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*Technical Specification*

**Digital cellular telecommunications system (Phase 2+);  
Universal Mobile Telecommunications System (UMTS);  
Telecommunication management;  
Fault Management;  
Part 2: Alarm Integration Reference Point (IRP):  
Information Service (IS)  
(3GPP TS 32.111-2 version 4.8.0 Release 4)**

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Reference

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Keywords

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## Foreword

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# Foreword

This Technical Specification has been produced by the 3<sup>rd</sup> Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

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# Introduction

The present document is part of a TS-family covering the 3<sup>rd</sup> Generation Partnership Project: Technical Specification Group Services and System Aspects; Telecommunication management; as identified below:

- 32.111-1 "Fault Management; Part 1: 3G fault management requirements".
- 32.111-2 "Fault Management; Part 2: Alarm Integration Reference Point (IRP): Information Service (IS)".**
- 32.111-3 "Fault Management; Part 3: Alarm Integration Reference Point (IRP): Common Object Request Broker Architecture (CORBA) Solution Set (SS)".
- 32.111-4 "Fault Management; Part 4: Alarm Integration Reference Point (IRP): Common Management Information Protocol (CMIP) Solution Set (SS)".

The present document is part of a set of TSs which describe the requirements and information model necessary for the Telecommunication Management (TM) of 3G systems. The TM principles and TM architecture are specified in TS 32.101 [6] and TS 32.102 [7].

A 3G system is composed of a multitude of Network Elements (NE) of various types and, typically, different vendors inter-operate in a co-ordinated manner in order to satisfy the network users' communication requirements.

The occurrence of failures in a NE may cause a deterioration of this NE's function and/or service quality and will, in severe cases, lead to the complete unavailability of the NE. In order to minimise the effects of such failures on the Quality of Service (QoS) as perceived by the network users it is necessary to:

- detect failures in the network as soon as they occur and alert the operating personnel as fast as possible;
- isolate the failures (autonomously or through operator intervention), i.e. switch off faulty units and, if applicable, limit the effect of the failure as much as possible by reconfiguration of the faulty NE/adjacent NEs;
- if necessary, determine the cause of the failure using diagnosis and test routines; and
- repair/eliminate failures in due time through the application of maintenance procedures.

This aspect of the management environment is termed "Fault Management" (FM). The purpose of FM is to detect failures as soon as they occur and to limit their effects on the network Quality of Service (QoS) as far as possible.

The latter is achieved by bringing additional/redundant equipment into operation, reconfiguring existing equipment/NEs, or by repairing/eliminating the cause of the failure.

Fault Management (FM) encompasses all of the above functionalities except commissioning/decommissioning of NEs and potential operator triggered reconfiguration (these are a matter of Configuration Management (CM)).

FM also includes associated features in the Operations System (OS), such as the administration of alarm list, the presentation of operational state information of physical and logical devices/resources/functions, and the provision and analysis of the alarm and state history of the network.



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# 1 Scope

The present document defines the Alarm Integration Reference Point (IRP) Information Service (IS), which addresses the alarm surveillance aspects of Fault Management (FM), applied to the Interface N (Itf-N).

The purpose of the Alarm IRP is to define an interface through which a "system" (typically a Network Element Manager or a Network Element) can communicate alarm information for its managed objects to one or several Manager Systems (typically Network Management Systems).

The present document defines the semantics of alarms and the interactions visible across the reference point in a protocol neutral way. It defines the semantics of the operations and notifications visible in the IRP. It does not define the syntax or encoding of the operations, notifications and their parameters.

---

# 2 References

The following documents contain provisions, which through reference in this text constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] ITU-T Recommendation Q.821: "Stage 2 and Stage 3 description for the Q3 interface – Alarm surveillance".
- [2] ITU-T Recommendation X.733 (1992): "Information technology - Open Systems Interconnection - Systems management: Alarm reporting function".
- [3] ITU-T Recommendation X.721: "Information Technology - Open Systems Interconnection - Structure of management information: Definition of management information".
- [4] GSM 12.11 version 6.2.0 Release 1997: "Fault management of the Base Station System (BSS)".
- [5] 3GPP TS 32.302: "Telecommunication management; Configuration Management (CM); Notification Integration Reference Point (IRP): Information Service (IS)".
- [6] 3GPP TS 32.101: "Telecommunication management; Principles and high level requirements".
- [7] 3GPP TS 32.102: "Telecommunication management; Architecture".
- [8] 3GPP TS 32.300: "Telecommunication management; Configuration Management (CM); Name convention for Managed Objects".
- [9] 3GPP TS 32.111-1: "Telecommunication management; Fault Management; Part 1: 3G fault management requirements".
- [10] 3GPP TS 32.622: "Telecommunication management; Configuration Management (CM); Generic network resources Integration Reference Point (IRP): Network Resource Model (NRM)".
- [11] ITU-T Recommendation M.3100 (07/95): "Generic network information model".
- [12] ITU-T Recommendation X.720: "Information technology - Open Systems Interconnection - Structure of management information: Management Information Model".
- [13] Void.

- [14] 3GPP TS 32.312: "Telecommunication management; Generic Integration Reference Point (IRP) management; Information Service (IS)".
- [15] ITU-T Recommendation X.736: "Information technology - Open Systems Interconnection - Systems Management: Security alarm reporting function".

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TS 32.111-1 [9] and the following apply:

**event:** It is an occurrence that is of significance to network operators, the NEs under surveillance and Network Management applications. Events do not have state.

**IRPManager:** Defined in TS 32.102 [7].

**IRP document version number string:** The IRP document version number (sometimes called "**IRPVersion**") string is used to identify a particular IRP solution set specification. It is derived using the following rule. Take the 3GPP document version number on the front page of the solution set specification, such as "3GPP TS 32.106-3 V3.2.0 (2000-12)". Discard the leading "3GPP TS ". Discard all characters after and including the last period. Eliminate leading and trailing spaces. Reduce multiple consecutive spaces with one space. Express the resultant in a string. Capitalised the string. For example, if the 3GPP document version number is "3GPP TS 32.106-3 V3.2.0 (2000-12)", then the IRP document version number shall be "32.106 V3.2".

**Matching-Criteria-Attributes:** It identifies a set of ITU-T Recommendation X.733 [2] defined attributes. Notifications carrying identical values for these attributes are considered to be carrying alarm information related to (a) the same network resource and (b) the same alarmed condition. The matching-criteria-attributes are: `objectInstance`, `eventType`, `probableCause` and `specificProblem`, if present.

**notification:** It refers to the transport of events from IRPAgent to IRPManager. In this IRP, notifications are used to carry alarm information from IRPAgent to IRPManager.

**IRPAgent:** Defined in TS 32.102 [7].

### 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

|       |  |
|-------|--|
| CCITT | The International Telegraph and Telephone Consultative Committee |
| CMIP  | Common Management Information Protocol                           |
| DN    | Distinguished Name   |
| EM    | Element Manager  |
| IOC   | Information Object Class   |
| IRP   | Integration Reference Point                                      |
| ITU-T | International Telecommunication Union, Telecommunication Sector  |
| Itf-N | Interface N  |
| MO    | Managed Object   |
| MOC   | Managed Object Class   |
| MOI   | Managed Object Instance  |
| NE    | Network Element  |
| NM    | Network Manager  |
| OS    | Operations System  |
| OSI   | Open System Interconnection                                      |
| RDN   | Relative Distinguished Name                                      |
| SS    | Solution Set   |
| UML   | Unified Modelling Language                                       |

## 4 Basic aspects

### 4.1 Background

Integration Reference Points (IRPs) are the means within 3G Telecom Management (TM) for specifying interoperable points of information exchange between systems and applications.

3GPP TS 32.101 [6] and 3GPP TS 32.102 [7] contain background and introductory information about the IRP concept.

### 4.2 System Overview

The following figures identify system contexts of the present document in terms of implementations called IRPAgent and IRPManager.

"IRPManager" depicts a process that interacts with IRPAgent for the purpose of receiving alarms via this IRP.

Examples of IRPManager can be Network Management Systems and Alarm viewing devices (such as a local craft terminal). IRPAgent implements and supports the Alarm IRP.

IRPAgent can be one Network Element (NE) (see figure 2) or it can be one Element Manager (EM) with one or more NEs (see figure 1). In the latter case, the interfaces (represented by a thick dotted line) between the EM and the NEs are not subject of this IRP. Whether EM and NE share the same hardware system is not relevant to the present document either.

By observing the interaction across the Alarm IRP, one cannot deduce if EM and NE are integrated in a single system or if they run in separate systems.

As indicated in figure 1 and figure 2, the subject document need to be complemented with the Notification IRP [5] (to allow IRPManager to subscribe to notifications issued by IRPAgent and (optionally) product-specific resource models describing the MOs maintained by the IRPAgent).

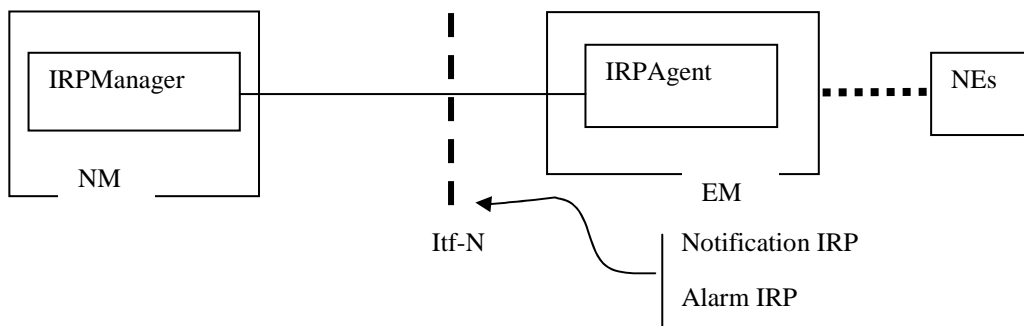


Figure 1: System Context A

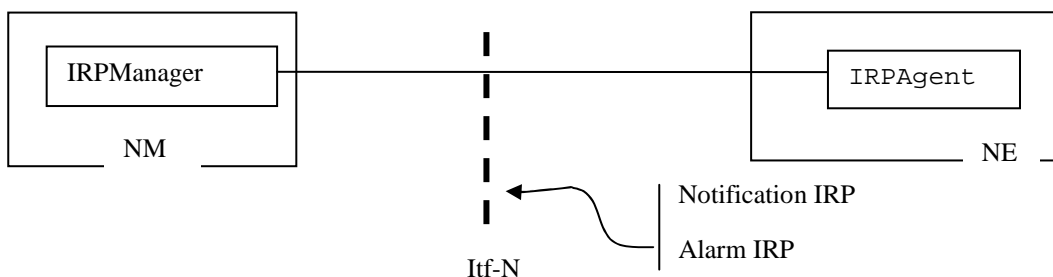


Figure 2: System Context B

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## 5 Information Object Classes

### 5.1 Information entities imported and local label

| Label reference  | Local label                 |
|--|-----------------------------|
| 32.302 [5], information object class, NotificationIRP    | NotificationIRP             |
| 32.302 [5], interface, notificationIRPNotification       | notificationIRPNotification |
| 32.622 [10], information object class, IRPAgent          | IRPAgent                    |
| 32.622 [10], information object class, ManagedGenericIRP | ManagedGenericIRP           |

### 5.2 Class diagram

This sub-clause introduces the set of information object classes (IOCs) that encapsulate information within the `IRPAgent`. The intent is to identify the information required for the AlarmIRP Agent implementation of its operations and notification emission. This sub-clause provides the overview of all support object classes in UML. Subsequent sub-clauses provide more detailed specification of various aspects of these support object classes.

### 5.2.1 Attributes and relationships

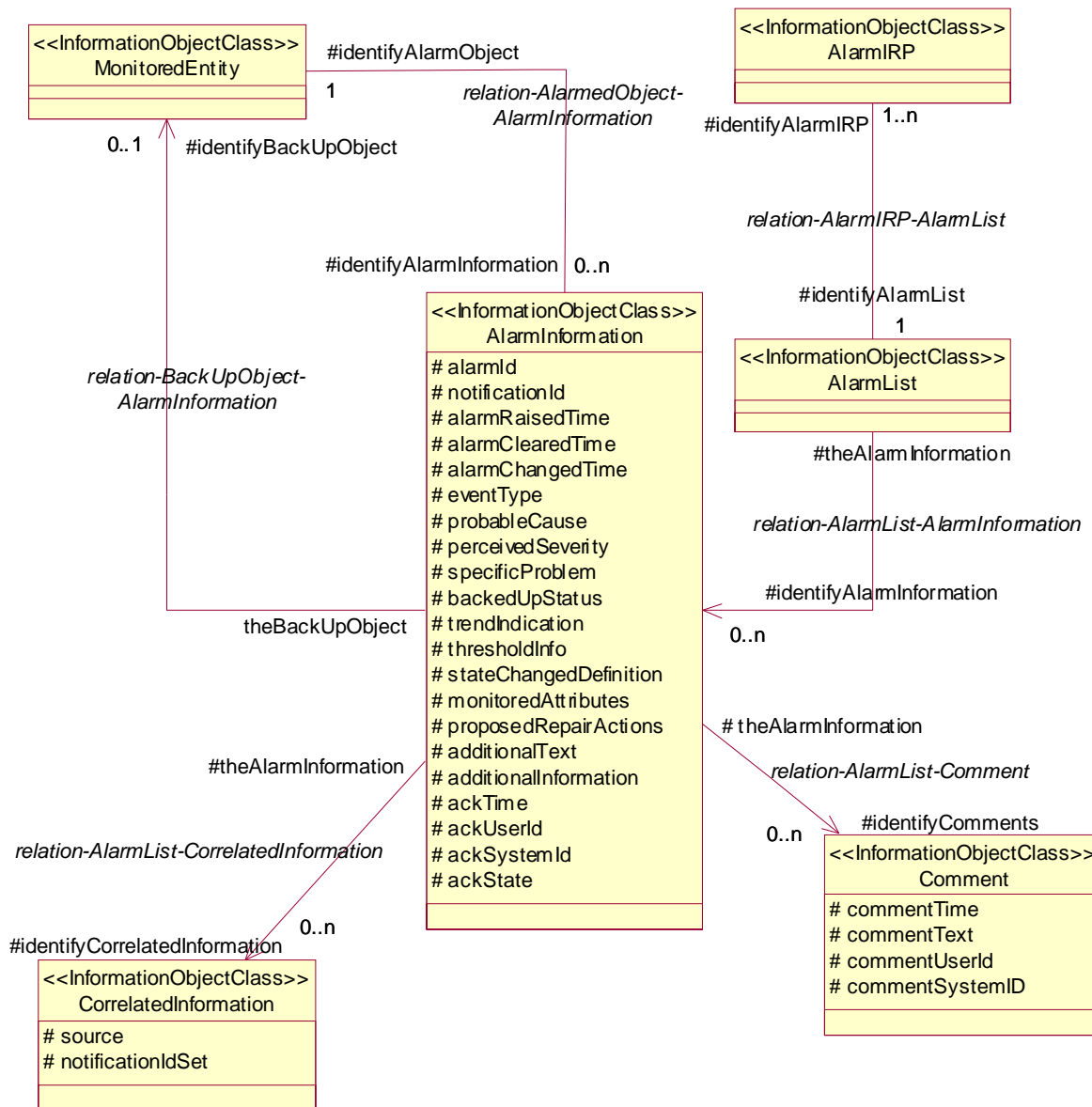


Figure:

## 5.2.2 Inheritance

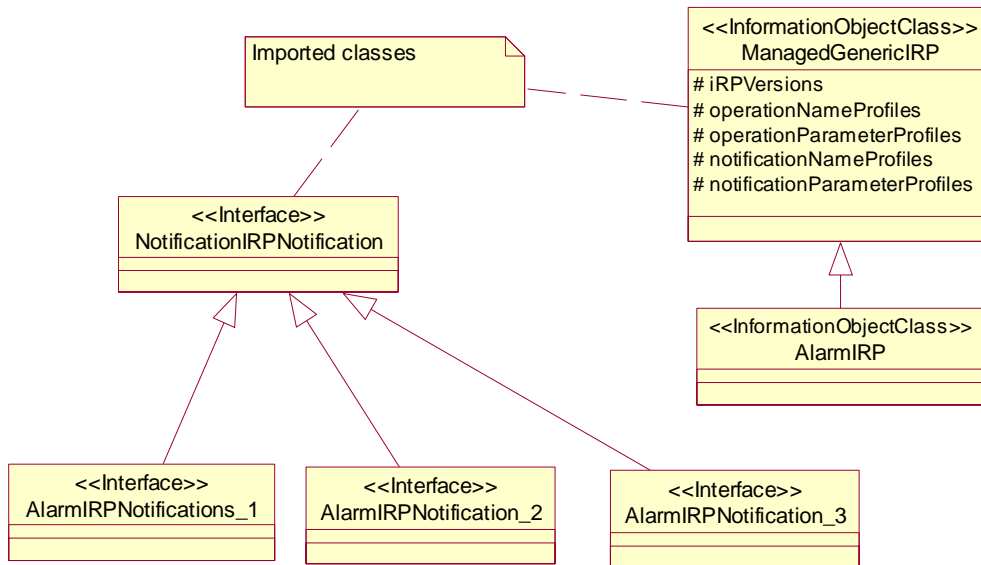


Figure:

## 5.3 Information Object Class Definitions

### 5.3.1 AlarmInformation

#### 5.3.1.1 Definition

*AlarmInformation* contains information about alarm condition of an alarmed *MonitoredEntity*.

One *IRPAgent* is related to at most one *AlarmList*. The *IRPAgent* or its related *AlarmIRP* or the related *AlarmList* assigns an identifier, called *alarmId*, to each *AlarmInformation* in the *AlarmList*. An *alarmId* unambiguously identifies one *AlarmInformation* in the *AlarmList*.

### 5.3.1.2 Attribute

| Attribute name   | Support Qualifier |
|--|-------------------|
| alarmId  | M                 |
| notificationId (see note)  | M                 |
| alarmRaisedTime  | M                 |
| alarmClearedTime   | M                 |
| alarmChangedTime   | O                 |
| eventType  | M                 |
| probableCause  | M                 |
| perceivedSeverity  | M                 |
| specificProblem  | O                 |
| backedUpStatus   | O                 |
| trendIndication  | O                 |
| thresholdInfo  | O                 |
| stateChangedDefinition   | O                 |
| monitoredAttributes  | O                 |
| proposedRepairActions  | O                 |
| additionalText   | O                 |
| additionalInformation  | O                 |
| ackTime  | M                 |
| ackUserId  | M                 |
| ackSystemId  | O                 |
| ackState   | M                 |
| NOTE: This attribute may be "retired/removed" in Release 5 when Log IRP is introduced. Its removal implies that information carried in this attribute is no longer made accessible to IRPManager via the <code>getAlarmList()</code> . |                   |

### 5.3.1.3 State diagram

Alarms have states. The alarm state information is captured in `AlarmInformation` in `AlarmList`.

The solid circle icon represents the Start State. The double circle icon represents the End State. In this state, the alarm is Cleared and acknowledged. The `AlarmInformation` shall not be accessible via the IRP and is removed from the `AlarmList`.

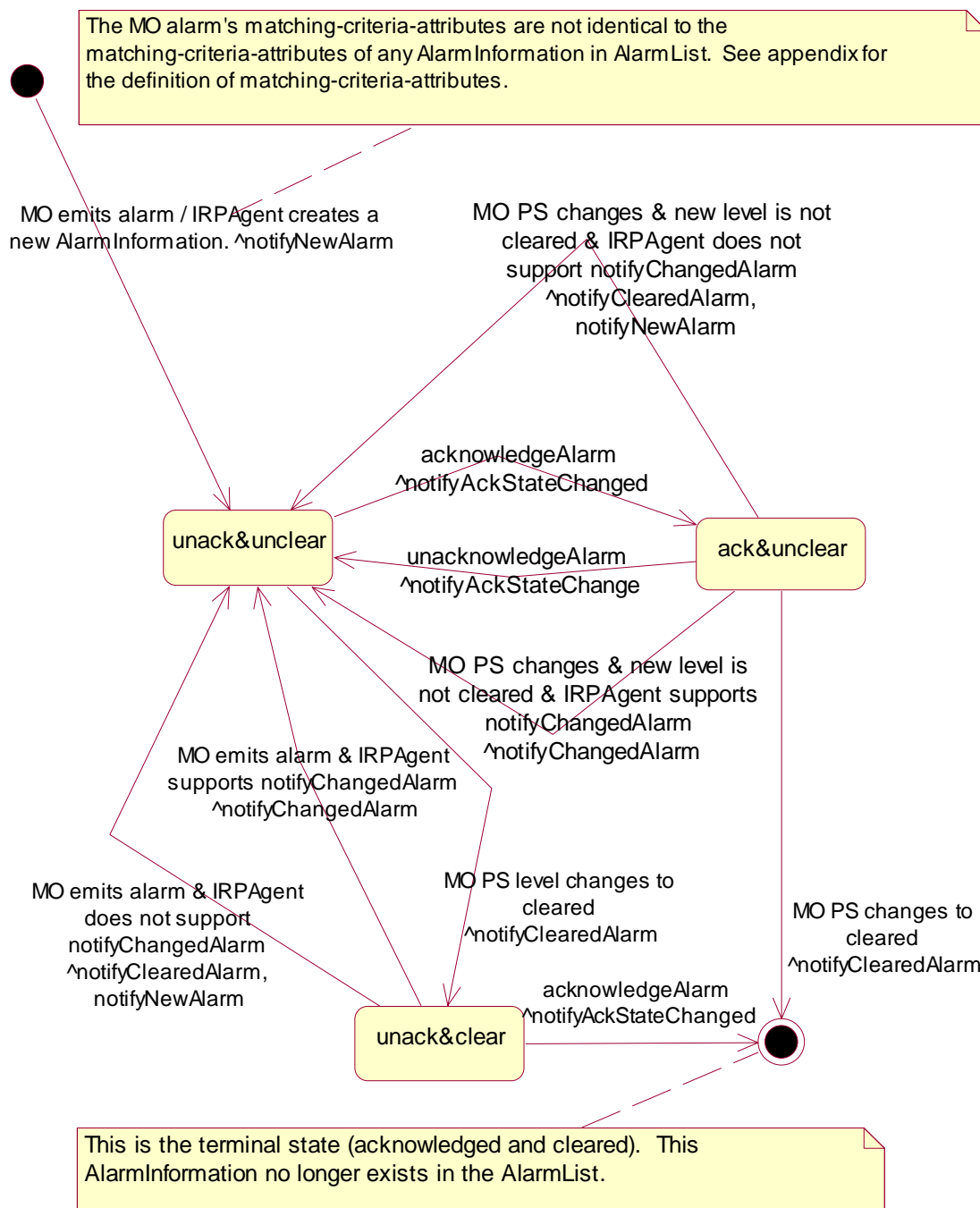
Note the state diagram uses " X / Y ^ Z " to label the arc that indicates state transition. The meanings of X, Y and Z are:

- X identifies the triggering event
- Y identifies the action of `IRPAgent` because of the triggering event
- Z is the notification to be emitted by `IRPAgent` because of the triggering event

Note that `acknowledgeAlarm^notifyAckStateChanged` and the `unacknowledgeAlarm^notifyAckStateChange` refer to cases when the request of the `IRPManager` is successful for the `AlarmInformation` concerned. They do not refer to the cases when the request is a failure since in the failure cases, no state transition would occur.

Note that, to reduce cluttering to the diagram, the `setComment^notifyComment` is not included in the figure. One transition should be applied from `unack&unclear` to itself. Similarly, another transition should be applied from `ack&unclear` to itself. Another one is from `unack&clear` to itself.

Note that "PS" used in the state diagram stands for "perceived severity".



### 5.3.2 AlarmList

#### 5.3.2.1 Definition

IRPAgent maintains an AlarmList. It contains all currently active alarms (i.e. AlarmInformation whose perceivedSeverity is not Cleared) and alarms that are Cleared but not yet acknowledged.

#### 5.3.2.2 Attribute

There is no additional attribute defined for this IOC besides those inherited.



## 5.3.3 AlarmIRP

### 5.3.3.1 Definition

AlarmIRP is the representation of the alarm management capabilities specified by the present document. This IOC inherits from ManagedGenericIRP IOC specified in [14].

### 5.3.4 Comment

#### 5.3.4.1 Definition

Comment contains commentary and associated information such as the time when the commentary is made.

#### 5.3.4.2 Attribute

| Attribute Name  | Support Qualifier |
|-----------------|-------------------|
| commentTime     | M                 |
| commentText     | M                 |
| commentUserId   | M                 |
| commentSystemId | O                 |

## 5.3.5 CorrelatedNotification

### 5.3.5.1 Definition

It identifies one MonitoredEntity. For that MonitoredEntity identified, a set of notification identifiers is also identified. One or more CorrelatedNotification instances can be related to an AlarmInformation. In this case, the information of the AlarmInformation is said to be correlated to information carried in the notifications identified by the CorrelatedNotification instances. See further definition of correlated notification in ITU-T Recommendation X.733 [2] clause 8.1.2.9.

The meaning of correlation is dependent on the type of notification itself. See the comment column of the correlatedNotification input parameter for each type of notification, such as notifyNewAlarm.

Notification carries AlarmInformation. The AlarmInformation instances referred to by the correlatedNotification may or may not exist in the AlarmList. For example, the AlarmInformation carried by the identified notification may have been acknowledged and Cleared and therefore, no longer exist in the AlarmList.

#### 5.3.5.2 Attribute

| Attribute Name    | Support Qualifier |
|-------------------|-------------------|
| source            | M                 |
| notificationIdSet | M                 |

## 5.3.6 MonitoredEntity

### 5.3.6.1 Definition

It encapsulates a subset of information of an IOC that can emit alarms. It can also encapsulate a subset of information of an IOC that serves as the back up object.

#### 5.3.6.2 Attribute

There is no attribute for this IOC.

## 5.4 Information relationships definition

### 5.4.1 relation-AlarmIRP-AlarmList (M)

#### 5.4.1.1 Definition

This represents the relationship between `AlarmIRP` and `AlarmList`.

#### 5.4.1.2 Role

| Name              | Definition   |
|-------------------|--|
| identifyAlarmIRP  | It represents the capability to obtain the identities of one or more AlarmIRP. |
| identifyAlarmList | It represents the capability to obtain the identify of one AlarmList.          |

#### 5.4.1.3 Constraint

There is no constraint for this relationship.

### 5.4.2 relation-AlarmList-AlarmInformation (M)

#### 5.4.2.1 Definition

This represents the relationship between `AlarmList` and `AlarmInformation`.

#### 5.4.2.2 Role

| Name                     | Definition  |
|--------------------------|---|
| theAlarmInformation      | It represents the AlarmInformation.   |
| identifyAlarmInformation | It represents a capability to obtain the information contained in AlarmInformation. |

#### 5.4.2.3 Constraint

| Name                     | Definition   |
|--------------------------|--|
| inv_hasAlarmInformation1 | No AlarmInformation playing the role of theAlarmInformation shall have its <code>perceivedSeverity = "cleared"</code> and its <code>ackState = "acknowledged"</code> . |
| inv_hasAlarmInformation2 | The <code>alarmId</code> of all AlarmInformation instances playing the role of theAlarmInformation are distinct.   |

### 5.4.3 relation-AlarmInformation-Comment (M)

#### 5.4.3.1 Definition

This represents the relationship between `AlarmInformation` and `Comment`.

#### 5.4.3.2 Role

| Name                | Definition   |
|---------------------|--|
| theAlarmInformation | It represents the AlarmInformation.  |
| identifyComment     | It represents a capability to obtain the information contained in Comment. |

#### 5.4.3.3 Constraint

There is no constraint.

## 5.4.4 relation-AlarmInformation-CorrelatedNotification (M)

### 5.4.4.1 Definition

This represents the relationship between `AlarmInformation` and `CorrelatedNotification`.

### 5.4.4.2 Role

| Name  | Definition  |
|---|---|
| <code>theAlarmInformation</code>            | It represents the <code>AlarmInformation</code> .   |
| <code>identifyCorrelatedNotification</code> | It represents a capability to obtain the information contained in <code>CorrelatedNotification</code> . |

### 5.4.4.3 Constraint

There is no constraint.

## 5.4.5 relation-AlarmedObject-AlarmInformation (M)

### 5.4.5.1 Definition

This represents the relationship between `MonitoredEntity` and `AlarmInformation`.

### 5.4.5.2 Role

| Name                                  | Definition   |
|---------------------------------------|--|
| <code>identifyAlarmedObject</code>    | It represents the capability to obtain the identification, in terms of <code>objectClass</code> and <code>objectInstance</code> , of alarmed network resource. |
| <code>identifyAlarmInformation</code> | It represents the capability to obtain the identities of <code>AlarmInformation</code> .   |

### 5.4.5.3 Constraint

| Name                            | Definition   |
|---------------------------------|--|
| <code>inv_relation-AI-ME</code> | All <code>AlarmInformation</code> involved in this relationship with the same <code>MonitoredEntity</code> shall have at least one different value in the following attributes: <code>eventType</code> , <code>probableCause</code> and <code>specificProblem</code> . |

## 5.4.6 relation-backUpObject-AlarmInformation (O)

### 5.4.6.1 Definition

The relationship represents the relationship between `AlarmInformation` and the `backUpObject`.

### 5.4.6.2 Role

| Name                              | Definition   |
|-----------------------------------|--|
| <code>identifyBackUpObject</code> | It represents a capability to obtain the identification, in terms of <code>objectClass</code> and <code>objectInstance</code> , of the <code>backUpObject</code> . |

### 5.4.6.3 Constraint

| Name                                  | Definition  |
|---------------------------------------|---|
| <code>inv_identifyBackUpObject</code> | This relationship is present if and only if the <code>AlarmInformation.backedUpStatus</code> attribute is present and is indicating true. |

## 5.5 Information attribute definition

### 5.5.1 Definition and legal values

| Name                  | Definition  | Legal Values  |
|-----------------------|---|---|
| alarmId               | It identifies one AlarmInformation in the AlarmList.  |   |
| notificationId        | It identifies the notification that carries the AlarmInformation.   |   |
| alarmRaisedTime       | It indicates the date and time when the alarm is first raised by the alarmed resource.  | All values indicating valid time.   |
| alarmChangedTime      | It indicates the last date and time when the AlarmInformation is changed by the alarmed resource. Changes to AlarmInformation caused by invocations of the IRPManager would not change this date and time.  | All values indicating valid time.   |
| alarmClearedTime      | It indicates the date and time when the alarm is Cleared.   | All values indicating valid time.   |
| eventType             | It indicates the type of event. See Annex A for information on event type.  | See Annex A.  |
| probableCause         | It qualifies alarm and provides further information than eventType. See Annex B for a complete listing.   | See Annex B.  |
| perceivedSeverity     | It indicates the relative level of urgency for operator attention.  | Critical, Major, Minor, Warning, Indeterminate, Cleared: see ITU-T Recommendation X.733 [2]. This IRP does not recommend the use of indeterminate.              |
| specificProblem       | It provides further qualification on the alarm than probableCause. This attribute value shall be single-value and of simple type such as integer or string. See definition in ITU-T Recommendation X.733 [2] clause 8.1.2.2.  | Provided by vendor.   |
| backedUpStatus        | It indicates if an object (the MonitoredEntity) has a back up. See definition in ITU-T Recommendation X.733 [2] clause 8.1.2.4.   | All values that carry the semantics of backedUpStatus defined by ITU-T X.733 [2] clause 8.1.2.4.  |
| trendIndication       | It indicates if some observed condition is getting better, worse, or not changing.  | "Less severe", "no change", "more severe": see definition in ITU-T Recommendation X.733 [2] clause 8.1.2.6.   |
| thresholdInfo         | It indicates the direction of threshold crossing.   | See definitions in ITU-T Recommendation X.733 [2] clause 8.1.2.7.   |
| stateChangeDefinition | It indicates MO attribute value changes. See definition in ITU-T Recommendation X.733 [2] clause 8.1.2.10.  |   |
| monitoredAttributes   | It indicates MO attributes whose value changes are being monitored. See definition in ITU-T Recommendation X.733 [2] clause 8.1.2.11.   |   |
| proposedRepairActions | It indicates proposed repair actions. See definition in ITU-T Recommendation X.733 [2] clause 8.1.2.12.   |   |
| additionalText        | It carries semantics that is outside the scope of this IRP specification. It may provide the identity of the NE (e.g. RNC, Node-B) from which the alarm has been originated. It corresponds to the "user label" attribute of the object class representing the NE in the Generic Network Resource Model [10].<br><br>It can contain further information on the alarm. | N/A   |
| additionalInformation | It contains information on the alarm and its semantics is outside the scope of this IRP.  | N/A   |
| ackTime               | It identifies the time when the alarm has been acknowledged or unacknowledged the last time.  | All values that indicate valid times and are later than that carried in alarmRaisedTime.  |
| ackUserId             | It identifies the last user who has changed the Acknowledgement State.  | It can be used to identify the human operator such as "John Smith" or it can identify a group, such as "Team Six", or it can contain no information such as "". |

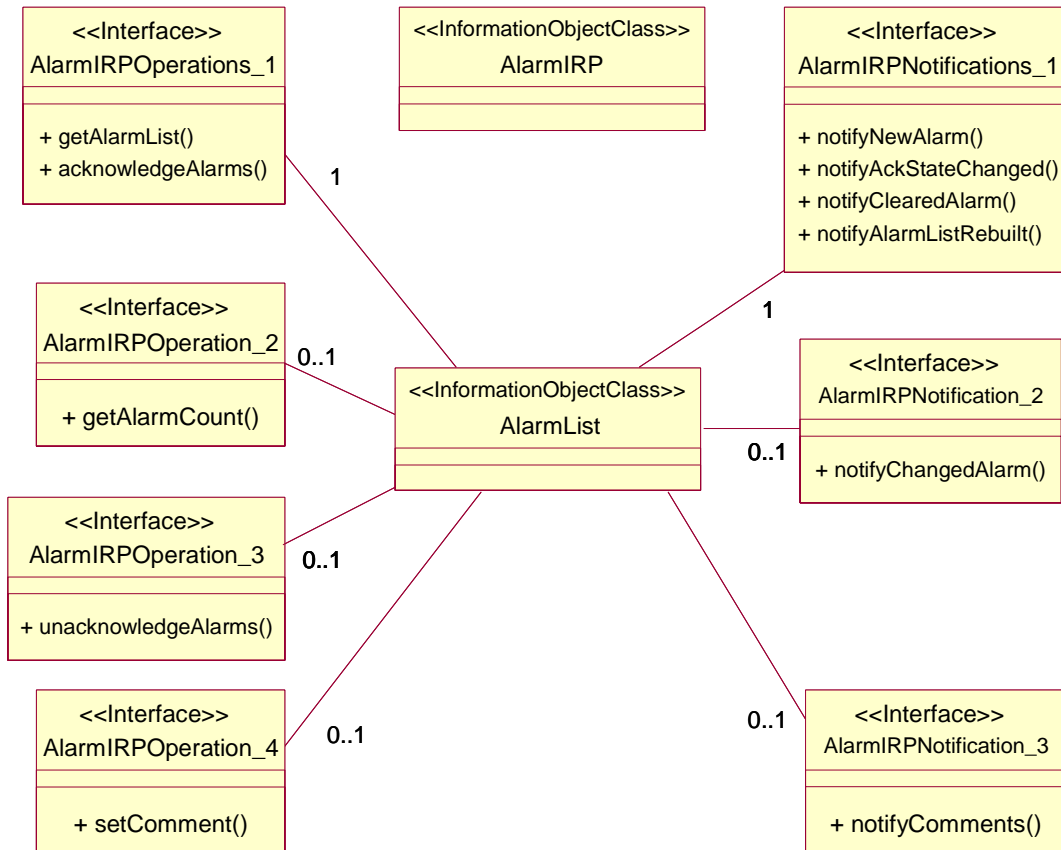
| Name              | Definition  | Legal Values  |
|-------------------|---|---|
| ackSystemId       | It identifies the system (EM or NM) from which the alarm has been acknowledged or unacknowledged the last time.                             | It can be used to identify the system, such as "system 6" or it can contain no information such as "".  |
| ackState          | It identifies the Acknowledgement State of the alarm.   | Acknowledged: the alarm has been acknowledged.<br><br>Unacknowledged: the alarm has been unacknowledged or the alarm has never been acknowledged. |
| commentTime       | It carries the time when the comment has been added to the alarm.   |   |
| commentText       | It carries the textual comment.   |   |
| commentUserId     | It carries the identification of the user who made the comment.   |   |
| commentSystemId   | It carries the identification of the system (EM or NM) from which the comment is made. That system supports the user that made the comment. |   |
| source            | It identifies one MonitoredEntity.  | All values that carry the semantics of DN.  |
| notificationIdSet | It carries one or more notification identifiers.  |   |

## 5.5.2 Constraints

| Name                 | Definition   |
|----------------------|--|
| inv_alarmChangedTime | Time indicated shall be later than that carried in alarmRaisedTime.  |
| inv_alarmClearedTime | Time indicated shall be later than that carried in alarmRaisedTime.  |
| inv_ackTime          | Time indicated shall be later than that carried in alarmRaisedTime.  |
| inv_notificationId   | NotificationIds shall be chosen to be unique across all notifications of a particular managed object (representing the NE) throughout the time that alarm correlation is significant. The algorithm by which alarm correlation is accomplished is outside the scope of this IRP. |

## 6 Interface Definition

### 6.1 Class diagram



### 6.2 Generic rules

Rule 1: Each operation with at least one input parameter supports a pre-condition `valid_input_parameter` which indicates that all input parameters shall be valid with regards to their information type. Additionally, each such operation supports an exception `operation_failed_invalid_input_parameter` which is raised when pre-condition `valid_input_parameter` is false. The exception has the same entry and exit state.

Rule 2: Each operation with at least one optional input parameter supports a set of pre-conditions `supported_optional_input_parameter_xxx` where "xxx" is the name of the optional input parameter and the pre-condition indicates that the operation supports the named optional input parameter. Additionally, each such operation supports an exception `operation_failed_unsupported_optional_input_parameter_xxx` which is raised when (a) the pre-condition `supported_optional_input_parameter_xxx` is false and (b) the named optional input parameter is carrying information. The exception has the same entry and exit state.

Rule 3: Each operation shall support a generic exception `operation_failed_internal_problem` that is raised when an internal problem occurs and that the operation cannot be completed. The exception has the same entry and exit state.

## 6.3 Interface AlarmIRPOperations\_1

### 6.3.1 acknowledgeAlarms (M)

#### 6.3.1.1 Definition

The IRPManager invokes this operation to acknowledge one or more alarms.

#### 6.3.1.2 Input Parameters

| Name                                     | Qualifier | Information Type  | Comment   |
|--|-----------|---|---|
| alarmInformationAndSeverityReferenceList | M         | List of AlarmInformation.alarmId and AlarmInformation.perceivedSeverity | It carries one or more identifiers identifying AlarmInformation instances in AlarmList, including optionally the perceivedSeverity of the AlarmInformation instance that is going to be acknowledged.<br>alarm InformationAndSeverity ReferenceList<br>{alarmId - Mandatory;<br>perceivedSeverity - Optional<br>} |
| AckUserId                                | M         | AlarmInformation.ackUserId  | It identifies the user acknowledging the alarm.   |
| ackSystemId                              | O         | AlarmInformation.ackSystemId  | It identifies the processing system on which the subject IRPManager runs. It may contain no information implying that IRPManager does not wish this information be kept in AlarmInformation in AlarmList.   |

#### 6.3.1.3 Output Parameters

| Name                             | Qualifier | Matching Information   | Comment  |
|----------------------------------|-----------|--|--|
| badAlarmInformationReferenceList | M         | List of pair of AlarmInformation.alarmId, ENUM (UnknownAlarmId, AcknowledgmentFailed, WrongPerceivedSeverity) and additional failure reason. | If allAlarmsAcknowledged is true, it contains no information.<br><br>If someAlarmAcknowledged is true, then it contains identifications of AlarmInformation that are (a) present in input parameter AlarmInformationReferenceList but are absent in the AlarmList = UnknownAlarmId; or (b) present in input parameter AlarmInformationReferenceList and are present in the AlarmList but the Acknowledgement Information (see note below table) has not changed, in contrast to IRPManager's request = AcknowledgmentFailed; or (c) present in input parameter AlarmInformationReferenceList and are present in the AlarmList but the perceivedSeverity to be acknowledged has changed and/or is different within the Alarm List = WrongPerceivedSeverity (applicable only if perceivedSeverity was provided). |
| status                           | M         | ENUM (OperationSucceeded, OperationFailed, OperationPartiallySucceeded)  | If someAlarmAcknowledged is true, status = OperationPartiallySucceeded.<br>If allAlarmsAcknowledged is true, status = OperationSucceeded.<br>If operation_failed is true, status = OperationFailed.  |

NOTE: Acknowledgement Information is defined as the information contained in AlarmInformation.ackTime, AlarmInformation.ackUserId, AlarmInformation.ackSystemId, AlarmInformation.ackState.

### 6.3.1.4 Pre-condition

atLeastOneValidId.

| Assertion Name    | Definition   |
|-------------------|--|
| atLeastOneValidId | The AlarmInformationReferenceList contains at least one identifier that identifies one AlarmInformation in AlarmList and that this identified AlarmInformation shall have its ackState indicating "unacknowledged" and, if provided, an equal perceivedSeverity. |

### 6.3.1.5 Post-condition

someAlarmAcknowledged OR allAlarmsAcknowledged.

| Assertion Name        | Definition   |
|-----------------------|--|
| someAlarmAcknowledged | At least one but not all AlarmInformation identified in input parameter AlarmInformationReferenceList has been acknowledged. Acknowledgement of an AlarmInformation means that the ackState attribute has been set to "acknowledged", that ackUserId, ackSystemId attributes of this AlarmInformation have been set to the values provided as input parameter and that the time of acknowledgeAlarms operation has been registered in ackTime attribute. |
| allAlarmsAcknowledged | All AlarmInformation identified in input parameter have been acknowledged. Acknowledgement of an AlarmInformation means that the ackState attribute has been set to "acknowledged", that ackUserId, ackSystemId attributes of this AlarmInformation have been set to the values provided as input parameter and that the time of acknowledgeAlarms operation has been registered in ackTime attribute.   |

### 6.3.1.6 Exceptions

| Name             | Definition   |
|------------------|--|
| operation_failed | <b>Condition:</b> Pre-condition is false or post-condition is false.<br><b>Returned Information:</b> The output parameter status.<br><b>Exit state:</b> Entry state. |

## 6.3.2 getAlarmList (M)

### 6.3.2.1 Definition

IRPManager requests IRPAgent to provide the list of AlarmInformation instances in AlarmList, including (when supported) the IOC instances associated with the AlarmInformation instances.

There are two modes of operation. One mode is synchronous. In this mode, the list of AlarmInformation instances in AlarmList is returned synchronously with the operation. The other mode is asynchronous. In this mode, the list of AlarmInformation instances is returned via notifications. In asynchronous mode of operation, the only information returned synchronously is the status of the operation. The mode of operation to be used is determined by means outside the scope of specification. To use asynchronous mode, the IRPManager must have established a subscription with the IRPAgent notificationIRP via the subscribe operation specified in [5].



### 6.3.2.2 Input Parameters

| Name          | Qualifier | Information Type   | Comment   |
|---------------|-----------|--|---|
| alarmAckState | O         | ENUM (all alarms, all active alarms, all active and acknowledged alarms, all active and unacknowledged, all Cleared and unacknowledged alarms, all unacknowledged) | It carries a constraint. The IRPAgent shall apply it on AlarmInformation instances in AlarmList when constructing its output parameter AlarmInformationList.        |
| filter        | O         | N/A  | It carries a filter constraint. The IRPAgent shall apply it on AlarmInformation instances in AlarmList when constructing its output parameter AlarmInformationList. |

### 6.3.2.3 Output Parameters

| Name                 | Qualifier | Matching Information                       | Comment  |
|----------------------|-----------|--|--|
| AlarmInformationList | M         | List of AlarmInformation.                  | <p>It carries AlarmInformation in AlarmList.</p> <p>Case when synchronous mode of operation is used:</p> <p>(a) The IRPAgent shall apply the constraints expressed in alarmAckState and filter to AlarmInformation instances when constructing this output parameter.</p> <p>Case when asynchronous mode of operation is used (i.e. this output parameter is conveyed via notifications):</p> <p>(a) If the filter parameter is present, the IRPAgent shall apply the constraint when constructing this output parameter. Furthermore, if the alarmAckState constraint is present, the IRPAgent shall apply that constraint as well. The filter constraint, if any, that is currently active in the notification channel is not used for the construction of this output parameter.</p> <p>(b) If the filter parameter is absent, the IRPAgent shall apply the filter constraint currently active in the notification channel when constructing this output parameter. If the alarmAckState constraint is present, the IRPAgent shall apply that constraint as well.</p> |
| status               | M         | ENUM (OperationSucceeded, OperationFailed) | <p>If allAlarmInformationReturned is true, status = OperationSucceeded.</p> <p>If operation_failed is true, status = OperationFailed.</p>  |

### 6.3.2.4 Pre-condition

There is no pre-condition.

### 6.3.2.5 Post-condition

allAlarmInformationReturned.

| Assertion Name              | Definition  |
|-----------------------------|---|
| allAlarmInformationReturned | All AlarmInformation that satisfy the constraints expressed in input parameters filter and alarmAckState and are present in the AlarmList at the moment of this operation invocation are returned. All AlarmInformation in AlarmList remains unchanged as the result of this operation. |

### 6.3.2.6 Exceptions

| Assertion Name   | Definition  |
|------------------|---|
| operation_failed | <p><b>Condition:</b> At least one input parameter is invalid or the pre-condition is false or the post-condition is not true.</p> <p><b>Returned Information:</b> The output parameter status.</p> <p><b>Exit state:</b> Entry state.</p> |

## 6.4 Interface AlarmIRPOperation\_2

### 6.4.1 getAlarmCount (O)

#### 6.4.1.1 Definition

An IRPManager wishes to know the amount of AlarmInformation kept in the AlarmList. The IRPManager requests the counts via this operation. Possible usage is for IRPManager to find out the number of AlarmInformation in AlarmList before invoking getAlarmList operation.

#### 6.4.1.2 Input Parameters

| Name          | Qualifier | Information Type   | Comment   |
|---------------|-----------|--|---|
| filter        | O         | N/A  | <p>It carries a filter constraint. The operation shall apply it when counting the AlarmInformation instances in AlarmList.</p> <p>Case when synchronous mode of operation is used for getAlarmList:</p> <p>(a) If this parameter is present, the operation shall count the AlarmInformation instances which satisfy both (a) this filter constraint and (b) the condition set by input parameter alarmAckState.</p> <p>(b) If this parameter is absent, the operation shall count all AlarmInformation instances that satisfy the condition set by input parameter alarmAckState.</p> <p>Case when asynchronous mode of operation is used for getAlarmList:</p> <p>(a) If this parameter is present, the operation shall count all AlarmInformation instances that satisfy this filter constraint and the condition set by input parameter alarmAckState.</p> <p>(b) If this parameter is absent, the operation shall count AlarmInformation instances that satisfy (a) the filter constraint currently active in the notification channel established between the IRPManager and the IRPAgent that is equipped with NotificationIRP capabilities and (b) the condition set by input parameter alarmAckState.</p> |
| alarmAckState | O         | ENUM (all alarms, all active alarms, all active and acknowledged alarms, all active and unacknowledged, all cleared and unacknowledged alarms, all unacknowledged) | It carries a constraint. The operation shall apply it on AlarmInformation instances in AlarmList when counting.   |

### 6.4.1.3 Output Parameters

| Name  | Qualifier | Matching Information                          | Comment  |
|---|-----------|---|--|
| criticalCount, majorCount, minorCount, warningCount, indeterminateCount, clearedCount | M         | N/A   | <p>They carry the number of AlarmInformation in AlarmList that has the following properties.</p> <p>Case when synchronous mode of operation is used:</p> <p>(a) The operation shall apply the constraints expressed in alarmAckState and filter to AlarmInformation instances when counting.</p> <p>Case when asynchronous mode of operation is used (i.e. this output parameter is conveyed via notifications):</p> <p>(a) If the filter parameter is present, the operation shall apply the constraint when counting. Furthermore, if the alarmAckState constraint is present, the operation shall apply that constraint as well. The filter constraint, if any, that is currently active in the notification channel is not used for the counting.</p> <p>(b) If the filter parameter is absent, the operation shall apply the filter constraint currently active in the notification channel when counting. If the alarmAckState constraint is present, the operation shall apply that constraint as well.</p> |
| status  | M         | ENUM<br>(OperationSucceeded, OperationFailed) | <p>If allAlarmInformationCounted is true, status = OperationSucceeded.</p> <p>If operation_failed is true, status = OperationFailed.</p>   |

### 6.4.1.4 Pre-condition

There are no pre-conditions.

### 6.4.1.5 Post-condition

allAlarmInformationCounted.

| Assertion Name             | Definition   |
|----------------------------|--|
| allAlarmInformationCounted | <p>All AlarmInformation that satisfy the constraints expressed in input parameters filter and alarmAckState and are present in the AlarmList at the moment of this operation invocation are counted and the result returned.</p> <p>All AlarmInformation in AlarmList remains unchanged as the result of this operation.</p> |

### 6.4.1.6 Exceptions

| Name             | Definition   |
|------------------|--|
| operation_failed | <p><b>Condition:</b> the pre-condition is false or the post-condition is true.</p> <p><b>Returned Information:</b> The output parameter status.</p> <p><b>Exit state:</b> Entry state.</p> |

## 6.5 Interface AlarmIRPOperation\_3

### 6.5.1 unacknowledgeAlarms (O)

#### 6.5.1.1 Definition

IRPManager invokes this operation to remove acknowledgement information kept in one or more AlarmInformation instances.

#### 6.5.1.2 Input Parameters

| Name                          | Qualifier | Information Type                 | Comment   |
|-------------------------------|-----------|----------------------------------|---|
| alarmInformationReferenceList | M         | List of AlarmInformation.alarmId | It carries one or more identifiers identifying AlarmInformation in AlarmList. |
| ackUserId                     | M         | AlarmInformation.ackUserId       | It identifies the user that invokes this operation.                           |
| ackSystemId                   | O         | AlarmInformation.ackSystemId     | It identifies the processing system on which the subject IRPManager runs.     |

#### 6.5.1.3 Output Parameters

| Name                             | Qualifier | Matching Information  | Comment  |
|----------------------------------|-----------|---|--|
| badAlarmInformationReferenceList | M         | List of pair of AlarmInformation.alarmId and the failure reason.        | If allAlarmsUnacknowledged is true, it contains no information.<br><br>If someAlarmUnacknowledged is true, then it contains identifications of AlarmInformation that are (a) present in input parameter AlarmInformationReferenceList but are absent in the AlarmList; or (b) present in input parameter AlarmInformationReferenceList and are present in the AlarmList but the Acknowledgement Information (see note below table) has not changed, in contrast to IRPManager's request. |
| status                           | M         | ENUM (OperationSucceeded, OperationFailed, OperationPartiallySucceeded) | If someAlarmUnacknowledged is true, status = OperationPartiallySucceeded.<br>If allAlarmsUnacknowledged is true, status = OperationSucceeded.<br>If operation_failed is true, status = OperationFailed.  |

NOTE: Acknowledgement Information is defined as the information contained in AlarmInformation.ackTime, AlarmInformation.ackUserId, AlarmInformation.ackSystemId and AlarmInformation.ackState.

#### 6.5.1.4 Pre-condition

atLeastOneValidId AND validUserId&SystemId.

| Assertion Name       | Definition   |
|----------------------|--|
| atLeastOneValidId    | The AlarmInformationReferenceList contains at least one identifier that identifies one AlarmInformation in AlarmList and that this identified AlarmInformation shall have its ackState indicating "acknowledged".              |
| validUserId&SystemId | The values of ackUserId and ackSystemId attributes of the AlarmInformation must be the same as the ones provided as input parameters. The AlarmInformation is identified by the input parameter AlarmInformationReferenceList. |

### 6.5.1.5 Post-condition

someAlarmUnacknowledged OR allAlarmsUnacknowledged.

| Assertion Name          | Definition  |
|-------------------------|---|
| someAlarmUnacknowledged | At least one but not all AlarmInformation identified in input parameter alarmListReferenceList has been unacknowledged. This means that the ackState attribute has been set to "unacknowledged", that ackTime, ackUserId, ackSystemId attributes of this AlarmInformation have been set to containing no information. |
| allAlarmsUnacknowledged | All AlarmInformation identified in input parameter have been unacknowledged. This means that the ackState attribute has been set to "unacknowledged", that ackTime, ackUserId, ackSystemId attributes of this AlarmInformation have been set to contain no information.   |

### 6.5.1.6 Exceptions

| Name             | Definition   |
|------------------|--|
| operation_failed | <b>Condition:</b> Pre-condition is false or post-condition is false.<br><b>Returned Information:</b> The output parameter status.<br><b>Exit state:</b> Entry state. |

## 6.6 Interface AlarmIRPOperation\_4

### 6.6.1 setComment (O)

#### 6.6.1.1 Definition

The IRPManager invokes this operation to record a comment in one or more AlarmInformation instances in AlarmList.

#### 6.6.1.2 Input Parameters

| Name                          | Qualifier | Information Type   | Comment   |
|-------------------------------|-----------|--|---|
| AlarmInformationReferenceList | M         | List of AlarmInformation.alarmId   | It carries one or more identifiers identifying AlarmInformation instances in the AlarmList. |
| commentUserId                 | M         | The Comment.commentUserId where Comment is involved in relation-AlarmInformation-Comment with an AlarmInformation.   |   |
| commentSystemId               | O         | The Comment.commentSystemId where Comment is involved in relation-AlarmInformation-Comment with an AlarmInformation. |   |
| commentText                   | M         | The comment.commentText where Comment is involved in relation-AlarmInformation-Comment with an AlarmInformation.     |   |

### 6.6.1.3 Output Parameter

| Name                               | Qualifier | Matching Information   | Comment  |
|------------------------------------|-----------|--|--|
| badAlarm Information ReferenceList | M         | List of pair of AlarmInformation.alarmId and the failure reason.         | If allUpdated is true, it contains no information.<br><br>If someUpdated is true, then it contains identifications of AlarmInformation that are not present in AlarmList or that they are present, but AlarmInformation.comments has not changed, in contrast to IRPManager's request. |
| Status                             | M         | ENUM( Operation succeeded, Operation failed, Operation partially failed) | If allUpdated is true, then status = OperationSucceeded.<br>If someUpdated is true, then status = OperationPartiallyFailed.<br>If exception operationFailed is raised, then status = OperationFailed.  |

### 6.6.1.4 Pre-condition

atLeastOneValidId.

| Assertion Name    | Properties  |
|-------------------|---|
| atLeastOneValidId | The AlarmInformationReferenceList contains at least one identifier that identifies one AlarmInformation in AlarmList. |

### 6.6.1.5 Post-condition

allUpdated OR someUpdated.

| Assertion Name | Properties  |
|----------------|---|
| allUpdated     | The AlarmInformation.comment of all alarms identified by the input parameter AlarmInformationReferenceList has been updated.<br>The input parameter commentText, commentUserId and commentSystemId are added to the AlarmInformation.comment. The time of the operation invocation is captured in the AlarmInformation.comment as well.<br>To make it possible to add the new comment, the IRPAgent may remove one or more old comment previously held by AlarmInformation.comments.  |
| someUpdated    | The AlarmInformation.comment attribute of at least one but not all alarms identified by the input parameter AlarmInformationReferenceList has been updated.<br>The input parameter commentText, commentUserId and commentSystemId are added to the AlarmInformation.comment. The time of the operation invocation is captured in the AlarmInformation.comment as well.<br>To add a new Comment, it may be necessary to remove one or more old Comment instances being held. The commentTime of the removed Comment instances shall be older than that of the remaining Comment instances. |

### 6.6.1.6 Exceptions

| Name             | Properties   |
|------------------|--|
| operation_failed | <b>Condition:</b> the pre-condition is false or the post-condition is false.<br><b>Returned Information:</b> The output parameter status.<br><b>Exit state:</b> Entry state. |

## 6.7 Interface AlarmIRPNotifications\_1

The present document does not specify methods for IRPManager to detect alarm loss. The use of `alarmId` to detect alarm loss is an arrangement made between IRPAgent and IRPManager. This arrangement is outside the scope of the present document. For example, IRPAgent may use integer sequence (e.g. 1, 2, 3, 4, 5, ...) as `alarmId` instances for its alarms. Based on this knowledge, IRPManager can detect alarm loss. This kind of arrangement may not be possible for all SS.

The present document does not specify how IRPAgent can determine if IRPManager has received alarms correctly. Not all SSs provide such capability.

The present document does not specify methods for IRPManager and IRPAgent to recover alarm loss. The only mechanism recommended to deal with alarm loss is the use of `getAlarmList` operation. The present document does not specify conditions under which IRPManager should invoke this operation.

### 6.7.1 notifyNewAlarm (M)

#### 6.7.1.1 Definition

A new `AlarmInformation` has been added in the `AlarmList`. The subscribed IRPManager instances are notified of this fact if the added `AlarmInformation` satisfies the current filter constraint of their subscription.

#### 6.7.1.2 Input Parameters

| Parameter Name                       | Qualifier | Matching Information   | Comment                                  |
|--------------------------------------|-----------|--|--|
| <code>objectClass</code>             | M,F       | <code>MonitoredEntity.objectClass</code> where the <code>MonitoredEntity</code> is identified by the relation- <code>AlarmedObject-AlarmInformation</code> of the new <code>AlarmInformation</code> .    |  |
| <code>objectInstance</code>          | M,F       | <code>MonitoredEntity.objectInstance</code> where the <code>MonitoredEntity</code> is identified by the relation- <code>AlarmedObject-AlarmInformation</code> of the new <code>AlarmInformation</code> . |  |
| <code>notificationId</code>          | M         | This carries the semantics of notification identifier.   |  |
| <code>eventTime</code>               | M,F       | <code>AlarmInformation.alarmRaisedTime</code>  |  |
| <code>systemDN</code>                | C,F       | IRPAgent. <code>systemDN</code> where the IRPAgent is related to the AlarmIRP that is related to this <code>AlarmList</code> .   | It carries the DN of the IRPAgent.       |
| <code>notificationType</code>        | M,F       | "notifyNewAlarm".  |  |
| <code>probableCause</code>           | M,F       | <code>AlarmInformation.probableCause</code>  |  |
| <code>perceivedSeverity</code>       | M,F       | <code>AlarmInformation.perceivedSeverity</code>  |  |
| <code>alarmType</code>               | M, F      | <code>AlarmInformation.eventType</code>  |  |
| <code>specificProblem</code>         | O         | <code>AlarmInformation.specificProblem</code>  |  |
| <code>correlatedNotifications</code> | O         | The set of <code>CorrelatedNotification</code> related to this <code>AlarmInformation</code> .   |  |
| <code>backedUpStatus</code>          | O         | <code>AlarmInformation.backedUpStatus</code>   |  |
| <code>backUpObject</code>            | O         | <code>MonitoredEntity.objectInstance</code> where the <code>MonitoredEntity</code> is identified by relation- <code>BackUpObject-AlarmInformation</code> of the new <code>AlarmInformation</code> .      | It carries the DN of the back up object. |
| <code>trendIndication</code>         | O         | <code>AlarmInformation.trendIndication</code>  |  |
| <code>thresholdInfo</code>           | O         | <code>AlarmInformation.thresholdInfo</code>  |  |
| <code>stateChangeDefinition</code>   | O         | <code>AlarmInformation.stateChange</code>  |  |
| <code>monitoredAttributes</code>     | O         | <code>AlarmInformation.monitoredAttributes</code>  |  |
| <code>proposedRepairActions</code>   | O         | <code>AlarmInformation.proposedRepairActions</code>  |  |
| <code>additionalText</code>          | O         | <code>AlarmInformation.additionalText</code>   |  |
| <code>additionalInformation</code>   | O         | <code>AlarmInformation.additionalInformation</code>  |  |
| <code>alarmId</code>                 | M         | <code>AlarmInformation.alarmId</code>  |  |

### 6.7.1.3 Triggering Event

#### 6.7.1.3.1 From-state

noMatchedAlarm.

| Assertion Name | Definition   |
|----------------|--|
| noMatchedAlarm | AlarmList does not contain an AlarmInformation that has the following properties:<br>Its matching-criteria-attributes values are identical to that of the newly generated network alarm and<br>It is involved in relation-AlarmObject-AlarmInformation with the same MonitoredEntity as the one identified by the newly generated network alarm. |

#### 6.7.1.3.2 To-state

newAlarmInAlarmList.

| Assertion Name      | Definition   |
|---------------------|--|
| newAlarmInAlarmList | AlarmList contains an AlarmInformation holding information conveyed by the newly generated network alarm. This AlarmInformation is involved in relation-AlarmObject-AlarmInformation with the same MonitoredEntity as the one identified by the newly generated network alarm.<br>The following attributes of the AlarmInformation shall be populated with information in the newly generated alarm.<br>alarmId, notificationId, alarmRaisedTime, eventType, probableCause, perceivedSeverity.<br>The following attributes of the same AlarmInformation shall be populated with information in the newly generated alarm if the information is present (in the newly generated alarm) and if the attribute is supported:<br>specificProblem, backedUpStatus, trendIndication, thresholdInfo, stateChangedDefinition, monitoredAttributes, proposedRepairActions, additionalText, additionalInformation |

## 6.7.2 notifyAckStateChanged (M)

### 6.7.2.1 Definition

The subscribed IRPManager instances are notified regarding changes in alarm Acknowledgement State. The AlarmInformation carried in the notification shall satisfy the current filter constraint of the subscription.

The notification shall contain all parameters that are filterable and are present in the original (related) notifyNewAlarm notification.

The IRPManager and the IRPAgent can acknowledge and unacknowledge alarms as defined by 3GPP TS 32.111-1 [9].



## 6.7.2.2 Input Parameters

| Parameter Name    | Qualifier | Matching Information   | Comment |
|-------------------|-----------|--|---------|
| objectClass       | M,F       | MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-alarmedObject-AlarmInformation of the AlarmInformation.    |         |
| objectInstance    | M,F       | MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-alarmedObject-AlarmInformation of the AlarmInformation. |         |
| notificationId    | M         | This carries the semantics of notification identifier.   |         |
| eventTime         | M,F       | AlarmInformation.ackTime   |         |
| systemDN          | C,F       | IRPAgent.systemDN  |         |
| notificationType  | M,F       | "notifyAckStateChanged"  |         |
| probableCause     | M,F       | AlarmInformation.probableCause   |         |
| perceivedSeverity | M,F       | AlarmInformation.perceivedSeverity   |         |
| alarmType         | M,F       | AlarmInformation.eventType   |         |
| alarmId           | M         | AlarmInformation.alarmId   |         |
| ackTime           | M         | AlarmInformation.ackTime   |         |
| ackState          | M         | AlarmInformation.ackState  |         |
| ackUserId         | M         | AlarmInformation.ackUserId   |         |
| ackSystemId       | O         | AlarmInformation.ackSystemId   |         |

## 6.7.2.3 Triggering Event

### 6.7.2.3.1 From-state

alarmInformationExists.

| Assertion Name         | Definition                                |
|------------------------|---|
| alarmInformationExists | The AlarmInformation exists in AlarmList. |

### 6.7.2.3.2 To-state

alarmAckStateHasChanged.

| Assertion Name          | Definition   |
|-------------------------|--|
| alarmAckStateHasChanged | The AlarmInformation.ackState of the AlarmInformation identified by from-state assertion alarmInformationExists have been updated. Specifically, the following attributes of the subject AlarmInformation are updated.<br>notificationId, ackTime, ackUserId, ackState, ackSystemId. |

## 6.7.3 notifyClearedAlarm (M)

### 6.7.3.1 Definition

IRPAgent notifies The subscribed IRPManager is notified of alarm clearing if the subject AlarmInformation satisfies the optional filter constraint expressed in the subscribe operation.

The notification shall contain all parameters that are filterable and are present in the original (related) notifyNewAlarm notification.

### 6.7.3.2 Input Parameters

| Parameter Name           | Qualifier | Matching Information  | Comment  |
|--------------------------|-----------|---|--|
| objectClass              | M,F       | MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation- AlarmedObject-AlarmInformation of the new AlarmInformation.    |  |
| objectInstance           | M,F       | MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation- AlarmedObject-AlarmInformation of the new AlarmInformation. |  |
| notificationId           | M         | This carries the semantics of notification identifier.  |  |
| eventTime                | M,F       | AlarmInformation.alarmClearedTime   |  |
| systemDN                 | C,F       | IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList.  |  |
| notificationType         | M,F       | "notifyClearedAlarm"  |  |
| probableCause            | M,F       | AlarmInformation.probableCause  |  |
| perceivedSeverity        | M,F       | AlarmInformation.perceivedSeverity  | Its value shall indicate Cleared.  |
| alarmType                | M,F       | AlarmInformation.eventType  |  |
| correlated Notifications | O         | The set of CorrelatedNotification related to this AlarmInformation.   | It contains references to other AlarmInformation instances whose perceivedSeverity levels are Cleared as well. In this way, perceivedSeverity level of multiple AlarmInformation instances can be Cleared by one notification. |
| alarmId                  | M         | AlarmInformation.alarmId  |  |

### 6.7.3.3 Triggering Event

#### 6.7.3.3.1 From-state

alarmMatched AND alarmCleared.

| Assertion Name | Definition  |
|----------------|---|
| alarmMatched   | The matching-criteria-attributes of the newly generated network alarm have values that are identical (matched) with ones in one AlarmInformation in AlarmList and the perceivedSeverity of the matched AlarmInformation is not Cleared. |
| alarmCleared   | The perceivedSeverity of the newly generated network alarm is Cleared.  |

#### 6.7.3.3.2 To-state

AlarmInformationCleared\_1.

| Assertion Name            | Definition  |
|---------------------------|---|
| AlarmInformationCleared_1 | The following attributes of the subject AlarmInformation are updated.<br>notificationId, perceivedSeverity (updated to Cleared),<br>alarmClearedTime. |

## 6.7.4 notifyAlarmListRebuilt (M)

### 6.7.4.1 Definition

The IRPAgent or its related AlarmIRP maintains an AlarmList. They can lose confidence in the integrity of its AlarmList. Under this condition, IRPAgent or its related AlarmIRP or the related AlarmList shall invoke notifyAlarmListRebuilt notification after the AlarmList has been rebuilt.

The IRPAgent can also invoke notifyAlarmListRebuilt notification indicating that part of the AlarmList has been rebuilt. In this case, the notification carries the managed object (MO) instance indicating that the AlarmList only have been rebuilt for alarms concerning this MO and its subordinate MOs. Furthermore, this notification indicates that there is no rebuilt going on for superior MOs of this MO.

### 6.7.4.2 Input Parameters

| Parameter Name   | Qualifier | Matching Information   | Comment  |
|------------------|-----------|--|--|
| objectClass      | M,F       | It carries the IRPAgent.objectClass or alternatively, the object class of another MO.              | If it carries the IRPAgent.objectClass, then all AlarmInformation instances in the AlarmList may have been rebuilt.<br>If it carries the object class of another MO, then all AlarmInformation instances related to the MO and its subordinate MOs may have been rebuilt. The AlarmInformation instances not related to the subject MO and its subordinate MOs are not subject to rebuilt. |
| objectInstance   | M,F       | It carries the IRPAgent.iRPAgentId or alternatively, the id of another MO.                         | If objectClass carries the IRPAgent.objectClass, then this parameter carries the RDN of the IRPAgent whose AlarmList has been rebuilt.<br>If objectClass carries the object class of another MO, then this parameter carries the RDN of the MO instance indicating that the AlarmList only have been rebuilt for alarms concerning that MO and its subordinate MOs.                        |
| notificationId   | M         | This carries the semantics of notification identifier.   |  |
| eventTime        | M,F       | It carries the time when the IRPAgent has rebuilt the AlarmList successfully.                      |  |
| systemDN         | C,F       | IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList. |  |
| notificationType | M,F       | "notifyAlarmListRebuilt".  |  |
| reason           | M         | "Agent-NE communication error", "Agent restarts", "indeterminate".<br>Other values can be added.   | It carries the reason why the IRPAgent has rebuilt the AlarmList.  |

### 6.7.4.3 Triggering Event

#### 6.7.4.3.1 From-state

alarmListRebuilt\_0.

| Assertion Name   | Definition   |
|------------------|--|
| alarmListRebuilt | IRPAgent loses confidence in part or whole of its AlarmList. IRPAgent has initiated procedure to repair its AlarmList. |

#### 6.7.4.3.2 To-state

alarmListRebuilt\_2.

| Assertion Name     | Definition                                       |
|--------------------|--|
| alarmListRebuilt_2 | IRPAgent rebuilt the whole or part of AlarmList. |

## 6.8 Interface AlarmIRPNotification\_2

### 6.8.1 notifyChangedAlarm (O)

#### 6.8.1.1 Definition

The subscribed IRPManager instances are notified regarding changes in AlarmInformation in AlarmList. This notification is only triggered by a change in perceivedSeverity attribute value (except to the value "Cleared"). The AlarmInformation carried in the notification shall satisfy the current filter constraint of the subscription.

The notification shall contain all parameters that are filterable and are present in the original (related) notifyNewAlarm notification.

#### 6.8.1.2 Input Parameters

| Parameter Name    | Qualifier | Matching Information   | Comment |
|-------------------|-----------|--|---------|
| objectClass       | M,F       | MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-alarmedObject-AlarmInformation of the new AlarmInformation.    |         |
| objectInstance    | M,F       | MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-alarmedObject-AlarmInformation of the new AlarmInformation. |         |
| notificationId    | M         | This carries the semantics of notification identifier.   |         |
| eventTime         | M,F       | AlarmInformation.alarmChangedTime  |         |
| systemDN          | C,F       | IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList.   |         |
| notificationType  | M,F       | "notifyChangedAlarm"   |         |
| probableCause     | M,F       | AlarmInformation.probableCause   |         |
| perceivedSeverity | M,F       | AlarmInformation.perceivedSeverity   |         |
| alarmType         | M,F       | AlarmInformation.eventType   |         |
| alarmId           | M         | AlarmInformation.alarmId   |         |

#### 6.8.1.3 Triggering Event

##### 6.8.1.3.1 From-state

alarmMatched AND alarmNotCleared AND alarmChanged.

| Assertion Name  | Definition  |
|-----------------|---|
| alarmMatched    | The matching-criteria-attributes of the newly generated network alarm has values that are identical (matches) with ones in one AlarmInformation in AlarmList. |
| alarmNotCleared | The perceivedSeverity of the newly generated network alarm is not Cleared.  |
| alarmChanged    | The perceivedSeverity of the newly generated network alarm and of the matched AlarmInformation are different.   |

##### 6.8.1.3.2 To-state

informationUpdate.

| Assertion Name    | Definition   |
|-------------------|--|
| informationUpdate | <ul style="list-style-type: none"> <li>The AlarmInformation identified in alarmMatched in from-state has been updated according to the following rules : perceivedSeverity is updated;</li> <li>notificationId is updated;</li> <li>alarmChangedTime is updated;</li> <li>ackTime, ackUserId and ackSystemId are updated to contain no information;</li> <li>ackState is updated to "unacknowledged";</li> </ul> |

## 6.9 Interface AlarmIRPNotification\_3

### 6.9.1 notifyComments (O)

#### 6.9.1.1 Definition

The subscribed IRPManager instances are notified regarding to the addition of Comment instance to an AlarmInformation instance in AlarmList. The AlarmInformation carried in the notification shall satisfy the current filter constraint of the subscription.

The notification shall contain all parameters that are filterable and are present in the original (related) notifyNewAlarm notification.

The IRPManager and the IRPAgent can add comments to instances of AlarmInformation as described in 3GPP TS 32.111-1 [9].

IRPAgent shall support this notification if it supports the operation setComment.

#### 6.9.1.2 Input Parameters

| Parameter Name    | Qualifier | Matching Information   | Comment |
|-------------------|-----------|--|---------|
| objectClass       | M,F       | MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-alarmedObject-AlarmInformation of the AlarmInformation.    |         |
| objectInstance    | M,F       | MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-alarmedObject-AlarmInformation of the AlarmInformation. |         |
| notificationId    | M         | This carries the semantics of notification identifier.   |         |
| eventTime         | M,F       | AlarmInformation.alarmChangedTime  |         |
| systemDN          | C,F       | IRPAgent.systemDN  |         |
| notificationType  | M,F       | "notifyComments"   |         |
| alarmType         | M,F       | AlarmInformation.eventType   |         |
| probableCause     | M,F       | AlarmInformation.probableCause   |         |
| perceivedSeverity | M,F       | AlarmInformation.perceivedSeverity   |         |
| comments          | M         | The set of Comment instances involved in a relationship with this AlarmInformation.  |         |
| alarmId           | M         | AlarmInformation.alarmId   |         |

#### 6.9.1.3 Triggering Events

##### 6.9.1.3.1 From-state

alarmInformationExists.

| Assertion Name         | Definition                            |
|------------------------|---------------------------------------|
| alarmInformationExists | The AlarmInformation is in AlarmList. |

##### 6.9.1.3.2 To-state

commentInserted.

| Assertion Name  | Definition  |
|-----------------|---|
| commentInserted | One Comment has been created and it is involved in a relationship with the AlarmInformation identified by from-state assertion alarmInformationExists. The following attributes of the newly created Comment instance shall be populated:<br>commentTime, commentText, commentUserId and commentSystemId. |

## Annex A (normative): Event Types

This annex lists and explains event types used by the present document.

Event type is defined in TS 32.302 [5]. Table A.1 lists some of the event types referred to in the present document.

Notification IRP: Information Service [5] defines a parameter called `notificationType` that shall be present in all notification. The present document defines a parameter called `alarmType` that shall be present in all notifications carrying alarm information. Examples of the `notificationType` are "notification of new alarm", "notification of AlarmList rebuilt", "notification of alarm cleared", etc. Examples of the `alarmType` are the event types defined in table A.1.

The present document also defines an attribute of `AlarmInformation` called `eventType`. The mapping of this `eventType` (internal attribute and not visible to `IRPManager`) to `notificationType` or `alarmType` (both visible to `IRPManager`) is defined in relevant sections of the present document. The choice of using "eventType" is to keep the list of attributes of `AlarmList` unchanged (compared to Release 99). One can replace this `eventType` with two attributes, called `notificationType` and `alarmType` so that mapping of these two attributes to the externally visible parameters of the same name will be straight-forward.

It is noted that the `AlarmInformation.eventType` can capture more information than the ITU-T defined event types [2]. One example is "notification of alarm list rebuilt".

It is noted that the mapping of the IS `notificationType` and `alarmType` to CMIP's event type or CORBA `event_name` or other fields are specified in the respective SS documents.

**Table A.1: Event Types**

| Event Types              | Explanation  |
|--------------------------|--|
| Communications Alarm     | An alarm of this type is associated with the procedure and/or process required conveying information from one point to another (ITU-T Recommendation X.733 [2]). |
| Processing Error Alarm   | An alarm of this type is associated with a software or processing fault (ITU-T Recommendation X.733 [2]).  |
| Environmental Alarm      | An alarm of this type is associated with a condition related to an enclosure in which the equipment resides (ITU-T Recommendation X.733 [2]).                    |
| Quality of Service Alarm | An alarm of this type is associated with degradation in the quality of a service (ITU-T Recommendation X.733 [2]).   |
| Equipment Alarm          | An alarm of this type is associated with an equipment fault (ITU-T Recommendation X.733 [2]).  |

## Annex B (normative): Probable Causes

This annex lists probable causes and their corresponding event types.

Sources of these probable causes are ITU-T Recommendation M.3100 [11], ITU-T Recommendation X.721 [3], ITU-T Recommendation X.733 [2], ITU-T Recommendation X.736 [15] and GSM 12.11 [4].

The list may be extended in the future, e.g. with UMTS-specific probable causes.

**Table B.1: Probable Causes from ITU-T Recommendation M.3100 [11]**

| M.3100 Probable cause            | Event type     |
|----------------------------------|----------------|
| Indeterminate                    | Unknown        |
| Alarm Indication Signal (AIS)    | Communications |
| Broadcast Channel Failure        | Communications |
| Call Setup Failure               | Communications |
| Communications Receive Failure   | Communications |
| Communications Transmit Failure  | Communications |
| Connection Establishment Error   | Communications |
| Degraded Signal                  | Communications |
| Demodulation Failure             | Communications |
| Far End Receiver Failure (FERF)  | Communications |
| Framing Error                    | Communications |
| Invalid Message Received         | Communications |
| Local Node Transmission Error    | Communications |
| Loss Of Frame (LOF)              | Communications |
| Loss Of Pointer (LOP)            | Communications |
| Loss Of Signal (LOS)             | Communications |
| Modulation Failure               | Communications |
| Payload Type Mismatch            | Communications |
| Transmission Error               | Communications |
| Remote Alarm Interface           | Communications |
| Remote Node Transmission Error   | Communications |
| Routing Failure                  | Communications |
| Excessive Bit Error Rate (EBER)  | Communications |
| Path Trace Mismatch              | Communications |
| Unavailable                      | Communications |
| Signal Label Mismatch            | Communications |
| Loss Of Multi Frame              | Communications |
| Antenna Failure                  | Equipment      |
| Back Plane Failure               | Equipment      |
| Battery Charging Failure         | Equipment      |
| Data Set Problem                 | Equipment      |
| Disk Failure                     | Equipment      |
| Equipment Identifier Duplication | Equipment      |
| External IF Device Problem       | Equipment      |
| Frequency Hopping Failure        | Equipment      |
| IO Device Error                  | Equipment      |
| Line Card Problem                | Equipment      |
| Loss Of Redundancy               | Equipment      |
| Loss Of Synchronisation          | Equipment      |
| Multiplexer Problem              | Equipment      |
| NE Identifier Duplication        | Equipment      |
| Power Problem                    | Equipment      |
| Power Supply Failure             | Equipment      |
| Processor Problem                | Equipment      |
| Protection Path Failure          | Equipment      |
| Protecting Resource Failure      | Equipment      |
| Protection Mechanism Failure     | Equipment      |
| Real Time Clock Failure          | Equipment      |
| Receiver Failure                 | Equipment      |

| <b>M.3100 Probable cause</b>         | <b>Event type</b>  |
|--------------------------------------|--------------------|
| Replaceable Unit Missing             | Equipment          |
| Replaceable Unit Type Mismatch       | Equipment          |
| Signal Quality Evaluation Failure    | Equipment          |
| Synchronisation Source Mismatch      | Equipment          |
| Terminal Problem                     | Equipment          |
| Timing Problem                       | Equipment          |
| Transceiver Failure                  | Equipment          |
| Transmitter Failure                  | Equipment          |
| Trunk Card Problem                   | Equipment          |
| Replaceable Unit Problem             | Equipment          |
| Air Compressor Failure               | Environmental      |
| Air Conditioning Failure             | Environmental      |
| Air Dryer Failure                    | Environmental      |
| Battery Discharging                  | Environmental      |
| Battery Failure                      | Environmental      |
| Commercial Power Failure             | Environmental      |
| Cooling Fan Failure                  | Environmental      |
| Cooling System Failure               | Environmental      |
| Engine Failure                       | Environmental      |
| Fire Detector Failure                | Environmental      |
| Fuse Failure                         | Environmental      |
| Generator Failure                    | Environmental      |
| Low Battery Threshold                | Environmental      |
| Pump Failure                         | Environmental      |
| Rectifier Failure                    | Environmental      |
| Rectifier High Voltage               | Environmental      |
| Rectifier Low F Voltage              | Environmental      |
| Ventilation System Failure           | Environmental      |
| Enclosure Door Open                  | Environmental      |
| Explosive Gas                        | Environmental      |
| External Equipment Failure           | Environmental      |
| External Point Failure               | Environmental      |
| Fire                                 | Environmental      |
| Flood                                | Environmental      |
| High Humidity                        | Environmental      |
| High Temperature                     | Environmental      |
| High Wind                            | Environmental      |
| Ice Build Up                         | Environmental      |
| Intrusion Detection                  | Environmental      |
| Low Fuel                             | Environmental      |
| Low Humidity                         | Environmental      |
| Low Cable Pressure                   | Environmental      |
| Low Temperature                      | Environmental      |
| Low Water                            | Environmental      |
| Smoke                                | Environmental      |
| Toxic Gas                            | Environmental      |
| Application Subsystem Failure        | Processing Error   |
| Configuration Or Customisation Error | Processing Error   |
| Database Inconsistency               | Processing Error   |
| File Error                           | Processing Error   |
| Storage Capacity Problem             | Processing Error   |
| Memory Mismatch                      | Processing Error   |
| Corrupt Data                         | Processing Error   |
| Loss of Real Time                    | Processing Error   |
| Out Of CPU Cycles                    | Processing Error   |
| Out Of Memory                        | Processing Error   |
| Reinitialized                        | Processing Error   |
| Software Environment Problem         | Processing Error   |
| Software Error                       | Processing Error   |
| Software Download Failure            | Processing Error   |
| Timeout Expired                      | Processing Error   |
| Underlying Resources Unavailable     | Processing Error   |
| Version Mismatch                     | Processing Error   |
| Bandwidth Reduced                    | Quality of service |



| M.3100 Probable cause         | Event type         |
|-------------------------------|--------------------|
| Congestion                    | Quality of service |
| Excessive Error Rate          | Quality of service |
| Excessive Response Time       | Quality of service |
| Excessive Retransmission Rate | Quality of service |
| Reduced Logging Capability    | Quality of service |
| System Resources Overload     | Quality of service |

Table B.2: Probable Causes from ITU-T Recommendation X.721 [3] / ITU-T Recommendation X.733 [2]

| X.733 Probable Cause                             | Event type         |
|--|--------------------|
| Adapter Error                                    | Equipment          |
| Application Subsystem Failure                    | Processing error   |
| Bandwidth Reduction                              | Quality of service |
| Call Establishment Error                         | Communications     |
| Communication Protocol Error                     | Communications     |
| Communication Subsystem Failure                  | Communications     |
| Configuration or Customizing Error               | Processing error   |
| Congestion                                       | Quality of service |
| Corrupt Data                                     | Processing error   |
| CPU Cycles Limit Exceeded                        | Processing error   |
| Data Set or Modem Error                          | Equipment          |
| Degraded Signal                                  | Communications     |
| DTE-DCE Interface Error                          | Communications     |
| Enclosure Door Open                              | Environmental      |
| Equipment Malfunction                            | Equipment          |
| Excessive Vibration                              | Environmental      |
| File Error                                       | Processing error   |
| Fire Detected                                    | Environmental      |
| Flood Detected                                   | Environmental      |
| Framing Error                                    | Communications     |
| Heating or Ventilation or Cooling System Problem | Environmental      |
| Humidity Unacceptable                            | Environmental      |
| Input/Output Device Error                        | Equipment          |
| Input Device Error                               | Equipment          |
| LAN Error  | Communications     |
| Leak Detection                                   | Environmental      |
| Local Node Transmission Error                    | Communications     |
| Loss of Frame                                    | Communications     |
| Loss of Signal                                   | Communications     |
| Material Supply Exhausted                        | Environmental      |
| Multiplexer Problem                              | Equipment          |
| Out of Memory                                    | Processing error   |
| Output Device Error                              | Equipment          |
| Performance Degraded                             | Quality of service |
| Power Problem                                    | Equipment          |
| Pressure Unacceptable                            | Environmental      |
| Processor Problem                                | Equipment          |
| Pump Failure                                     | Environmental      |
| Queue Size Exceeded                              | Quality of service |
| Receive Failure                                  | Equipment          |
| Receiver Failure                                 | Equipment          |
| Remote Node Transmission Error                   | Communications     |
| Resource at or Nearing Capacity                  | Quality of service |
| Response Time Excessive                          | Quality of service |
| Re-transmission Rate Excessive                   | Quality of service |
| Software Error                                   | Processing error   |
| Software Program Abnormally Terminated           | Processing error   |
| Software Program Error                           | Processing error   |
| Storage Capacity Problem                         | Processing error   |
| Temperature Unacceptable                         | Environmental      |
| Threshold Crossed                                | Quality of service |
| Timing Problem                                   | Equipment          |
| Toxic Leak Detected                              | Environmental      |

| X.733 Probable Cause            | Event type       |
|---------------------------------|------------------|
| Transmit Failure                | Equipment        |
| Transmitter Failure             | Equipment        |
| Underlying Resource Unavailable | Processing error |
| Version Mismatch                | Processing error |

Table B.3: Probable Causes from GSM 12.11 [4]

| GSM 12.11 Probable Cause                | Event Type       |
|---|------------------|
| A-bis to BTS interface failure          | Equipment        |
| A-bis to TRX interface failure          | Equipment        |
| Antenna problem                         | Equipment        |
| Battery breakdown                       | Equipment        |
| Battery charging fault                  | Equipment        |
| Clock synchronisation problem           | Equipment        |
| Combiner problem                        | Equipment        |
| Disk problem                            | Equipment        |
| Equipment failure                       | Equipment        |
| Excessive receiver temperature          | Equipment        |
| Excessive transmitter output power      | Equipment        |
| Excessive transmitter temperature       | Equipment        |
| Frequency hopping degraded              | Equipment        |
| Frequency hopping failure               | Equipment        |
| Frequency redefinition failed           | Equipment        |
| Line interface failure                  | Equipment        |
| Link failure                            | Equipment        |
| Loss of synchronisation                 | Equipment        |
| Lost redundancy                         | Equipment        |
| Mains breakdown with battery back-up    | Equipment        |
| Mains breakdown without battery back-up | Equipment        |
| Power supply failure                    | Equipment        |
| Receiver antenna fault                  | Equipment        |
| Receiver Failure                        | Equipment        |
| Receiver multicoupler failure           | Equipment        |
| Reduced transmitter output power        | Equipment        |
| Signal quality evaluation fault         | Equipment        |
| Timeslot hardware failure               | Equipment        |
| Transceiver problem                     | Equipment        |
| Transcoder problem                      | Equipment        |
| Transcoder or rate adapter problem      | Equipment        |
| Transmitter antenna failure             | Equipment        |
| Transmitter antenna not adjusted        | Equipment        |
| Transmitter failure                     | Equipment        |
| Transmitter low voltage or current      | Equipment        |
| Transmitter off frequency               | Equipment        |
| Database inconsistency                  | Processing error |
| File system call unsuccessful           | Processing error |
| Input parameter out of range            | Processing error |
| Invalid parameter                       | Processing error |
| Invalid pointer                         | Processing error |
| Message not expected                    | Processing error |
| Message not initialised                 | Processing error |
| Message out of sequence                 | Processing error |
| System call unsuccessful                | Processing error |
| Timeout expired                         | Processing error |
| Variable out of range                   | Processing error |
| Watch dog timer expired                 | Processing error |
| Cooling system failure                  | Environmental    |
| External equipment failure              | Environmental    |
| External power supply failure           | Environmental    |
| External transmission device failure    | Environmental    |
| Fan failure                             | Environmental    |
| High humidity                           | Environmental    |
| High temperature                        | Environmental    |

| GSM 12.11 Probable Cause       | Event Type         |
|--------------------------------|--------------------|
| Intrusion detected             | Environmental      |
| Low humidity                   | Environmental      |
| Low temperature                | Environmental      |
| Smoke detected                 | Environmental      |
| Excessive Error Rate           | Quality of service |
| Reduced alarm reporting        | Quality of service |
| Reduced event reporting        | Quality of service |
| Reduced logging capability     | Quality of service |
| System resources overload      | Quality of service |
| Broadcast channel failure      | Communications     |
| Connection establishment error | Communications     |
| Invalid message received       | Communications     |
| Invalid MSU received           | Communications     |
| LAPD link protocol failure     | Communications     |
| Local alarm indication         | Communications     |
| Remote alarm indication        | Communications     |
| Routing failure                | Communications     |
| SS7 protocol failure           | Communications     |
| Transmission error             | Communications     |

This table identifies probable causes that are defined by more than one standard. This is for information only.

**Table B.4: Duplicated Probable Causes**

| Duplicated Probable Cause                   | GSM 12.11 | X.721 X.733 | M.3100 | Event Type     |
|---|-----------|-------------|--------|----------------|
| Broadcast Channel Failure                   | X         |             | X      | Communications |
| Call Establishment Failure (X.721/X.733)    |           | X           | X      | Communications |
| Call Setup Failure (M.3100)                 |           |             |        |                |
| Connection Establishment Error              | X         |             | X      | Communications |
| Degraded Signal                             |           | X           | X      | Communications |
| Framing Error                               |           | X           | X      | Communications |
| Invalid Message Received                    | X         |             | X      | Communications |
| Local Node Transmission Error               |           | X           | X      | Communications |
| Loss of Frame                               |           | X           | X      | Communications |
| Loss of Signal                              |           | X           | X      | Communications |
| Remote Node Transmission Error              |           | X           | X      | Communications |
| Routing Failure                             | X         |             | X      | Communications |
| Antenna Failure (M.3100)                    | X         |             | X      | Equipment      |
| Antenna Problem (GSM 12.11)                 |           |             |        |                |
| Battery Charging Failure (M.3100)           | X         |             | X      | Equipment      |
| Battery Charging Fault (GSM 12.11)          |           |             |        |                |
| Disk Failure (M.3100)                       | X         |             | X      | Equipment      |
| Disk Problem (GSM 12.11)                    |           |             |        |                |
| Equipment Failure (GSM 12.11)               | X         | X           |        | Equipment      |
| Equipment Malfunction (X.721/X.733)         |           |             |        |                |
| Frequency Hopping Failure                   | X         |             | X      | Equipment      |
| IO Device Error (M.3100)                    |           | X           | X      | Equipment      |
| Input/Output Device Error (X.721/X.733)     |           |             |        |                |
| Loss Of Redundancy (M.3100)                 | X         |             | X      | Equipment      |
| Lost Redundancy (GSM 12.11)                 |           |             |        |                |
| Loss Of Synchronisation                     | X         |             | X      | Equipment      |
| Multiplexer Problem                         |           | X           | X      | Equipment      |
| Power Problem                               |           | X           | X      | Equipment      |
| Power Supply Failure                        | X         |             | X      | Equipment      |
| Processor Problem                           |           | X           | X      | Equipment      |
| Receiver Failure                            | X         | X           | X      | Equipment      |
| Signal Quality Evaluation Failure (M.3100)  | X         |             | X      | Equipment      |
| Signal Quality Evaluation Fault (GSM 12.11) |           |             |        |                |
| Timing Problem                              |           | X           | X      | Equipment      |
| Transceiver Failure (M.3100)                | X         |             | X      | Equipment      |
| Transceiver Problem (GSM 12.11)             |           |             |        |                |
| Transmitter Failure                         | X         | X           | X      | Equipment      |
| Cooling System Failure                      | X         |             | X      | Environmental  |

| Duplicated Probable Cause   | GSM 12.11 | X.721 X.733 | M.3100 | Event Type   |
|---|-----------|-------------|--------|--|
| External Equipment Failure  | X         |             | X      | Environmental  |
| Enclosure Door Open   |           | X           | X      | Environmental  |
| Fan Failure (GSM 12.11)<br>Cooling Fan Failure (M.3100)   | X         |             | X      | Environmental  |
| Fire Detected (X.721/X.733)<br>Fire (M.3100)  |           | X           | X      | Environmental  |
| Flood Detected (X.721/X.733)<br>Flood (M.3100)  |           | X           | X      | Environmental  |
| High Humidity   | X         |             | X      | Environmental  |
| High Temperature  | X         |             | X      | Environmental  |
| Intrusion Detected (GSM 12.11)<br>Intrusion Detection (X.736/M.3100)                              | X         |             | X      | Environmental  |
| Low Humidity  | X         |             | X      | Environmental  |
| Low Temperature   | X         |             | X      | Environmental  |
| Pump Failure  |           | X           | X      | Environmental  |
| Smoke Detected (GSM 12.11)<br>Smoke (M.3100)  | X         |             | X      | Environmental  |
| Application Subsystem Failure   |           | X           | X      | Processing Error   |
| Bandwidth Reduced<br>Bandwidth Reduction (X.721/X.733)  |           | X           | X      | Quality of Service   |
| Configuration or Customisation Error (M.3100)<br>Configuration or Customizing Error (X.721/X.733) |           | X           | X      | Processing Error   |
| Database Inconsistency  | X         |             | X      | Processing Error   |
| File Error  |           | X           | X      | Processing Error   |
| Storage Capacity Problem  |           | X           | X      | Processing Error   |
| Excessive Bit Error Rate (M.3100)<br>Excessive Error Rate (GSM 12.11)<br>Excessive Error Rate     | X         |             | X      | Communications (M.3100)<br>Quality of Service (GSM 12.11/M.3100) |
| Corrupt Data  |           | X           | X      | Processing Error   |
| Out Of Memory   |           | X           | X      | Processing Error   |
| Software Error  |           | X           | X      | Processing Error   |
| Timeout Expired   | X         |             | X      | Processing Error   |
| Underlying Resource Unavailable (M.3100)<br>Underlying Resource Unavailable (X.721/X.733)         |           | X           | X      | Processing Error   |
| Version Mismatch  |           | X           | X      | Processing Error   |
| Congestion  |           | X           | X      | Quality of Service   |
| Reduced Logging Capability  | X         |             | X      | Quality of Service   |
| System Resources Overload   | X         |             | X      | Quality of Service   |
| Excessive Response Time (M.3100)<br>Response Time Excessive (X.721/X.733)                         |           | X           | X      | Quality of Service   |
| Excessive Retransmission Rate (M.3100)<br>Re-Transmission Rate Excessive (X.721/X.733)            |           | X           | X      | Quality of Service   |

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## Annex C (informative): Examples of using notifyChangedAlarm

This annex describes a number of valid and invalid interactions governing the case when IRPAgent is reporting a specific fault of a particular network resource whose alarm severity level changes from, e.g. "Critical" to "Minor" and then to "Cleared".

In the following examples:

ni is notificationId,  
moc is managedObjectClass,  
moi is managedObjectInstance,  
et is eventType,  
pc is probableCause,  
sp is specificProblem,  
ps is perceivedSeverity and  
ai is alarmId.

EXAMPLE 1: Valid sequence 1 to support the hypothetical case:

(1) NotifyNewAlarm

(ni=1, ai=X, moc=A, moi=B, et=C, pc=D, sp=E, ps=Critical)

(2) NotifyChangedAlarm

(ni=2, ai=X, moc=A, moi=B, et=C, pc=D, sp=E, ps=Minor)

(3) NotifyClearedAlarm

(ni=3, ai=X, moc=A, moi=B, et=C, pc=D, sp=E, ps=Cleared)

EXAMPLE 2: Valid sequence 2 to support the hypothetical case (assuming that the alarm with "ai=X" is acknowledged after either (1) or (2), but before (3)):

(1) NotifyNewAlarm

(ni=1, ai=X, moc=A, moi=B, et=C, pc=D, sp=E, ps=Critical)

(2) NotifyClearedAlarm

(ni=2, ai=X, moc=A, moi=B, et=C, pc=D, sp=E, ps=Cleared)

(3) NotifyNewAlarm

(ni=3, ai=Y, moc=A, moi=B, et=C, pc=D, sp=E, ps=Minor)

NotifyClearedAlarm

(ni=4, ai=Y, moc=A, moi=B, et=C, pc=D, sp=E, ps=Cleared)

EXAMPLE 3: Invalid sequence 1 to support the hypothetical case:

- (1) NotifyNewAlarm  
(ni=1, ai=X, moc=A, moi=B, et=C, pc=D, sp=E, ps=Critical)
- (2) NotifyChangedAlarm  
(ni=2, ai=Y, moc=A, moi=B, et=C, pc=D, sp=E, ps=Minor)
- (3) NotifyClearedAlarm  
(ni=3, ai=Y, moc=A, moi=B, et=C, pc=D, sp=E, ps=Cleared)

Interaction (2) is illegal since it uses a different ai for the same alarm. It should use ai=X as in interaction (1).

EXAMPLE 4: Invalid sequence 2 to support the hypothetical case:

- (1) NotifyNewAlarm  
(ni=1, ai=X, moc=A, moi=B, et=C, pc=D, sp=E, ps=Critical)
- (2) NotifyNewAlarm  
(ni=2, ai=X, moc=A, moi=B, et=C, pc=D, sp=E, ps=Minor)

Interaction (2) is illegal since it invokes notifyNewAlarm using same ai value. It should use notifyChangedAlarm with the same ai value.

## Annex D (informative): Change history

| Change history |       |           |     |     |  |       |       |
|----------------|-------|-----------|-----|-----|--|-------|-------|
| Date           | TSG # | TSG Doc.  | CR  | Rev | Subject/Comment  | Old   | New   |
| Mar 2000       | SA_07 | SP-000012 | --  | --  | Approved at TSG SA #7 and placed under Change Control  | 2.0.0 | 3.0.0 |
| Mar 2000       | --    | --        | --  | --  | Cosmetic   | 3.0.0 | 3.0.1 |
| Jun 2000       | SA_08 | SP-000250 | 004 | --  | Split of TS - Part 2: Alarm Integration Reference Point (IRP): Information Service (IS)                    | 3.0.1 | 3.1.0 |
| Sep 2000       | --    | --        | --  | --  | Cosmetic   | 3.1.0 | 3.1.1 |
| Sep 2000       | SA_09 | SP-000438 | 001 | --  | Correction of qualifier for SystemDN   | 3.1.1 | 3.2.0 |
| Sep 2000       | SA_09 | SP-000438 | 002 | --  | Addition of a missing constraint in acknowledgeAlarm operation   | 3.1.1 | 3.2.0 |
| Dec 2000       | SA_10 | SP-000520 | 003 | --  | Incorrect modifiable attributes  | 3.2.0 | 3.3.0 |
| Dec 2000       | SA_10 | SP-000520 | 004 | --  | Add acknowledgement information to getAlarmList result   | 3.2.0 | 3.3.0 |
| Dec 2000       | SA_10 | SP-000520 | 005 | --  | Identification of valid Event Types and Extended Event Types within Notifications                          | 3.2.0 | 3.3.0 |
| Dec 2000       | SA_10 | SP-000520 | 006 | --  | A cleared Alarm shall be given perceived severity "Cleared" and nothing else                               | 3.2.0 | 3.3.0 |
| Dec 2000       | SA_10 | SP-000520 | 007 | --  | Inconsistent behaviour for cleared not yet acknowledged alarms   | 3.2.0 | 3.3.0 |
| Jun 2001       | SA_12 | SP-010282 | 008 | --  | Alarm IRP: IS Rel4 - Addition of feature   | 3.3.1 | 4.0.0 |
| Sep 2001       | SA_13 | SP-010474 | 009 | --  | Definition of thresholdInfo in Alarm IRP: IS   | 4.0.0 | 4.1.0 |
| Dec 2001       | SA_14 | SP-010639 | 010 | --  | Correction of notifyChangedAlarm example #2  | 4.1.0 | 4.2.0 |
| Dec 2001       | SA_14 | SP-010639 | 011 | --  | Update of notificationId missing in To-state of notifyClearedAlarm   | 4.1.0 | 4.2.0 |
| Mar 2002       | SA_15 | SP-020028 | 012 | --  | Addition of "perceivedSeverity" as parameter to "acknowledgeAlarms operation" (IS)                         | 4.2.0 | 4.3.0 |
| Mar 2002       | SA_15 | SP-020039 | 013 | --  | Addition of parameter in Alarm List Rebuilt notification   | 4.2.0 | 4.3.0 |
| Mar 2002       | SA_15 | SP-020039 | 014 | --  | Addition of new notification notifyPotentialFaultyAlarmList  | 4.2.0 | 4.3.0 |
| Mar 2002       | SA_15 | SP-020039 | 015 | --  | Additional trigger event for notifyAlarmListRebuilt  | 4.2.0 | 4.3.0 |
| Sep 2002       | SA_17 | SP-020474 | 016 | --  | Remove functionality in the Rel-4 Information Service corresponding to Rel-5 Fault Management requirements | 4.3.0 | 4.4.0 |
| Dec 2002       | SA_18 | SP-020751 | 019 | --  | Add additionalInformation parameter in notification in Alarm IRP: IS                                       | 4.4.0 | 4.5.0 |
| Mar 2003       | SA_19 | SP-030062 | 021 | --  | Add Missing ITU-T M.3100 Probable Causes   | 4.5.0 | 4.6.0 |
| Mar 2003       | SA_19 | SP-030063 | 023 | --  | Corrections regarding Alarm Acknowledgement and Alarm Comments - alignment with 32.111-1                   | 4.5.0 | 4.6.0 |
| Jun 2004       | SA_24 | SP-040241 | 030 | --  | Incorrect alarm interface class diagram  | 4.6.0 | 4.7.0 |
| Mar 2005       | SA_27 | SP-050021 | 039 | --  | Inclusion of additional event types for duplicate probable causes  | 4.7.0 | 4.8.0 |
|                |       |           |     |     |  |       |       |
|                |       |           |     |     |  |       |       |

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## History

| <b>Document history</b> |                |             |
|-------------------------|----------------|-------------|
| V4.0.0                  | June 2001      | Publication |
| V4.1.0                  | September 2001 | Publication |
| V4.2.0                  | December 2001  | Publication |
| V4.3.0                  | March 2002     | Publication |
| V4.4.0                  | September 2002 | Publication |
| V4.5.0                  | December 2002  | Publication |
| V4.6.0                  | March 2003     | Publication |
| V4.7.0                  | June 2004      | Publication |
| V4.8.0                  | March 2005     | Publication |