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 6.4.0 Release 6)
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Foreword

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Foreword

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Version x.y.z

where:

x  the first digit:
   1  presented to TSG for information;
   2  presented to TSG for approval;
   3  or greater indicates TSG approved document under change control.

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.

Introduction

The present document is part of a TS-family covering the 3rd 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)".
32.111-5  "Fault Management; Part 5: Alarm Integration Reference Point (IRP): eXtensible Markup Language (XML) definitions".

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

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.
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 N Interface.

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 Alarm IRP IS 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] 3GPP TS 32.150: "Telecommunication management; Integration Reference Point (IRP) Concept and definitions"


[4] 3GPP TS 32.401 "Telecommunication management; Performance Management (PM); Concept and requirements".

[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".


[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)".


[14] 3GPP TS 32.312: "Telecommunication management; Generic Integration Reference Point (IRP) management; Information Service (IS)".
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**: occurrence that is of significance to network operators, the NEs under surveillance and Network Management applications. Events do not have state.

**IRPAgent**: See 3GPP TS 32.102 [7].

**IRPManager**: See 3GPP TS 32.102 [7].

**IRP document version number string (IRPVersion)**: which identifies a particular IRP solution set specification.

NOTE: 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. Capitalized 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**: which identifies a set of ITU-T Recommendation X.733 [2] defined attributes

NOTE: 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**: which refers to the transport of events from IRPAgent to IRPManager

NOTE: In this IRP, notifications are used to carry alarm information from IRPAgent to IRPManager.

3.2 Abbreviations

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

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIS</td>
<td>Alarm Indication Signal</td>
</tr>
<tr>
<td>BSS</td>
<td>Base Station System</td>
</tr>
<tr>
<td>CM</td>
<td>Configuration Management</td>
</tr>
<tr>
<td>CMIP</td>
<td>Common Management Information</td>
</tr>
<tr>
<td>Protocol</td>
<td></td>
</tr>
<tr>
<td>DN</td>
<td>Distinguished Name</td>
</tr>
<tr>
<td>EBER</td>
<td>Excessive Bit Error Rate</td>
</tr>
<tr>
<td>EM</td>
<td>Element Manager</td>
</tr>
<tr>
<td>FERF</td>
<td>Far End Receiver Failure</td>
</tr>
<tr>
<td>FM</td>
<td>Fault Management</td>
</tr>
<tr>
<td>IOC</td>
<td>Information Object Class</td>
</tr>
<tr>
<td>IRP</td>
<td>Integration Reference Point</td>
</tr>
<tr>
<td>IS</td>
<td>Information Service</td>
</tr>
<tr>
<td>LOF</td>
<td>Loss Of Frame</td>
</tr>
<tr>
<td>LOP</td>
<td>Loss Of Pointer</td>
</tr>
<tr>
<td>LOS</td>
<td>Loss Of Signal</td>
</tr>
<tr>
<td>MO</td>
<td>Managed Object</td>
</tr>
<tr>
<td>MOI</td>
<td>Managed Object Instance</td>
</tr>
<tr>
<td>NE</td>
<td>Network Element</td>
</tr>
<tr>
<td>NM</td>
<td>Network Manager</td>
</tr>
</tbody>
</table>
4 Basic aspects

4.1 Void

4.2 System Context

The general definition of the System Context for the present IRP is found in 3GPP TS 32.150 [1] subclause 4.7.

In addition, the set of related IRP(s) relevant to the present IRP is shown in the two diagrams below.

Figure 1: System Context A

Figure 2: System Context B
5  Information Object Classes

5.1  Information entities imported and local label

<table>
<thead>
<tr>
<th>Label reference</th>
<th>Local label</th>
</tr>
</thead>
<tbody>
<tr>
<td>32.302 [5], information object class, NotificationIRP</td>
<td>NotificationIRP</td>
</tr>
<tr>
<td>32.302 [5], interface, notificationIRP</td>
<td>notificationIRP</td>
</tr>
<tr>
<td>32.622 [10], information object class, IRPAgent</td>
<td>IRPAgent</td>
</tr>
<tr>
<td>32.312 [14], information object class, ManagedGenericIRP</td>
<td>ManagedGenericIRP</td>
</tr>
</tbody>
</table>

5.2  Class diagram

This 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 clause provides the overview of all support object classes in UML. Subsequent clauses provide more detailed specification of various aspects of these support object classes.
5.2.1 Attributes and relationships

Figure:
5.2.2 Inheritance

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

<table>
<thead>
<tr>
<th>Attribute name</th>
<th>Support Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmId</td>
<td>M</td>
</tr>
<tr>
<td>notificationId (note 1)</td>
<td>M</td>
</tr>
<tr>
<td>alarmRaisedTime</td>
<td>M</td>
</tr>
<tr>
<td>alarmClearedTime</td>
<td>M</td>
</tr>
<tr>
<td>alarmChangedTime</td>
<td>M</td>
</tr>
<tr>
<td>eventType</td>
<td>O</td>
</tr>
<tr>
<td>vendorSpecificAlarmType</td>
<td>O</td>
</tr>
<tr>
<td>probableCause</td>
<td>M</td>
</tr>
<tr>
<td>perceivedSeverity</td>
<td>M</td>
</tr>
<tr>
<td>specificProblem</td>
<td>O</td>
</tr>
<tr>
<td>backedUpStatus</td>
<td>O</td>
</tr>
<tr>
<td>trendIndication</td>
<td>O</td>
</tr>
<tr>
<td>thresholdInfo</td>
<td>O</td>
</tr>
<tr>
<td>stateChangedDefinition</td>
<td>O</td>
</tr>
<tr>
<td>monitoredAttributes</td>
<td>O</td>
</tr>
<tr>
<td>proposedRepairActions</td>
<td>O</td>
</tr>
<tr>
<td>additionalText</td>
<td>O</td>
</tr>
<tr>
<td>additionalInformation</td>
<td>O</td>
</tr>
<tr>
<td>ackTime</td>
<td>M</td>
</tr>
<tr>
<td>ackUserId</td>
<td>M</td>
</tr>
<tr>
<td>clearSystemId</td>
<td>O (see note 2)</td>
</tr>
<tr>
<td>ackSystemId</td>
<td>M</td>
</tr>
<tr>
<td>ackState</td>
<td>O</td>
</tr>
<tr>
<td>clearUserId</td>
<td>M (see note 2)</td>
</tr>
<tr>
<td>serviceUser</td>
<td>O (see note 3)</td>
</tr>
<tr>
<td>serviceProvider</td>
<td>O (see note 3)</td>
</tr>
<tr>
<td>securityAlarmDetector</td>
<td>O (see note 3)</td>
</tr>
</tbody>
</table>

**NOTE 1:** 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 getAlarmList() function.

**NOTE 2:** These attributes and qualifiers are applicable only if the IRPAgent supports clearAlarms() (they are absent if clearAlarms() is not supported).

**NOTE 3:** These attributes must be supported if the IRPAgent emits notifyNewAlarm that carries security alarm information.

### 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".
This is the terminal state (acknowledged and cleared)
This AlarmInformation no longer exists in the AlarmList.

Figure:

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 3GPP TS 32.312 [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

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Support Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>commentTime</td>
<td>M</td>
</tr>
<tr>
<td>commentText</td>
<td>M</td>
</tr>
<tr>
<td>commentUserId</td>
<td>M</td>
</tr>
<tr>
<td>commentSystemId</td>
<td>O</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Support Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>source</td>
<td>M</td>
</tr>
<tr>
<td>notificationIdSet</td>
<td>M</td>
</tr>
</tbody>
</table>

5.3.6 MonitoredEntity

5.3.6.1 Definition

It encapsulates a subset of information of an IOC that can emit alarms. The types of IOCs that can emit alarms are:

a) All NRM IRP IOCs whose notification tables include alarm notifications.

b) VSE subclass of 3GPP defined IOCs and VSE defined IOCs in case alarm is caused by these IOCs.

NOTE: The use of VsDataContainer for emitting alarm is for further study.
The objectClass and objectInstance of the notification carrying alarms shall identify the suitable and precise object to help IRPManager get as detailed as possible alarm source information and locate alarms accurately.

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>identifyAlarmIRP</td>
<td>It represents the capability to obtain the identities of one or more AlarmIRP.</td>
</tr>
<tr>
<td>identifyAlarmList</td>
<td>It represents the capability to obtain the identify of one AlarmList.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>theAlarmInformation</td>
<td>It represents the AlarmInformation.</td>
</tr>
<tr>
<td>identifyAlarmInformation</td>
<td>It represents a capability to obtain the information contained in AlarmInformation.</td>
</tr>
</tbody>
</table>

5.4.2.3 Constraint

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>inv_hasAlarmInformation1</td>
<td>No AlarmInformation playing the role of the AlarmInformation shall have its perceivedSeverity = &quot;cleared&quot; and its ackState = &quot;acknowledged&quot;.</td>
</tr>
<tr>
<td>inv_hasAlarmInformation2</td>
<td>The alarmId of all AlarmInformation instances playing the role of the AlarmInformation are distinct.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>theAlarmInformation</td>
<td>It represents the AlarmInformation.</td>
</tr>
<tr>
<td>identifyComment</td>
<td>It represents a capability to obtain the information contained in Comment.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>theAlarmInformation</td>
<td>It represents the AlarmInformation.</td>
</tr>
<tr>
<td>identifyCorrelatedNotification</td>
<td>It represents a capability to obtain the information contained in CorrelatedNotification.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>identifyAlarmedObject</td>
<td>It represents the capability to obtain the identification, in terms of objectClass and objectInstance, of alarmed network resource.</td>
</tr>
<tr>
<td>identifyAlarmInformation</td>
<td>It represents the capability to obtain the identities of AlarmInformation.</td>
</tr>
</tbody>
</table>

5.4.5.3 Constraint

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

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>identifyBackUpObject</td>
<td>It represents a capability to obtain the identification, in terms of objectClass and objectInstance, of the backUpObject.</td>
</tr>
</tbody>
</table>

### 5.4.6.3 Constraint

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>inv_identifyBackUpObject</td>
<td>This relationship is present if and only if the AlarmInformation.backedUpStatus attribute is present and is indicating true.</td>
</tr>
</tbody>
</table>
### 5.5 Information attribute definition

#### 5.5.1 Definition and legal values

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Legal Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmId</td>
<td>It identifies one AlarmInformation in the AlarmList.</td>
<td></td>
</tr>
<tr>
<td>notificationId</td>
<td>It identifies the notification that carries the AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>alarmRaisedTime</td>
<td>It indicates the date and time when the alarm is first raised by the alarmed resource.</td>
<td>All values indicating valid time.</td>
</tr>
<tr>
<td>alarmChangedTime</td>
<td>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.</td>
<td>All values indicating valid time.</td>
</tr>
<tr>
<td>alarmClearedTime</td>
<td>It indicates the date and time when the alarm is Cleared.</td>
<td>All values indicating valid time.</td>
</tr>
<tr>
<td>eventType</td>
<td>It indicates the type of event. See Annex A for information on event type.</td>
<td>See Annex A.</td>
</tr>
<tr>
<td>vendorSpecificAlarmType</td>
<td>It indicates the vendor specific alarm that identifies the NE alarm type or NE related alarm type. It is a vendor specific expression of eventType.</td>
<td>Vendor defined</td>
</tr>
<tr>
<td>probableCause</td>
<td>It qualifies alarm and provides further information than eventType. See Annex B for a complete listing.</td>
<td>See Annex B.</td>
</tr>
<tr>
<td>perceivedSeverity</td>
<td>It indicates the relative level of urgency for operator attention.</td>
<td>Critical, Major, Minor, Warning, Indeterminate, Cleared: see ITU-T Recommendation X.733 [2]. This IRP does not recommend the use of indeterminate.</td>
</tr>
<tr>
<td>specificProblem</td>
<td>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.</td>
<td>Provided by vendor.</td>
</tr>
<tr>
<td>backedUpStatus</td>
<td>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.</td>
<td>All values that carry the semantics of backedUpStatus defined by ITU-T X.733 [2] clause 8.1.2.4.</td>
</tr>
<tr>
<td>trendIndication</td>
<td>It indicates if some observed condition is getting better, worse, or not changing.</td>
<td>&quot;Less severe&quot;, &quot;no change&quot;, &quot;more severe&quot;: see definition in ITU-T Recommendation X.733 [2] clause 8.1.2.6.</td>
</tr>
<tr>
<td>thresholdInfo</td>
<td>It indicates the crossed threshold information such as: The identifier of the monitored attribute whose value has crossed a threshold, The threshold settings, The observed value that have crossed a threshold, etc.</td>
<td>See definition in ITU-T Recommendation X.733 [2] clause 8.1.2.7. See also for information in TS 32.401 [4] subclause 5.6.</td>
</tr>
<tr>
<td>monitoredAttributes</td>
<td>It indicates MO attributes whose value changes are being monitored. See definition in ITU-T Recommendation X.733 [2] clause 8.1.2.11.</td>
<td></td>
</tr>
<tr>
<td>additionalText</td>
<td>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 &quot;user label&quot; attribute of the object class representing the NE in the Generic Network Resource Model [10]. It can contain further information on the alarm.</td>
<td>N/A</td>
</tr>
<tr>
<td>additionalInformation</td>
<td>It contains information on the alarm and its semantics is outside the scope of this IRP.</td>
<td>N/A</td>
</tr>
<tr>
<td>Name</td>
<td>Definition</td>
<td>Legal Values</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ackTime</td>
<td>It identifies the time when the alarm has been acknowledged or unacknowledged the last time.</td>
<td>All values that indicate valid time that are later than that carried in alarmRaisedTime.</td>
</tr>
<tr>
<td>ackUserId</td>
<td>It identifies the last user who has changed the Acknowledgement State.</td>
<td>It can be used to identify the human operator such as &quot;John Smith&quot; or it can identify a group, such as &quot;Team Six&quot;, or it can contain no information such as &quot;&quot;.</td>
</tr>
<tr>
<td>ackSystemId</td>
<td>It identifies the system (EM or NM) from which the alarm has been acknowledged or unacknowledged the last time.</td>
<td>It can be used to identify the system, such as &quot;system 6&quot; or it can contain no information such as &quot;&quot;.</td>
</tr>
<tr>
<td>ackState</td>
<td>It identifies the Acknowledgement State of the alarm.</td>
<td>Acknowledged: the alarm has been acknowledged.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unacknowledged: the alarm has been unacknowledged or the alarm has never been acknowledged.</td>
</tr>
<tr>
<td>commentTime</td>
<td>It carries the time when the comment has been added to the alarm.</td>
<td></td>
</tr>
<tr>
<td>commentText</td>
<td>It carries the textual comment.</td>
<td></td>
</tr>
<tr>
<td>commentUserId</td>
<td>It carries the identification of the user who made the comment.</td>
<td></td>
</tr>
<tr>
<td>commentSystemId</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>source</td>
<td>It identifies one MonitoredEntity.</td>
<td>All values that carry the semantics of DN.</td>
</tr>
<tr>
<td>notificationIdSet</td>
<td>It carries one or more notification identifiers.</td>
<td></td>
</tr>
<tr>
<td>clearUserId</td>
<td>It carries the identity of the user who invokes the clearAlarms operation.</td>
<td>It can be used to identify the human operator such as &quot;John Smith&quot; or it can identify a group, such as &quot;Team Six&quot;, or it can contain no information such as &quot;&quot;.</td>
</tr>
<tr>
<td>clearSystemId</td>
<td>It carries the identity of the system in which the IRPManager runs. That IRPManager supports the user who invokes the clearAlarms().</td>
<td>It can be used to identify the system, such as &quot;system 6&quot; or it can contain no information such as &quot;&quot;.</td>
</tr>
<tr>
<td>serviceUser</td>
<td>It identifies the service-user whose request for service provided by the serviceProvider led to the generation of the security alarm.</td>
<td>This attribute may carry no information if the server user is not identifiable.</td>
</tr>
<tr>
<td>serviceProvider</td>
<td>It identifies the service-provider whose service is requested by the serviceUser and the service request provokes the generation of the security alarm.</td>
<td></td>
</tr>
<tr>
<td>securityAlarmDetector</td>
<td>It carries the identity of the detector of the security alarm.</td>
<td>This attribute may carry no information if the security alarm detector is not identifiable.</td>
</tr>
</tbody>
</table>

### 5.5.2 Constraints

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>inv_alarmChangedTime</td>
<td>Time indicated shall be later than that carried in alarmRaisedTime.</td>
</tr>
<tr>
<td>inv_alarmClearedTime</td>
<td>Time indicated shall be later than that carried in alarmRaisedTime.</td>
</tr>
<tr>
<td>inv_ackTime</td>
<td>Time indicated shall be later than that carried in alarmRaisedTime.</td>
</tr>
<tr>
<td>inv_notificationId</td>
<td>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.</td>
</tr>
</tbody>
</table>
6 Interface Definition

6.1 Class diagram

![Class diagram of AlarmIRP and related classes and operations]

Figure:

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Information Type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmInformationAndSeverityReferenceList</td>
<td>M</td>
<td>List of AlarmInformation.alarmId and AlarmInformation.perceivedSeverity</td>
<td>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. alarm InformationAndSeverity ReferenceList {alarmId - Mandatory; perceivedSeverity - Optional}</td>
</tr>
<tr>
<td>AckUserId</td>
<td>M</td>
<td>AlarmInformation.ackUserId</td>
<td>It identifies the user acknowledging the alarm.</td>
</tr>
<tr>
<td>ackSystemId</td>
<td>O</td>
<td>AlarmInformation.ackSystemId</td>
<td>It identifies the processing system on which the subject IRPManager runs. It may be absent implying that IRPManager does not wish this information be kept in AlarmInformation in AlarmList.</td>
</tr>
</tbody>
</table>

6.3.1.3 Output Parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>badAlarmInformationReferenceList</td>
<td>M</td>
<td>List of pair of AlarmInformation.alarmId, ENUM (UnknownAlarmId, AcknowledgmentFailed, WrongPerceivedSeverity) and additional failure reason.</td>
<td>If allAlarmsAcknowledged is true, it contains no information. 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).</td>
</tr>
<tr>
<td>status</td>
<td>M</td>
<td>ENUM (OperationSucceeded, OperationFailed, OperationPartiallySucceeded)</td>
<td>If someAlarmAcknowledged is true, status = OperationPartiallySucceeded. If allAlarmsAcknowledged is true, status = OperationSucceeded. If operation_failed is true, status = OperationFailed.</td>
</tr>
</tbody>
</table>

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

**Assertion Name**

<table>
<thead>
<tr>
<th>atLeastOneValidId</th>
</tr>
</thead>
</table>

**Definition**

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

**Assertion Name**

<table>
<thead>
<tr>
<th>someAlarmAcknowledged</th>
<th>allAlarmsAcknowledged</th>
</tr>
</thead>
</table>

**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

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>operation_failed</td>
<td>Condition: Pre-condition is false or post-condition is false. Returned Information: The output parameter status. Exit state: Entry state.</td>
</tr>
</tbody>
</table>

6.3.2 getAlarmList (M)

6.3.2.1 Definition

The IRPManager invokes this operation in order to request the IRPAgent to provide either the complete list of AlarmInformation instances in the AlarmList, including (when supported) the IOC instances associated with the AlarmInformation instances (full alarm alignment), or only a part of this list (partial alarm alignment).

The parameters baseObjectClass and baseObjectInstance are used to identify the part of the alarm list to be returned. If they are absent, then the complete alarm list shall be provided (full alarm alignment). If they identify a certain MO, then only the AlarmInformation instances (and associated IOC instances) related to this MO and its subordinate MOs shall be provided (partial alarm alignment).

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. A method allowing to abort an ongoing alarm alignment process shall be available in the asynchronous mode. 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 3GPP TS 32.302 [5].
### 6.3.2.2 Input Parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Information Type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmAckState</td>
<td>O</td>
<td>ENUM</td>
<td>It carries a constraint. The IRPAgent shall apply it on AlarmInformation instances in AlarmList when constructing its output parameter AlarmInformationList.</td>
</tr>
<tr>
<td>baseObjectClass</td>
<td>O, see note 1</td>
<td>This parameter is either absent or carries the object class of a certain MO. If this parameter is absent, then all AlarmInformation instances in the AlarmList shall be returned. If the parameter carries the object class of a certain MO, then all AlarmInformation instances (and associated IOC instances) of the MO identified by the parameter baseObjectInstance and its subordinate MOs shall be returned. The AlarmInformation instances not related to the subject MO and its subordinate MOs shall not be returned (see note 2).</td>
<td></td>
</tr>
<tr>
<td>baseObjectInstance</td>
<td>O, see note 1</td>
<td>This parameter is either absent or carries the DN of a certain MO. If the objectClass parameter is absent, then this parameter shall be absent. If the baseObjectClass parameter carries the object class of a certain MO, then this parameter shall carry the DN of the related MO instance. The AlarmList has to be returned only for alarms concerning that MO and its subordinate MOs (see note 2).</td>
<td></td>
</tr>
<tr>
<td>filter</td>
<td>O</td>
<td>N/A</td>
<td>It carries a filter constraint. The IRPAgent shall apply it on AlarmInformation instances in AlarmList when constructing its output parameter AlarmInformationList.</td>
</tr>
</tbody>
</table>

**NOTE 1:** If the notification notifyAlarmListRebuilt supports indicating that only a part of the alarm list has been rebuilt then the operation getAlarmList shall support partial alarm alignment.

**NOTE 2:** The legal values of the parameters baseObjectClass and baseObjectInstance are restricted to those carried by the parameters baseObjectClass and baseObjectInstance in the recent notifyAlarmListRebuilt notifications. The timeline for “recent” is vendor-specific.
6.3.2.3 Output Parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlarmInformationList</td>
<td>M</td>
<td>List of AlarmInformation.</td>
<td>It carries the requested AlarmInformation instances including (when supported) the associated IOC instances in AlarmList.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Case when synchronous mode of operation is used:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(a) The IRPAgent shall apply the constraints expressed in alarmAckState and filter to AlarmInformation instances when constructing this output parameter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Case when asynchronous mode of operation is used (i.e. this output parameter is conveyed via notifications):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(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.</td>
</tr>
<tr>
<td>status</td>
<td>M</td>
<td>ENUM</td>
<td>If allAlarmInformationReturned is true, status = OperationSucceeded. If operation_failed is true, status = OperationFailed.</td>
</tr>
</tbody>
</table>

6.3.2.4 Pre-condition

baseObjectExists

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>baseObjectExists</td>
<td>If the parameters baseObjectClass and baseObjectInstance are provided the object identified by them has to exist. If they are not provided this pre-condition is not applicable.</td>
</tr>
</tbody>
</table>

6.3.2.5 Post-condition

allAlarmInformationReturned.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>allAlarmInformationReturned</td>
<td>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.</td>
</tr>
</tbody>
</table>

6.3.2.6 Exceptions

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>operation_failed</td>
<td>Condition: At least one input parameter is invalid or the pre-condition is false or the post-condition is not true. Returned Information: The output parameter status. Exit state: Entry state.</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Information Type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>filter</td>
<td>O</td>
<td>N/A</td>
<td>It carries a filter constraint. The operation shall apply it when counting the AlarmInformation instances in AlarmList.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Case when synchronous mode of operation is used for getAlarmList:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(b) If this parameter is absent, the operation shall count all AlarmInformation instances that satisfy the condition set by input parameter alarmAckState.</td>
</tr>
<tr>
<td>alarmAckState</td>
<td>O</td>
<td>ENUM (all alarms, all active alarms, all active and acknowledged alarms, all cleared and unacknowledged alarms, all unacknowledged alarms)</td>
<td>It carries a constraint. The operation shall apply it on AlarmInformation instances in AlarmList when counting.</td>
</tr>
</tbody>
</table>
6.4.1.3 Output Parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>criticalCount, majorCount, minorCount, warningCount, indeterminateCount, clearedCount</td>
<td>M</td>
<td>N/A</td>
<td>They carry the number of AlarmInformation in AlarmList that has the following properties. Case when synchronous mode of operation is used: (a) The operation shall apply the constraint expressed in alarmAckState and filter to AlarmInformation instances when counting. Case when asynchronous mode of operation is used (i.e. this output parameter is conveyed via notifications): (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. (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.</td>
</tr>
<tr>
<td>status</td>
<td>M</td>
<td>ENUM</td>
<td>If allAlarmInformationCounted is true, status = OperationSucceeded. If operation_failed is true, status = OperationFailed.</td>
</tr>
</tbody>
</table>

6.4.1.4 Pre-condition

There are no pre-conditions.

6.4.1.5 Post-condition

allAlarmInformationCounted.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>allAlarmInformationCounted</td>
<td>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. All AlarmInformation in AlarmList remains unchanged as the result of this operation.</td>
</tr>
</tbody>
</table>

6.4.1.6 Exceptions

<table>
<thead>
<tr>
<th>Name</th>
<th>Condition</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>operation_failed</td>
<td>Condition: the pre-condition is false or the post-condition is true. Returned Information: The output parameter status. Exit state: Entry state.</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Information Type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmInformationReferenceList</td>
<td>M</td>
<td>List of</td>
<td>It carries one or more identifiers identifying AlarmInformation in AlarmList.</td>
</tr>
<tr>
<td>ackUserId</td>
<td>M</td>
<td>AlarmInformation.ackUserId</td>
<td>It identifies the user that invokes this operation.</td>
</tr>
<tr>
<td>ackSystemId</td>
<td>O</td>
<td>AlarmInformation.ackSystemId</td>
<td>It identifies the processing system on which the subject IRPManager runs.</td>
</tr>
</tbody>
</table>

6.5.1.3 Output Parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>badAlarmInformationReferenceList</td>
<td>M</td>
<td>List of pair of</td>
<td>If allAlarmsUnacknowledged is true, it contains no information. 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.</td>
</tr>
<tr>
<td>status</td>
<td>M</td>
<td>ENUM (OperationSucceeded, OperationFailed, OperationPartiallySucceeded)</td>
<td>If someAlarmUnacknowledged is true, status = OperationPartiallySucceeded. If allAlarmsUnacknowledged is true, status = OperationSucceeded. If operation_failed is true, status = OperationFailed.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>atLeastOneValidId</td>
<td>The AlarmInformationReferenceList contains at least one identifier that identifies one AlarmInformation in AlarmList and that this identified AlarmInformation shall have its ackState indicating “acknowledged”.</td>
</tr>
<tr>
<td>validUserId&amp;SystemId</td>
<td>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.</td>
</tr>
</tbody>
</table>

6.5.1.5 Post-condition

someAlarmUnacknowledged OR allAlarmsUnacknowledged.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>someAlarmUnacknowledged</td>
<td>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.</td>
</tr>
<tr>
<td>allAlarmsUnacknowledged</td>
<td>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.</td>
</tr>
</tbody>
</table>
6.5.1.6 Exceptions

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>operation_failed</td>
<td><strong>Condition:</strong> Pre-condition is false or post-condition is false.</td>
</tr>
<tr>
<td></td>
<td><strong>Returned Information:</strong> The output parameter status.</td>
</tr>
<tr>
<td></td>
<td><strong>Exit state:</strong> Entry state.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Information Type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlarmInformation ReferenceList</td>
<td>M</td>
<td>List of AlarmInformation.alarmId</td>
<td>It carries one or more identifiers identifying AlarmInformation instances in the AlarmList.</td>
</tr>
<tr>
<td>commentUserId</td>
<td>M</td>
<td>The Comment.commentUserId where Comment is involved in relation-AlarmInformation-Comment with an AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>commentSystemId</td>
<td>O</td>
<td>The Comment.commentSystemId where Comment is involved in relation-AlarmInformation-Comment with an AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>commentText</td>
<td>M</td>
<td>The comment.commentText where Comment is involved in relation-AlarmInformation-Comment with an AlarmInformation.</td>
<td></td>
</tr>
</tbody>
</table>

6.6.1.3 Output Parameter

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>badAlarm Information ReferenceList</td>
<td>M</td>
<td>List of pair of AlarmInformation.alarmId and the failure reason.</td>
<td>If allUpdated is true, it contains no information. 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.</td>
</tr>
<tr>
<td>Status</td>
<td>M</td>
<td>ENUM(Operation succeeded, Operation failed, Operation partially failed)</td>
<td>If allUpdated is true, then status = OperationSucceeded. If someUpdated is true, then status = OperationPartiallyFailed. If exception operationFailed is raised, then status = OperationFailed.</td>
</tr>
</tbody>
</table>

6.6.1.4 Pre-condition

atLeastOneValidId.
### 6.6.1.5 Post-condition

\textit{allUpdated OR someUpdated.}

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>atLeastOneValidId</td>
<td>The AlarmInformationReferenceList contains at least one identifier that identifies one AlarmInformation in AlarmList.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>allUpdated</td>
<td>The AlarmInformation.comment of all alarms identified by the input parameter AlarmInformationReferenceList has been updated. 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. To make it possible to add the new comment, the IRPAgent may remove one or more old comment previously held by AlarmInformation.comments.</td>
</tr>
<tr>
<td>someUpdated</td>
<td>The AlarmInformation.comment attribute of at least one but not all alarms identified by the input parameter AlarmInformationReferenceList has been updated. 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. 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.</td>
</tr>
</tbody>
</table>

### 6.6.1.6 Exceptions

<table>
<thead>
<tr>
<th>Name</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>operation_failed</td>
<td>Condition: the pre-condition is false or the post-condition is false. Returned Information: The output parameter status. Exit state: Entry state.</td>
</tr>
</tbody>
</table>

### 6.7 Interface AlarmIRPOperation_5

#### 6.7.1 clearAlarms (O)

#### 6.7.1.1 Definition

The IRPManager invokes this operation to clear one or more AlarmInformation instances in AlarmList. For example, this operation can be used to support the manual clearing of the ADMC (automatic detection and manual clearing, see also 3GPP TS 32.111-1 [9]) alarms.

#### 6.7.1.2 Input Parameter

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Information Type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmInformationReferenceList</td>
<td>M</td>
<td>List of AlarmInformation.alarmId</td>
<td>It carries one or more identifiers identifying AlarmInformation instances in the AlarmList.</td>
</tr>
<tr>
<td>clearUserId</td>
<td>M</td>
<td>N/A</td>
<td>It identifies the user clearing the alarm.</td>
</tr>
<tr>
<td>clearSystemId</td>
<td>O</td>
<td>N/A</td>
<td>It identifies the processing system on which the subject IRPManager runs. It may be absent implying that IRPManager does not wish this information be known to the IRPAgent.</td>
</tr>
</tbody>
</table>
### 6.7.1.3 Output Parameter

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>badAlarmInformationReferenceList</td>
<td>M</td>
<td>List of pair of AlarmInformation.alarmId and the failure reason.</td>
<td>If allCleared is true, it contains no information. If someCleared is true, then it contains identifications of AlarmInformation that are not present in AlarmList or that are present in AlarmList but remain unchanged, in contrast to IRPManager's request.</td>
</tr>
<tr>
<td>status</td>
<td>M</td>
<td>ENUM(Operation succeeded, Operation failed, Operation partially failed)</td>
<td>If allCleared is true, then status = OperationSucceeded. If someCleared is true, then status = OperationPartiallyFailed. If exception operationFailed is raised, then status = OperationFailed.</td>
</tr>
</tbody>
</table>

### 6.7.1.4 Pre-condition

atLeastOneValidId.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>atLeastOneValidId</td>
<td>The input parameter alarmInformationReferenceList contains at least one identifier that identifies one AlarmInformation in AlarmList.</td>
</tr>
</tbody>
</table>

### 6.7.1.5 Post-condition

allCleared OR someCleared.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>allCleared</td>
<td>The AlarmInformation.perceivedSeverity of all instances identified by the input parameter alarmInformationReferenceList are set to 'cleared'. The AlarmInformation.clearUserId and AlarmInformation.clearSystemId of all instances identified are set with values carried by input parameters clearUserId and clearSystemId respectively.</td>
</tr>
<tr>
<td>someCleared</td>
<td>It has the same properties as allCleared except that it is applicable to one or more but not all instances identified by the input parameter alarmInformationReferenceList.</td>
</tr>
</tbody>
</table>

### 6.7.1.6 Exceptions

<table>
<thead>
<tr>
<th>Name</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>operation_failed</td>
<td>Condition: the pre-condition is false or the post-condition is false. Retruned Information: The output parameter status. Exit state: Entry state.</td>
</tr>
</tbody>
</table>

### 6.8 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.
6.8.1 notifyNewAlarm (M)

6.8.1.1 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.

There are two tables for Input Parameters. If alarmType parameter indicates "Communications Alarm", "Processing Error Alarm", "Environmental Alarm", "Quality Of Service Alarm" or "Equipment Alarm", the first table (see clause 6.8.1.2) shall be applicable for this notifyNewAlarm. If alarmType parameter indicates "Integrity Violation", "Operational Violation", "Physical Violation", "Security Violation" or "Time Domain Violation", the second table (see clause 6.8.1.2a) shall be applicable.

6.8.1.2 Input Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>objectClass</td>
<td>M,F</td>
<td>MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AlarmedObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>objectInstance</td>
<td>M,F</td>
<td>MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AlarmedObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>notificationId</td>
<td>M</td>
<td>This carries the semantics of notification identifier.</td>
<td></td>
</tr>
<tr>
<td>eventTime</td>
<td>M,F</td>
<td>AlarmInformation.alarmRaisedTime</td>
<td></td>
</tr>
<tr>
<td>systemDN</td>
<td>C,F</td>
<td>IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>It carries the DN of the IRPAgent.</td>
<td></td>
</tr>
<tr>
<td>notificationType</td>
<td>M,F</td>
<td>&quot;notifyNewAlarm&quot;</td>
<td></td>
</tr>
<tr>
<td>probableCause</td>
<td>M,F</td>
<td>AlarmInformation.probableCause</td>
<td></td>
</tr>
<tr>
<td>perceivedSeverity</td>
<td>M,F</td>
<td>AlarmInformation.perceivedSeverity</td>
<td></td>
</tr>
<tr>
<td>alarmType</td>
<td>M, F</td>
<td>AlarmInformation.eventType</td>
<td>The notification structure defined by this table is applicable if this parameter indicates &quot;Communications Alarm&quot;, &quot;Processing Error Alarm&quot;, &quot;Environmental Alarm&quot;, &quot;Quality Of Service Alarm&quot; or &quot;Equipment Alarm&quot;.</td>
</tr>
<tr>
<td>vendorSpecificAlarmType</td>
<td>O, F</td>
<td>AlarmInformation.vendorSpecificAlarmType</td>
<td></td>
</tr>
<tr>
<td>specificProblem</td>
<td>O</td>
<td>AlarmInformation.specificProblem</td>
<td></td>
</tr>
<tr>
<td>correlatedNotifications</td>
<td>O</td>
<td>The set of CorrelatedNotification related to this AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>backedUpStatus</td>
<td>O</td>
<td>AlarmInformation.backedUpStatus</td>
<td></td>
</tr>
<tr>
<td>backUpObject</td>
<td>O</td>
<td>MonitoredEntity.objectInstance where the MonitoredEntity is identified by relation-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BackUpObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>It carries the DN of the back up object.</td>
<td></td>
</tr>
<tr>
<td>trendIndication</td>
<td>O</td>
<td>AlarmInformation.trendIndication</td>
<td></td>
</tr>
<tr>
<td>thresholdInfo</td>
<td>O</td>
<td>AlarmInformation.thresholdInfo</td>
<td></td>
</tr>
<tr>
<td>stateChangeDefinition</td>
<td>O</td>
<td>AlarmInformation.stateChange</td>
<td></td>
</tr>
<tr>
<td>monitoredAttributes</td>
<td>O</td>
<td>AlarmInformation.monitoredAttributes</td>
<td></td>
</tr>
<tr>
<td>proposedRepairActions</td>
<td>O</td>
<td>AlarmInformation.proposedRepairActions</td>
<td></td>
</tr>
<tr>
<td>additionalText</td>
<td>O</td>
<td>AlarmInformation.additionalText</td>
<td></td>
</tr>
<tr>
<td>additionalInformation</td>
<td>O</td>
<td>AlarmInformation.additionalInformation</td>
<td></td>
</tr>
<tr>
<td>alarmIid</td>
<td>M</td>
<td>AlarmInformation.alarmIid</td>
<td></td>
</tr>
</tbody>
</table>
### 6.8.1.2a Input Parameters for notification related to security alarm

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>objectClass</td>
<td>M,F</td>
<td>MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-AlarmedObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>objectInstance</td>
<td>M,F</td>
<td>MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-AlarmedObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>notificationId</td>
<td>M</td>
<td>This carries the semantics of notification identifier.</td>
<td></td>
</tr>
<tr>
<td>eventTime</td>
<td>M,F</td>
<td>AlarmInformation.alarmRaisedTime</td>
<td></td>
</tr>
<tr>
<td>SystemDN</td>
<td>C,F</td>
<td>IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList.</td>
<td>It carries the DN of the IRPAgent.</td>
</tr>
<tr>
<td>notificationType</td>
<td>M,F</td>
<td>“notifyNewAlarm”.</td>
<td></td>
</tr>
<tr>
<td>probableCause</td>
<td>M,F</td>
<td>AlarmInformation.probableCause</td>
<td></td>
</tr>
<tr>
<td>perceivedSeverity</td>
<td>M,F</td>
<td>AlarmInformation.perceivedSeverity</td>
<td></td>
</tr>
<tr>
<td>alarmType</td>
<td>M, F</td>
<td>AlarmInformation.eventType</td>
<td></td>
</tr>
<tr>
<td>vendorSpecificAlarmType</td>
<td>O, F</td>
<td>AlarmInformation.vendorSpecificAlarmType</td>
<td></td>
</tr>
<tr>
<td>correlatedNotifications</td>
<td>O</td>
<td>The set of CorrelatedNotification related to this AlarmInformation</td>
<td></td>
</tr>
<tr>
<td>additionalText</td>
<td>O</td>
<td>AlarmInformation.additionalText</td>
<td></td>
</tr>
<tr>
<td>additionalInformation</td>
<td>O</td>
<td>AlarmInformation.additionalInformation</td>
<td></td>
</tr>
<tr>
<td>serviceUser</td>
<td>M</td>
<td>AlarmInformation.serviceUser</td>
<td>This may contain no information if the identity of the service-user (requesting the service) is not known.</td>
</tr>
<tr>
<td>serviceProvider</td>
<td>M</td>
<td>AlarmInformation.serviceProvider</td>
<td>This shall always identify the service-provider receiving a service request, from serviceUser, that provokes the security alarm.</td>
</tr>
<tr>
<td>securityAlarmDetector</td>
<td>M</td>
<td>AlarmInformation.securityAlarmDetector</td>
<td>This may contain no information if the detector of the security alarm is the serviceProvider.</td>
</tr>
<tr>
<td>alarmId</td>
<td>M</td>
<td>AlarmInformation.alarmId</td>
<td></td>
</tr>
</tbody>
</table>

### 6.8.1.3 Triggering Event

#### 6.8.1.3.1 From-state

**noMatchedAlarm.**

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>noMatchedAlarm</td>
<td>AlarmList does not contain an AlarmInformation that has the following properties: Its matching-criteria-attributes values are identical to that of the newly generated network alarm and it is involved in relation-AlarmObject-AlarmInformation with the same MonitoredEntity as the one identified by the newly generated network alarm.</td>
</tr>
</tbody>
</table>
6.8.1.3.2 To-state

newAlarmInAlarmList.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>newAlarmInAlarmList</td>
<td>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. The following attributes of the AlarmInformation shall be populated with information in the newly generated alarm: alarmId, notificationId, alarmRaisedTime, eventType, probableCause, perceivedSeverity. 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: specificProblem, backedUpStatus, trendIndication, thresholdInfo, stateChangedDefinition, monitoredAttributes, proposedRepairActions, additionalText, additionalInformation.</td>
</tr>
</tbody>
</table>

6.8.2 notifyAckStateChanged (M)

6.8.2.1 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].

6.8.2.2 Input Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>objectClass</td>
<td>M,F</td>
<td>MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-AlarmObject-AlarmInformation of the AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>objectInstance</td>
<td>M,F</td>
<td>MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-AlarmObject-AlarmInformation of the AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>notificationId</td>
<td>M</td>
<td>This carries the semantics of notification identifier.</td>
<td></td>
</tr>
<tr>
<td>eventTime</td>
<td>M,F</td>
<td>AlarmInformation.ackTime</td>
<td></td>
</tr>
<tr>
<td>systemDN</td>
<td>C,F</td>
<td>IRPAgent.systemDN</td>
<td></td>
</tr>
<tr>
<td>notificationType</td>
<td>M,F</td>
<td>&quot;notifyAckStateChanged&quot;</td>
<td></td>
</tr>
<tr>
<td>probableCause</td>
<td>M,F</td>
<td>AlarmInformation.probableCause</td>
<td></td>
</tr>
<tr>
<td>perceivedSeverity</td>
<td>M,F</td>
<td>AlarmInformation.perceivedSeverity</td>
<td></td>
</tr>
<tr>
<td>alarmType</td>
<td>M,F</td>
<td>AlarmInformation.eventType</td>
<td></td>
</tr>
<tr>
<td>alarmId</td>
<td>M</td>
<td>AlarmInformation.alarmId</td>
<td></td>
</tr>
<tr>
<td>ackState</td>
<td>M</td>
<td>AlarmInformation.ackState</td>
<td></td>
</tr>
<tr>
<td>ackUserId</td>
<td>M</td>
<td>AlarmInformation.ackUserId</td>
<td>If this AlarmInformation has been acknowledged by a human operator, than this parameter contains the operator identifier. If it has been acknowledged by a System (EM or NM), than this parameter contains the identifier of the System.</td>
</tr>
<tr>
<td>ackSystemId</td>
<td>O</td>
<td>AlarmInformation.ackSystemId</td>
<td>This parameter always contains the identifier of the System (EM or NM) where the acknowledgement request was originated.</td>
</tr>
</tbody>
</table>
6.8.2.3 Triggering Event

6.8.2.3.1 From-state
alarmInformationExists.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmInformationExists</td>
<td>The AlarmInformation exists in AlarmList.</td>
</tr>
</tbody>
</table>

6.8.2.3.2 To-state
alarmAckStateHasChanged.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmAckStateHasChanged</td>
<td>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. notificationId, ackTime, ackUserId, ackState, ackSystemId.</td>
</tr>
</tbody>
</table>

6.8.3 notifyClearedAlarm (M)

6.8.3.1 Definition
IRPAgent notifies the subscribed IRPManager 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.
### 6.8.3.2 Input Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>objectClass</td>
<td>M,F</td>
<td>MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-AlarmedObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>objectInstance</td>
<td>M,F</td>
<td>MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-AlarmedObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>notificationId</td>
<td>M</td>
<td>This carries the semantics of notification identifier.</td>
<td></td>
</tr>
<tr>
<td>eventTime</td>
<td>M,F</td>
<td>AlarmInformation.alarmClearedTime</td>
<td></td>
</tr>
<tr>
<td>systemDN</td>
<td>C,F</td>
<td>IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList.</td>
<td></td>
</tr>
<tr>
<td>notificationType</td>
<td>M,F</td>
<td>“notifyClearedAlarm”</td>
<td></td>
</tr>
<tr>
<td>probableCause</td>
<td>M,F</td>
<td>AlarmInformation.probableCause</td>
<td></td>
</tr>
<tr>
<td>perceivedSeverity</td>
<td>M,F</td>
<td>AlarmInformation.perceivedSeverity Its value shall indicate Cleared.</td>
<td></td>
</tr>
<tr>
<td>alarmType</td>
<td>M,F</td>
<td>AlarmInformation.eventType</td>
<td></td>
</tr>
<tr>
<td>correlated Notifications</td>
<td>O</td>
<td>The set of CorrelatedNotification related to this AlarmInformation.</td>
<td>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.</td>
</tr>
<tr>
<td>clearUserId</td>
<td>O</td>
<td>AlarmInformation.clearUserId</td>
<td>It is present if the AlarmInformation is cleared by the IRPManager using clearAlarms.</td>
</tr>
<tr>
<td>clearSystemId</td>
<td>O</td>
<td>AlarmInformation.clearSystemId</td>
<td>It is present if clearUserId is present and if AlarmInformation.clearSystemId contains information.</td>
</tr>
<tr>
<td>alarmId</td>
<td>M</td>
<td>AlarmInformation.alarmId</td>
<td></td>
</tr>
</tbody>
</table>

### 6.8.3.3 Triggering Event

#### 6.8.3.3.1 From-state

alarmMatchedAndCleared OR clearedByIRPManager.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmMatchedAndCleared</td>
<td>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 AND The perceivedSeverity of the newly generated network alarm is cleared.</td>
</tr>
<tr>
<td>clearedByIRPManager</td>
<td>Reception of a valid clearAlarms operation that identifies the subject AlarmInformation instances. This triggering event shall occur regardless of the perceivedSeverity state of the identified AlarmInformation instances.</td>
</tr>
</tbody>
</table>
6.8.3.3.2 To-state

\[ \text{AlarmInformationCleared}_1 \text{ OR AlarmInformationCleared}_2. \]

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlarmInformationCleared(_1)</td>
<td>Case if From-state is alarmMatchedAndCleared:</td>
</tr>
<tr>
<td></td>
<td>The following attributes of the subject AlarmInformation are updated: notificationId, perceivedSeverity ((\text{updated to } \text{Cleared}),) alarmClearedTime.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>AlarmInformationCleared(_2)</td>
<td>Case if From-state is clearedByIRPManager:</td>
</tr>
<tr>
<td></td>
<td>The following attributes of the subject AlarmInformation are updated: notificationId, perceivedSeverity ((\text{updated to } \text{Cleared}),) alarmClearedTime, alarmClearedUserId, alarmClearedSystemId.</td>
</tr>
</tbody>
</table>

6.8.4 \textbf{notifyAlarmListRebuilt} (M)

6.8.4.1 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.
### 6.8.4.2 Input Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>objectClass</td>
<td>M,F</td>
<td>It carries the IRPAgent.objectClass or alternatively, the object class of another MO.</td>
<td>If it carries the IRPAgent.objectClass, then all AlarmInformation instances in the AlarmList may have been rebuilt. If it carries the object class of another MO, then all AlarmInformation instances of the MO identified by the parameter objectInstance 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.</td>
</tr>
<tr>
<td>objectInstance</td>
<td>M,F</td>
<td>It carries the IRPAgent.iRPAgentId or alternatively, the id of another MO.</td>
<td>If objectClass carries the IRPAgent.objectClass, then this parameter carries the RDN of the IRPAgent whose AlarmList has been rebuilt. 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.</td>
</tr>
<tr>
<td>notificationId</td>
<td>M</td>
<td></td>
<td>This carries the semantics of notification identifier.</td>
</tr>
<tr>
<td>eventTime</td>
<td>M,F</td>
<td></td>
<td>It carries the time when the IRPAgent has rebuilt the AlarmList successfully.</td>
</tr>
<tr>
<td>systemDN</td>
<td>C,F</td>
<td>IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList.</td>
<td></td>
</tr>
<tr>
<td>notificationType</td>
<td>M,F</td>
<td>&quot;notifyAlarmListRebuilt&quot;.</td>
<td>It carries the reason why the IRPAgent has rebuilt the AlarmList. This may carry different reasons than that carried by the immediate previous notifyPotentialFaultyAlarmList.</td>
</tr>
<tr>
<td>reason</td>
<td>M</td>
<td>&quot;Agent-NE communication error&quot;, &quot;Agent restarts&quot;, &quot;indeterminate&quot;. Other values can be added.</td>
<td></td>
</tr>
<tr>
<td>alarmListAlignmentRequirement</td>
<td>O (note)</td>
<td>ENUM (alignmentRequired, alignmentNotRequired)</td>
<td>It carries an enumeration of &quot;alignmentRequired&quot; and &quot;alignmentNotRequired&quot;. IRPAgent uses alignmentRequired to indicate that IRPAgent current AL is not identical to the one that could have been built using (a) IRPAgent AL information at the time it emits the immediate previous notifyPotentialFaultyAlarmList() and (b) the notifications (carrying alarm information) emitted after the previously identified notification and before the subject notification. Otherwise, the IRPAgent uses alignmentNotRequired. When this parameter is absent, it implies alignmentRequired.</td>
</tr>
</tbody>
</table>

**NOTE:** If IRPAgent supports notifyPotentialFaultyAlarmList() notification, it shall support this parameter. If IRPAgent does not support notifyPotentialFaultyAlarmList() notification, it shall not support this parameter.
6.8.4.3 Triggering Event

6.8.4.3.1 From-state

alarmListRebuilt_0 OR alarmListRebuilt_1.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmListRebuilt_0</td>
<td>IRPAgent has cold-started, initialized, re-initialized or rebooted and it has initiated procedure to rebuild its AlarmList.</td>
</tr>
<tr>
<td>alarmListRebuilt_1</td>
<td>IRPAgent loses confidence in part or whole of its AlarmList. IRPAgent has initiated procedure to repair its AlarmList.</td>
</tr>
</tbody>
</table>

6.8.4.3.2 To-state

alarmListRebuilt_2.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmListRebuilt_2</td>
<td>IRPAgent rebuilt the whole or part of AlarmList.</td>
</tr>
</tbody>
</table>

6.9 Interface AlarmIRPNotification_2

6.9.1 notifyChangedAlarm (O)

6.9.1.1 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.

6.9.1.2 Input Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>objectClass</td>
<td>M,F</td>
<td>MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-AlarmedObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>objectInstance</td>
<td>M,F</td>
<td>MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-AlarmedObject-AlarmInformation of the new AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>notificationId</td>
<td>M</td>
<td>This carries the semantics of notification identifier.</td>
<td></td>
</tr>
<tr>
<td>eventTime</td>
<td>M,F</td>
<td>AlarmInformation.alarmChangedTime</td>
<td></td>
</tr>
<tr>
<td>systemDN</td>
<td>C,F</td>
<td>IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList.</td>
<td></td>
</tr>
<tr>
<td>notificationType</td>
<td>M,F</td>
<td>&quot;notifyChangedAlarm&quot;</td>
<td></td>
</tr>
<tr>
<td>probableCause</td>
<td>M,F</td>
<td>AlarmInformation.probableCause</td>
<td></td>
</tr>
<tr>
<td>perceivedSeverity</td>
<td>M,F</td>
<td>AlarmInformation.perceivedSeverity</td>
<td></td>
</tr>
<tr>
<td>alarmType</td>
<td>M,F</td>
<td>AlarmInformation.eventType</td>
<td></td>
</tr>
<tr>
<td>alarmId</td>
<td>M</td>
<td>AlarmInformation.alarmId</td>
<td></td>
</tr>
</tbody>
</table>
6.9.1.3 Triggering Event

6.9.1.3.1 From-state

alarmMatched AND alarmNotCleared AND alarmChanged.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmMatched</td>
<td>The matching-criteria-attributes of the newly generated network alarm has</td>
</tr>
<tr>
<td></td>
<td>values that are identical (matches) with ones in one AlarmInformation in</td>
</tr>
<tr>
<td></td>
<td>AlarmList.</td>
</tr>
<tr>
<td>alarmNotCleared</td>
<td>The perceivedSeverity of the newly generated network alarm is not Cleared.</td>
</tr>
<tr>
<td>alarmChanged</td>
<td>The perceivedSeverity of the newly generated network alarm and of the</td>
</tr>
<tr>
<td></td>
<td>matched AlarmInformation are different.</td>
</tr>
</tbody>
</table>

6.9.1.3.2 To-state

informationUpdate.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>informationUpdate</td>
<td>• The AlarmInformation identified in alarmMatched in from-state has been</td>
</tr>
<tr>
<td></td>
<td>updated according to the following rules: perceivedSeverity is updated;</td>
</tr>
<tr>
<td></td>
<td>• notificationId is updated;</td>
</tr>
<tr>
<td></td>
<td>• alarmChangedTime is updated;</td>
</tr>
<tr>
<td></td>
<td>• ackTime, ackUserId and ackSystemId are updated to contain no information;</td>
</tr>
<tr>
<td></td>
<td>• ackState is updated to &quot;unacknowledged&quot;.</td>
</tr>
</tbody>
</table>

6.10 Interface AlarmIRPNotification_3

6.10.1 notifyComments (O)

6.10.1.1 Definition

The subscribed IRPManager instances are notified regarding to the addition of a Comment instance to an AlarmInformation instance in the 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.
Input Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>objectClass</td>
<td>M,F</td>
<td>MonitoredEntity.objectClass where the MonitoredEntity is identified by the relation-AlarmedObject-AlarmInformation of the AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>objectInstance</td>
<td>M,F</td>
<td>MonitoredEntity.objectInstance where the MonitoredEntity is identified by the relation-AlarmedObject-AlarmInformation of the AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>notificationId</td>
<td>M</td>
<td>This carries the semantics of notification identifier.</td>
<td></td>
</tr>
<tr>
<td>eventTime</td>
<td>M,F</td>
<td>Comment.commentTime of the last Comment added</td>
<td></td>
</tr>
<tr>
<td>systemDN</td>
<td>C,F</td>
<td>IRPAgent.systemDN</td>
<td></td>
</tr>
<tr>
<td>notificationType</td>
<td>M,F</td>
<td>&quot;notifyComments&quot;</td>
<td></td>
</tr>
<tr>
<td>alarmType</td>
<td>M,F</td>
<td>AlarmInformation.eventType</td>
<td></td>
</tr>
<tr>
<td>probableCause</td>
<td>M,F</td>
<td>AlarmInformation.probableCause</td>
<td></td>
</tr>
<tr>
<td>perceivedSeverity</td>
<td>M,F</td>
<td>AlarmInformation.perceivedSeverity</td>
<td></td>
</tr>
<tr>
<td>comments</td>
<td>M</td>
<td>The set of Comment instances involved in a relationship with this AlarmInformation.</td>
<td></td>
</tr>
<tr>
<td>alarmId</td>
<td>M</td>
<td>AlarmInformation.alarmId</td>
<td></td>
</tr>
</tbody>
</table>

6.10.1.3 Triggering Events

6.10.1.3.1 From-state

alarmInformationExists.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarmInformationExists</td>
<td>The AlarmInformation is in AlarmList.</td>
</tr>
</tbody>
</table>

6.10.1.3.2 To-state

commentInserted.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>commentInserted</td>
<td>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: commentTime, commentText, commentUserId and commentSystemId.</td>
</tr>
</tbody>
</table>

6.11 Interface AlarmIRPNotification_4

6.11.1 notifyPotentialFaultyAlarmList (O)

6.11.1.1 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 notifyPotentialFaultyAlarmList. They then can begin to rebuild the faulty AlarmList, if found necessary. After the successful rebuilt or the discovery that rebuilt is not necessary, they shall invoke notifyAlarmListRebuilt notification.

This notification can identify a set of AlarmInformation that is potentially faulty or unreliable. This identification is done in the following way. If the MOI of an AlarmInformation is the same or is a subordinate to the MOI carried in the notification, then the AlarmInformation may be faulty or unreliable.

This notification can identify all the AlarmInformation instances of the AlarmList that are potentially faulty or unreliable. In this case, the notification shall carry a MOI identifying the IRPAgent.
The IRPManager behavior, on reception of this notifyPotentialFaultyAlarmList notification, is not specified. The IRPManager behavior is considered not essential for the specification of the interface itself. However, the following are recommended actions the IRPManager should take, in case it receives this notification.

1) The IRPManager should not perform any task requiring the integrity of the AlarmInformation identified as faulty or unreliable by the subject notification.

2) The IRPManager should not invoke operations that require integrity of the AlarmList such as getAlarmList, acknolwedgeAlarms operations.

6.11.1.2 Input Parameters

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Qualifier</th>
<th>Matching Information</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>objectClass</td>
<td>M,F</td>
<td>It carries the class of the IRPAgent or alternatively, the class of another MO.</td>
<td>If it carries the IRPAgent.objectClass, then all AlarmInformation instances in the AlarmList may not be reliable. If it carries the object class of another MO, then all AlarmInformation instances of the MO identified by the parameter objectInstance and its subordinate MOs may not be reliable. The AlarmInformation instances not related to the subject MO and its subordinate MOs are reliable.</td>
</tr>
<tr>
<td>objectInstance</td>
<td>M,F</td>
<td>It carries the DN of the IRPAgent or alternatively, the DN of another MO.</td>
<td>If objectClass carries the IRPAgent.objectClass, then this parameter carries the DN of the IRPAgent. If objectClass carries the object class of another MO, then this parameter carries the DN of the MO instance.</td>
</tr>
<tr>
<td>notificationId</td>
<td>M</td>
<td>This carries the semantics of notification identifier.</td>
<td></td>
</tr>
<tr>
<td>eventTime</td>
<td>M,F</td>
<td>It carries the time when the IRPAgent has lost confidence of its AlarmList content.</td>
<td></td>
</tr>
<tr>
<td>systemDN</td>
<td>C,F</td>
<td>IRPAgent.systemDN where the IRPAgent is related to the AlarmIRP that is related to this AlarmList.</td>
<td></td>
</tr>
<tr>
<td>notificationType</td>
<td>M,F</td>
<td>“notifyPotentialFaultyAlarmList”.</td>
<td></td>
</tr>
<tr>
<td>reason</td>
<td>M</td>
<td>“Agent-NE communication error”, “Agent restarts”, “indeterminate”. Other values can be added.</td>
<td>It carries the reason why the IRPAgent has to rebuild its AlarmList.</td>
</tr>
</tbody>
</table>

6.11.1.3 Triggering Event

6.11.1.3.1 From-state

faultyAlarmListDetected.

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>faultyAlarmListDetected</td>
<td>IRPAgent detects faults in part or whole of its AlarmList.</td>
</tr>
</tbody>
</table>

6.11.1.3.2 To-state

faultyAlarmList

<table>
<thead>
<tr>
<th>Assertion Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>faultyAlarmList</td>
<td>IRPAgent initiates the AlarmList rebuild process.</td>
</tr>
</tbody>
</table>
Annex A (normative):
Event Types

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

Event type is defined in 3GPP TS 32.302 [5]. The table below lists some of the event types referred to in the present document.

Notification IRP: Information Service in 3GPP TS 32.302 [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 below.

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 ITU-T Recommendation X.733 [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>
<thead>
<tr>
<th>Event Types</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications Alarm</td>
<td>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]).</td>
</tr>
<tr>
<td>Processing Error Alarm</td>
<td>An alarm of this type is associated with a software or processing fault (ITU-T Recommendation X.733 [2]).</td>
</tr>
<tr>
<td>Environmental Alarm</td>
<td>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]).</td>
</tr>
<tr>
<td>Quality of Service Alarm</td>
<td>An alarm of this type is associated with degradation in the quality of a service (ITU-T Recommendation X.733 [2]).</td>
</tr>
<tr>
<td>Equipment Alarm</td>
<td>An alarm of this type is associated with an equipment fault (ITU-T Recommendation X.733 [2]).</td>
</tr>
<tr>
<td>Integrity Violation</td>
<td>An indication that information may have been illegally modified, inserted or deleted.</td>
</tr>
<tr>
<td>Operational Violation</td>
<td>An indication that the provision of the requested service was not possible due to the unavailability, malfunction or incorrect invocation of the service.</td>
</tr>
<tr>
<td>Physical Violation</td>
<td>An indication that a physical resource has been violated in a way that suggests a security attack.</td>
</tr>
<tr>
<td>Security Service or Mechanism Violation</td>
<td>An indication that a security attack has been detected by a security service or mechanism.</td>
</tr>
<tr>
<td>Time Domain Violation</td>
<td>An indication that an event has occurred at an unexpected or prohibited time.</td>
</tr>
</tbody>
</table>
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], and ITU-T Recommendation X.736 [15]. In addition, probable causes for 2G and 3G wireless systems are listed.


<table>
<thead>
<tr>
<th>M.3100 Probable cause</th>
<th>Event type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indeterminate</td>
<td>Unknown</td>
</tr>
<tr>
<td>Alarm Indication Signal (AIS)</td>
<td>Communications</td>
</tr>
<tr>
<td>Broadcast Channel Failure</td>
<td>Communications</td>
</tr>
<tr>
<td>Call Setup Failure</td>
<td>Communications</td>
</tr>
<tr>
<td>Communications Receive Failure</td>
<td>Communications</td>
</tr>
<tr>
<td>Communications Transmit Failure</td>
<td>Communications</td>
</tr>
<tr>
<td>Connection Establishment Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Degraded Signal</td>
<td>Communications</td>
</tr>
<tr>
<td>Demodulation Failure</td>
<td>Communications</td>
</tr>
<tr>
<td>Far End Receiver Failure (FERF)</td>
<td>Communications</td>
</tr>
<tr>
<td>Framing Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Invalid Message Received</td>
<td>Communications</td>
</tr>
<tr>
<td>Local Node Transmission Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Loss Of Frame (LOF)</td>
<td>Communications</td>
</tr>
<tr>
<td>Loss Of Pointer (LOP)</td>
<td>Communications</td>
</tr>
<tr>
<td>Loss Of Signal (LOS)</td>
<td>Communications</td>
</tr>
<tr>
<td>Modulation Failure</td>
<td>Communications</td>
</tr>
<tr>
<td>Payload Type Mismatch</td>
<td>Communications</td>
</tr>
<tr>
<td>Transmission Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Remote Alarm Interface</td>
<td>Communications</td>
</tr>
<tr>
<td>Remote Node Transmission Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Routing Failure</td>
<td>Communications</td>
</tr>
<tr>
<td>Excessive Bit Error Rate (EBER)</td>
<td>Communications</td>
</tr>
<tr>
<td>Path Trace Mismatch</td>
<td>Communications</td>
</tr>
<tr>
<td>Unavailable</td>
<td>Communications</td>
</tr>
<tr>
<td>Signal Label Mismatch</td>
<td>Communications</td>
</tr>
<tr>
<td>Loss Of Multi Frame</td>
<td>Communications</td>
</tr>
<tr>
<td>Antenna Failure</td>
<td>Equipment</td>
</tr>
<tr>
<td>Back Plane Failure</td>
<td>Equipment</td>
</tr>
<tr>
<td>Battery Charging Failure</td>
<td>Equipment</td>
</tr>
<tr>
<td>Data Set Problem</td>
<td>Equipment</td>
</tr>
<tr>
<td>Disk Failure</td>
<td>Equipment</td>
</tr>
<tr>
<td>Equipment Identifier Duplication</td>
<td>Equipment</td>
</tr>
<tr>
<td>External IF Device Problem</td>
<td>Equipment</td>
</tr>
<tr>
<td>Frequency Hopping Failure</td>
<td>Equipment</td>
</tr>
<tr>
<td>IO Device Error</td>
<td>Equipment</td>
</tr>
<tr>
<td>Line Card Problem</td>
<td>Equipment</td>
</tr>
<tr>
<td>Loss Of Redundancy</td>
<td>Equipment</td>
</tr>
<tr>
<td>Loss Of Synchronization</td>
<td>Equipment</td>
</tr>
<tr>
<td>Multiplexer Problem</td>
<td>Equipment</td>
</tr>
<tr>
<td>NE Identifier Duplication</td>
<td>Equipment</td>
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<tr>
<td>Power Problem</td>
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<td>Power Supply Failure</td>
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<td>Processor Problem</td>
<td>Equipment</td>
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<td>Protection Path Failure</td>
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<tr>
<td>Protecting Resource Failure</td>
<td>Equipment</td>
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<tr>
<td>Protection Mechanism Failure</td>
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<td>Real Time Clock Failure</td>
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<td>Receiver Failure</td>
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<td>Replaceable Unit Missing</td>
<td>Equipment</td>
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<td>M.3100 Probable cause</td>
<td>Event type</td>
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<tr>
<td>-----------------------------------------------</td>
<td>------------------</td>
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<td>Replaceable Unit Type Mismatch</td>
<td>Equipment</td>
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<td>Signal Quality Evaluation Failure</td>
<td>Equipment</td>
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<td>Synchronization Source Mismatch</td>
<td>Equipment</td>
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<td>Terminal Problem</td>
<td>Equipment</td>
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<tr>
<td>Timing Problem</td>
<td>Equipment</td>
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<tr>
<td>Transceiver Failure</td>
<td>Equipment</td>
</tr>
<tr>
<td>Transmitter Failure</td>
<td>Equipment</td>
</tr>
<tr>
<td>Trunk Card Problem</td>
<td>Equipment</td>
</tr>
<tr>
<td>Replaceable Unit Problem</td>
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</tr>
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<td>Air Compressor Failure</td>
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<td>Air Conditioning Failure</td>
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<tr>
<td>Air Dryer Failure</td>
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<tr>
<td>Battery Discharging</td>
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<tr>
<td>Battery Failure</td>
<td>Environmental</td>
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<tr>
<td>Commercial Power Failure</td>
<td>Environmental</td>
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<tr>
<td>Cooling Fan Failure</td>
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<tr>
<td>Cooling System Failure</td>
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<tr>
<td>Engine Failure</td>
<td>Environmental</td>
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<tr>
<td>Fire Detector Failure</td>
<td>Environmental</td>
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<tr>
<td>Fuse Failure</td>
<td>Environmental</td>
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<tr>
<td>Generator Failure</td>
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<tr>
<td>Low Battery Threshold</td>
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<td>Pump Failure</td>
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<td>Rectifier Failure</td>
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<tr>
<td>Rectifier High Voltage</td>
<td>Environmental</td>
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<tr>
<td>Rectifier Low F Voltage</td>
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<tr>
<td>Ventilation System Failure</td>
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<td>Enclosure Door Open</td>
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<tr>
<td>Explosive Gas</td>
<td>Environmental</td>
</tr>
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<td>External Equipment Failure</td>
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<td>External Point Failure</td>
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<tr>
<td>Fire</td>
<td>Environmental</td>
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<tr>
<td>Flood</td>
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<tr>
<td>High Humidity</td>
<td>Environmental</td>
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<tr>
<td>High Temperature</td>
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<tr>
<td>High Wind</td>
<td>Environmental</td>
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<tr>
<td>Ice Build Up</td>
<td>Environmental</td>
</tr>
<tr>
<td>Intrusion Detection</td>
<td>Environmental</td>
</tr>
<tr>
<td>Low Fuel</td>
<td>Environmental</td>
</tr>
<tr>
<td>Low Humidity</td>
<td>Environmental</td>
</tr>
<tr>
<td>Low Cable Pressure</td>
<td>Environmental</td>
</tr>
<tr>
<td>Low Temperature</td>
<td>Environmental</td>
</tr>
<tr>
<td>Low Water</td>
<td>Environmental</td>
</tr>
<tr>
<td>Smoke</td>
<td>Environmental</td>
</tr>
<tr>
<td>Toxic Gas</td>
<td>Environmental</td>
</tr>
<tr>
<td>Application Subsystem Failure</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Configuration Or Customisation Error</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Database Inconsistency</td>
<td>Processing Error</td>
</tr>
<tr>
<td>File Error</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Storage Capacity Problem</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Memory Mismatch</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Corrupt Data</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Loss of Real Time</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Out Of CPU Cycles</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Out Of Memory</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Reinitialized</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Software Environment Problem</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Software Error</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Software Download Failure</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Timeout Expired</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Underlaying Resources Unavailable</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Version Mismatch</td>
<td>Processing Error</td>
</tr>
<tr>
<td>Bandwidth Reduced</td>
<td>Quality of service</td>
</tr>
<tr>
<td>Congestion</td>
<td>Quality of service</td>
</tr>
</tbody>
</table>
### M.3100 Probable cause

<table>
<thead>
<tr>
<th>Event type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive Error Rate</td>
</tr>
<tr>
<td>Excessive Response Time</td>
</tr>
<tr>
<td>Excessive Retransmission Rate</td>
</tr>
<tr>
<td>Reduced Logging Capability</td>
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<tr>
<td>System Resources Overload</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>X.721/X.733/X.736 Probable Cause</th>
<th>Event type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter Error</td>
<td>Equipment</td>
</tr>
<tr>
<td>Application Subsystem Failure</td>
<td>Processing error</td>
</tr>
<tr>
<td>Authentication Failure</td>
<td>Security Service or Mechanism Violation</td>
</tr>
<tr>
<td>Bandwidth Reduction</td>
<td>Quality of service</td>
</tr>
<tr>
<td>Breach of Confidentiality</td>
<td>Security Service or Mechanism Violation</td>
</tr>
<tr>
<td>Cable Tamper</td>
<td>Physical Violation</td>
</tr>
<tr>
<td>Call Establishment Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Communication Protocol Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Communication Subsystem Failure</td>
<td>Communications</td>
</tr>
<tr>
<td>Configuration or Customizing Error</td>
<td>Processing error</td>
</tr>
<tr>
<td>Congestion</td>
<td>Quality of service</td>
</tr>
<tr>
<td>Corrupt Data</td>
<td>Processing error</td>
</tr>
<tr>
<td>CPU Cycles Limit Exceeded</td>
<td>Processing error</td>
</tr>
<tr>
<td>Data Set or Modem Error</td>
<td>Equipment</td>
</tr>
<tr>
<td>Degraded Signal</td>
<td>Communications</td>
</tr>
<tr>
<td>Delayed Information</td>
<td>Time Domain Violation</td>
</tr>
<tr>
<td>Denial of Service</td>
<td>Operational Violation</td>
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<td>DTE-DCE Interface Error</td>
<td>Communications</td>
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<tr>
<td>Duplicate Information</td>
<td>Integrity Violation</td>
</tr>
<tr>
<td>Enclosure Door Open</td>
<td>Environmental</td>
</tr>
<tr>
<td>Equipment Malfunction</td>
<td>Equipment</td>
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<td>Excessive Vibration</td>
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<td>File Error</td>
<td>Processing error</td>
</tr>
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<td>Fire Detected</td>
<td>Environmental</td>
</tr>
<tr>
<td>Flood Detected</td>
<td>Environmental</td>
</tr>
<tr>
<td>Framing Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Heating or Ventilation or Cooling System Problem</td>
<td>Environmental</td>
</tr>
<tr>
<td>Humidity Unacceptable</td>
<td>Environmental</td>
</tr>
<tr>
<td>Information Missing</td>
<td>Integrity Violation</td>
</tr>
<tr>
<td>Information Modification detected</td>
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</tr>
<tr>
<td>Information out of Sequence</td>
<td>Integrity Violation</td>
</tr>
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<td>Input/Output Device Error</td>
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</tr>
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<td>Input Device Error</td>
<td>Equipment</td>
</tr>
<tr>
<td>Intrusion Detection</td>
<td>Physical Violation</td>
</tr>
<tr>
<td>Key Expired</td>
<td>Time Domain Violation</td>
</tr>
<tr>
<td>LAN Error</td>
<td>Communications</td>
</tr>
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<td>Leak Detection</td>
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<tr>
<td>Local Node Transmission Error</td>
<td>Communications</td>
</tr>
<tr>
<td>Loss of Frame</td>
<td>Communications</td>
</tr>
<tr>
<td>Loss of Signal</td>
<td>Communications</td>
</tr>
<tr>
<td>Material Supply Exhausted</td>
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<td>Multiplexer Problem</td>
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</tr>
<tr>
<td>Non-Repudiation Failure</td>
<td>Security Service or Mechanism Violation</td>
</tr>
<tr>
<td>Out of Hours Activity</td>
<td>Time Domain Violation</td>
</tr>
<tr>
<td>Out of Memory</td>
<td>Processing error</td>
</tr>
<tr>
<td>Out of Service</td>
<td>Operational Violation</td>
</tr>
<tr>
<td>Output Device Error</td>
<td>Equipment</td>
</tr>
<tr>
<td>Performance Degraded</td>
<td>Quality of service</td>
</tr>
<tr>
<td>Power Problem</td>
<td>Equipment</td>
</tr>
<tr>
<td>Pressure Unacceptable</td>
<td>Environmental</td>
</tr>
<tr>
<td>Procedural Error</td>
<td>Operational Violation</td>
</tr>
<tr>
<td>Processor Problem</td>
<td>Equipment</td>
</tr>
<tr>
<td>Pump Failure</td>
<td>Environmental</td>
</tr>
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</table>

**ETSI**
<table>
<thead>
<tr>
<th>Event Type</th>
<th>X.721/X.733/X.736 Probable Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of service</td>
<td>Queue Size Exceeded</td>
</tr>
<tr>
<td>Equipment</td>
<td>Receive Failure</td>
</tr>
<tr>
<td>Equipment</td>
<td>Receiver Failure</td>
</tr>
<tr>
<td>Communications</td>
<td>Remote Node Transmission Error</td>
</tr>
<tr>
<td>Quality of service</td>
<td>Resource at or Nearing Capacity</td>
</tr>
<tr>
<td>Quality of service</td>
<td>Response Time Excessive</td>
</tr>
<tr>
<td>Quality of service</td>
<td>Re-transmission Rate Excessive</td>
</tr>
<tr>
<td>Quality of service</td>
<td>Software Error</td>
</tr>
<tr>
<td>Processing error</td>
<td>Software Program Abnormally Terminated</td>
</tr>
<tr>
<td>Processing error</td>
<td>Software Program Error</td>
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<tr>
<td>Processing error</td>
<td>Storage Capacity Problem</td>
</tr>
<tr>
<td>Processing error</td>
<td>Temperature Unacceptable</td>
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<tr>
<td>Environment</td>
<td>Threshold Crossed</td>
</tr>
<tr>
<td>Quality of service</td>
<td>Timing Problem</td>
</tr>
<tr>
<td>Environmental</td>
<td>Toxic Leak Detected</td>
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<tr>
<td>Equipment</td>
<td>Transmit Failure</td>
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<tr>
<td>Equipment</td>
<td>Transmitter Failure</td>
</tr>
<tr>
<td>Equipment</td>
<td>Underlying Resource Unavailable</td>
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<td>Processing error</td>
<td>Unexpected Information</td>
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<td>Integrity Violation</td>
<td>Unauthorised Access Attempt</td>
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<tr>
<td>Operational Violation</td>
<td>Underlying Resource Unavailable</td>
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<td>Physical Violation</td>
<td>Unexpected Information</td>
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<tr>
<td>Security Service or Mechanism Violation</td>
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<tr>
<td>Processing error</td>
<td>X.721/X.733/X.736 Probable Cause</td>
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### Table B.3: Probable Causes for 2G & 3G Wireless Systems

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<thead>
<tr>
<th>2G &amp; 3G Wireless Systems</th>
<th>Event Type</th>
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<td>A-bis to BTS interface failure</td>
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<td>A-bis to TRX interface failure</td>
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<td>Antenna problem</td>
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<td>Battery breakdown</td>
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<tr>
<td>Battery charging fault</td>
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<td>Clock synchronization problem</td>
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<td>Combiner problem</td>
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<td>Disk problem</td>
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<td>Equipment failure</td>
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<tr>
<td>Excessive receiver temperature</td>
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<tr>
<td>Excessive transmitter output power</td>
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<tr>
<td>Excessive transmitter temperature</td>
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<tr>
<td>Frequency hopping degraded</td>
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<tr>
<td>Frequency hopping failure</td>
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<td>Frequency redefinition failed</td>
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<td>Line interface failure</td>
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<td>Mains breakdown with battery back-up</td>
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<td>Mains breakdown without battery back-up</td>
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<td>Receiver Failure</td>
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<td>Signal quality evaluation fault</td>
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<td>Transcoder problem</td>
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<td>Transcoder or rate adapter problem</td>
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<td>Transmitter antenna not adjusted</td>
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<td>Transmitter low voltage or current</td>
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Table B.4 identifies probable causes that are defined by more than one standard. This is for information only.

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

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<th>Duplicated Probable Cause</th>
<th>2G &amp; 3G</th>
<th>X.721 X.733</th>
<th>X.736</th>
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<td>Loss of Signal</td>
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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)

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

(2) 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

\( (n_i=3, a_i=Y, m_o=c=A, m_o=B, e_t=C, p_c=D, s_p=E, p_s=Cleared) \)

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

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

(1) NotifyNewAlarm

\( (n_i=1, a_i=X, m_o=c=A, m_o=B, e_t=C, p_c=D, s_p=E, p_s= Critical) \)

(2) NotifyNewAlarm

\( (n_i=2, a_i=X, m_o=c=A, m_o=B, e_t=C, p_c=D, s_p=E, p_s=Minor) \)

Interaction (2) is illegal since it invokes notifyNewAlarm using same \( a_i \) value. It should use notifyChangedAlarm with the same \( a_i \) value.
### Change history

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# History

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