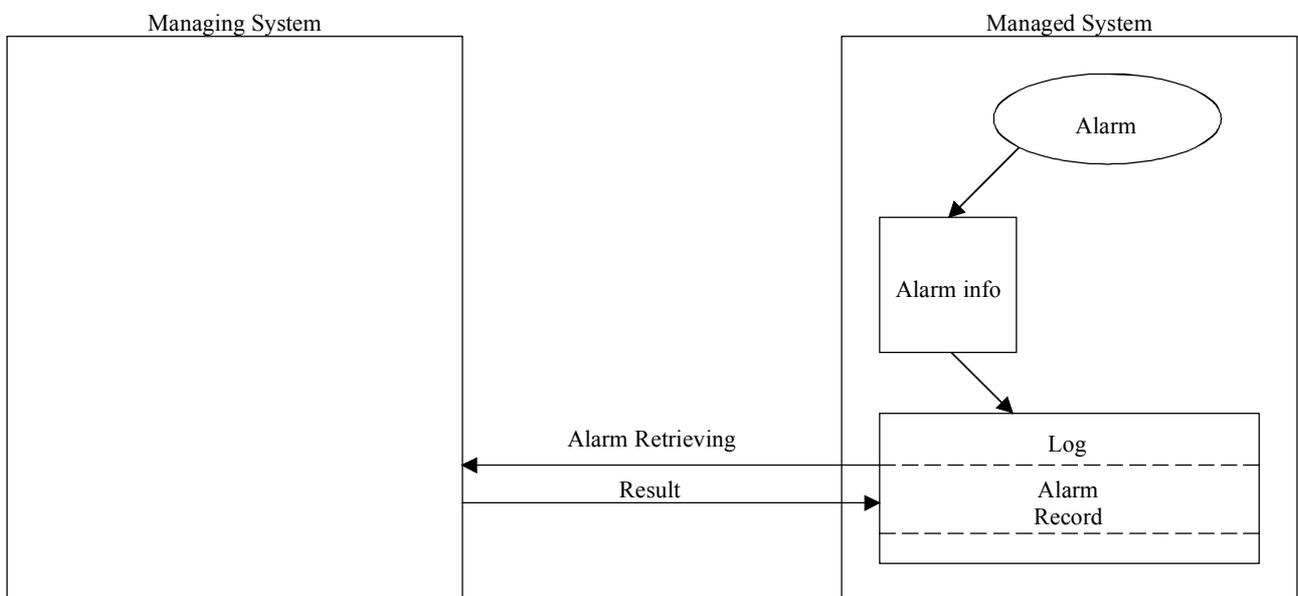
T1136770-91

Figure 5/Q.821 – Alarm retrieval FU

Managing System   Managed System

Alarm

Alarm info

Alarm Report Deleting

Result

Log

Alarm
Record

T1136780-91
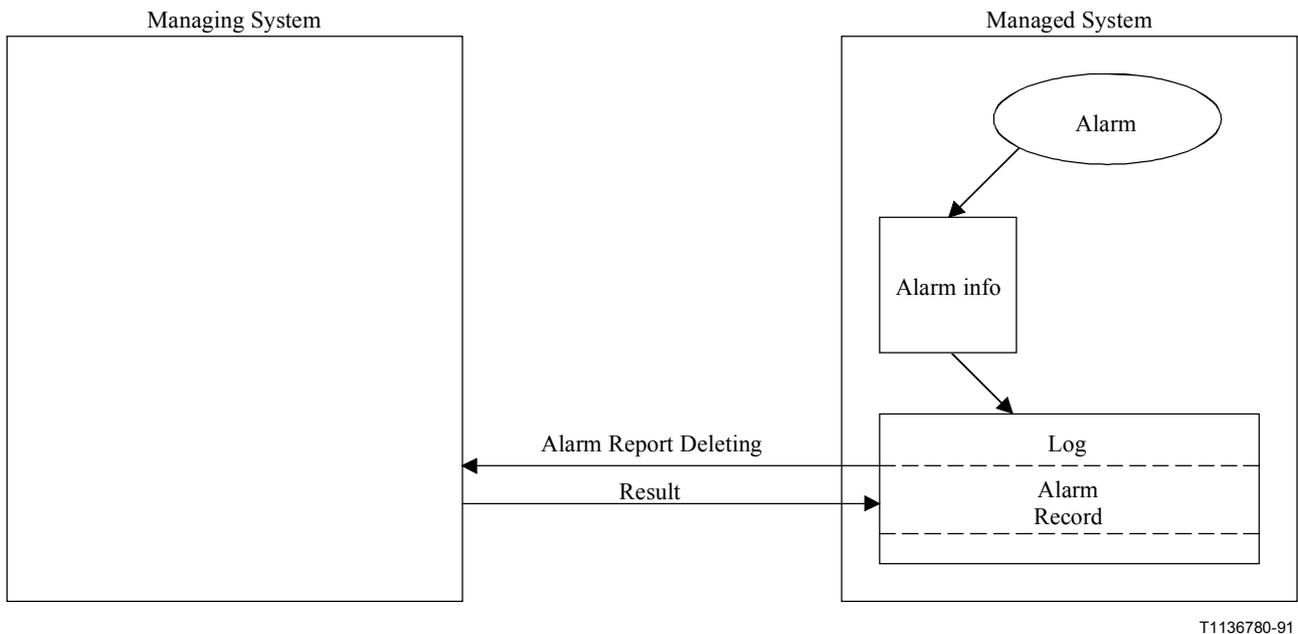
Figure 6/Q.821 – Alarm report deletion FU

5.3.5.1 Alarm Report Deleting Service

The Alarm Report Deleting service is used to remove specific Alarm Records. This service supports the Delete Alarm Report History function described in 5.1.

For the service definition, see [15] under Deletion of Log Records.

5.3.6 Current Alarm Summary Reporting Functional Unit

The Current Alarm Summary Reporting functional unit contains only the Current Alarm Summary Reporting service described below. Figure 7 shows the interactions between the managing and managed system for this functional unit. Note that the Management Operations Schedule and Current Alarm Summary Control objects shown in Figure 7 may be predefined. The Management Operations Schedule object shall be present (to provide a Destination Address) but need not be modifiable by the managing system.

Managing System

Managed System

Management (Note)
Operations
Schedule

Pokes

Current Alarm
Summary Reporting

Current (Note)
Alarm
Summary
Control

Confirmation (optional)
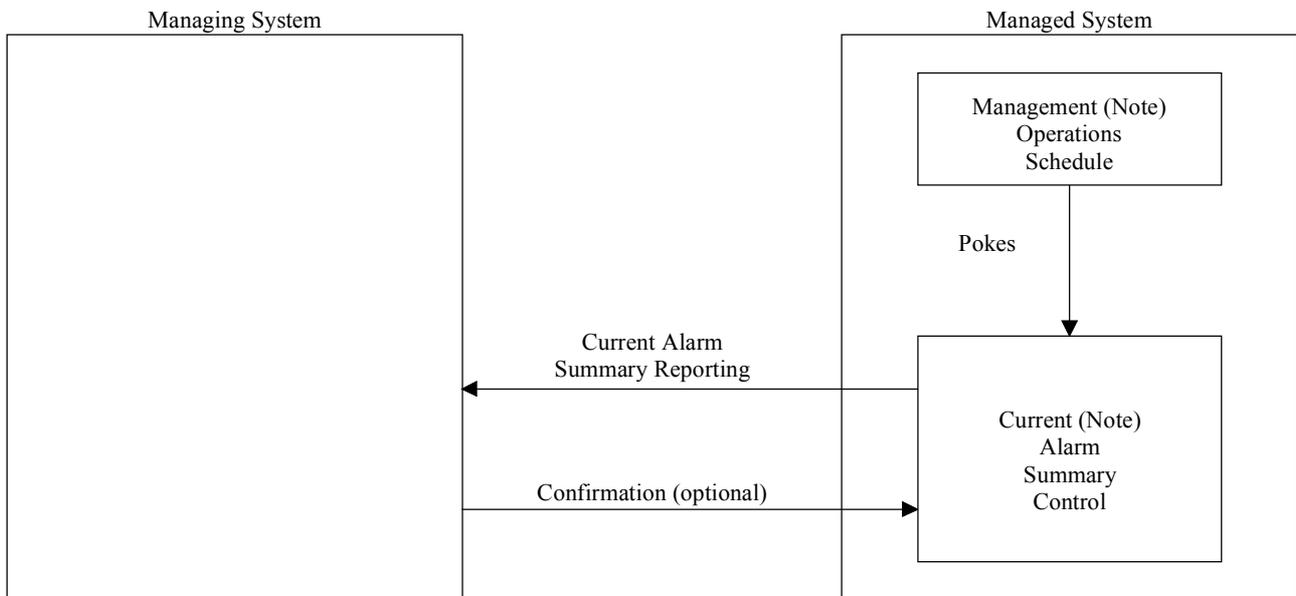
T1136790-91

NOTE – The services associated with the Management Operations Schedule and some of the services associated with the Current Alarm Summary Control object classes are not provided in this Functional Unit.

Figure 7/Q.821 – Current alarm summary reporting FU

5.3.6.1   Current Alarm Summary Reporting Service

The Current Alarm Summary Reporting service allows a managed system to report a summary of the alarm conditions of specified managed objects to its managing system(s).

The Current Alarm Summary Reporting service is invoked when the Current Alarm Summary Control object pointed to by the Management Operations Schedule object (via the Affected Object Class and Affected Object Instance attributes) is poked. This service supports the Report Current Alarm Summary function identified in 5.1.

Table 7 lists the parameters for the Current Alarm Summary Reporting service.

Table 7/Q.821 – Current Alarm Summary Reporting Service Parameters

Parameter name	Req/Ind	Rsp/Cnf
Invoke Identifier	P	P
Mode	P	–
Managed Object Class	P	P
Managed Object Instance	P	P
Event Type	M	C(=)
Event Time	P	–
Event Information		
Alarm Summary Data	M	–
Current Time	–	P
Event reply	–	C
Errors	–	P

The following parameters are defined for use in the Current Alarm Summary Reporting Service:

Invoke Identifier

See Invoke Identifier [6].

Mode

See Mode [6]. The values for this parameter are either confirmed or unconfirmed.

Managed Object Class

See Managed Object Class [6]. This parameter shall indicate the Current Alarm Summary Control object class.

Managed Object Instance

See Managed Object Instance [6].

Event Type

This parameter specifies the type of alarm being reported and shall therefore indicate the Current Alarm Summary Report. It may be included in the response if the Event Reply parameter is present in the response.

Event Time

See Event Time [6].

Alarm Summary Data

This parameter includes the results of an alarm summary report generation by a managed system. These results include multiple sequences of the following parameters:

– Object of Reference [9].
– Perceived Severity [9] (Optional).
– Alarm Status [9] (Optional).
– Probable Cause [9] (Optional).

Current Time

See Current Time [6].

Event Reply

See Event Reply [6]. The inclusion of this parameter in the response is conditional upon the successful receipt of the event report in the confirmed mode.

Errors

See Errors [6]. This parameter shall be included in a failure confirmation.

5.3.6.2   Other services

The inclusion of other services in the Basic Current Alarm Summary Reporting functional unit is for further study.

5.3.7   Basic Management Operations Scheduling Functional Unit

The Basic Management Operations Scheduling functional unit contains the Suspend Management Operations Schedule service and the Resume Management Operations Schedule service. Figure 8 shows the interactions between the managing and managed system for this functional unit. Note that the Management Operations Schedule object shown in Figure 8 may be predefined. In such cases, only the Administrative State attribute is modifiable by the Managing System.

Managing System   Managed System

Suspend Management
Operations Schedule

Resume Management
Operations Schedule

Management (Note)
Operations
Schedule

Confirmation (optional)

T1136800-91
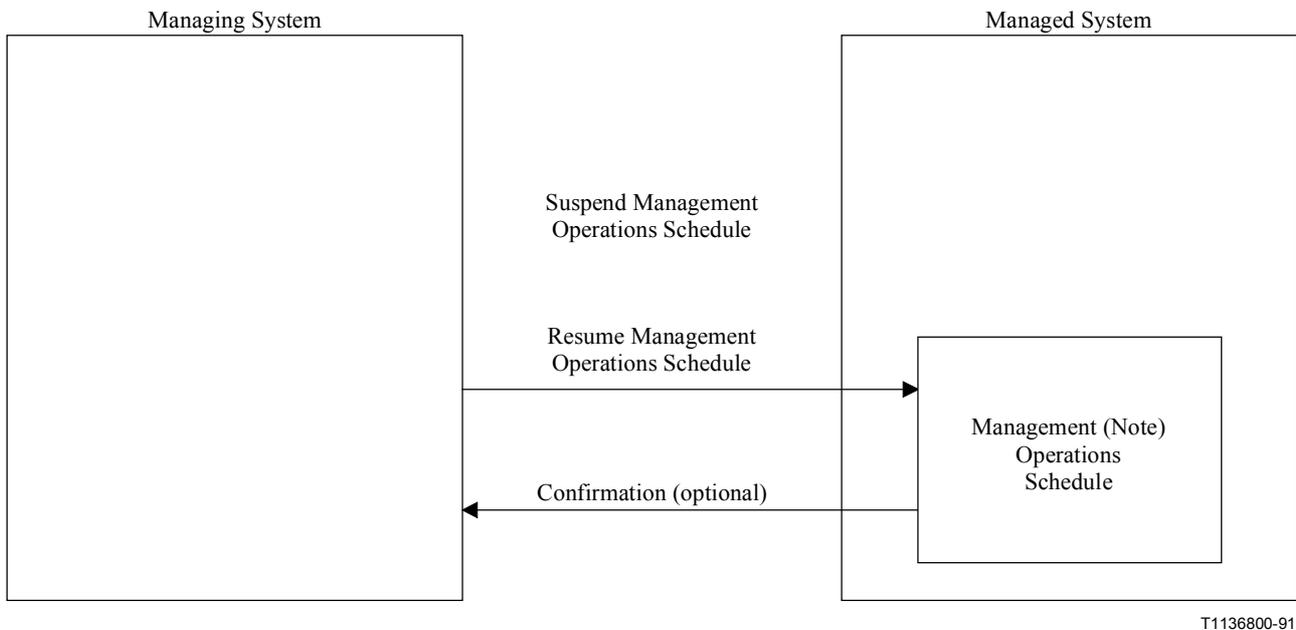
NOTE – Some services associated with the Management Operations Schedule object class are not provided in this Functional Unit.

Figure 8/Q.821 – Basic management operations scheduling FU

5.3.7.1 Suspend Management Operations Schedule Service

The Suspend Management Operations Schedule Service allows a managing system to inhibit the scheduled operation of a service (such as the Current Alarm Summary Reporting service) triggered by an instance of the Management Operations Schedule object class in a managed system. This service utilizes the PT-SET service and procedures defined in [16]. This service supports the Inhibit Current Alarm Summary function identified in 5.1.

The semantics of the Management Operations Schedule attributes are defined in 5.2.

5.3.7.2 Resume Management Operations Schedule Service

The Resume Management Operations Schedule Service allows a managing system to resume the scheduled operation of a service (such as the Current Alarm Summary Reporting service) triggered by an instance of the Management Operations Schedule object class in a managed system. This service utilizes the PT-SET service and procedures defined in [16]. This service supports the Allow Current Alarm Summary function identified in 5.1.

The semantics of the Management Operations Schedule attributes are defined in 5.2.

5.3.8 Enhanced Management Operations Scheduling Functional Unit

The Enhanced Management Operations Scheduling functional unit contains the Initiate Management Operations Schedule service, the Terminate Management Operations Schedule service, the Set Management Operations Schedule service, and the Get Management Operations Schedule service. Figure 9 shows the interactions between the managing and managed system for this functional unit.

If a bilateral agreement exists between two error reporting service users, the Initiate and Terminate Management Operations Schedule services can be omitted. In this case, operation of the Management Operations Schedule starts automatically at system initialization.

Managing System   Managed System

Initiate/Terminate/
Set/Get Management
Operations Schedule

Management
Operations
Schedule

Confirmation (optional)

T1136810-91
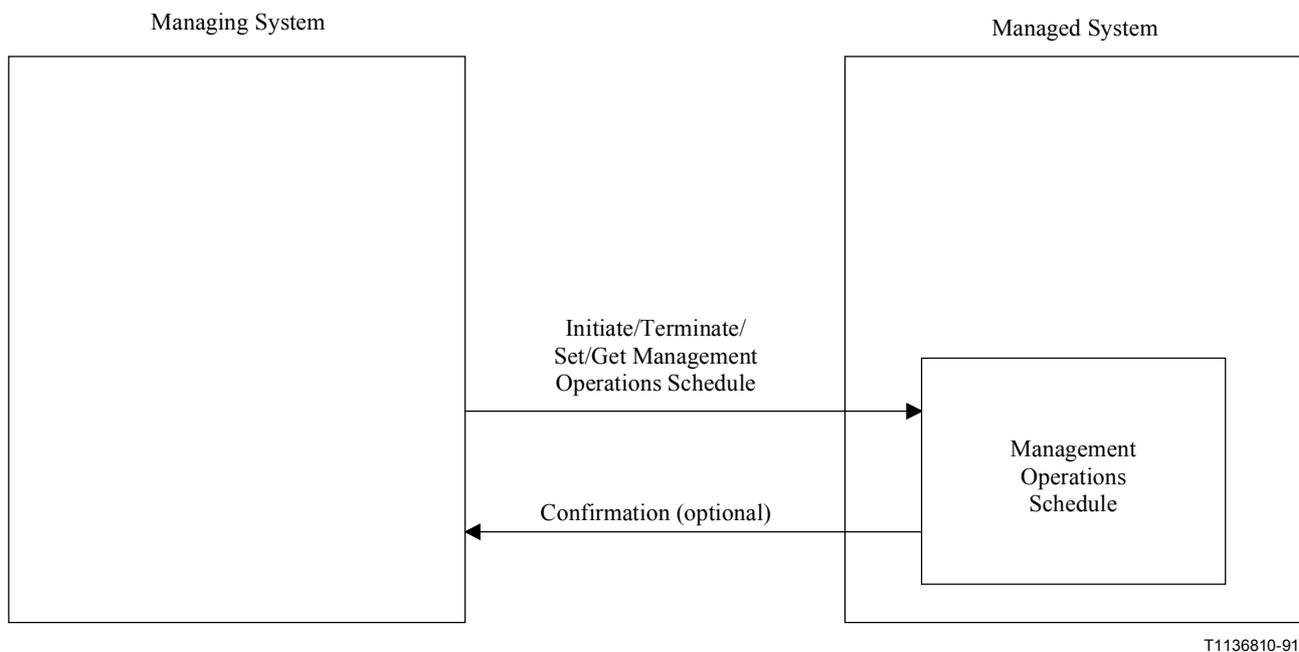
Figure 9/Q.821 – Enhanced management operations scheduling FU

5.3.8.1 Initiate Management Operations Schedule Service

The Initiate Management Operations Schedule Service allows a managing system to create an instance of the Management Operations Schedule object class in a managed system. This service utilizes the PT-CREATE service and procedures defined in [16]. This service supports the Schedule Current Alarm Summary and Route Current Alarm Summary functions identified in 5.1.

The semantics of the Management Operations Schedule attributes are defined in 5.2.

5.3.8.2 Terminate Management Operations Schedule Service

The Terminate Management Operations Schedule Service allows a managing system to delete an instance of the Management Operations Schedule object class in a managed system. This service utilizes the PT-DELETE service and procedures defined in [16]. This service supports the Schedule Current Alarm Summary function identified in 5.1.

The semantics of the Management Operations Schedule attributes are defined in 5.2.

5.3.8.3 Set Management Operations Schedule Service

The Set Management Operations Schedule service is a confirmed service that allows a managing system to set the attribute values of a specified instance of a Management Operations Schedule object. This service utilizes the PT-SET service and procedures defined in [16]. This service supports the Schedule Current Alarm Summary and Route Current Alarm Summary functions identified in 5.1.

The semantics of the Management Operations Schedule attributes are defined in 5.2.

5.3.8.4 Get Management Operations Schedule Service

The Get Management Operations Schedule service allows a managing system to retrieve the values of given attributes of a specified instance of a Management Operations Schedule object. This service utilizes the PT-GET service and procedures defined in [16]. This service supports the Request Current Alarm Summary Schedule and Request Current Alarm Summary Route functions identified in 5.1.

The semantics of the Management Operations Schedule attributes are defined in 5.2.

5.3.9   Current Alarm Summary Reporting Control Functional Unit

The Current Alarm Summary Reporting Control functional unit contains the Initiate Current Alarm Summary Control service, the Terminate Current Alarm Summary Control service, the Set Current Alarm Summary Control service, and the Get Current Alarm Summary Control service. Figure 10 shows the interactions between the managing and managed system for this functional unit.

5.3.9.1   Initiate Current Alarm Summary Control Service

The Initiate Current Alarm Summary Control Service allows a managing system to create an instance of the Current Alarm Summary Control object class in a managed system. This service utilizes the PT-CREATE service and procedures defined in [16]. This service supports the Schedule Current Alarm Summary function identified in 5.1.

The semantics of the Current Alarm Summary Control attributes are defined in 5.2.

5.3.9.2   Terminate Current Alarm Summary Control Service

The Terminate Current Alarm Summary Control Service allows a managing system to delete an instance of the Current Alarm Summary Control object class in a managed system. This service utilizes the PT-DELETE service and procedures defined in [16]. This service supports the Schedule Current Alarm Summary function identified in 5.1.

The semantics of the Current Alarm Summary Control attributes are defined in 5.2.

5.3.9.3   Set Current Alarm Summary Control Service

The Set Current Alarm Summary Control service is a confirmed service that allows a managing system to set the attribute values of a specified instance of a Current Alarm Summary Control object. This service utilizes the PT-SET service and procedures defined in [16].

This service allows a managing system to alter the criteria used to select objects to be included in Current Alarm Summary reports. This service supports the Schedule Current Alarm Summary function identified in 5.1.

The semantics of the Current Alarm Summary Control attributes are defined in 5.2.

5.3.9.4   Get Current Alarm Summary Control Service

The Get Current Alarm Summary Control service allows a managing system to retrieve the values of given attributes of a specified instance of a Current Alarm Summary Control object. This service utilizes the PT-GET service and procedures defined in [16]. This service supports the Request Current Alarm Summary Schedule function identified in 5.1.

The semantics of the Current Alarm Summary Control attributes are defined in 5.2.

5.3.10   Current Alarm Summary Retrieval Functional Unit

The Current Alarm Summary Retrieval functional unit contains only the Retrieve Current Alarm Summary service described below. Figure 11 shows the interactions between the managing and managed system for this functional unit. Note that the Current Alarm Summary Control object shown in Figure 11 may be predefined. If this is the only Current Alarm Summary-related functional unit supported, the Current Alarm Summary Control object class shall be present but need not be modifiable by the managing system.

T1136820-91
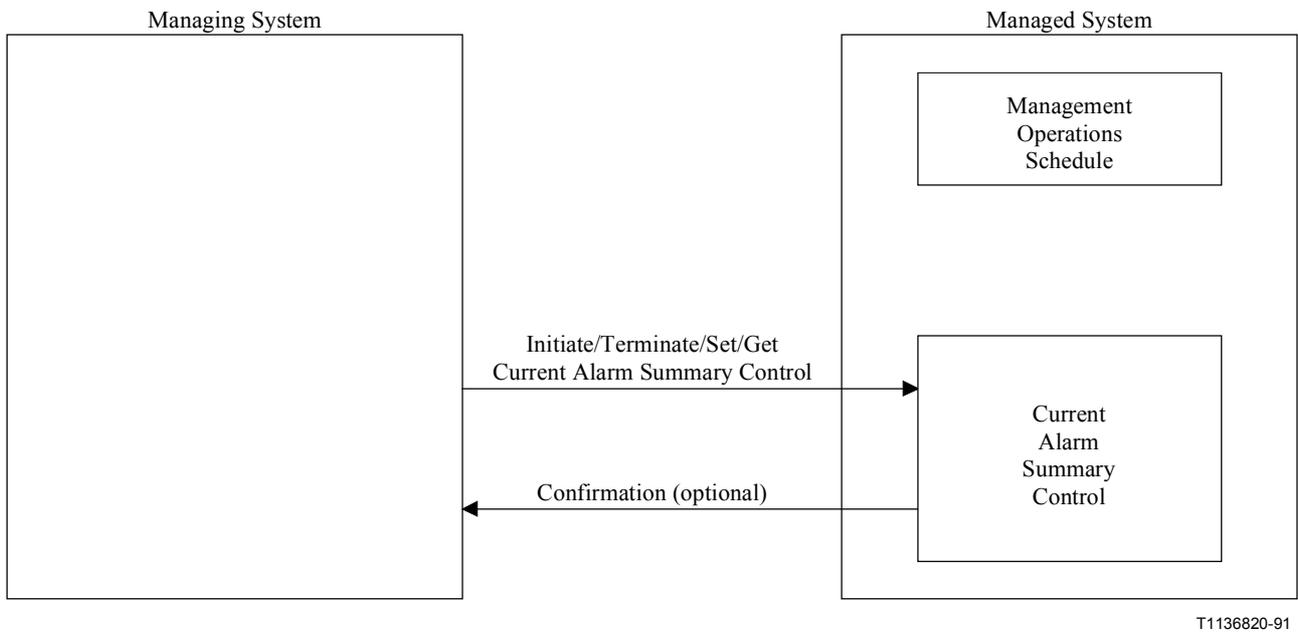
Figure 10/Q.821 – Current alarm summary reporting control FU

T1136830-91
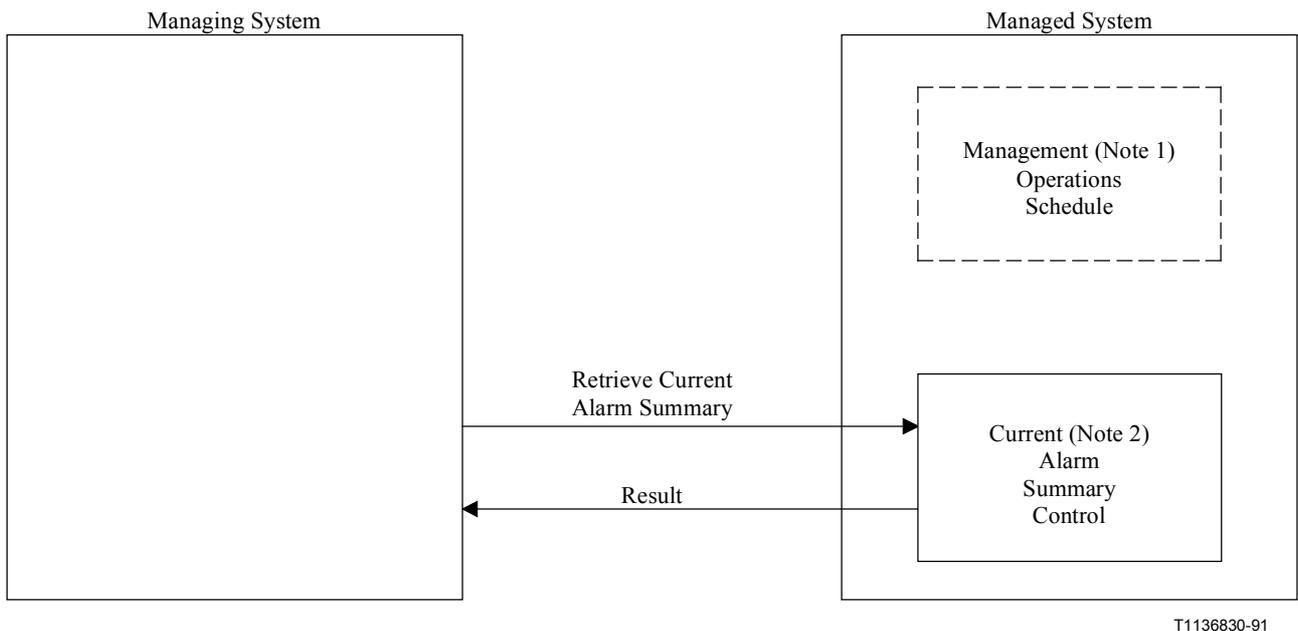
NOTE 1 – This object class is not required in the Functional Unit.

NOTE 2 – Some services associated with the Current Alarm Summary Control object class are not provided in this Functional Unit.

Figure 11/Q.821 – Current alarm summary retrieval FU

5.3.10.1 Retrieve Current Alarm Summary Service

The Retrieve Current Alarm Summary service is used to request that a Current Alarm Summary report be sent from the managed system to the managing system. This service utilizes the CMIS M-ACTION service and procedures defined in [6]. It supports the Request Current Alarm Summary function identified in 5.1.

Table 8 shows the parameters used in the Retrieve Current Alarm Summary service.

Table 8/Q.821 – Retrieve Current Alarm Summary Service Parameters

Parameter name	Req/Ind	Rsp/Cnf
Invoke Identifier	P	P
Linked Identifier[a]	–	P
Mode	P	–
Base Object Class	P	–
Base Object Instance	P	–
Scope[a]	P	–
Filter[a]	P	–
Access Control	P	–
Managed Object Class	–	P
Managed Object Instance	–	P
Action Type	M	C(=)
Action Information		
Summary Contents	U	–
Current Time	–	P
Alarm Summary Data	–	C
Errors	–	P
[a] Use of this parameter requires selection of the appropriate CMIS FU(s).		

The following parameters are defined for use in the Alarm Retrieving Service:

Invoke Identifier

See Invoke Identifier [6].

Linked Identifier

See Linked Identifier [6]. If the Base Object Class references the Managed Element object class [18] or one of its subclasses, this parameter is included in the response when multiple replies (one for each Current Alarm Summary Control) are to be sent.

Mode

See Mode [6]. The value of this parameter shall be confirmed.

Base Object Class

See Base Object Class [6]. This parameter is used to indicate the Current Alarm Summary Control object class if desired summary report can be generated by a single instance of the Current Alarm Summary Control object class. If multiple replies are desired, this parameter indicates the Managed Element object class or one of its subclasses. The Scope and Filter parameters are used to select the Current Alarm Summary Control objects from which the alarm summary report is to be generated.

Base Object Instance

See Base Object Instance [6]. This parameter specifies the instance of the Managed Element object class or one of its subclasses or the Current Alarm Summary Control object class indicated by the Base Object Class parameter.

Scope

See Scope [6]. If multiple alarm summary reports are desired, this parameter is used to indicate that the 1st level (n = 1) subordinates (Current Alarm Summary Control) of the base object class (Managed Element object class or one of its subclasses) is to be searched. This parameter is not applicable if the Current Alarm Summary Control object class is specified in the Base Object Class parameter.

Filter

See Filter [6]. If multiple alarm summary reports are desired, this parameter is used to indicate the criteria to be used when searching the Current Alarm Summary Control subordinates of the Managed Element object class or one of its subclasses. This parameter indicates the Current Alarm Summary Control object class and any other conditions desired to establish the selection criteria.

Access Control

See Access Control [6]. The use of this parameter is for further study.

Managed Object Class

See Managed Object Class [6]. This parameter indicates the Current Alarm Summary Control object class. It is included in success responses when multiple alarm summary reports are requested.

Managed Object Instance

See Managed Object Instance [6]. This parameter indicates the instance of the Current Alarm Summary Control object class for each response.

Action Type

See Action Type [6]. This parameter shall indicate the Retrieve Current Alarm Summary action type.

Summary Contents

This parameter is used to control the attributes that shall be included in the report. It may include any of the following:
–   Perceived Severity [9].
–   Alarm Status [9].
–   Probable Cause [9].

Current Time

See Current Time [6].

Alarm Summary Data

This parameter includes the results of an alarm summary report generation by a managed system. These results include multiple sequences of the following parameters:

–   Object Identifier [9].

–   Perceived Severity [9] (Optional).

–   Alarm Status [9] (Optional).

–   Probable Cause [9] (Optional).

Errors

See Errors [6].

5.3.10.2   Other services

The inclusion of other services in the Current Alarm Retrieval functional unit is for further study.

5.3.11   Alarm Event Criteria Management Functional Unit

The Alarm Event Criteria Management functional unit contains the Set Alarm Severity Assignment List and Get Alarm Severity Assignment List services. Figure 12 shows the interactions between the managing and managed system for this functional unit.
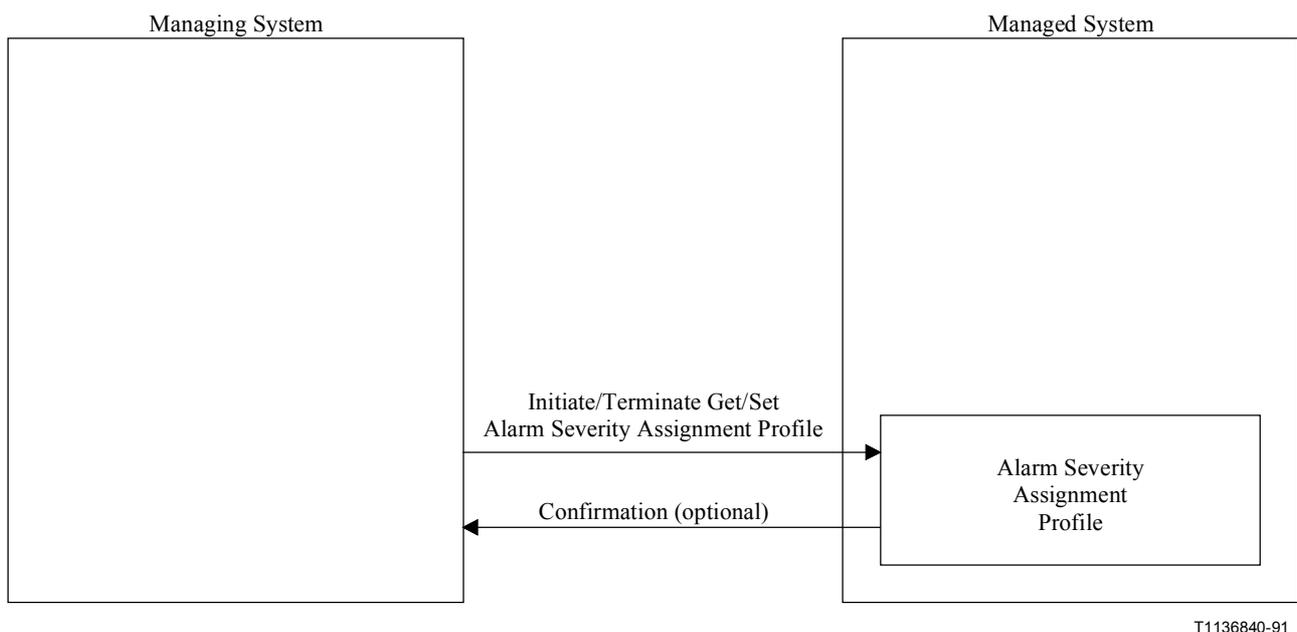
Figure 12/Q.821 – Alarm event criteria management FU

5.3.11.1   Initiate Alarm Severity Assignment Profile Service

The Initiate Alarm Severity Assignment Profile service allows a managing system to create an instance of the Alarm Severity Assignment Profile object class in a managed system. This service utilizes the PT-CREATE service and procedures defined in [16]. This service supports the Condition Alarm Event Criteria function identified in 5.1.

The semantics of the Alarm Severity Assignment Profile attributes are defined in [18].

5.3.11.2 Terminate Alarm Severity Assignment Profile Service

The Terminate Alarm Severity Assignment Profile service allows a managing system to delete an instance of the Alarm Severity Assignment Profile object class in a managed system. This service utilizes the PT-DELETE service and procedures defined in [16]. This service supports the Condition Alarm Event Criteria function identified in 5.1.

The semantics of the Alarm Severity Assignment Profile attributes are defined in [18].

5.3.11.3 Set Alarm Severity Assignment Profile Service

The Set Alarm Severity Assignment Profile service allows a managing system to modify the alarm severity assignment list associated with the Alarm Severity Assignment Profile object instance. This service utilizes the PT-SET service and procedures defined in [16]. This service supports the Condition Alarm Event Criteria function identified in 5.1.

The semantics of the Alarm Severity Assignment Profile object class are described in [18].

5.3.11.4 Get Alarm Severity Assignment Profile Service

The Get Alarm Severity Assignment Profile service allows a managing system to retrieve the alarm severity assignment list associated with the Alarm Severity Assignment Profile object instance. This service utilizes the PT-GET service and procedures defined in [16]. This service supports the Request Alarm Event Criteria function identified in 5.1.

The semantics of the Alarm Severity Assignment Profile object class are described in [18].

5.3.12 Alarm Indication Management Functional Unit

The Alarm Indication Management functional unit contains the Inhibit Audible and Visual Local Alarms service, the Allow Audible and Visual Local Alarms service, and the Reset Audible Alarm service.

Figure 13 shows the interactions between the managing and managed system for this functional unit.
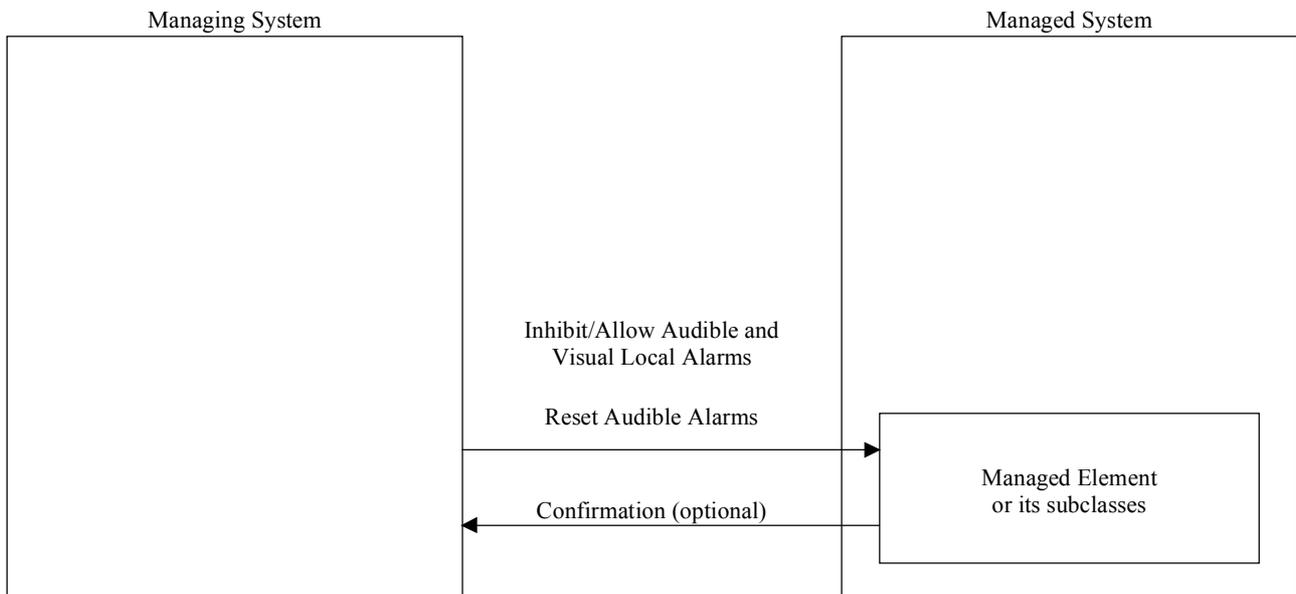
Figure 13/Q.821 − Alarm indication management FU

5.3.12.1 Inhibit Audible and Visual Local Alarms Service

The Inhibit Audible and Visual Local Alarms service allows a managing system to disable audible and visual local alarms.

This service utilizes the CMIS M-ACTION service and procedures defined in [6]. This service supports the Inhibit Audible/Visual Alarm Indication function identified in 5.1.

Table 9 shows the parameters used in the Inhibit Audible and Visual Local Alarms Service.

Table 9/Q.821 – Inhibit audible and Visual Local Alarms Service

Parameter name	Req/Ind	Rsp/Cnf
Invoke Identifier	P	P
Linked Identifier[a)]	–	P
Mode	P	–
Base Object Class	P	–
Base Object Instance	P	–
Scope[a)]	P	–
Access Control	P	–
Managed Object Class	–	P
Managed Object Instance	–	P
Action Type	M	C(=)
Current Time	–	P
Errors	–	P
[a)] Use of this parameter requires selection of the appropriate CMIS FU(s).		

The following parameters are defined for use in the Inhibit Audible and Visual Local Alarms Service:

Invoke Identifier

See Invoke Identifier [6].

Linked Identifier

See Linked Identifier [6]. This parameter is included in the response when multiple actions (one for each object class instance) are requested.

Mode

See Mode [6].

Base Object Class

See Base Object Class [6]. This parameter identifies the Managed Element object class or one of its subclasses.

Base Object Instance

See Base Object Instance [6]. This parameter identifies an instance of the Managed Element or one of its subclasses.

Scope

See Scope [6]. If multiple actions are desired, this parameter is used to indicate that the appropriate level subordinates of the base object class (Managed Element object class or one of its subclasses) are to be searched.

Access Control

See Access Control [6]. The use of this parameter is for further study.

Managed Object Class

See Managed Object Class [6]. This parameter indicates the object class acted upon. It is included in success responses when multiple actions are requested.

Managed Object Instance

See Managed Object Instance [6]. This parameter indicates the instance of the object class acted upon. It is included in success responses when multiple actions are requested.

Action Type

See Action Type [6]. This parameter shall indicate the Inhibit Audible and Visual Local Alarms Service.

Current Time

See Current Time [6].

Errors

See Errors [6].

5.3.12.2 Allow Audible and Visual Local Alarms Service

The Allow Audible and Visual Local Alarms service allows a managing system to enable audible and visual local alarms to sound. This service utilizes the CMIS M-ACTION service and procedures defined in [6]. This service supports the Allow Audible/Visual Alarm Indication function identified in 5.1.

Table 10 shows the parameters used in the Allow Audible and Visual Local Alarms Service.

Table 10/Q.821 – Inhibit audible and Visual Local Alarms Service

Parameter name	Req/Ind	Rsp/Cnf
Invoke Identifier	P	P
Linked Identifier[a)]	–	P
Mode	P	–
Base Object Class	P	–
Base Object Instance	P	–
Scope[a)]	P	–
Access Control	P	–
Managed Object Class	–	P
Managed Object Instance	–	P
Action Type	M	C(=)
Current Time	–	P

Table 10/Q.821 – Inhibit audible and Visual Local Alarms Service *(concluded)*

Parameter name	Req/Ind	Rsp/Cnf
Errors	–	P
a) Use of this parameter requires selection of the appropriate CMIS FU(s).		

The following parameters are defined for use in the Allow Audible and Visual Local Alarms Service:

Invoke Identifier

See Invoke Identifier [6].

Linked Identifier

See Linked Identifier [6]. This parameter is included in the response when multiple actions (one for each object class instance) are requested.

Mode

See Mode [6].

Base Object Class

See Base Object Class [6]. This parameter identifies the Managed Element object class or one of its subclasses.

Base Object Instance

See Base Object Instance [6]. This parameter identifies an instance of the Managed Element or one of its subclasses.

Scope

See Scope [6]. If multiple actions are desired, this parameter is used to indicate that the appropriate level subordinates of the base object class (Managed Element object class or one of its subclasses) are to be searched.

Access Control

See Access Control [6]. The use of this parameter is for further study.

Managed Object Class

See Managed Object Class [6]. This parameter indicates the object class acted upon. It is included in success responses when multiple actions are requested.

Managed Object Instance

See Managed Object Instance [6]. This parameter indicates the instance of the object class acted upon. It is included in success responses when multiple actions are requested.

Action Type

See Action Type [6]. This parameter shall indicate the Allow Audible and Visual Local Alarms Service.

Current Time

See Current Time [6].

Errors

See Errors [6].

5.3.12.3 Reset Audible Alarms Service

The Reset Audible Alarms service allows a managing system to retire existing audible and visual local alarms without inhibiting them in the future. This service utilizes the CMIS M-ACTION service and procedures defined in [6]. This service supports the Reset Audible Alarms function identified in 5.1.

Table 11 shows the parameters used in the Reset Audible Alarm Service.

Table 11/Q.821 – Reset Audible Alarms Service

Parameter name	Req/Ind	Rsp/Cnf
Invoke Identifier	P	P
Linked Identifier[a]	–	P
Mode	P	–
Base Object Class	P	–
Base Object Instance	P	–
Scope[a]	P	–
Access Control	P	–
Managed Object Class	–	P
Managed Object Instance	–	P
Action Type	M	C(=)
Current Time	–	P
Errors	–	P
[a] Use of this parameter requires selection of the appropriate CMIS FU(s).		

The following parameters are defined for use in the Reset Audible Alarms Service:

Invoke Identifier

See Invoke Identifier [6].

Linked Identifier

See Linked Identifier [6]. This parameter is included in the response when multiple actions (one for each object class instance) are requested.

Mode

See Mode [6].

Base Object Class

See Base Object Class [6]. This parameter identifies the Managed Element object class or one of its subclasses.

Base Object Instance

See Base Object Instance [6]. This parameter identifies an instance of the Managed Element or one of its subclasses.

Scope

See Scope [6]. If multiple actions are desired, this parameter is used to indicate that the appropriate level subordinates of the base object class (Managed Element object class or one of its subclasses) are to be searched.

Access Control

See Access Control [6]. The use of this parameter is for further study.

Managed Object Class

See Managed Object Class [6]. This parameter indicates the object class acted upon. It is included in success responses when multiple actions are requested.

Managed Object Instance

See Managed Object Instance [6]. This parameter indicates the instance of the object class acted upon. It is included in success responses when multiple actions are requested.

Action Type

See Action Type [6]. This parameter shall indicate the Reset Audible Alarms Service.

Current Time

See Current Time [6].

Errors

See Errors [6].

5.3.13 Basic Log Control Functional Unit

The Basic Log Control functional unit contains the Suspend Logging service and the Resume Logging service. Figure 14 shows the interactions between the managing and managed system for this functional unit. Note that the Log object shown in Figure 14 may either have a predefined Discriminator Construct, or the Discriminator Construct may be absent.

5.3.13.1 Suspend Logging Service

The Suspend Logging Service allows a managing system to inhibit the logging of Log Records. This service supports the Inhibit Logging function identified in 5.1.

For the service definition, see [15] under Suspension of Logging.

5.3.13.2 Resume Logging Service

The Resume Logging Service allows a managing system to resume the logging of Log Records. This service supports the Allow Logging function identified in 5.1.

For the service definition, see [15] under Resumption of Logging.

5.3.14 Enhanced Log Control Functional Unit

The Enhanced Log Control functional unit contains the Initiate Log service, the Terminate Log service, the Set Log service, and the Get Log service. Figure 15 shows the interactions between the managing and managed system for this functional unit. Note that the Log object shown in Figure 15 may either be predefined or be created using the Initiate Log service.

5.3.14.1 Initiate Log Service

The Initiate Log Service allows a managing system to create an instance of the Log object class in a managed system. This service supports the Condition Logging function identified in 5.1.

For the service definition, see [15] under Initiation of Logging.

5.3.14.2 Terminate Log Service

The Terminate Log Service allows a managing system to delete an instance of the Log object class in a managed system. This service supports the Condition Logging function identified in 5.1.

For the service definition, see [15] under Termination of Logging.
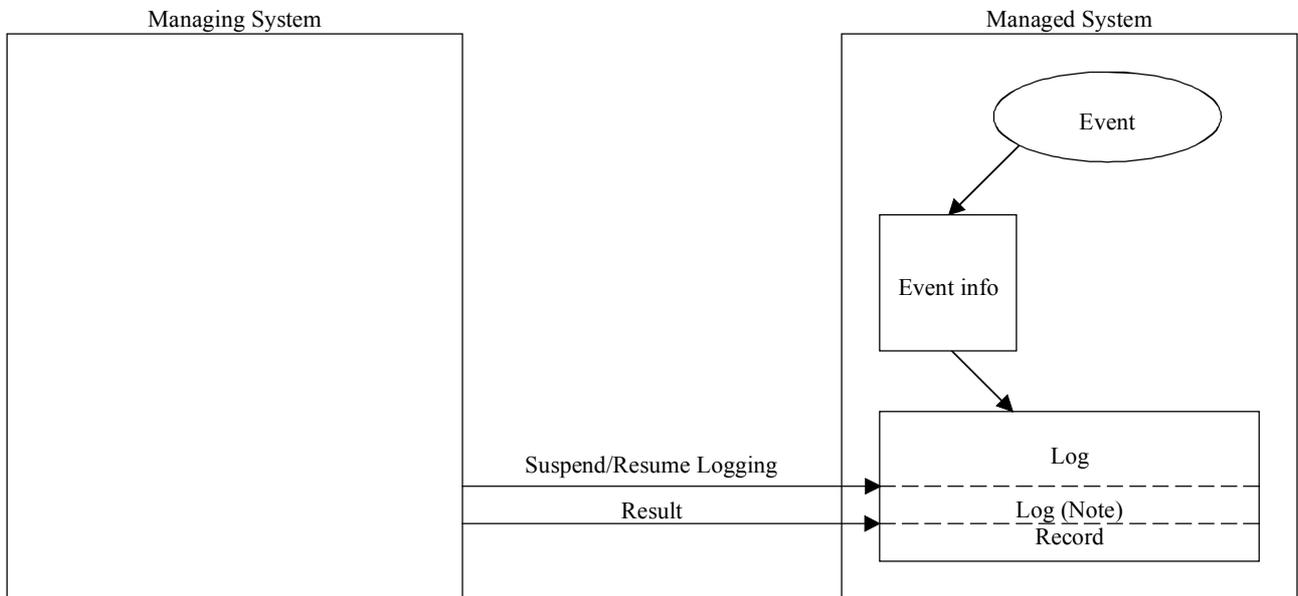
NOTE – Or subclasses of Log Record, such as Alarm Record.

Figure 14/Q.821 – Basic log control FU
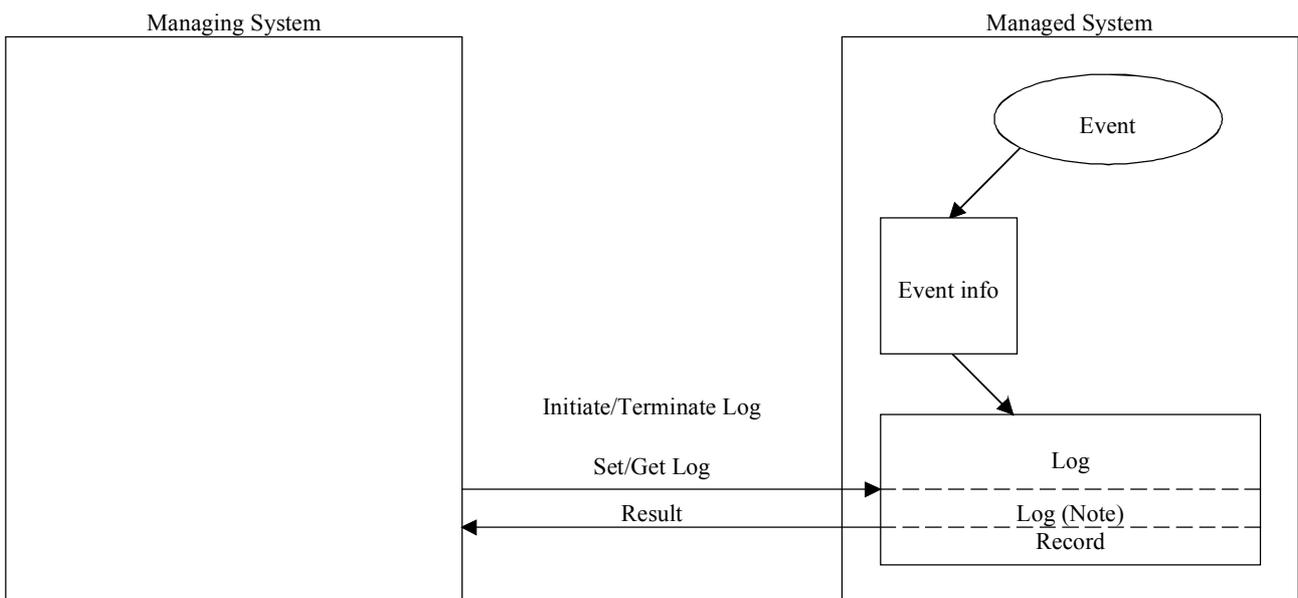
NOTE – Or subclasses of LOG Record, such as Alarm Record.

Figure 15/Q.821 – Enhanced log control FU

5.3.14.3 Set Log Service

The Set Log service is a confirmed service that allows a managing system to set the attribute values of a specified instance of a Log object. This service supports the Condition Logging function identified in 5.1.

For the service definition, see [15] under Modification of Logging Attributes.

5.3.14.4 Get Log Service

The Get Log service allows a managing system to retrieve the values of given attributes of a specified instance of a Log object. This service supports the Request Log Condition function identified in 5.1.

For the service definition, see [15] under Retrieving Logging Attributes.

5.4 Alarm Surveillance Protocol Specification

5.4.1 Elements of procedure

Except for the services identified below, this specification makes use of the elements of procedure defined for the services described in 5.3.

The elements of procedure for the Current Alarm Summary Reporting service are identical to the elements of procedure found in 11.1.9 of [16].

The elements of procedure for the Retrieve Current Alarm Summary, the Inhibit/Allow Audible and Visual Local Alarms, and Reset Audible Alarm services are identical to the elements of procedure found in 11.1.8 of [16].

5.4.2 Abstract syntax

5.4.2.1 Managed objects

This specification references the following support objects whose ASN.1 value notation is specified in [9].

a)   alarmRecord

b)   discriminator

c)   eventForwardingDiscriminator

d)   eventLogRecord

e)   log

f)   logRecord

This specification references the following managed objects whose ASN.1 value notation are specified in [18].

a)   alarmSeverityAssignmentProfile

b)   managedElement

This specification references the following support objects whose ASN.1 value notation is specified in Annex A.

a)   currentAlarmSummaryControl

b)   managementOperationsSchedule

5.4.2.2 Attributes

This specification references the following attributes associated with the objects specified in 5.2 whose abstract syntax is defined in [9].

a) activeDestination

b) administrativeState

c) availabilityStatus

d) backUpDestinationList

e) backUpObject

f) backedUpStatus

g) capacityAlarmThreshold

h) confirmedMode

i) currentLogSize

j) destination

k) discriminatorConstruct

l) discriminatorId

m) eventType

n) intervalsOfDay

o) logFullAction

p) logId

q) logRecordId

r) loggingTime

s) managedObjectClass

t) managedObjectInstance

u) maxLogSize

v) monitoredAttributes

w) numberOfRecords

x) operationalState

y) perceivedSeverity

z) probableCause

aa) proposedRepairActions

bb) schedulerName

cc) specificProblems

dd) startTime

ee) stateChangeDefinition

ff) stopTime

gg) thresholdInfo

hh) trendIndication

ii) weekMask

This specification references the following attributes associated with the objects specified in 5.2 whose abstract syntax is defined in [18].

a) alarmSeverityAssignmentList

b) alarmSeverityAssignmentProfileId

c) managedElementId

The objects defined in this specification inherit attributes from Top as specified in [9]; these attributes are not repeated here.

This specification references the following attributes whose abstract syntax is defined in Annex A.

a)   affectedObjectClass

b)   affectedObjectInstances

c)   alarmStatusList

d)   beginTime

e)   currentAlarmSummaryControlId

f)   destinationAddress

g)   endTime

h)   interval

i)   objectList

j)   perceivedSeverityList

k)   probableCauseList

l)   scheduled

5.4.2.3   Notifications

This specification references the following events defined in [16].

a)   attributeValueChangeNotification

b)   objectCreationNotification

c)   objectDeletionNotification

This specification references the following event defined in [17].

a)   stateChangeNotification

This specification references the following events defined in [11].

a)   communicationsAlarm

b)   equipmentAlarm

c)   environmentalAlarm

d)   processingErrorAlarm

e)   qualityOfServiceAlarm

This specification references the following event defined in Annex A.

a)   currentAlarmSummaryReport

5.4.2.4   Actions

This specification references the following actions defined in [18].

a)   allowAudibleAndVisualLocalAlarms

b)   inhibitAudibleAndVisualLocalAlarms

This specification references the following actions defined in Annex A.

a)   retrieveCurrentAlarmSummary

b)   resetAudibleAlarm

5.4.2.5 Parameters

This specification references the following parameters defined in Annex A.

a)   correlatedRecordNameParameter

b)   logRecordIdParameter

c)   suspectObjectNameParameter

5.4.2.6 Name Bindings

This specification references the following name bindings associated with the objects specified in 5.2 whose abstract syntax is defined in [18].

a)   LogRecord-log

5.4.3 Negotiation of Functional Units

This specification assigns the following object identifier values:

{ccitt(0) recommendation(0) q(17) q821(821) protocolSupport(1) functionalUnitPackage(1)}

as a value of the ASN.1 type FunctionalUnitPackageId defined in [20] to use for negotiating the following functional units:

0	kernel
1	alarm report retrieval
2	basic alarm report control
3	enhanced alarm report control
4	current alarm summary reporting
5	basic management operations scheduling
6	enhanced management operations scheduling
7	current alarm summary control
8	current alarm summary retrieval
9	basic log control
10	enhanced log control
11	alarm report deletion
12	alarm event criteria management
13	alarm indication management
14	alarm synchronization
15	cancel alarm synchronisation

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 5.3.

Within the systems management application context, the mechanism for negotiating the functional units is described in [20].

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

6 Alarm Synchronization

6.1 Overview of Alarm Synchronization

This clause gives a brief summary of the Alarm Synchronization capabilities.

6.1.1 Introduction

Many Fault Management systems need to maintain a collection of uncleared alarm conditions. This allows systems providing alarm surveillance to provide their users a description of current network faults. Following communication outages and other system failures, this collection needs to be

synchronized with the agent's complete set of uncleared alarm conditions. (We are calling this collection of uncleared alarms as "Current Alarms", see 6.1.2, Current Alarms.) In addition, many manager systems need the full complement of alarm information.

Managers may need to synchronize their alarm databases during the following situations:

1)   A communications loss of either short or long duration.

2)   Serious problems within the manager (e.g. a disk crash).

3)   An operator error (e.g. inadvertent deletion of alarms).

4)   The initial manager to agent connection.

5)   Verification of whether alarm conditions are still pending.

6)   Modification of an Event Forwarding Discriminator's Discriminator Construct [9].

6.1.2   Current Alarms

Current Alarms are active alarms that have not yet been cleared. Alarms become current when they are initially emitted as notifications. Alarms are no longer current when they are cleared by notifications. Alarms may also no longer be current when their managed object instance has been deleted. The process of clearing alarms is further discussed in Appendix I.

In this ITU-T Recommendation, it is the agent's responsibility to maintain the collection of Current Alarms. Current Alarms are not required to be maintained in managed objects.

6.1.3   Itemized Requirements

This subclause describes the Alarm Synchronization requirements. The Alarm Synchronization service requirements are as follows:

1)   Put in line the manager with the information contained in the agent about Current Alarms (i.e. alarms not yet cleared) at the time of the Alarm Synchronization request.

2)   Alarm Synchronization and Alarm Reporting [11] will operate independently (in both manager and agent) from the interface perspective.

3)   Alarm Synchronization will work with any number of managers, each with different requirements regarding Alarm Synchronization and Alarm Reporting.

4)   It will be possible for the manager to select the Current Alarms to be received based on the Alarm Synchronization selection criteria; these criteria must at least be able to support the criteria used in Alarm Reporting (see the Event Forwarding Discriminator managed object Discriminator Construct attribute [9]).

5)   The manager will be able to request Alarm Synchronization on demand.

6)   The Alarm Synchronization process will have a beginning and end that is visible on the interface.

7)   It will be possible for a manager to invoke multiple Alarm Synchronization requests independent of any request from itself or other managers.

8)   Alarm Synchronization shall be able to coexist with existing management information models.

9)   The management information model will support, as an option, the cancellation (by the initiator) of a previous Alarm Synchronization request.

10)   The semantics of ITU-T Recommendation X.733 [11] existing parameters will not be changed when used for Alarm Synchronization.

11)   All mandatory alarm parameters will be returned by Alarm Synchronization per matched Current Alarm (i.e. Event Type, Managed Object Class, Managed Object Instance, Perceived Severity and Probable Cause).

12) The agent will support the reporting of one or more optional alarm parameters, as agreed upon in the Service Level Agreement (i.e. Additional Information, Additional Text, Backed-Up Status, Back-Up Object, Correlated Notifications, Event Time, Monitored Attributes, Notification Identifier, Proposed Repair Actions, Specific Problems, State Change Definition, Threshold Information and Trend Indication). The Service Level Agreement is outside the scope of this ITU-T Recommendation.

13) A manager not having requested Alarm Synchronization information, or not using this service, must not be impacted by an Alarm Synchronization launched by another manager.

14) The agent is responsible for maintaining the Current Alarms.

15) Alarm Synchronization will be invoked on demand. The use of a schedule (as used with Management Operations Schedule) is not required.

6.1.4 Other Information

Fault Management systems may also want to synchronize their local version of state management information with that of an agent [16] (as an example, to determine which managed object instances are currently disabled). While this is a problem outside the scope of this ITU-T Recommendation, it can be accomplished by issuing **M-GET** request(s) on the desired state management attributes.

Alarm Synchronization does not apply to the following:

1) Obtain all alarms that were reported while there was a communication loss between the manager and agent system. This problem is being addressed in ITU-T Recommendation X.734 [12]. It defines Disseminating Log and Disseminating Queue managed objects to prevent loss of notifications during short communication losses.

   In contrast to this, Alarm Synchronization must also function following an extended communications loss.

   Alarm Synchronization does not return all alarms (including both the original event and the clearing event), only those alarms that have not yet been cleared. It returns the current state, not history.

2) An audit capability to obtain all information in the MIB specific to alarm states of the managed object instances and Current Alarms. This is a specialized form of a generic database synchronization. This problem is being addressed in ITU-T Recommendation X.792 [28]. This function will only retrieve data that is actually stored in the MIB.

   In contrast to this, Alarm Synchronization does not assume that Current Alarms are stored in the MIB (also see 7.4, Relationship with ITU-T Recommendation X.735).

6.2 Alarm Synchronization Information Model

6.2.1 Model overview

The Alarm Synchronization management information model is defined to overcome limitations to Current Alarm Summary Control managed object class definition criteria and reported information. Alarm Synchronization will include more alarm information than is currently contained in the Current Alarm Summary Control managed object class. This management information model uses the linked reply mechanism available with action requests to identify the start and end of the reports, as shown in Figure 16.
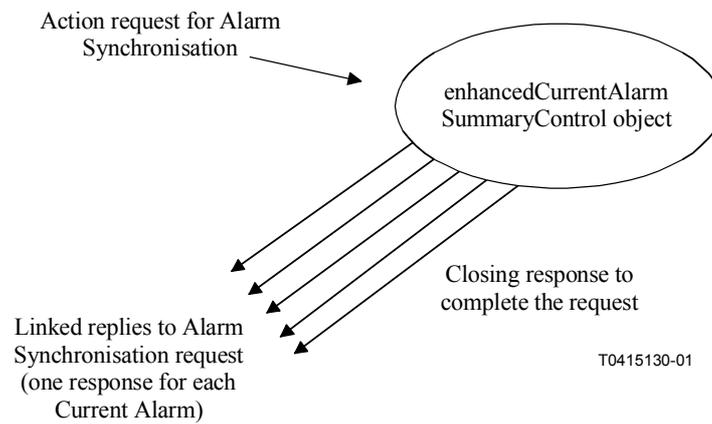
Figure 16/Q.821 – Overview of Alarm Synchronization

Alarm Synchronization action requests may also be cancelled by a Cancel Alarm Synchronization action request.

6.2.2 Alarm Synchronization Managed Object Class

The following managed object class is required to meet the functional requirements specified in 6.1.3, Itemized Requirements.

6.2.2.1 enhancedCurrentAlarmSummaryControl

The Enhanced Current Alarm Summary Control managed object class provides the functionality to perform Alarm Synchronization. Its capabilities and behaviour are described throughout clause 6. The definition for the enhancedCurrentAlarmSummaryControl managed object class is shown in A.1.3.

6.2.3 Inheritance Hierarchy

Figure 17 contains the inheritance hierarchy.
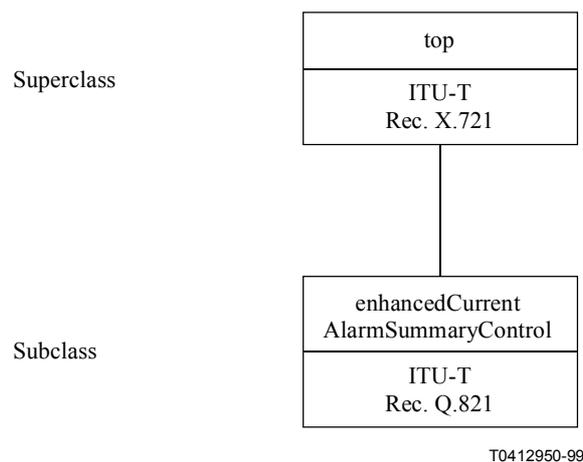
Figure 17/Q.821 – Inheritance Hierarchy

6.2.4   Name Binding Strategies

6.2.4.1   Naming Tree Hierarchy

Figure 18 contains the Alarm Synchronization naming tree.

As we shall see in 6.2.6.1, alarmSynchronization, Enhanced Current Alarm Summary Control managed object instances can only retrieve alarms from managed object instances in the naming hierarchy of its immediate superior object. Any managed object instance which is not in the naming hierarchy of an Enhanced Current Alarm Summary Control's immediate superior object will not have its alarms visible via Alarm Synchronization. (Using Recommendation ITU-T M.3100 [18] for an example, if a particular management information model uses Network managed objects as an immediate superior object to Managed Element managed objects and Managed Element managed objects as an immediate superior object to Enhanced Current Alarm Summary Control managed objects, then alarms from Network managed object instances would not be visible via Alarm Synchronization via those particular Enhanced Current Alarm Summary Control managed objects.)

Enhanced Current Alarm Summary Control managed object instances may be at different levels of the naming hierarchy and may have different types of immediate superior objects. Other name bindings may be defined, as required.
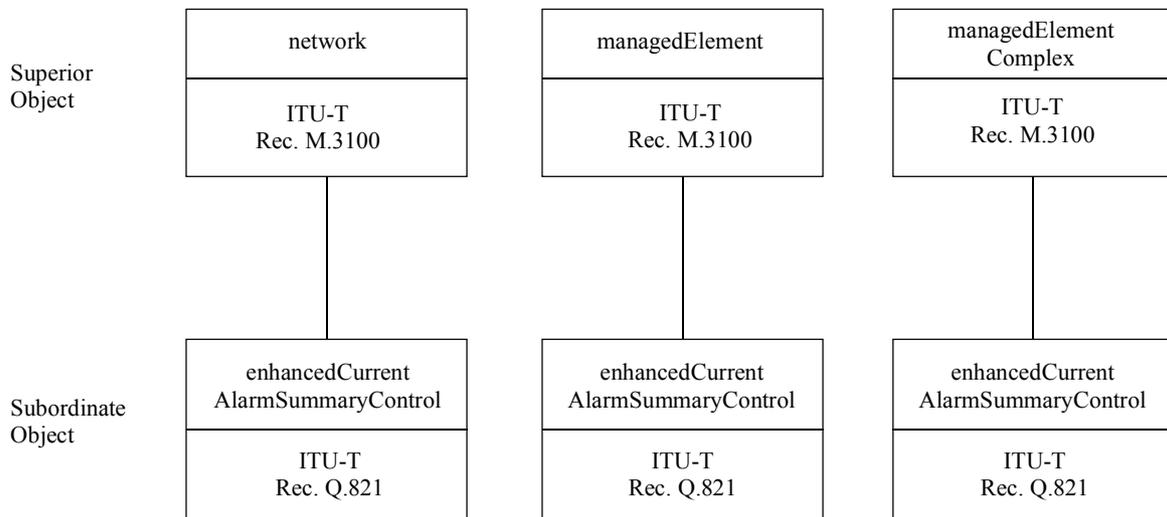
Figure 18/Q.821 – Naming Tree Hierarchy

Object Creation and Deletion Strategy

It is the agent's responsibility to create and delete Enhanced Current Alarm Summary Control managed object instances. These instances should only be created when the agent is providing the Alarm Synchronization service. Typically, Enhanced Current Alarm Summary Control managed object instances are created upon creation of a superior managed object instance. (As an example, if the enhancedCurrentAlarmSummaryControl-managedElement name binding is used, automatic creation would occur upon creation of a Managed Element managed object instance.)

There will typically be at most one Enhanced Current Alarm Summary Control managed object instance per immediate superior managed object instance. (As an example, if it is named relative to Managed Element and there are multiple Managed Element managed object instances, there will typically be one Enhanced Current Alarm Summary Control managed object per Managed Element

instance.) The Enhanced Current Alarm Summary Control objects may occur at different levels of the naming tree and have different types of superior objects.

6.2.4.2   enhancedCurrentAlarmSummaryControl-managedElement

The name binding of enhancedCurrentAlarmSummaryControl to managedElement is defined in A.4.

6.2.4.3   enhancedCurrentAlarmSummaryControl-managedElementComplex

The name binding of enhancedCurrentAlarmSummaryControl to managedElementComplex is defined in A.4.

6.2.4.4   enhancedCurrentAlarmSummaryControl-network

The name binding of enhancedCurrentAlarmSummaryControl to network is defined in A.4.

6.2.5   Attributes

This subclause describes the managed object class attributes used in Alarm Synchronization. See ITU-T Recommendation X.721 [9] for the attributes from the Top managed object class.

6.2.5.1   enhancedCurrentAlarmSummaryControlId

The Enhanced Current Alarm Summary Control Id attribute is used for naming the Enhanced Current Alarm Summary Control managed object instances. The definition for the enhancedCurrentAlarmSummaryControlId attribute is shown in A.3.

6.2.6   Actions

The Alarm Synchronization service supports two actions: Alarm Synchronization and Cancel Alarm Synchronization.

6.2.6.1   alarmSynchronization

The Alarm Synchronization action results in a download of the Current Alarm information maintained in the agent. The initiator of the request can also set selection criteria to reduce the amount of Current Alarm data returned. The download of Current Alarm information may be cancelled through a Cancel Alarm Synchronization action (if supported in this managed object instance). The definition for the alarmSynchronization action is shown in A.5.

Only Current Alarms issued from the Enhanced Current Alarm Summary Control managed object instance's immediate superior or from subordinate objects of the immediate superior may be returned. As an example, if the enhancedCurrentAlarmSummaryControl-managedElement name binding is used, then the Enhanced Current Alarm Summary Control managed object instance has a Managed Element managed object instance as its immediate superior. Only Current Alarms issued from this Managed Element managed object instance or from subordinate objects to this Managed Element managed object instance may be returned.

6.2.6.1.1   Information Syntax

The Alarm Synchronization action allows the following methods for providing the selection criteria to select which Current Alarms will be returned:

1)   All objects relative to superior – All Current Alarms issued from the Enhanced Current Alarm Summary Control managed object instance's immediate superior and its subordinate objects will be selected and returned.

2)   Filter and scoping – This selection uses a scoping and filtering mechanism similar to that used by CMIS, as defined in ITU-T Recommendation X.710 [6].

     The Base Managed Object is used as the base managed object instance for scoping. It must either consist of the Enhanced Current Alarm Summary Control managed object instance's

immediate superior or a subordinate managed object instance to the Enhanced Current Alarm Summary Control managed object instance's immediate superior.

As with CMIS, the Scope may be set to:

1) Base managed object;

2) First level only;

3) Whole sub-tree;

4) Individual levels (with a selected level); or

5) Base to nth level (0 to nth level selected).

Only Current Alarms issued from the selected managed object instances (via the Scope) will be furthered filtered.

The Criteria filter can be used to further restrict the Current Alarm selection criteria. One use of this filter is to set its value based on the Event Forwarding Discriminator's Discriminator Construct(s) [9] used by this manager. This would then result in the same selection criteria as used in event reporting [12]. Similar to Discriminator Construct, the following attributes may be specified in the filter as they apply toward Current Alarms [12]:

1) Managed Object Class.

2) Managed Object Instance.

3) Event Type.

4) Individual AlarmInfo attributes (Probable Cause, Specific Problems, Perceived Severity, Backed-Up Status, Back-Up Objects, Trend Indication, Threshold Information, Notification Identifier, Correlated Notifications, State Change Definition, Monitored Attributes, Proposed Repair Actions, Additional Text and Additional Information).

Only Current Alarms issued from the selected managed object instances (via the Scope) and matching the supplied filter (via the Criteria) will be returned.

1) Simple object list – All Current Alarms issued from managed object instances in this list will be selected and returned. Each supplied managed object instance must either contain the Enhanced Current Alarm Summary Control managed object instance's immediate superior or a subordinate managed object instance to the Enhanced Current Alarm Summary Control managed object instance's immediate superior.

Current Alarms will be selected by the methods above and returned when they have matched the supplied selection criteria. It may occur that no Current Alarms will match the supplied selection criteria.

Appendix III shows different examples of setting the selection criteria.

6.2.6.1.2   Reply Syntax

The Alarm Synchronization reply will return a sequence of Current Alarms (if any) that matches the supplied selection criteria. More than one Current Alarm may be returned per Enhanced Current Alarm Summary Control managed object instance. (According to ITU-T Recommendation X.710 [6], multiple replies to a single management operation may occur with an **M-ACTION** operation for a single managed object instance in which the action is defined to produce multiple results.) Each individual reply includes alarm information for one Current Alarm. When multiple Current Alarms are present in the same managed object instance, each alarm is sent in a separate linked response.

It is the agent's responsibility to retrieve its Current Alarms at one moment in time (i.e. a snap shot). Since events may occur at any time, the collection of Current Alarms may be changing at any time.

The individual parameters have the same semantics as described in ITU-T Recommendations X.733 [11] and X.734 [12]. The following parameters may be returned in the action reply:

1) Alarm Managed Object Class (from the alarm).

2) Alarm Managed Object Instance (from the alarm).

3) Event Time (optional).

4) Event Type.

5) Probable Cause.

6) Specific Problems (optional).

7) Perceived Severity.

8) Backed-Up Status (optional).

9) Back-Up Object (optional).

10) Trend Indication (optional).

11) Threshold Information (optional).

12) Notification Identifier (optional).

13) Correlated Notifications (optional).

14) State Change Definition (optional).

15) Monitored Attributes (optional).

16) Proposed Repair Actions (optional).

17) Additional Text (optional).

18) Additional Information (optional).

This ITU-T Recommendation recognizes that different agent systems will maintain different amounts of data on Current Alarm conditions. In addition, different agent systems may not maintain all of the information available in the original alarm. Therefore, this ITU-T Recommendation allows agents to optionally return less data than returned in the original alarm. As an example, if the Proposed Repair Actions parameter was not maintained by the agent for Current Alarms, then it would not be returned for Alarm Synchronization, even if it were supplied in the original alarm.

Each parameter that is returned must exactly match the original alarm parameter.

An error response of Cancelled Alarm Synchronization Parameter type (see 6.2.7.2) indicates that the Alarm Synchronization action has been cancelled by a Cancel Alarm Synchronization action request. After receipt of this parameter, no additional Current Alarms will be sent.

An error response of Invalid Base Managed Object Error Parameter type (see 6.2.7.4) indicates that the supplied Base Managed Object parameter was not valid or not recognized. This will end this action request.

An error response of Invalid Object Instance Error Parameter type (see 6.2.7.5) indicates that a supplied Object Instance in the Object List parameter was not valid. An Invalid Object Instance Error Parameter will be returned for each invalid Object Instance in the Object List. Note that this will not end this action request, Current Alarms matching valid Object Instances in the Object List may still be returned. Alarm Synchronization does not specify the return order between Current Alarms and Invalid Object Instance Error Parameter errors. As discussed in ITU-T Recommendation X.711 [7], individual action linked replies may contain an action result, a processing failure or an action error. In Alarm Synchronization, the Invalid Object Instance Error Parameter processing errors may be intermixed with Alarm Synchronization Data action results, action errors and other processing errors.

6.2.6.1.3   Alarm Synchronization Parameters

Parameters for the Alarm Synchronization action request are as shown in Table 12 (see ITU-T Recommendation X.710 [6] for a more complete description of each parameter):

Table 12/Q.821 – Alarm Synchronization M_ACTION Parameters

Parameter Name	Req/Ind	Rsp/Cnf	Notes
Invoke Identifier	M	M	
Linked Identifier	–	C	
Mode	M	–	
Base Object Class	M	–	
Base Object Instance	M	–	
Scope	O	–	
Filter	O	–	
Managed Object Class	–	C	
Managed Object Instance	–	C	
Access Control	O	–	
Synchronization	O	–	
Action Type	M	C(=)	
Alarm Synchronization Info	M	–	One choice must be supplied
All Objects Relative To Superior	C	–	
Scoped Criteria	C	–	
Base Managed Object	C	–	
Scope	C	–	
Criteria	C	–	
Simple object List	C	–	
Current Time	–	O	
Alarm Synchronization Data	–	C	
Alarm Managed Object Class	–	C	Mandatory, if reply issued
Alarm Managed Object Instance	–	C	Mandatory, if reply issued
Event Time	–	C	
Event Type	–	C	Mandatory, if reply issued
Probable Cause	–	C	Mandatory, if reply issued
Specific Problems	–	C	
Perceived Severity	–	C	Mandatory, if reply issued
Backed–Up Status	–	C	
Back–Up Object	–	C	
Trend Indication	–	C	
Threshold Information	–	C	
Notification Identifier	–	C	
Correlated Notifications	–	C	
State Change Definition	–	C	
Monitored Attributes	–	C	
Proposed Repair Actions	–	C	

Table 12/Q.821 – Alarm Synchronization M_ACTION Parameters *(concluded)*

Parameter Name	Req/Ind	Rsp/Cnf	Notes
Additional Text	–	C	
Additional Information	–	C	
Errors	–	C	Errors may occur either in the action request or in individual link replies

6.2.6.2 cancelAlarmSynchronization

The Cancel Alarm Synchronization action allows the termination of a single current Alarm Synchronization action request. When an Alarm Synchronization request is cancelled, a Cancelled Alarm Synchronization Parameter error response is sent in the Alarm Synchronization request. The definition for the cancelAlarmSynchronization action is shown in A.5.

6.2.6.2.1 Information Syntax

The Cancel Alarm Synchronization action must supply the Invoke Identifier of a current Alarm Synchronization action request to succeed.

An error response of No Such Invoke Id Error Parameter type (see 6.2.7.7, noSuchInvokeIdErrorParameter) indicates that the supplied Invoke Identifier does not match a pending Alarm Synchronization request. In this case, the Invoke Identifier is either invalid or the Alarm Synchronization request has already been completed.

6.2.6.2.2 Cancel Alarm Synchronization Parameters

Parameters for the Cancel Alarm Synchronization action request are shown in Table 13 (see ITU-T Recommendation X.710 [6] for a more complete description of each parameter):

Table 13/Q.821 – Cancel Alarm Synchronization Parameters

Parameter Name	Req/Ind	Rsp/Cnf	Notes
Invoke Identifier	M	M	
Linked Identifier	–	–	
Mode	M	–	
Base Object Class	M	–	
Base Object Instance	M	–	
Scope	O	–	
Filter	O	–	
Managed Object Class	–	O	
Managed Object Instance	–	O	
Access Control	O	–	
Synchronization	O	–	
Action Type	M	C(=)	
Cancel Alarm Synchronization	M	–	
Invoke Identifier	M	–	Must match Alarm Synchronization invoke identifier

Table 13/Q.821 – Cancel Alarm Synchronization Parameters *(concluded)*

Parameter Name	Req/Ind	Rsp/Cnf	Notes
Current Time	–	O	
Action Reply	–	–	
Errors	–	C	

6.2.7 Parameters

The following subclauses describe the Alarm Synchronization parameters. For additional information, see A.6.

6.2.7.1 Parameter Re-definition

Additional Information data may have been defined in the alarm using parameters of EVENT-INFO type [11]. If the agent is to return Additional Information data via Alarm Synchronization, each of these parameters must be redefined using the same ASN.1 definitions but using parameters of ACTION-REPLY type. This is needed because EVENT-INFO parameters cannot be used in action requests [13].

In Alarm Synchronization the syntax of the parameters correlatedRecordNameParameter (redefined correlatedRecordNameActionParameter) (see A.6.5), logRecordIdParameter (redefined logRecordIdActionParameter) (see A.6.8) and suspectObjectListParameter (redefined suspectObjectListActionParameter) (see A.6.10) are reused in new parameters as shown by the following example:

correlatedRecordNameParameter PARAMETER
     CONTEXT EVENT-INFO;
     WITH SYNTAX Q821-ASN1Module.CorrelatedRecordName;
     BEHAVIOUR correlatedRecordNameBeh BEHAVIOUR
     DEFINED AS
     "-- see 5.3.1.1 --";;
REGISTERED AS { q821Parameter 2 };

The parameter correlatedRecordNameActionParameter is defined as follows:

correlatedRecordNameActionParameter PARAMETER
     CONTEXT ACTION-REPLY;
     WITH SYNTAX Q821-ASN1Module.CorrelatedRecordName;
     BEHAVIOUR
          correlatedRecordNameBeh;
     REGISTERED AS { q821Parameter 5 };

The change between the two parameters is that an ACTION-REPLY context is used instead of an EVENT-INFO context. Of course, each parameter has a unique registration object identifier. Both parameters use exactly the same syntax.

6.2.7.2 cancelledAlarmSynchronizationParameter

The Cancelled Alarm Synchronization Parameter parameter is used to indicate that an Alarm Synchronization action has been cancelled by a Cancel Alarm Synchronization action request. This parameter can only be used when the managed object instance contains the Cancel Alarm Synchronization Package package and, therefore, the Cancel Alarm Synchronization action. The definition for the cancelledAlarmSynchronizationParameter parameter is shown in A.6.

6.2.7.3 correlatedRecordNameActionParameter

The Correlated Record Name Action Parameter parameter redefines Correlated Record Name Parameter parameter so it can be returned in the Alarm Synchronization action reply (see 6.2.7.1, Parameter Redefinition). The definition for the correlatedRecordNameActionParameter parameter is shown in A.6.

6.2.7.4 invalidBaseManagedObjectErrorParameter

The Invalid Base Managed Object Error Parameter parameter is used to indicate the Base Managed Object value supplied with the Alarm Synchronization action information is not valid. This may typically occur if the supplied Object Instance is invalid or it is not in the Enhanced Current Alarm Summary Control managed object instance immediate superior's naming tree. The definition for the invalidBaseManagedObjectErrorParameter parameter is shown in A.6.

6.2.7.5 invalidObjectInstanceErrorParameter

The Invalid Object Instance Error Parameter parameter is used to indicate an Object Instance in the Object List supplied with the Alarm Synchronization action information is not valid. This may typically occur if a supplied Object Instance is invalid or it is not in the Enhanced Current Alarm Summary Control managed object instance immediate superior's naming tree. More than one Invalid Object Instance Error Parameter parameter may be returned in a single Alarm Synchronization request. The definition for the invalidObjectInstanceErrorParameter parameter is shown in A.6.

6.2.7.6 logRecordIdActionParameter

The Log Record Id Action Parameter parameter redefines Log Record Id Parameter parameter so it can be returned in the Alarm Synchronization action reply (see 6.2.7.1, Parameter Redefinition). The definition for the logRecordIdActionParameter parameter is shown in A.6.

6.2.7.7 noSuchInvokeIdErrorParameter

The No Such Invoke Id Error Parameter parameter is used to indicate the Invoke Id value supplied with the Cancel Alarm Synchronization action information is not valid. This may typically occur if an Invoke Id is supplied that does not match pending Alarm Synchronization action requests or if the Alarm Synchronization action has already been completed. The definition for the noSuchInvokeIdErrorParameter parameter is shown in A.6.

6.2.7.8 suspectObjectListActionParameter

The Suspect Object List Action Parameter parameter redefines Suspect Object List Parameter parameter so it can be returned in the Alarm Synchronization action reply (see 6.2.7.1, Parameter Redefinition). The definition for the suspectObjectListActionParameter parameter is shown in A.6.

6.2.8 Notifications

The following subclauses describe the Alarm Synchronization event notifications. For additional information, see A.5.

6.2.8.1 Object Creation/Object Deletion

The Object Creation and Object Deletion event notifications, defined in ITU-T Recommendation X.721 [9], are generated on the creation and deletion of each Enhanced Current Alarm Summary Control managed object instance. The Object Creation and Deletion Strategy is described in 6.2.4.1.

6.3   Alarm Synchronizaton Functional Units

Two functional units are defined for the management of the Alarm Synchronization function:

1)   Alarm Synchronization functional unit − This functional unit supports only the Alarm Synchronization service.

2)   Cancel Alarm Synchronization functional unit − This functional unit supports both the Alarm Synchronization and Cancel Alarm Synchronization services.

7   Relationship with other ITU-T Recommendations

This ITU-T Recommendation uses the service defined in [17] for the notification of state changes, the services defined in [16] for the creation and deletion of managed objects, the retrieval of attributes, and the notification of object creation, object deletion, and attribute value changes. Control of the reporting and logging services defined in this ITU-T Recommendation is provided by mechanisms specified in [12] and [15].

7.1   Relationship with ITU-T Recommendation M.3100

ITU-T Recommendation M.3100 [18] defines the Current Problem List attribute. It also defines a number of managed object classes that include or optionally include the Current Problem List attribute. The Current Problem List attribute contains a set of Probable Cause and Alarm Status values. This attribute may not be included in all managed object instances that can emit alarms. It also does not include sufficient data for Alarm Synchronization.

7.2   Relationship with ITU-T Recommendation X.733

ITU-T Recommendation X.733 [11] defines the Alarm Reporting service. This includes the definition of what constitutes an alarm and how it is transmitted from the agent to the manager.

Alarm Synchronization totally depends on the Alarm Reporting service. It uses the alarm parameter definitions provided in ITU-T Recommendation X.733. In particular, Alarm Synchronization uses the Alarm Reporting definition for alarm clearing (see also Appendix I).

The Alarm Reporting and Alarm Synchronization services may occur simultaneously. Alarms may arrive while an Alarm Synchronization action request is progressing. Issues due to the intermixing of Alarm Reporting and Alarm Synchronization data are discussed in Appendix II.

7.3   Relationship with ITU-T Recommendation X.734

ITU-T Recommendation X.734 [12] defines the mechanisms for transmitting notifications from the agent to the manager.

Alarm Synchronization uses these definitions to define the term Current Alarm. Current Alarms are created as new alarms are produced and deleted as alarms are cleared. This is shown in Figure 19. See Appendix I for details on alarm clearing.
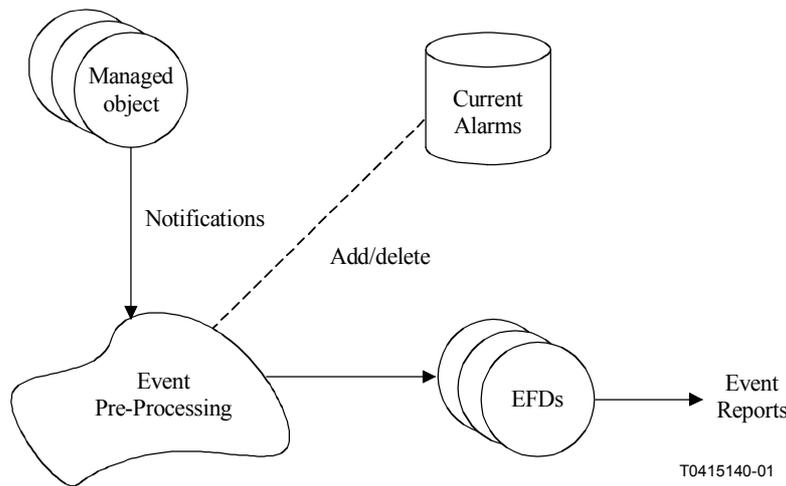
Figure 19/Q.821 – Current Alarm Creation And Deletion Model

Alarm Synchronization does not specify the order between the creation and deletion of Current Alarms, the distribution of alarms as notifications and the creation of alarm records. Current alarms may include alarms not reported to all managers, due to EFD settings.

Subclause 6.1.3, Itemized Requirements, includes a reference to ITU-T Recommendation X.734 [12].

7.4 Relationship with ITU-T Recommendation X.735

ITU-T Recommendation X.735 [15] defines the mechanisms for maintaining notification logs, potentially including logs of alarms in alarm records. Alarm Synchronization did not choose to use alarm records as the basis of its support for the following reasons:

1) Logs may be disabled or have scheduled unavailability.

2) Logs may become full and either wrap or halt.

3) Logs may be managed by managers. Alarm records may be deleted from a log by a manager while they are still current. It is the responsibility of the agent to manage its collection of Current Alarms.

4) Logs may filter the alarm records based on a Discriminator Construct.

5) Logs contain historical information. If Log Records are used, analysis is required to determine which alarms are still current and which have been cleared.

8 Conformance

There are two conformance classes: general conformance class and dependent conformance class. A system claiming to implement the elements of procedure for the services referenced by this ITU-T Recommendation 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.

8.1 General conformance class requirement

A system claiming general conformance shall support this Stage 2 and Stage 3 Description for all managed object classes that import the management information defined in this ITU-T Recommendation.

NOTE – This is applicable to all subclasses of the support object classes defined in this ITU-T Recommendation.

8.1.1 Static conformance

The system shall:

a) support the role of manager or agent or both, with respect to the kernel and one or more of the functional units defined in 5.3;

b) support the transfer syntax derived from the encoding rules specified in [21] and named {joint-iso-ccitt asn1(1) basicEncoding(1)}, for the purpose of generating and interpreting the MAPDUs, defined by the abstract data types referenced in 5.4.2.2, 5.4.2.3, 5.4.2.4 and 5.4.2.5;

c) when acting in the agent role, support one or more instances of the following managed object classes if such object classes are required by the supported functional units:

   – alarmRecord

   – alarmSeverityAssignmentProfile

   – currentAlarmSummaryControl

   – eventForwardingDiscriminator

   – log

   – managementOperationsSchedule

   – support the Enhanced Alarm Summary Control object

   – support the creation of at least one managed object of the Enhanced Current Alarm Summary Control managed object class.

8.1.2 Dynamic conformance

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

a) support the elements of procedure defined in:

   [16] for the PT-GET, PT-CREATE, PT-DELETE, PT-SET, Object creation reporting, Object deletion reporting and Attribute value change reporting services;

   [17] for the State change reporting service;

   [11] for the Alarm reporting service.

8.2 Dependent conformance class requirement

8.2.1 Static conformance

The system shall:

a) supply a system conformance statement which identifies the standardized use of this Stage 2 and Stage 3 Description;

b) support the transfer syntax derived from the encoding rules specified in [21] and named {joint-iso-ccitt asn1(1) basicEncoding(1)}, for the purpose of generating and interpreting the MAPDUs, defined by the abstract data types referenced in 5.4.2.2, 5.4.2.3, 5.4.2.4 and 5.4.2.5, as required by a standardized use of this Stage 2 and Stage 3 Description;

c) support one or more instances of the relevant managed object classes required by supported functional units when acting in the agent role.

8.2.2 Dynamic conformance

The system shall support the elements of procedure referenced by this ITU-T Recommendation as required by a standardized use of this Stage 2 and Stage 3 Description.

8.2.3 Conformance to support managed object definition

The Current Alarm Summary Control and Management Operations Schedule object classes supported by the open system shall comply with the behaviour specified in 5.2 and the syntax specified in Annex A.

The Log, Log Record, Event Log Record, Discriminator, Event forwarding Discriminator, and Alarm Record object classes supported by the open system shall comply with the behaviour and the syntax specified in [9].

The Managed Element object class and the Alarm Severity Assignment Profile or their subclasses supported by the open system shall comply with the behaviour and the syntax specified in [18] or the defining specification.

The Enhanced Current Alarm Summary Control managed object classes supported by the open system shall comply with the behaviour specified in clause 6 and the syntax specified in Annex A.

ANNEX A

Alarm surveillance definition of management information

A.1   Generic Object Classes

A.1.1   Current Alarm Summary Control

The semantics of this managed object class are described in 5.2.2.1.

currentAlarmSummaryControl MANAGED OBJECT CLASS
 DERIVED FROM "Recommendation X.721:1992":top;
 CHARACTERIZED BY currentAlarmSummaryControlPkg PACKAGE
 BEHAVIOUR currentAlarmSummaryControlBeh BEHAVIOUR
 DEFINED AS
 "-- *see 5.2.2.1 --*";;
 ATTRIBUTES
 currentAlarmSummaryControlId
 GET,
 alarmStatusList
 GET-REPLACE
 ADD-REMOVE,
 objectList
 GET-REPLACE
 ADD-REMOVE,
 perceivedSeverityList
 GET-REPLACE
 ADD-REMOVE,
 probableCauseList
 GET-REPLACE
 ADD-REMOVE;
 ACTIONS
 retrieveCurrentAlarmSummary;
 NOTIFICATIONS
 currentAlarmSummaryReport;;;

REGISTERED AS { q821ObjectClass 1 };

A.1.2   Management Operations Schedule

The semantics of this managed object class are described in 5.2.2.2.

managementOperationsSchedule MANAGED OBJECT CLASS
 DERIVED FROM "Recommendation X.721:1992":top;

CHARACTERIZED BY managementOperationsSchedulePkg PACKAGE
BEHAVIOUR managementOperationsScheduleBeh BEHAVIOUR
DEFINED AS
"-- *see 5.2.2.2* --";;
ATTRIBUTES
"Recommendation X.721:1992":administrativeState
GET-REPLACE,
affectedObjectClass
GET-REPLACE,
affectedObjectInstances
GET-REPLACE,
beginTime
GET-REPLACE,
-- *first activation at begin time, if*
-- *present, or else when schedule is created*
destinationAddress
GET,
-- *As this attribute is 'GET' only, the way to set the Q.821 destinationAddress is to*
-- *re-create an instance of managementOperationsSchedule with the new*
-- *destinationAddress(es).*
endTime
DEFAULT VALUE Q821-ASN1Module.
managementOperationsScheduleEndTimeDefault
GET-REPLACE,
interval
GET-REPLACE,
scheduIeId
GET ;;;
CONDITIONAL PACKAGES
managementOperationsScheduleOperationalStatePkg PACKAGE
ATTRIBUTES
"Recommendation X.721:1992":operationalState
GET;
REGISTERED AS { q821Package 1 };
PRESENT IF "an instance supports it.";

REGISTERED AS { q821ObjectClass 2 };

A.1.3   Enhanced Current Alarm Summary Control

enhancedCurrentAlarmSummaryControl MANAGED OBJECT CLASS
DERIVED FROM "Recommendation X.721":top;
CHARACTERIZED BY
"Recommendation M.3100":createDeleteNotificationsPackage,
enhancedCurrentAlarmSummaryControlPkg PACKAGE
BEHAVIOUR
enhancedCurrentAlarmSummaryControlBeh BEHAVIOUR
DEFINED AS
"-- *see 6.2.2.1, enhancedCurrentAlarmSummaryControl on model* --";;
ATTRIBUTES
enhancedCurrentAlarmSummaryControlId GET SET-BY-CREATE;
ACTIONS
alarmSynchronization
logRecordIdActionParameter
correlatedRecordNameActionParameter
invalidBaseManagedObjectErrorParameter
invalidObjectInstanceErrorParameter
suspectObjectListActionParameter
cancelledAlarmSynchronizationParameter;;;
CONDITIONAL PACKAGES
cancelAlarmSynchronizationPackage PRESENT IF "supported by the agent";

REGISTERED AS { q821ObjectClass 3 };

A.2 Package Definitions

A.2.1 Cancel Alarm Synchronization Package

```
cancelAlarmSynchronizationPackage PACKAGE
    BEHAVIOUR
    cancelAlarmSynchronizationPackageBeh BEHAVIOUR
    DEFINED AS
    "-- see 6.2.2.1, enhancedCurrentAlarmSummaryControl on model --";;
    ACTIONS
    cancelAlarmSynchronization noSuchInvokeIdErrorParameter;
```

REGISTERED AS { q821Package 1 };

A.3 Attributes

A.3.1 Affected Object Class

The semantics of this attribute are described in 5.2.2.2 b).

```
affectedObjectClass ATTRIBUTE
    WITH ATTRIBUTE SYNTAX Q821-ASN1Module.AffectedObjectClass;
    MATCHES FOR EQUALITY;
    BEHAVIOUR affectedObjectClassBeh BEHAVIOUR
    DEFINED AS
    "-- see 5.2.2.2 b) --";;
```

REGISTERED AS { q821Attribute 1 };

A.3.2 Affected Object Instances

The semantics of this attribute are described in 5.2.2.2 c).

```
affectedObjectInstances ATTRIBUTE
    WITH ATTRIBUTE SYNTAX Q821-ASN1Module.ObjectList;
    MATCHES FOR EQUALITY;
    BEHAVIOUR affectedObjectInstancesBeh BEHAVIOUR
    DEFINED AS
    "-- see 5.2.2.2 c) --";;
```

REGISTERED AS { q821Attribute 2 };

A.3.3 Alarm Status List

The semantics of this attribute are described in 5.2.2.1 b).

```
alarmStatusList ATTRIBUTE
    WITH ATTRIBUTE SYNTAX Q821-ASN1Module.AlarmStatusList;
    MATCHES FOR EQUALITY;
    BEHAVIOUR alarmStatusListBeh BEHAVIOUR
    DEFINED AS
    "-- see 5.2.2.1 b) --";;
```

REGISTERED AS { q821Attribute 3 };

A.3.4 Begin Time

The semantics of this attribute are described in 5.2.2.2 d).

```
beginTime ATTRIBUTE
    WITH ATTRIBUTE SYNTAX Q821-ASN1Module.StartTime;
    MATCHES FOR EQUALITY;
    BEHAVIOUR beginTimeBeh BEHAVIOUR
```

DEFINED AS
"*-- see 5.2.2.2 d) --*";;

REGISTERED AS { q821Attribute 4 };

A.3.5   Current Alarm Summary Control Id

The semantics of this attribute are described in 5.2.2.1 a).

currentAlarmSummaryControlId ATTRIBUTE
     WITH ATTRIBUTE SYNTAX Q821-ASN1Module.NameType;
     MATCHES FOR EQUALITY;
     BEHAVIOUR currentAlarmSummaryControlIdBeh BEHAVIOUR
     DEFINED AS
     "*-- see 5.2.2.1 a) --*";;

REGISTERED AS { q821Attribute 5 };

A.3.6   Control

The semantics of this attribute are described in 5.2.2.2 e).

destinationAddress ATTRIBUTE
     WITH ATTRIBUTE SYNTAX Q821-ASN1Module.DestinationAddress;
     MATCHES FOR EQUALITY;
     BEHAVIOUR destinationAddressBeh BEHAVIOUR
     DEFINED AS
     "*-- see 5.2.2.2 e) --*";;

REGISTERED AS { q821Attribute 6 };

A.3.7   End Time

The semantics of this attribute are described in 5.2.2.2 f).

endTime ATTRIBUTE
     WITH ATTRIBUTE SYNTAX Q821-ASN1Module.StopTime;
     MATCHES FOR EQUALITY;
     BEHAVIOUR endTimeBeh BEHAVIOUR
     DEFINED AS
     "*-- see 5.2.2.2 f) --*";;

REGISTERED AS { q821Attribute 7 };

A.3.8   Interval

The semantics of this attribute are described in 5.2.2.2 g).

interval ATTRIBUTE
     WITH ATTRIBUTE SYNTAX Q821-ASN1Module.Interval;
     MATCHES FOR EQUALITY;
     BEHAVIOUR intervalBeh BEHAVIOUR
     DEFINED AS
     "*-- see 5.2.2.2 g) --*";;

REGISTERED AS { q821Attribute 8 };

A.3.9   Object List

The semantics of this attribute are described in 5.2.2.1 c).

objectList ATTRIBUTE
     WITH ATTRIBUTE SYNTAX Q821-ASN1Module.ObjectList;
     MATCHES FOR EQUALITY;

BEHAVIOUR objectListBeh BEHAVIOUR
DEFINED AS
"-- *see 5.2.2.1 c)* --";;

REGISTERED AS { q821Attribute 9 };

A.3.10 Perceived Severity

The semantics of this attribute are described in 5.2.2.1 d).

perceivedSeverityList ATTRIBUTE
WITH ATTRIBUTE SYNTAX Q821-ASN1Module.PerceivedSeverityList;
MATCHES FOR EQUALITY;
BEHAVIOUR perceivedSeverityListBeh BEHAVIOUR
DEFINED AS
"-- *see 5.2.2.1 d)* --";;

REGISTERED AS { q821Attribute 10 };

A.3.11 Probable Cause List

The semantics of this attribute are described in 5.2.2.1 e).

probableCauseList ATTRIBUTE
WITH ATTRIBUTE SYNTAX Q821-ASN1Module.ProbableCauseList;
MATCHES FOR EQUALITY;
BEHAVIOUR probableCauseListBeh BEHAVIOUR
DEFINED AS
"-- *see 5.2.2.1 e)* --";;

REGISTERED AS { q821Attribute 11 };

A.3.12 Schedule Id

The semantics of this attribute are described in 5.2.2.2 i).

scheduleId ATTRIBUTE
WITH ATTRIBUTE SYNTAX Q821-ASN1Module.NameType;
MATCHES FOR EQUALITY;
BEHAVIOUR scheduleIdBeh BEHAVIOUR
DEFINED AS
"-- *see 5.2.2.2 i)* --";;

REGISTERED AS { q821Attribute 12 };

A.3.13 Enhanced Current Alarm Summary Control ID

enhancedCurrentAlarmSummaryControlId ATTRIBUTE
WITH ATTRIBUTE SYNTAX Q821-ASN1Module.NameType;
MATCHES FOR EQUALITY, ORDERING, SUBSTRINGS;
BEHAVIOUR
"Recommendation X.721": rDNIdBehaviour,
enhancedCurrentAlarmSummaryControlIdBeh BEHAVIOUR
DEFINED AS
"-- *see 6.2.5.1, enhancedCurrentAlarmSummaryControlId on model* --";;

REGISTERED AS { q821Attribute 13 };

A.4   Name Bindings

A.4.1   Current Alarm Summary Control – Managed Element

currAlarmSumControl-managedElement NAME BINDING
SUBORDINATE OBJECT CLASS currentAlarmSummaryControl AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS "ITU-T Rec. M.3100:1995":
managedElement AND SUBCLASSES;
WITH ATTRIBUTE currentAlarmSummaryControlId;
CREATE;
DELETE
DELETES-CONTAINED-OBJECTS;

REGISTERED AS { q821NameBinding 1 };

A.4.2   Management Operations Schedule – Managed Element

managementOperationsSchedule-managedElement NAME BINDING
SUBORDINATE OBJECT CLASS managementOperationsSchedule AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS " ITU-T Rec. M.3100:1995":
managedElement AND SUBCLASSES;
WITH ATTRIBUTE scheduleId;
CREATE;
DELETE
DELETES-CONTAINED-OBJECTS;

REGISTERED AS { q821NameBinding 2 };

A.4.3   Enhanced Current Alarm Summary Control-Managed Element

enhancedCurrentAlarmSummaryControl-managedElement NAME BINDING
SUBORDINATE OBJECT CLASS enhancedCurrentAlarmSummaryControl
AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS "Recommendation M.3100":managedElement
AND SUBCLASSES;
WITH ATTRIBUTE enhancedCurrentAlarmSummaryControlId;
BEHAVIOUR
enhancedCurrentAlarmSummaryControl-managedElementBeh BEHAVIOUR
DEFINED AS
"-- *see 6.2.4, Name Binding Strategies on model* --";;

REGISTERED AS { q821NameBinding 3 };

A.4.4   Enhanced Current Alarm Summary Control-Managed Element Complex

enhancedCurrentAlarmSummaryControl-managedElementComplex NAME BINDING
SUBORDINATE OBJECT CLASS enhancedCurrentAlarmSummaryControl
AND SUBCLASSES;
NAMED BY SUPERIOR OBJECT CLASS
"Recommendation M.3100":managedElementComplex AND SUBCLASSES;
WITH ATTRIBUTE enhancedCurrentAlarmSummaryControlId;
BEHAVIOUR
enhancedCurrentAlarmSummaryControl-managedElementComplexBeh BEHAVIOUR
DEFINED AS
"-- *see 6.2.4, Name Binding Strategies on model* --";;

REGISTERED AS { q821NameBinding 4 };

A.4.5   Enhanced Current Alarm Summary Control-Network

enhancedCurrentAlarmSummaryControl-network NAME BINDING
SUBORDINATE OBJECT CLASS enhancedCurrentAlarmSummaryControl
AND SUBCLASSES;

NAMED BY SUPERIOR OBJECT CLASS "Recommendation M.3100":network
AND SUBCLASSES;
WITH ATTRIBUTE enhancedCurrentAlarmSummaryControlId;
BEHAVIOUR
enhancedCurrentAlarmSummaryControl-networkBeh BEHAVIOUR
DEFINED AS
"-- *see 6.2.4, Name Binding Strategies on model* --";;

REGISTERED AS { q821NameBinding 5 };

A.5   Notifications and Actions

A.5.1   Current Alarm Summary Report

The semantics of this notification are described in 5.3.6.1.

currentAlarmSummaryReport NOTIFICATION
BEHAVIOUR currentAlarmSummaryReportBeh BEHAVIOUR
DEFINED AS
"-- *see 5.3.6.1* --";;
WITH INFORMATION SYNTAX Q821-ASN1Module.AlarmSummaryData;

REGISTERED AS { q821Notification 1 };

A.5.2   Retrieve Current Alarm Summary

The semantics of this action are described in 5.3.10.1.

retrieveCurrentAlarmSummary ACTION
BEHAVIOUR retrieveCurrentAlarmSummaryBeh BEHAVIOUR
DEFINED AS
"-- *see 5.3.10.1* --";;
MODE CONFIRMED;
WITH INFORMATION SYNTAX Q821-ASN1Module.SummaryContents;
WITH REPLY SYNTAX Q821-ASN1Module.AlarmSummaryData;

REGISTERED AS { q821Action 1 };

A.5.3   Reset Audible Alarm

The semantics of this action are described in 5.3.12.3.

resetAudibleAlarm ACTION
BEHAVIOUR resetAudibleAlarmBeh BEHAVIOUR
DEFINED AS
"-- *see 5.3.12.3* --";;

REGISTERED AS { q821Action 2 };

A.5.4   Alarm Synchronization

alarmSynchronization ACTION
BEHAVIOUR
alarmSynchronizationBeh BEHAVIOUR
DEFINED AS
"-- *see 6.2.6.1, alarmSynchronization on model* --";;
MODE CONFIRMED;
WITH INFORMATION SYNTAX Q821-ASN1Module.AlarmSynchronizationInfo;
WITH REPLY SYNTAX Q821-ASN1Module. AlarmSynchronizationData;

REGISTERED AS { q821Action 3 };

A.5.5   cancelAlarmSynchronization

cancelAlarmSynchronization ACTION
    BEHAVIOUR
    cancelAlarmSynchronizationBeh BEHAVIOUR
    DEFINED AS
    "-- *see 6.2.6.2, cancelAlarmSynchronization on model* --**";;**
    MODE CONFIRMED;
    WITH INFORMATION SYNTAX Q821-ASN1Module.CancelAlarmSynchronization;

REGISTERED AS { q821Action 4 };

A.6   Parameters

A.6.1   Log Record Id Parameter

The semantics of this parameter are described in 5.3.1.1.

logRecordIdParameter   PARAMETER
    CONTEXT EVENT-INFO;
    WITH SYNTAX Q821-ASN1Module.LogRecordId;
    BEHAVIOUR logRecordIdBeh BEHAVIOUR
    DEFINED AS
    "-- *see 5.3.1.1* --**";;**

REGISTERED AS { q821Parameter 1 };

A.6.2   Correlated Record Name Parameter

The semantics of this parameter are described in 5.3.1.1.

correlatedRecordNameParameter   PARAMETER
    CONTEXT EVENT-INFO;
    WITH SYNTAX Q821-ASN1Module.CorrelatedRecordName;
    BEHAVIOUR correlatedRecordNameBeh BEHAVIOUR
    DEFINED AS
    "-- *see 5.3.1.1* --**";;**

REGISTERED AS { q821Parameter 2 };

A.6.3   Suspect Object List Parameter

The semantics of this parameter are described in 5.3.1.1.

suspectObjectListParameter   PARAMETER
    CONTEXT EVENT-INFO;
    WITH SYNTAX Q821-ASN1Module.SuspectObjectList;
    BEHAVIOUR suspectObjectListBeh BEHAVIOUR
    DEFINED AS
    "-- *see 5.3.1.1* --**";;**

REGISTERED AS { q821Parameter 3 };

A.6.4   Cancelled Alarm Synchronization Parameter

canceledAlarmSynchronizationParameter PARAMETER
    CONTEXT SPECIFIC-ERROR;
    WITH SYNTAX Q821-ASN1Module.CancelledAlarmSynchronization;
    BEHAVIOUR
    cancelledAlarmSynchronizationBeh BEHAVIOUR
    DEFINED AS
    "-- *see 6.2.7.2, cancelledAlarmSynchronizationParameter on model* --**";;**

REGISTERED AS { q821Parameter 4 };

A.6.5 Correlated Record Name Action Parameter

correlatedRecordNameActionParameter PARAMETER
    CONTEXT ACTION-REPLY;
    WITH SYNTAX Q821-ASN1Module.CorrelatedRecordName;
    BEHAVIOUR
    correlatedRecordNameBeh;

REGISTERED AS { q821Parameter 5 };

A.6.6 Invalid Base Managed Object Error Parameter

invalidBaseManagedObjectErrorParameter PARAMETER
    CONTEXT SPECIFIC-ERROR;
    WITH SYNTAX Q821-ASN1Module.InvalidBaseManagedObjectError;
    BEHAVIOUR
    invalidBaseManagedObjectErrorBeh BEHAVIOUR
    DEFINED AS
    "-- *see 6.2.7.4, invalidBaseManagedObjectErrorParameter on model* --**";;**

REGISTERED AS { q821Parameter 6 };

A.6.7 Invalid Object Instance Error Parameter

invalidObjectInstanceErrorParameter PARAMETER
    CONTEXT SPECIFIC-ERROR;
    WITH SYNTAX Q821-ASN1Module.InvalidObjectInstanceError;
    BEHAVIOUR
    invalidObjectInstanceErrorBeh BEHAVIOUR
    DEFINED AS
    "-- *see 6.2.7.5, invalidObjectInstanceErrorParameter on model* --**";;**

REGISTERED AS { q821Parameter 7 };

A.6.8 Log Record Id Action Parameter

logRecordIdActionParameter PARAMETER
    CONTEXT ACTION-REPLY;
    WITH SYNTAX Q821-ASN1Module.LogRecordId;
    BEHAVIOUR
    logRecordIdBeh;

REGISTERED AS { q821Parameter 8 };

A.6.9 No Such Invoke Id Error Parameter

noSuchInvokeIdErrorParameter PARAMETER
    CONTEXT SPECIFIC-ERROR;
    WITH SYNTAX Q821-ASN1Module.NoSuchInvokeIdError;
    BEHAVIOUR
    noSuchInvokeIdErrorBeh BEHAVIOUR
    DEFINED AS
    "-- *see 6.2.7.7, noSuchInvokeIdErrorParameter on model* --**";;**

REGISTERED AS { q821Parameter 9 };

A.6.10 Suspect Object List Action Parameter

suspectObjectListActionParameter PARAMETER
    CONTEXT ACTION-REPLY;
    WITH SYNTAX Q821-ASN1Module.SuspectObjectList;
    BEHAVIOUR
    suspectObjectListBeh;

REGISTERED AS { q821Parameter 10 };

A.7 Abstract Syntax Definitions

Extensibility rules

In accordance with ITU-T Recommendation X.680 (Amendment 1) [23] on extensibility rules, the productions that are extensible types are indicated by including the symbols enclosed in parentheses in their type descriptions, "...".

The following types will be indicated as being extensible:

1)   ENUMERATED;

2)   named INTEGER;

3)   named BIT STRING;

4)   SET;

5)   SEQUENCE;

6)   CHOICE.

Under the rules of extensibility new enumerations (for ENUMERATED types), new bit name assignments (for named BIT STRING types), new named numbers (for named INTEGER types) and new elements (for SET, SEQUENCE and CHOICE types) may be added in future versions of this ITU-T Recommendation.

When processing information in a System Management Application Protocol (SMAP) PDU, the accepting SMAP-machine shall issue RORJapdu (corresponding to the service RO-REJECT-U) with "mistypedResult" parameter for the following conditions:

1)   Enumerations not recognized;

2)   Unrecognized named numbers;

3)   Unrecognized named bits;

4)   Unrecognized tagged elements of sets, sequences and choices.

This subclause specifies the ASN.1 syntax for the supporting productions identified in A.1 through A.6.

Q821-ASN1Module

{ ccitt(0) recommendation(0) q(17) q821(821) asn1Module(2) q821ASN1Module(0) }

DEFINITIONS ::= BEGIN
 -- EXPORTS everything

IMPORTS
BackedUpStatus, CorrelatedNotifications, ObservedValue,
PerceivedSeverity, ProbableCause, StartTime,
StopTime, TrendIndication, ThresholdInfo
FROM
Attribute-ASN1Module { joint-iso-ccitt ms(9) smi(3) part2(2) asn1Module(2) 1 }

AlarmInfo
FROM
Notification-ASN1Module { joint-iso-ccitt ms(9) smi(3) part2(2) asn1Module(2) 2 }

AlarmStatus, NameType
FROM
ASN1DefinedTypeModule
{ ccitt(0) recommendation(0) m(13) gnm(3100) informationModel(0) asn1Modules(2)
asn1DefinedTypesModule(0) }

Attribute, AttributeId, ObjectInstance
FROM
CMIP-1 { joint-iso-ccitt ms(9) cmip(1) modules(0) protocol(3) }

AE-title
FROM
ACSE-1 { joint-iso-ccitt association-control(2) apdus(0) version(1) }
-- Note that the syntax of AE-title to be used is from ITU-T Rec. X.227|ISO/IEC 8650-1 and not "ANY"

DistinguishedName
FROM
InformationFramework { joint-iso-ccitt ds(5) modules(1) informationFramework(1) }

EventTime
FROM Attribute-ASN1Module
{ joint-iso-ccitt ms(9) smi(3) part2(2) asn1Module(2) 1 }

ObjectClass, ObjectInstance, EventTypeId, InvokeIDType, Scope, CMISFilter
FROM CMIP-1
{ joint-iso-ccitt ms(9) cmip(1) modules(0) protocol(3) }
;

q821InformationModel OBJECT IDENTIFIER ::= { ccitt(0) recommendation(0)
q(17) q821(821) informationMode(0) }

q821StandardSpecificExtension OBJECT IDENTIFIER ::= { q821InformationModel
standardSpecificExtension(0) }

q821ObjectClass OBJECT IDENTIFIER ::= { q821InformationModel
managedObjectClass(3) }

q821Package OBJECT IDENTIFIER ::= { q821InformationModel package(4) }

q821Parameter OBJECT IDENTIFIER ::= { q821InformationModel parameter(5) }

q821NameBinding OBJECT IDENTIFIER ::= { q821InformationModel namebinding(6) }

q821Attribute OBJECT IDENTIFIER ::= { q821InformationModel attribute(7) }

q821AttributeGroup OBJECT IDENTIFIER ::= { q821InformationModel attributeGroup(8) }

q821Action OBJECT IDENTIFIER ::= { q821InformationModel action(9) }

q821Notification OBJECT IDENTIFIER ::= { q821InformationModel notification(10) }

managementOperationsScheduleEndTimeDefault StopTime ::= continual : NULL

AffectedObjectClass ::= OBJECT IDENTIFIER
AlarmStatusList ::= SET OF AlarmStatus

AlarmSummaryData ::= SEQUENCE OF ObjectAlarmSummary

AlarmSynchronizationData ::= SEQUENCE {
alarmManagedObjectClass   ObjectClass,
alarmManagedObjectInstance   ObjectInstance,
eventTime   EventTime   OPTIONAL,
eventType   EventTypeId,
alarmInfo   COMPONENTS OF AlarmInfo
}

AlarmSynchronizationInfo ::= CHOICE {
allObjectsRelativeToSuperior   [0] NULL,
scopedCriteria   [1] ScopedCriteria,
simpleObjectList   2] ObjectList
}

AlarmSummaryInfo ::= SEQUENCE { perceivedSeverity [0] PerceivedSeverity OPTIONAL,
**   alarmStatus [1] AlarmStatus OPTIONAL,**
**   probableCause [2] ProbableCause OPTIONAL }**

CancelAlarmSynchronization ::= CancelledAlarmSynchronization

CancelledAlarmSynchronization ::= InvokeIDType
-- *error response to action for Alarm Synchronization if cancelled prior to completion*

CorrelatedRecordName ::= ObjectInstance

CountInterval ::= SEQUENCE {
**   count   INTEGER,**
**   startTime   GeneralizedTime,**
**   window   TimeInterval }**

CountWindow ::= SEQUENCE {
**   count   INTEGER,**
**   window   TimeInterval }**

DestinationAddress ::= CHOICE { singleAddress AE-title,
**   groupAddress GraphicString }**

GaugeParameters ::= CHOICE {
**   up   [1] SEQUENCE { high ObservedValue, low ObservedValue },**
**   down [2] SEQUENCE { high ObservedValue, low ObservedValue }}**

LogRecordId ::= NumericName

Interval ::= CHOICE { days [0] INTEGER,
**   hours   [1] INTEGER,**
**   minutes   [2] INTEGER,**
**   seconds   [3] INTEGER }**

InvalidBaseManagedObjectError ::= ObjectInstance
-- *error response for an invalid Base Managed Object parameter*

InvalidObjectInstanceError ::= ObjectInstance
-- *error response for an invalid Object List Object Instance parameter*

NoSuchInvokeIdError ::= InvokeIDType
-- *error response to Cancel Alarm Synchronization request*

NotificationId ::= INTEGER

NumericName ::= INTEGER

ObjectAlarmSummary ::= SEQUENCE{ objectOfReference ObjectOfReference,
**   summaryInfo SEQUENCE OF AlarmSummaryInfo }**

ObjectList ::= SET OF ObjectListChoice

ObjectListChoice ::= CHOICE { singleObject [1] ObjectInstance,
**   rangeOfObjects [2] RangeOfObjects }**

-- *The rangeOfObjects may be used to specify a group*
-- *of objects which are named in a contiguous manner*

-- *without having to specify each instance explicitly.*
-- *This mechanism may only be used to specify object*
-- *instances which use INTEGER as the final RDN of their DN.*
-- *To use this mechanism, the DN of the superior object and a range*
-- *of INTEGERs is specified. Each INTEGER in the range can be concatenated*
-- *with the DN of the superior object to form the DN of an indicated object.*

ObjectOfReference ::= ObjectInstance

PerceivedSeverityList ::= SET OF PerceivedSeverity

ProbableCauseList ::= SET OF ProbableCause

ProblemData ::= SEQUENCE { identifier [0] OBJECT IDENTIFIER,
    significance   [1] BOOLEAN DEFAULT FALSE,
    information   [2] ANY DEFINED BY identifier }

RangeOfObjects ::= SEQUENCE {
    superiorObjectName   ObjectInstance,
    terminalRDNRange   TerminalRDNRange }

ScopedCriteria ::= SEQUENCE {
    baseManagedObject   ObjectInstance,
    scope   Scope,
    criteria   CMISFilter DEFAULT and : {}
}

simpleObjectList ::= SET OF ObjectInstance

StatusChange ::= SET OF SEQUENCE { statusAttributeID OBJECT IDENTIFIER,
    oldStatusValue   [1] ANY DEFINED BY statusAttributeID OPTIONAL,
    newStatusValue   [2] ANY DEFINED BY statusAttributeID }

SummaryContents ::= BIT STRING { includePerceivedSeverity(0),
    includeAlarmStatus(1),
    includeProbableCause(2) }

SuspectObject ::= SEQUENCE { suspectObjectClass OBJECT IDENTIFIER,
    suspectObjectInstance ObjectInstance,
    failureProbability INTEGER (0..100) OPTIONAL *--in the range 1 ..100--* }

SuspectObjectList ::= SET OF SuspectObject

TerminalRDNRange ::= SEQUENCE {
    attributeId   OBJECT IDENTIFIER,
    firstObjectInRange   INTEGER,
    lastObjectInRange   INTEGER }

Threshold ::= CHOICE {
    absoluteCount   [0] INTEGER,
    countOverFixedTimeInterval   [1] CountInterval,
    countOverSlidingWindow   [2] CountWindow,
    valueAndDuration   [3] ValueDuration,
    absoluteValue   [4] REAL,
    gauge   [5] GaugeParameters }

TimeInterval ::= SEQUENCE {
    day   [0] INTEGER (0..31) DEFAULT 0,
    hour   [1] INTEGER (0..23) DEFAULT 0,
    minute   [2] INTEGER (0..59) DEFAULT 0,
    second   [3] INTEGER (0..59) DEFAULT 0,
    msec   [4] INTEGER (0..999) DEFAULT 0 }
-- *TimeInterval shall be non-zero*

```
ValueDuration ::= SEQUENCE {
     value REAL,
     duration TimeInterval }
```
-- *the following is the bit string to be used when specifying*
-- *the functional units for alarm surveillance*

```
AlarmSurveillanceFunctionalUnits ::= BIT STRING { as-kernel(0),
as-alarm-retrieval(1),
as-basic-arc(2),
as-enhanced-arc(3),
as-cur-alm-sum-reporting(4),
as-basic-mos(5),
as-enhanced-mos(6),
as-cur-alm-sum-control(7),
as-cur-alm-sum-retrieval(8),
as-basic-log-control(9),
as-enhanced-log-control(10),
as-alarm-deletion(11),
as-alarm-event-criteria(12),
as-alarm-indication(13),
as-alarm-synch(14),
as-alarm-synch-cancel(15)}
END
```

APPENDIX I

Integrating Alarm Synchronization With Alarm Clearing

Alarm Clearing Clarified

According to ITU-T Recommendation X.733 [11], the use of clearing alarms is optional. When they are provided, alarms are cleared based on their Perceived Severity value. A Perceived Severity value of "Cleared" can clear zero, one or more previously reported alarms.

Alarms are cleared based on the value of the following alarm parameters:

1) Managed Object Class.

2) Managed Object Instance.

3) Event Type.

4) Probable Cause.

5) Specific Problems (when provided). An empty Specific Problems is to be treated equivalent to a Specific Problems parameter that is not provided.

6) Correlated Notifications (when provided). An empty Correlated Notifications is to be treated equivalent to a Correlated Notifications parameter that is not provided.

Multiple collections of alarms may be cleared based on the Correlated Notifications attribute. The Correlated Notifications attribute contains a set of Notification Identifiers for which this new alarm is correlated. (It also will include Managed Object Instances when the alarm containing the Notification Identifier was from a different Managed Object Instance than used in this alarm.) Alarms may be correlated with alarms from any managed object instance.

All Notification Identifiers contained in the Correlated Notifications attribute must already have been used in the Notification Identifier attribute of a previously sent alarm. Notification Identifier values must be unique across all notifications of a particular managed object class throughout the time the correlation is significant.

Alarms are cleared based on the following cases:

1) Specific Problems and Correlated Notifications not provided (or empty) in the clearing alarm – Clear all alarms that exactly match Managed Object Class, Managed Object Instance, Event Type and Probable Cause. Alarms are cleared irrespective of their Specific Problems or Correlated Notifications values.

2) Specific Problems is provided (and non-empty) and Correlated Notifications is not provided (or empty) in the clearing alarm – Clear all alarms that exactly match Managed Object Class, Managed Object Instance, Event Type, Probable Cause and Specific Problems. Also, clear all alarms that exactly match Managed Object Class, Managed Object Instance, Event Type and Probable Cause and match a non-empty subset of Specific Problems. Alarms are cleared irrespective of their Correlated Notifications values.

3) Specific Problems is not provided (or empty) and Correlated Notifications is provided (and non-empty) in the clearing alarm – Clear all alarms in the Correlated Notifications set. No other alarms are cleared by this alarm. Note that this may result in alarms from other managed object classes being cleared.

4) Specific Problems and Correlated Notifications are provided (and non-empty) in the clearing alarm – Clear all alarms in the Correlated Notifications set. No other alarms are cleared by this alarm. Note that this may result in alarms from other managed object classes being cleared.

Some systems choose to clear alarms one-for-one, to reduce this complexity.

Since alarm correlation is integrated with alarm clearing, it is important that the agent clears the old alarm conditions and resends them as new alarms (with updated Correlated Notifications information) when it changes its alarm correlations.

Alarm clearing may be progressing while Alarm Synchronization data is arriving. See Appendix II for a discussion of these issues.

Alarm Clearing Examples

The following examples are used to demonstrate the clearing of alarms. In these examples, the alarms have arrived in ascending order and are still pending. "–" is used to indicate the optional field was not provided. The letters A, B, etc. are used to indicate different values for that particular attribute type. As an example, MOC-A (Managed Object Class A) is different from MOC-B. See Table I.1.

Table I.1/Q.821 – Sample Non-Cleared Alarms

Alarm	1	2	3	4	5	6	7	8	9
Managed Object Class	MOC-A	MOC-A	MOC-A	MOC-A	MOC-A	MOC-A	MOC-B	MOC-B	MOC-A
Managed Object Instance	MOI-A	MOI-A	MOI-A	MOI-A	MOI-B	MOI-B	MOI-C	MOI-D	MOI-A
Event Type	ET-A	ET-A	ET-A	ET-A	ET-A	ET-A	ET-A	ET-A	ET-A
Probable Cause	PC-A	PC-A	PC-A	PC-A	PC-A	PC-A	PC-A	PC-A	PC-A
Specific Problems	–	–	{SP-A}	{SP-A} {SP-C}	–	–	–	{SP-B}	–
Perceived Severity	Critical	Major	Minor	Minor	Critical	Major	Critical	Critical	Critical
Notification Identifier	–	–	–	–	54	55	54	55	56
Correlated Notifications	–	–	–	–	–	{54}	–	{55} {54,MOI-C}	{56} {54,MOI-B} {55,MOI-B} {54,MOI-C} {55,MOI-D}

The following examples list clearing alarms and which of the alarms in Table I.1 would be cleared if that alarm were the next alarm to arrive.

Individual examples:

a)   Managed Object Class = MOC-A.

Managed Object Instance = MOI-A.

Event Type = ET-A.

Probable Cause = PC-B.

Specific Problems = <not supplied>.

Perceived Severity = Cleared.

Correlated Notifications = <not supplied>.

Resulting Alarms Cleared = none (Case #1). [Different Probable Cause]

b)   Managed Object Class = MOC-A.

Managed Object Instance = MOI-A.

Event Type = ET-A.

Probable Cause = PC-A.

Specific Problems = <not supplied>.

Perceived Severity = Cleared.

Correlated Notifications = <not supplied>.

Resulting Alarms Cleared = 1, 2, 3, 4 and 9 (Case #1).

c)   Managed Object Class = MOC-A.

Managed Object Instance = MOI-A.

Event Type = ET-A.

Probable Cause = PC-A.

Specific Problems = {SP-A}.

Perceived Severity = Cleared.

Correlated Notifications = <not supplied>.

Resulting Alarms Cleared = 3 (Case #2).

d)   Managed Object Class = MOC-A.

Managed Object Instance = MOI-A.

Event Type = ET-A.

Probable Cause = PC-A.

Specific Problems = {SP-A}{SP-C}.

Perceived Severity = Cleared.

Correlated Notifications = <not supplied>.

Resulting Alarms Cleared = 3 and 4 (Case #2).

e)   Managed Object Class = MOC-A.

Managed Object Instance = MOI-B.

Event Type = ET-A.

Probable Cause = PC-A.

Specific Problems = <not supplied>.

Perceived Severity = Cleared.

Correlated Notifications = <not supplied>.

Resulting Alarms Cleared = 5 and 6 (Case #1).

f)   Managed Object Class = MOC-A.

Managed Object Instance = MOI-B.

Event Type = ET-A.

Probable Cause = PC-A.

Specific Problems = <not supplied>.

Perceived Severity = Cleared.

Correlated Notifications = {54}.

Resulting Alarms Cleared = 5 (Case #3).

g)   Managed Object Class = MOC-B.

Managed Object Instance = MOI-D.

Event Type = ET-A.

Probable Cause = PC-A.

Specific Problems = {SP-B}.

Perceived Severity = Cleared.

Correlated Notifications = {55}{54,MOI-C}.

Resulting Alarms Cleared = 7 and 8 (Case #4).

h)   Managed Object Class = MOC-A.

Managed Object Instance = MOI-A.

Event Type = ET-A.

Probable Cause = PC-A.

Specific Problems = <not supplied>.

Perceived Severity = Cleared.

Correlated Notifications = {56}{54,MOI-B}{55,MOI-B}{54,MOI-C}{55,MOI-D}.

Resulting Alarms Cleared = 5, 6, 7, 8 and 9 (Case #3).

APPENDIX II

Alarm Synchronization Race Condition

Alarm Reporting [11] alarms may arrive while Alarm Synchronization alarms are being retrieved. This means that new alarms can be interleaved with Alarm Synchronization Current Alarms. The new alarms may either be a fault or a clearing of a fault. Managers that process Alarm Reporting alarms and Alarm Synchronization alarms sequentially may arrive with a race condition when Alarm Reporting clear alarms arrive before the matching Alarm Synchronization alarms. This is a race condition because the end results will depend on the order of the arriving alarms. This is probably best shown through an example.

Example

Let us go through a simple example. The manager has initiated an Alarm Synchronization request. Suppose the agent has the four Current Alarms as shown in Table II.1. Also suppose the agent has a notification which will clear one of the Current Alarms. We know that asynchronous event notifications can still arrive any time during an Alarm Synchronization request. Suppose these alarms arrive in the following order:

Table II.1/Q.821 – Race Condition Example #1

Order	1	2	3	4	5
Type	Alarm Synch	Alarm Synch	Alarm Synch	Alarm Reporting	Alarm Synch
Managed Object Class	MOC-A	MOC-B	MOC-C	MOC-C	MOC-D
Managed Object Instance	MOI-A	MOI-B	MOI-C	MOI-C	MOI-D
Event Type	ET-A	ET-A	ET-A	ET-A	ET-A
Probable Cause	PC-A	PC-A	PC-A	PC-A	PC-A
Perceived Severity	Critical	Major	Minor	Cleared	Major

If the manager processes these requests in order from 1 through 5, the Alarm Reporting alarm will clear the Alarm Synchronization alarm that arrived earlier. The end result is that alarms for MOC-A, MOC-B and MOC-D still exist (which is correct).

If we change the order slightly, as in Table II.2, we could end up with the following result:

Table II.2/Q.821 – Race Condition Example #2

Order	1	2	3	4	5
Type	Alarm Synch	Alarm Synch	Alarm Reporting	Alarm Synch	Alarm Synch
Managed Object Class	MOC-A	MOC-B	MOC-C	MOC-C	MOC-D
Managed Object Instance	MOI-A	MOI-B	MOI-C	MOI-C	MOI-D
Event Type	ET-A	ET-A	ET-A	ET-A	ET-A
Probable Cause	PC-A	PC-A	PC-A	PC-A	PC-A
Perceived Severity	Critical	Major	Cleared	Minor	Major

If the manager processes these requests in order, the Alarm Reporting alarm will not clear an Alarm Synchronization alarm, since it has not already arrived. The end result is that alarms for MOC-A, MOC-B, MOC-C and MOC-D still exist (which is incorrect, the end result should be alarms for MOC-A, MOC-B and MOC-D).

This is even more complicated when Correlated Notifications and how they clear alarms are taken into effect (see Appendix I).

Suggestions on handling this race condition

New Alarm Reporting alarms still need to be processed while Alarm Synchronization is occurring. It is typically not prudent to ignore critical alarms until an Alarm Synchronization request has been completed.

The handling of this race condition must be handled by the manager. The agent is sending a snap shot of its Current Alarms and sending asynchronous events when they occur.

The arriving of clearing alarms that are outside the scope of the Alarm Synchronization selection criteria will not cause this race condition.

The handling of this race condition will depend on the Fault Management needs of the system and how alarms are cleared by the agent. One system handled this problem by applying Alarm Reporting alarms as they arrived, buffering them and re-applying them following the completion of Alarm Synchronization. (Alarm Synchronization does have a well-defined completion.) The amount of buffering can be reduced by not buffering alarm conditions that will not cause this race condition.

Other race conditions may potentially exist. Perceived Severity values may be received in different orders. This may or may not be important to a manager.

In addition, if we look at the case where there are no Current Alarms, we may issue an Alarm Synchronization request and receive new alarms before we receive the indication of no Current Alarms.

APPENDIX III

Alarm Synchronization Selection Criteria Example

This will show some examples of the Alarm Synchronization selection criteria. Using ITU-T Recommendation M.3100 [18] for an example, let us assume the following naming sub-tree (see Figure III.1):

T0415150-01
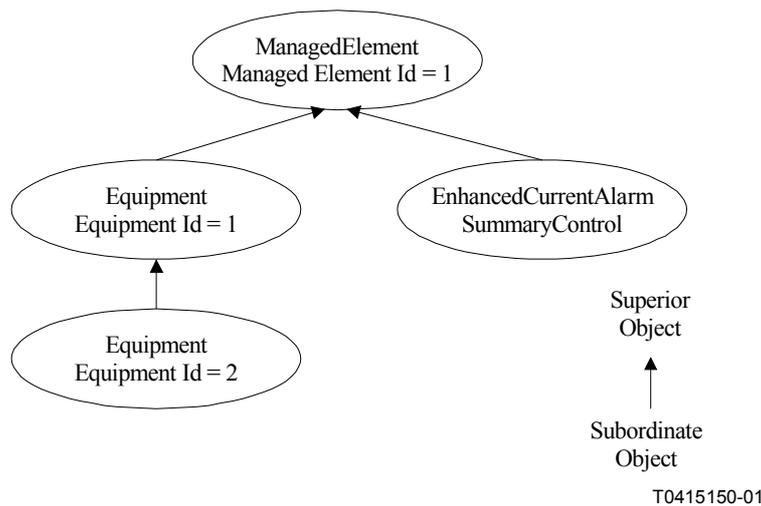
Figure III.1/Q.821 – Sample naming tree for alarm synchronization example

Let us also assume the following collection of Current Alarms (see Table III.1):

Table III.1/Q.821 – Current alarm distribution for alarm synchronization example

Class	Instance	Current Alarm
Managed Element	Managed Element Id = 1	A
Equipment	Equipment Id = 1	B
Equipment	Equipment Id = 2	C

In this example, there are three Current Alarms, which we are designating as A, B and C.

Individual examples:

1)   Alarm Synchronization Info Choice = All Objects Relative To Superior.

        Current Alarms retrieved = A, B and C.

2)   Alarm Synchronization Info Choice = Scoped Criteria.

        Base Managed Object = Managed Element, Managed Element Id = 1.

        Scope = Whole Sub-tree [7].

        Criteria = and {}[1].

        Current Alarms retrieved = A, B and C. (Effectively the same as the earlier example.)

3)   Alarm Synchronization Info Choice = Scoped Criteria.

        Base Managed Object = Equipment, Equipment Id = 1.

        Scope = Base Object.

        Criteria = and {}.

        Current Alarms retrieved = B.

4)   Alarm Synchronization Info Choice = Object List.

        Object Instance #1 = Equipment, Equipment Id = 1.

        Object Instance #2 = Equipment, Equipment Id = 2.

        Current Alarms retrieved = B and C.

5)   Alarm Synchronization Info Choice = Object List.

        Object Instance #1 = Equipment, Equipment Id = 1.

        Object Instance #2 = Equipment, Equipment Id = 2.

        Object Instance #3 = Equipment, Equipment Id = 3 (i.e. outside the scope).

        Current Alarms retrieved = B and C. This will also issue an Invalid Object Instance Error Parameter error for Object Instance #3.

---

[1] This selects all Current Alarms. Criteria will typically be set to retrieve only those Current Alarms that will be sent as notifications based on an Event Forwarding Discriminator's Discriminator Construct.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	**Switching and signalling**
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure and Internet protocol aspects
Series Z	Languages and general software aspects for telecommunication systems