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5G; Fault management (3GPP TS 28.111 version 18.3.0 Release 18)

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In the present document **"shall"**, **"shall not"**, **"should"**, **"should not"**, **"may"**, **"need not"**, **"will"**, **"will not"**, **"can"** and **"cannot"** are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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- z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- can** indicates that something is possible
- cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

- will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

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1 Scope

The present document describes the SBMA based Fault Management service (see [14]). It includes stages 1, 2 and 3.

The present document of the Fault Management MnS is based on the SBMA principles using CRUD operations, modeled OAM data in the NRM together with fault management specific notifications. An IRP based solution for fault management is out of scope for the present document.

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 TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 28.532: "Management and orchestration; Generic Management services".
- [3] ETSI TS 101 251 (V6.3.0): "Digital cellular telecommunications system (Phase 2+); Fault management of the Base Station System (BSS) (GSM 12.11 version 6.3.0 Release 1997)".
- [4] 3GPP TS 28.516: "Fault Management (FM) for mobile networks that include virtualized network functions; Procedure".
- [5] 3GPP TS 28.622: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [6] ITU-T Recommendation X.721 (02/92): "Information technology - Open Systems Interconnection - Structure of management information: Definition of management information".
- [7] ITU-T Recommendation M.3100: "Generic network information model".
- [8] ITU-T Recommendation X.733 (02/92): "Information technology - Open Systems Interconnection - Systems Management: Alarm reporting function".
- [9] Text Attribution: Creator: ONAP, under Creative Commons Attribution 4.0 International License, <https://creativecommons.org/licenses/by/4.0/>, URI to access the text: https://github.com/onap/vnfrqts-requirements/blob/05f26fac2b941513a7d0e856b99fd8c61d688299/docs/Chapter8/ves7_1spec.rst#resource-structure.
- [10] 3GPP TS 32.158: "Management and orchestration; Design rules for Representational State Transfer (REST) Solution Sets (SS)".
- [11] Void
- [12] 3GPP TS 32.401: "Telecommunication management; Performance Measurement (PM); Concept and requirements".
- [13] ITU-T Recommendation X.736 (01/92): "Information technology - Open Systems Interconnection - Systems Management: Security alarm reporting function".
- [14] 3GPP TS 28.533: "Management and orchestration; Architecture framework".
- [15] 3GPP TS 32.160: "Management and orchestration; Management service template".

- [16] 3GPP TS 28.623: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Alarm: A representation of an error or failure that requires attention or reaction by an operator or some machine. Alarms have state.

Alarm identifying attributes: A set of attributes (*objectInstance*, *alarmType*, *probableCause* and *specificProblem*, if present) that identify an alarm. *ObjectInstance* identifies the network resource, while *alarmType*, *probableCause* and *specificProblem* (if present) identify the alarming condition.

Alarming condition: Identifies the reason an alarm is raised. Identified by a combination of *alarmType*, *probableCause* and *specificProblem* (if present).

Error: A state of the system different from the correct system state. An error may or may not lead to a service failure. An error has a begin and end time.

Event: Anything that occurs at a certain point in time, for example a configuration change, a threshold crossing, a transition to an error state or a transition to a failure state. Events do not have states.

Failure: A state of inability to deliver the correct service as defined by the service specification. A service failure is the result of an error. A failure has a begin and end time.

Fault: The (hypothesized or adjudged) cause for an error or a failure (such as system malfunctions, a defect in system design, a defect in software, or external interference).

MonitoredEntity: Any class that can have an alarmed state.

Root cause: The primary fault (cause), if any, leading to one or multiple errors or failures.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

ADAC	Automatically Detected and Automatically Cleared
ADMC	Automatically Detected and Manually Cleared
CRUD	Create, Read, Update, Delete basic data manipulation operations
FM	Fault Management
ME	Managed Element
MnS	Management Service
NRM	Network Resource Model

4 Concepts and overview

A (managed) systems may experience faults such as malfunctions, a defect in system design, a defect in the software, or external interference. These faults may (or may not) lead to a system state that is different from the correct or desired system state. An incorrect system state is called error. Errors are hence caused by faults. Faults and errors are not always externally observable and may remain undetected.

Errors, in turn, may (or may not) cause failures. A failure is the inability to deliver the correct service as defined by the service specification. A failure is hence always externally observable.

In summary, a fault may cause one or more errors, and an error may cause one or more failures.

An alarm is the management representation of a fault, a (detected) error or a failure that requires attention or reaction by an operator or some machine.

Fault Management is concerned with representing, managing, and reporting alarms. Fault Management is often also referred to as Alarm Management. The alarm model is independent from the underlying managed system. The same model can be used to represent alarms from any 3GPP generation or other networks and any resource. Specifics of the managed system manifest themselves only in the values of the information elements of the alarm model.

Alarms allow to report any kind of issue, from small faults without service impact to large scale failures of telecommunication services affecting many users.

A prerequisite for Fault Management as defined in the present document is that the managed system is represented by managed objects, that are organized in hierarchical object trees, in the management system.

The solution specified in the present document is based on ITU-T X.733 [8].

Fault Management is considered a generic management service. It shall be able to support fault indications about any generation of 3GPP or other networks and any resource that can be addressed by a distinguished name e.g. ManagedElements, ENBs or NetworkSlices or non-3GPP managed resources.

Fault management can handle alarms about any kind of fault in a 3GPP system from small hardware errors to service failures effecting many users.

5 Requirements

Requirement label	Description	Motivation
REQ-FM-MC-1	The 3GPP management system shall have the capability to provide alarm notifications to authorized consumers.	Motivation: the consumer should receive information about alarms immediately when an alarm is raised or changed.
REQ-FM-MC-2	The 3GPP management system shall have the capability to allow authorized consumers to subscribe to alarm notifications.	Motivation: Needed for REQ-FM-MC-1. Producers will not send notification without an explicit subscription.
REQ-FM-MC-3	The 3GPP management system shall have the capability to allow authorized consumers to unsubscribe from alarm notifications.	Motivation: The consumer needs to be able to indicate that it is no longer interested in receiving immediate alarm information
REQ-FM-MC-4	The 3GPP management system should have the capability to allow authorized consumers to provide a filter for alarm notifications .	Motivation: The consumer shall be able to indicate that it is interested only in a subset of alarms.
REQ-FM-MC-5	The 3GPP management system shall have the capability to allow authorized consumers to retrieve the alarm list .	Motivation: The consumer shall be able to read all current alarms. It needs this if the sequence of received alarm notifications does not provide a reliable and complete view of the alarm situation. This may happen after the start-up of the consumer fault management service, if the connection or some alarm notifications are lost, or if the alarm producer was not able to provide on-time indication of all alarm changes.

Requirement label	Description	Motivation
REQ-FM-MC-6	The 3GPP management system should have the capability to allow authorized consumers to retrieve a filtered subset of the alarm list .	Motivation: If the consumer is interested only in a subset of alarms, it shall be able to retrieve only that subset.
REQ-FM-MC-7	The 3GPP management system shall have the capability to provide changed alarm notifications to its authorized consumer.	Motivation: the consumer should receive information about changed alarms immediately.
REQ-FM-MC-8	The 3GPP management system shall have the capability to provide cleared alarm notifications to its authorized consumer.	Motivation: the consumer should receive information about cleared alarms immediately.
REQ-FM-MC-9	The 3GPP management system shall have the capability to provide new generated alarm notifications to its authorized consumer.	Motivation: the consumer should receive information about alarms immediately when an alarm is raised.
REQ-FM-MC-10	The 3GPP management system should have the capability to indicate that the alarm list is potentially faulty .	Motivation: the consumer should receive information when the alarm list is corrupt or out-of-date.
REQ-FM-MC-11	The 3GPP management system shall have the capability to indicate that the alarm list was rebuilt and is reliable again after a previous disturbance.	Motivation: the consumer should receive information when the correct alarm information is available again.
REQ-FM-MC-12	The 3GPP management system should have the capability to satisfy the request to acknowledge one or multiple alarms . If this capability is not supported, then the producer shall be able to automatically acknowledge alarms.	Motivation: the consumer should be able to register in the producer that it has received the alarm and has done some vendor specific level of processing of the alarm information.
REQ-FM-MC-13	The 3GPP management system should have the capability to satisfy the request to clear one or multiple alarms . This capability is only applicable if one or more of the alarms supported by the producer is of type ADMC.	Motivation: If the producer supports ADMC alarms, the consumer shall be able to clear those.
REQ-FM-MC-14	The 3GPP management system should have the capability to provide acknowledgement state change notifications to its authorized consumer.	Motivation: the consumer should receive information about acknowledged alarms immediately.

6 Solution description

6.1 Solution components

The solution consists of the basic solution and the following optional solution components:

- Dedicated perceived severity change notification
- Acknowledging alarms by MnS consumers
- Commenting alarms by MnS consumers
- Alarm correlation
- Reliability of alarm lists

Table 6.1-1: FM solution components

Usage	Operations and notifications	NRM
FM basic	notifyNewAlarm notifyChangedAlarmGeneral notifyClearedAlarm	AlarmList
Dedicated perceived severity change notification	notifyChangedAlarm	
Acknowledging alarms by MnS consumers	notifyAckStateChanged	alarmRecord.ackTime alarmRecord.ackUserId alarmRecord.ackSystemId alarmRecord.ackState
Commenting alarms by MnS consumers	notifyComments	alarmRecord:comments, datatype:alarmComment
Alarm correlation	notifyCorrelatedNotificationChanged	alarmRecord:correlatedNotifications alarmRecord:rootCauseIndicator
Reliability of alarm lists	notifyPotentialFaultyAlarmList notifyAlarmListRebuilt	AlarmList.unreliableAlarmScope

6.2 Model driven approach

The solution for Fault Management is based on the model driven approach.

NRM data is written to control the behaviour of the fault management.

Data provided to the fault management consumer is made available in two ways (representing the same information). MnS consumers may use the a read operation to read any data. Additionally, data that should be provided as soon as it is available in the MnS producer is sent to subscribed MnS consumers in notifications (e.g. information about a new alarm).

For this reason, only an alarm model is defined. The CRUD operations defined in TS 28.532 [2], clause 11.1 are used for interacting with the instantiation of the model.

Since the generic provisioning notifications defined in TS 28.532 [2], clause 11.1 are not used in all cases, the present document also defines some specific alarm notifications to report changes in the alarm model.

Interactions with the alarm model with both operations and notifications may be subject to access control.

6.3 Alarm records

An alarm is described by a set of attributes. This set of attributes is referred to as alarm record. An alarm record is hence the management representation of an alarm.

The object instance attribute in an alarm record identifies the object that represents the alarmed entity in the management system. Objects are identified using their Distinguished Name (DN). Note that all is needed is a DN. It is not required that the object really exists in the management system and can be accessed with CRUD operations.

The alarm type (ITU-T X.733 [8], clause 8.1.1) attribute specifies roughly in which area of the supervised system an alarm has occurred:

- If the alarm type is equal to "COMMUNICATIONS_ALARM", the alarm is principally associated with the procedures and/or processes required to convey information from one point to another.
- If the alarm type is equal to "PROCESSING_ERROR_ALARM", the alarm is principally associated with a software or processing fault.
- If the alarm type is equal to "EQUIPMENT_ALARM", the alarm is principally associated with an equipment fault.
- If the alarm type is equal to "ENVIRONMENTAL_ALARM", the alarm type is principally associated with a condition relating to an enclosure in which the equipment resides.