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Technical Report

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Foreword

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Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

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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

Fault Management (FM) is a very basic functionality of network management. The purpose of FM is to detect failures as soon as they occur and to minimize their impact on the network services. Thus FM functionality consists of functions for detecting, locating, isolating and correcting the failures. These basic functions are same, or at least very similar regardless of the IT environment.

FM functionalities had been specified and standardized by several organizations. Even if the functions are same the specifications differ. The differences lead to implementation of several variants of the same functionality. This is an expensive aspect for both vendors and service provides. This study aims to provide background information and recommendations on how to get better alignment of FM specifications between two telecom specification organizations, namely 3GPP and TMF.

1 Scope

The present document collects, compares and analyzes the specifications of Fault Management (FM) as defined by 3GPP and TMF. These two organizations have both a complete set of FM specifications consisting of requirement, technology-independent and solution set specification for

- Fault Management interface – operations and notifications and
- Alarm content

The present documentidentifies similarities and differences of the Fault Management capabilities in 3GPP and TMF and provides recommendations to align these capabilities.

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"."

[2] TMF RN306: "MTOSI 2.0 Release Notes", Version 2.1

[3] MTOSI 2.0: MTOSI_R2-0_DDP_Maps.xls

[4] TIP Technical Coordination Team, Feature Description, Resource FM Harmonization, 12 December, 2008, Final, Rev 1.0

[5] 3GPP TS 32.111-2: "Telecommunication management; Fault Management; Part 2: Alarm Integration Reference Point (IRP): Information Service (IS)".

[6] MTOSI 2.0: Network Resource Assurance - DDP IA, TMF612_NRA, Version 1.0

[7] TMF518_FMW, Framework - DDP BA, Version 1.1

[8] NGMN Operations Requirements - Top ten network operations requirements for multi-vendor, multi-technology environment.

[9] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[10] 3GPP TS 32.111-3: "Telecommunication management; Fault Management; Part 3: Alarm Integration Reference Point (IRP): Common Object Request Broker Architecture (CORBA) Solution Set (SS)".

[11] 3GPP TR 32.832: "Study on Alarm Correlation and Alarm Root Cause Analysis".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [9] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [9].

OS TMF Operations System (OS) refers to any management system covering SML, NML, and/or EML functionality [7]

3.2 Symbols

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

3.3 Abbreviations

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

API	Application Programming Interface
BA	Business Agreement
DDP	Document Delivery Package
FMW	Framework
IA	Information Agreement
IIS	Interface Implementation Specification
IRP	Integration Reference Point
MTOSI	Multi-Technology Operations System Interface
NRA	Network Resource Assurance
NRM	Network Resource Model
RTM	Resource Trouble Management
TIP	TM Forum Interface Program
TMF	TeleManagement Forum

4 Comparison of Fault Management standards

4.1 Reference Architectures

4.1.1 3GPP

4.1.2 TMF TIP

4.2 Fault Management standards in 3GPP and TMF TIP

4.2.1 3GPP Alarm IRP

3GPP is using the Integration Reference Point (IRP) concept for interface, Network Resource Model (NRM) and data definition specifications see 3GPP TS 32.150 [1] for detailed description of IRP concept.
The 3GPP Release 9 "Telecommunication management; Fault Management;" interface related specifications are:

3GPP TS32.111-1: "Part 1: 3G fault management requirements".
3GPP TS32.111-2: "Part 2: Alarm Integration Reference Point (IRP): Information Service (IS)".
3GPP TS32.111-3: "Part 3: Alarm Integration Reference Point (IRP): Common Object Request Broker Architecture (CORBA) Solution Set (SS)".
3GPP TS32.111-5: "Part 5: Alarm Integration Reference Point (IRP): eXtensible Markup Language (XML) definitions".
3GPP TS32.111-7: "Part 7: Alarm IRP SOAP Solution Set (SS)".

The 3GPP Release 10 "Telecommunication management; Fault Management;" interface related specifications are:

3GPP TS32.111-1: "Part 1: 3G fault management requirements".
3GPP TS32.111-2: "Part 2: Alarm Integration Reference Point (IRP): Information Service (IS)".
3GPP TS32.111-6: "Part 6: Alarm Integration Reference Point (IRP): Solution Set (SS) definitions".

The above mentioned specifications define the requirements, semantics and syntax of the Fault Management interface and Alarm content.
The Alarm IRP is utilizing the services defined in 3GPP TS 32.30x (Configuration Management; Notification IRP) and inheriting object definitions from 3GPP TS 32.31x (Generic IRP management) and 3GPP TS 32.62x (Generic network resources IRP).

4.2.2 TMF TIP Resource Trouble Management

Currently TIP ecosystem has two set of specifications:

- OSS/J Fault Management API (JSR 263)
- MTOSI Resource Trouble Management (TMF518_RTM) and the similar requirements in TMF 513 (basically the MTNM requirements on FM

TMF TIP is harmonizing their fault management specifications. The goal is to have one common TIP FM specification.

MTOSI RTM specification consist of a Document Delivery Package (DDP) containing:

- TMF518_RTM Resource Trouble, Business Agreement (BA)
- RTM TMF612_RTM Resource Trouble, Information Agreement (IA)
- RTM TMF864_RTM_XML Resource Trouble, Interface Implementation Specification (IIS)

The above mentioned specifications define the requirements, semantics and syntax of the Fault Management interface and Alarm content. Resource Trouble Management interface is utilizing and inheriting the notification mechanism and object definitions specified in Framework DDP, NetworkResourceBasic DDP and NetworkResourceAssurance DDP. The document structure is similar to 3GPP. For further information on MTOSI specification structure, see TMF RN306 [2].

OSS/J Fault Management API (JSR 263) consists of set of specifications/documents: Overview Document, API User Guide Document, API Source, XML Schema and Web Services WSDL. The Fault Monitoring API provides interfaces, as specified by the OSS/J Design Guidelines, which allow clients to collect and acknowledge alarms. The API enables reception of alarms, state changes, and threshold crossing alerts from the network and maintaining a list of active alarms.

4.3 Interface (operations) comparison

3GPP and TMF specifications define a set of operations by which one management system may interact with another management system. The following table contains a list of operations defined in 3GPP Alarm IRP and identifies the same or similar operations defined in TMF MTOSI and OSS/J (Chapter 5.4 MTOSI – OSS/J Harmonization for Resource FM in [4]).

Table 4.3: Interface Operations Comparison

3GPP	MTOSI	OSS/J
acknowledgeAlarms (M)	acknowledgeAlarms	acknowledgeAlarms (M)
unacknowledgeAlarms (O)	unacknowledgeAlarms	unAcknowledgeAlarms (M)
getAlarmList (M)	getActiveAlarms	getAlarmsByKeys and getAlarmsByTemplate
clearAlarms (O)	no equivalent	clearAlarms (M)
setComments (O)	no equivalent	commentAlarms
getAlarmCount (O)	getActiveAlarmsCount	getAlarmCount
no equivalent?	no equivalent	unclearAlarms
no equivalent	no equivalent	createAlarm
no equivalent	no equivalent	createAlarms

TMF MTOSI specifies also other alarm related operation which has no direct equivalent operations in 3GPP. Some operations like setting alarm reporting on and off may be implemented by other defined mechanisms. The TMF MTOSI operation groups and operations are following (RTM ops tab in [3]):

AlarmControl
- setAlarmReportingOff
- setAlarmReportingOn
- setGtpAlarmReportingOff
- setGtpAlarmReportingOn

AlarmSeverityAssignmentProfileControl
- assignAlarmSeverityAssignmentProfile
- createAlarmSeverityAssignmentProfile
- deassignAlarmSeverityAssignmentProfile
- deleteAlarmSeverityAssignmentProfile
- modifyAlarmSeverityAssignmentProfile

AlarmSeverityAssignmentProfileRetrieval
- getAlarmSeverityAssignmentProfile
- getAlarmSeverityAssignmentProfileByResource
- getAlarmSeverityAssignmentProfileIterator
- getAllAlarmSeverityAssignmentProfilesWrtOs
- getAsapAssociatedResourceNames

MaintenanceControl
- getActiveMaintenanceOperations
- getActiveMaintenanceOperationsIterator
- performMaintenanceOperation

ProtectionControl
- performProtectionCommand

ProtectionRetrieval
- getAllEquipmentProtectionGroups
- getAllNonPreemptibleUnprotectedTpNames
- getAllPreemptibleTerminationPointNames
- getAllProtectedTerminationPointNames
- getAllProtectionGroups
- getContainingProtectionGroupNames
- getEquipmentProtectionGroup
- getProtectionGroup
- retrieveEquipmentSwitchData
- retrieveSwitchData
- getEquipmentProtectionGroupIterator
- getProtectionGroupIterator

4.4 Notification comparison

3GPP and TMF specifications define a set of notifications by which one management system may inform/notify another management system. 3GPP and TMF have chosen a different approach related the notification mechanism. 3GPP has defined several notifications for changed alarm and/or alarm content where as TMF has specified one notification and the content of that one notification is changed accordingly.

3GPP Alarm IRP defines following notifications (see 3GPP TS 32.111-2 [5]):

- notifyNewAlarm (M)
- notifyAckStateChanged (M)
- notifyChangedAlarm (O)
- notifyComments (O)
- notifyClearAlarm (M)
- notifyAlarmListRebuilt (M)
- notifyPotentialFaultyAlarmList (O)

TMF MTOSI RTM DDP does not contain the alarm notification definition but imports the definition from NRA DDP:

- AlarmNotification

AlarmNotifcation inherits attributes from CommonEventInformation and EventInformation defined in MTOSI FMW.

Another difference between 3GPP and MTOSI is the treatment of threshold crossing notifications. 3GPP notify threshold crossings utilizing the generic alarm notification that contains the threshold info in attributes. MTOSI has a separate notification for this purpose: TCANotification defined in NRA.

4.5 Alarm content comparison

4.5.1 3GPP

3GPP Alarm IRP defines alarm content, alarm attributes, as follows (see 3GPP TS 32.111-2 [5]):

- alarmId
- notificationId
- alarmRaisedTime
- alarmChangedTime
- alarmClearedTime
- eventType
- probableCause
- perceivedSeverity
- specificProblem
- backedUpStatus
- trendIndication
- thresholdInfo
- stateChangeDefinition
- monitoredAttributes
- proposedRepairActions
- additionalText
- additionalInformation
- ackTime
- ackUserId
- ackSystemId
- ackState
- commentTime
- commentText
- commentUserId
- commentSystemId
- correlatedNotifications
- source
- notificationIdSet
- clearUserId
- clearSystemId
- serviceUser
- serviceProvider
- securityAlarmDetector

4.5.2 TMF MTOSI

MTOSI NRA defines the content of Alarm Notification as follows [6]:

- acknowledgeIndication
- additionalText
- affectedPtpRefList
- aliasNameList
- isClearable
- isEdgePointRelated
- layerRate
- nativeProbableCause
- perceivedSeverity
- probableCause
- probableCauseQualifier
- rootCauseAlarmIndication
- serviceAffecting
- x733_AdditionalInformation
- x733_BackUpObject
- x733_BackedUpStatus
- x733_CorrelatedNotificationList
- x733_EventType
- x733_MonitoredAttributeList
- x733_ProposedRepairActionList
- x733_SpecificProblems
- x733_TrendIndication

And following attributes are inherited from CommonEventInformation and EventInformation objects defined in FMW:

- additionalInfo
- notificationId
- sourceTime
- objectName
- objectType
- osTime

4.5.3 Comparison

4.5.3.1 MTOSI alarm fields and 3GPP alarm fields comparison

The following table shows the MTOSI alarm fields and the equivalent field in the 3GPP model which can be used to represent that data:

Table 4.5.3.1: Alarm Fields Comparison

MTOSI Field			Maps into the following 3GPP Field	Comments
Source structutre	**MTOSI Field**	**Definition**		
EventType	isEdgePointRelated	TRUE if this event relates to a PTP that is an edge point or to a PGP that contains a PTP that is an edge point. FALSE otherwise; this field is optional in this case.	n/a	Not mapped - See below
	isClearable	Indicates if the event is clearable (or is itself a clear).	n/a	Not mapped - See below
	aliasNameList	Identifies all the object list of aliases to describe the network entity as portrayed on the OS user interface.	n/a	Not mapped - See below
	layerRate	The layer which this alarm is relevant to.	Derived from **objectClass**, **objectInstance**	
	probableCause	ProbableCauseEnumType is derived from string type. There are several restrictions on the value. The schema processor preserves value's whitespace.	-	See 4.3
	ru	This boolean parameter stands for Remote Unit (RU). It indicates the location of the network resource the alarm probable cause is associated with. The default setting (false) is for an alarm detected with a local network resource. And, the value is "true" when the alarm is associated with a remote network resource.	n/a	Not mapped - See below
	contra	This is a boolean parameter used to distinguish the direction of the signal related alarm. The default setting (false) is for an alarm detected on the signal that is related to the sink atomic function. And, the value is "true" for an alarm detected on the signal that is related to the source atomic function.	n/a	Not mapped - See below
	probableCauseQualifier	This is used with other attributes; objectName, layerRate, and probableCause to uniquely identify an alarm This attribute is optional. Its form is unqualified.	n/a	See 4.5
	nativeProbableCause	Identifies the probableCause as portrayed on the OS user interface.	-	See 4.3
	additionalText	More information about the alarm. such as, "Unit is mismounted".	**additionalText**	
	perceivedSeverity	Indicates the severity of the alarm.	**perceivedSeverity**	
	affectedPtpRefList	A list of affected TPs. Contained CTPs are not listed. This field is optional for all alarms except for alarms on equipment. This is used to indicate a list of TPs affected by an equipment failure for example. If the alarm is an alarm on an equipment that supports PTPs, then the ports (PTPs) supported by this equipment will be listed in this field (irrespective of whether the alarm is Service Affecting or not). The list should be ordered by PTP names (ASCII order).	n/a	Not mapped - See below
	serviceAffecting	Indicates whether the alarm has affected service	n/a	Not mapped - See below
	rootCauseAlarmIndication	The RCAI indicator has two values, i.e., TRUE (meaning that the alarm is a Root Cause Alarm Indication) or FALSE (meaning the alarm is a raw alarm).	n/a	Not mapped - See below
	acknowledgeIndication	The acknowledge indication state.	**ackState**	
	X733_EventType	Classifies the alarm into one of the five basic categories specified in ITU-T X.733. Value is one of the following: "communicationsAlarm", "environmentalAlarm", "equipmentAlarm", "processingErrorAlarm", "qualityofServiceAlarm" This field is optional.	**AlarmType**	

	X733_SpecificProblems	Identifies further refinements to the Probable cause of the alarm. (Similar to ProbableCauseQualifier, but this parameter is designed to be human readable and compatible with ITU usage.) This field is optional.	-	
	X733_BackedUpStatus	Specifies whether or not the object emitting the alarm has been backed-up, and services provided to the user have, therefore, not been disrupted. Value is one of the following: "BACKED_UP", "NOT_BACKED_UP" This field is optional.	**backedUpStatus**	
	X733_BackUpObjectRef	Specifies the object that is providing back-up services for the object about which the notification pertains. This parameter shall be present when the X733::BackedupStatus parameter is present and has the value "BACKED_UP". This field is optional otherwise.	**BackUpObject**	
	X733_TrendIndication	Specifies the current severity trend of the object. If present it indicates that there are one or more alarms ("outstanding alarms") which have not been cleared, and pertain to the same object as that to which this alarm ("current alarm") pertains. Value is one of the following: "MORE_SEVERE", "NO_CHANGE", "LESS_SEVERE" This field is optional.	**trendIndication**	
	X733_CorrelatedNotificationList	Contains a set of Notification identifiers and, if necessary, their associated object names. This set is defined to be the set of all notifications to which this notification is considered to be correlated. This field is optional.	**correlatedNotifications**	
	X733_MonitoredAttributeList	Defines one or more attributes of the managed object and their corresponding values at the time of the alarm. This field is optional.	**monitoredAttributes**	
	X733_ProposedRepairActionList	Used if the cause is known and the system being managed can suggest one or more solutions (such as switch in standby equipment, retry, replace media). This field is optional.	**proposedRepairActions**	
	X733_AdditionalInformation	Allows the inclusion of a set of additional information. (For consistency with X.733) This field is optional.	**additionalInformation**	
EventInformationType	objectType	Identifies the type of the object associated with the event. This attribute is needed to allow simple notification filtering based on the object type.	Derived from **objectClass**, **objectInstance**	
	objectName	Identifies the name of the object associated with the event.	Derived from **objectClass**, **objectInstance**	
	osTime	The time at which the event was reported by the OS (EMS).	**alarmRaisedTime**	
commonEventInformationType	notificationId	The uniqueness and the sequence of the notificationId are not guaranteed.	**notificationId**	
	sourceTime	The time at which the event was reported by the source system (NE, EMS or OS).	n/a	Not mapped - See below
	vendorExtensions	Containment for all vendor extensions	**additionalInformation**	

Unmappable fields:

From the analysis above the following MTOSI data is not directly mappable to 3GPP:

- isEdgePointRelated, aliasNameList, serviceAffecting, affectedPtpRefList, rootCauseAlarmIndication, sourceTime, ru and contra.

In order to maintain backward compatibility it is proposed to send these fields as (name, value) pairs in additionalInformation. This will allow the client to identify if and when the information is provided, but without impacting the existing model.

Proposal: Add additional constants.

This requires additional constants to be added to AdditionalInformation of the form:

const string AI_MTOSI_ISEDGEPOINTRELATED = "ai_mtosi_isedgepointrelated";

4.5.3.2 Alarm Life Cycle

Alarms in MTOSI are considered "active" in the raised state and inactive in the "cleared" state, independently of the alarm acknowledgement state – therefore it does not fit into either of the two models in 3GPP TS 32.111-2 [5]). .

Proposal: Allow a lifecycle model in 3GPP which meets the MTOSI behaviour

4.5.3.3 Probable Cause, Native Probable Cause and Specific Problems

MTOSI and 3GPP have different definitions of the probable cause and specific problems field – in addition, MTOSI uses a native probable cause field as follows:

	Probable Cause	Native Probable Cause	Specific Problems
Definition in 3GPP	X.733 probable cause	n/a	X733 specific problem
Definition in MTOSI	MTOSI probable cause grouping	Name of the alarm on the EMS GUI	X733 specific problem

***Proposal**: Specific Problem can be used for the Name of the alarm. There does not seem to be any need to create another native probable cause field for 3GPP.*

However, any probable cause values defined in MTOSI that are not in the probable cause list in 32.111-3 should be added. The table below shows the proposed mapping for each MTOSI ProbableCause value:

MTOSI ProbableCauseEnumType value	3GPP TS 32.111-3 [10] ProbableCause Value	New / Existing
VENDOR_EXT	VENDOR_EXT = n	New
MINOR_EXT	MINOR_EXT = n	New
UNIDENTIFIED	INDETERMINATE = 0	Existing
AIS	ALARM_INDICATION_SIGNAL = 1	Existing
AMS	AMS = n	New
ATPC_FAIL	ATPC_FAIL =n	New
AU-AIS	AU_ALARM_INDICATION_SIGNAL = n	New
BER_SD	DEGRADED_SIGNAL = 3;	Existing
BER_SF	FAILED_SIGNAL = n	New
BLOCKED_FE	BLOCKED_FE=n	New
CFG_ABORT	CFG_ABORT = n	New
CFG_ABORT_FE	CFG_ABORT_FE = n	New
DCC_FAILURE	DCC_FAILURE = n	New
DEMODULATION_FAIL	DEMODULATION_FAILURE = 20	Existing
EMS	EMS = n	New
EMS_ALM_LOSS	EMS_ALM_LOSS = n	New
EMS_LIFECYCLE_LOSS	EMS_LIFECYCLE_LOSS = n	New
EMS_ALM_AND_LIFECYCLE_LOSS	EMS_ALM_AND_LIFECYCLE_LOSS = n	New
EQPT	EQUIPMENT_MALFUNCTION = 315;	Existing
ENV	ENV = n	New
FF	FF = n	New
FOP_APS	FOP_APS = n	New
INSUFF_LINKS	INSUFF_LINKS = n	New
INSUFF_LINKS_FE	INSUFF_LINKS_FE= n	New
LCD	LCD = n	New
LIF	LIF = n	New
LOA	LOA = n	New
LOC	LOC = n	New
LODS	LODS = n	New
LOF	LOSS_OF_FRAME = 6	Existing
LOM	LOSS_OF_MULTI_FRAME = 16	Existing
LOP	LOSS_OF_POINTER = 7	Existing
LOPC	LOPC = n	New
LOS	LOSS_OF_SIGNAL = 8	Existing
LOTC	LOTC = n	New
MODULATION_FAIL	MODULATION_FAILURE = 19	Existing
MS-AIS	MS-AIS = n	New
OS	OS = n	New
OS_ALM_LOSS	OS_ALM_LOSS = n	New
OS_LIFECYCLE_LOSS	OS_LIFECYCLE_LOSS = n	New
OS_ALM_AND_LIFECYCLE_LOSS	OS_ALM_AND_LIFECYCLE_LOSS = n	New
OSC-AIS	OSC-AIS = n	New
OSC_BER_SF	OSC_BER_SF = n	New
OSC_FERF	OSC_FERF = n	New
OSC_LOF	OSC_LOF = n	New
OSC_LOS	OSC_LOS = n	New
OSC_SD	OSC_SD = n	New
PLM	PAYLOAD_TYPE_MISMATCH = 9	Existing
RAI	RAI = n	New
RX_FAIL	RECEIVER_FAILURE = 61	Existing
RX_MIS_CONNECT	RX_MIS_CONNECT = n	New
RX_UNUSABLE_FE	RX_UNUSABLE_FE = n	New
SECURITY_VIOLATION	SECURITY_VIOLATION = n	New
SQL	SQL = n	New
SSF	SSF = n	New
STARTUP_FE	STARTUP_FE = n	New
TCF	TCF = n	New
TCFE	TCFE = n	New
TCFI	TCFI = n	New
TIM	PATH_TRACE_MISMATCH = 13	Existing
TIMING_SYNCH	TIMING_SYNCH = n	New

TSD	TSD = n	New
TSF	TSF = n	New
TU-AIS	TU-AIS = n	New
TX_DEGRADE	TX_DEGRADE = n	New
TX_FAIL	TRANSMIT_FAILURE = 354	Existing
TX_MIS_CONNECT	TX_MIS_CONNECT = n	New
TX_UNUSABLE_FE	TX_UNUSABLE_FE = n	New
UAT	UAT = n	New
UNEQ	UNEQ = n	New
VC-AIS	VC-AIS = n	New
VC-RDI	VC-RDI = n	New
VP-AIS	VP-AIS = n	New
VP-RDI	VP-RDI = n	New
XPIC_FAIL	XPIC_FAIL = n	New

4.5.3.4 Alarm Filtering

This clause looks at the alarm filtering requirements for the following operations:

- Get alarm counts,
- Retrieve alarms list
- Register for alarm notifications

Filter Type	MTOSI Filtering attribute	3GPP Equivalent	3GPP Support		
			Alarm counts	Subscriptions	Alarm List
Selection of platform alarms or network alarms	Source	Supported via filtering in the object name	Supported – assuming the base object can represent the "management system" in the NRM	Supported – assuming the base object can represent the "management system" in the NRM	Supported – assuming the base object can represent the "management system" in the NRM
Selection of NEs to filter on	Scope	Not supported directly by 3GPP. Only a single base object per request – client can make multiple requests	-	-	-
Selection of alarm severities	PerceivedSeverityList	Supported via filtering on the severity - (sev=X) OR (sev=Y)	Supported – the data is returned per severity and the client can determine which severities to use	Supported	Supported
Selection of probable cause	ProbableCauseList	Supported by filtering on probableCause	N/A	Supported	Supported
Selection of acknowledgement state	AcknowledgeIndication	Supported by filtering on ack state	Supported	Supported	Supported

(Filters From Table 3-1 in the RTM)

Proposal: No changes required.

4.5.3.5 Alarm Uniqueness

In 3GPP alarm uniqueness is handled by the alarm id – in MTOSI alarm uniqueness is handled by the combination of { layerRate, probableCause. probableCauseQualifier, objectName }. In the generation of 3GPP messages it will be required to map the data in these fields into a single alarmId.

Proposal: It is assumed a mechanism can be provided to do this mapping (EMS specific).

4.5.3.6 Handling of ADMC alarms

For 3GPP it is not clear how ADMC alarms (transient conditions) should be reported – the following options are available:

Option#	Forwarded when the alarm is raised	Sent in resync data	Clearable from the n/b system
1	Yes	No	No
2	Yes	Yes	No
3	Yes	Yes	Yes

Proposal: Option 3 . Add something in the alarm notification to indicate whether the alarm is ADAC or ADMC.

Alternatively add this in the additional info field.

4.6 3GPP FM and TIP RAM BA comparison

This clause provides a comparison between existing 3GPP Fault Management related specifications and TMF TIP Resource Alarm Management Business Agreement. TIP RAM BA is the requirement specification for TIP alarm management (common FM interface for previous MTOSI/MTNM and OSS/J FM interfaces) and is currently in member evaluation phase. The information agreement (IS in 3GPP) is currently in draft status and assumed to be released during 2011. Since this study is about potential harmonization of 3GPP and TMF Fault Management functions the inclusion of this comparison is necessary. For complete TIP RAM BA, see [7]. The BA contains additional information than included in this clause.

The comparison is done between the existing and stable 3GPP Alarm IRP and TMF FM requirements (BA [7], currently work in progress). The goal is to define the recommendations for updates of the Alarm IRP, which would satisfy TMF TIP FM requirements and that would allow the 3GPP Alarm IRP specifications to be the solution for TMF TIP FM.

4.6.1 Business Requirements

R_TMF_RAM_BA_BR_0001	**Alarm Subscription** The Interface shall support subscription to alarm reports based on filtering conditions and the subsequent reporting of alarms to subscribed OSSs.
3GPP support	Compliant. Notification IRP. NtfSubscription.
Recommended 3GPP updates	None From TMF point of view: Relationship/dependency to TIP Framework for notification services SA5: No change, use Notification IRP; 3GPP intends to provide solution for TMF requirements based on IRP Framework

R_TMF_RAM_BA_BR_0002	**Alarm Synchronization** The Interface shall support synchronization with respect to the list of active alarms known to the alarm generator OSS (the real up-to-date list) and the alarm subscribers, which might have an out-of-date list.
3GPP support	Compliant. Alarm IRP. Notifications: notifyPotentialFaultyAlarmList and notifyAlarmListRebuilt + getAlarmList
Recommended 3GPP updates	None

4.6.2 Category I: Static and Structural Requirements

4.6.2.1 General

R_TMF_RAM_BA_I_0003	**Unambiguous Alarm ID** The alarm should have a unique and unambiguous Alarm ID.
3GPP support	Compliant. AlarmId.
Recommended 3GPP updates	None

R_TMF_RAM_BA_I_0004	**X.733 Alarm Attributes** The Alarm must contain structured information according to the X.733 specification The following attributes are needed: - Managed Object class - Managed Object instance - Event type - Event time - Probable Cause - Specific Problems - Perceived Severity - Threshold information - Notification identifier - Correlated Notifications - Proposed Repair Action - Additional Text - Additional Info
3GPP support	Compliant
Recommended 3GPP updates	None

R_TMF_RAM_BA_I_0005	**"Managed Object Instance" Attribute Information Structure** The information in the "managed object" attribute of the Alarm must allow a clear and unambiguous identification of the component (HW or SW), which is the originator of the Alarm.
3GPP support	Compliant. objectClass + objectInstance.
Recommended 3GPP updates	None

R_TMF_RAM_BA_I_0006	**Resource Name Resolution** The client OSS shall not be required to access to an external inventory to be understand the name and type of the resource on which the alarm applies (i.e. ManagedObject instance).
3GPP support	Compliant. objectClass + objectInstance.
Recommended 3GPP updates	None

R_TMF_RAM_BA_I_0007	**Settable Severity** The Perceived Severity shall be settable through the interface. (Additional note in BA: "It can also be set internally by the alarm owning system")
3GPP support	Not compliant
Recommended 3GPP updates	None The perceivedSeverity of an alarm record is decided by the NE reporting the alarm. This signals the NE's relative (in)ability to function as planned. Therefore changing this severity level would result in loosing essential alarm information. Note: TR 32.832 [11] is addressing a solution for this item (see AC2).

4.6.2.2 Correlation

R_TMF_RAM_BA_I_0008	**Alarm Correlation** An alarm can be correlated to one or more underlying alarms.
3GPP support	For 3GPP support refer to TR 32.832 [11]
Recommended 3GPP updates	Refer to TR 32.832 [11] for details on how 3GPP is addressing Alarm Correlation and Root-cause Analysis.

R_TMF_RAM_BA_I_0009	**Fault Symptom** A fault can have one or more symptoms. Each symptom can be reported by an alarm.
3GPP support	For 3GPP support refer to TR 32.832 [11]
Recommended 3GPP updates	Refer to TR 32.832 [11] for details on how 3GPP is addressing Alarm Correlation and Root-cause Analysis.

R_TMF_RAM_BA_I_0010	**Contributory Alarms** A fault can have one or more contributory alarms. These alarms are generated as a consequence of the problem. They are not sufficient by themselves to identify a fault.
3GPP support	For 3GPP support refer to TR 32.832 [11]
Recommended 3GPP updates	None. Refer to TR 32.832 [11] for details on how 3GPP is addressing Alarm Correlation and Root-cause Analysis.

R_TMF_RAM_BA_I_0011	**Root Cause** A fault has typically one root cause, which can be represented by an alarm. The Interface shall allow an alarm generating OSS to indicate if an alarm is a root cause alarm indication.
3GPP support	For 3GPP support refer to TR 32.832 [11]
Recommended 3GPP updates	Refer to TR 32.832 [11] for details on how 3GPP is addressing Alarm Correlation and Root-cause Analysis.

4.6.2.3 Tracking

R_TMF_RAM_BA_I_0012	**Tracking info for action** When an action (ack, clear, comment…) is done on an alarm, information identifying the user doing the action, the system from which the action is done and the time of the action shall be tracked and kept in the alarm.
3GPP support	Compliant. Maintained by IRPAgent and information contained by notifyAckStateChanged, notifyClearedAlarm alarmRaisedTime, alarmClearedTime, alarmChangedTime ackTime, ackUserId, ackSystemId clearUserId, clearSystemId
Recommended 3GPP updates	None

R_TMF_RAM_BA_I_0013	**Alarm Escalation** It shall be possible to escalate an alarm and the alarm will track the escalation. Several levels of escalation are possible showing increasing levels of escalation.
3GPP support	Supported from NE-perspective via reporting of perceivedSeverity changes (notifyChangedAlarm)
Recommended 3GPP updates	Refer to TR 32.832 [11] for details on how 3GPP is addressing Alarm Correlation and Root-cause Analysis. 3GPP considers this capability as NM-layer feature. 3GPP may enhance furture alarm interface capabilities to support alarm escalation when considering NM-layer alarm management features.

R_TMF_RAM_BA_I_0014	**Clear Status** The alarm shall include a Clear status (uncleared, cleared). Clearance of the correlated (symptom or contributory) alarms does not imply clearance of the parent alarm. The time when the alarm was cleared shall be available across the interface.
3GPP support	Compliant. States defined for both acknowledgment and alarm clearing. notifyClearedAlarm and notifyChangedAlarm carries the info on clear/unclear. Corresponding data: alarmClearedTime, clearUserId, clearSystemId
Recommended 3GPP updates	None

R_TMF_RAM_BA_I_0015	**Ack Status**
3GPP support	Compliant. States defined for both acknowledgment and alarm clearing. notifyAckStateChanged and notifyChangedAlarm carries the info on clear/unclear. Corresponding data: ackState, ackUserId, ackSystemId
Recommended 3GPP updates	None

R_TMF_RAM_BA_I_0016	**Comments** The alarm can include comments. Information identifying the user entering the comment, the system from which the comment is entered and the time of the action shall be part of the comment.
3GPP support	Compliant. setComment and getAlarmlist provides this information, but notifyComments does not provide the user id.
Recommended 3GPP updates	None

4.6.2.4 Miscellaneous

R_TMF_RAM_BA_I_0017	**Planned Outage** The alarm shall include a planned outage indication. It indicates that the object associated with an alarm is in planned outage (in planned maintenance, or out-of-service). This might also be used when an equipment is being commissioned to avoid the alarms propagating to other FM systems.
3GPP support	For 3GPP support refer to TR 32.832 [11]
Recommended 3GPP updates	Refer to TR 32.832 [11] for details on how 3GPP is addressing Alarm Correlation and Root-cause Analysis (see section on "Use of notification data").

4.6.3 Category II: Normal Sequences, Dynamic Requirements

4.6.3.1 Alarm Notification

R_TMF_RAM_BA_II_0018	**Sending/Receiving Alarms** It must be possible to send/notify (Server) and receive/listen to (Client) Alarms. The alarm owning system will be the one sending/notifying alarms, acting as a server. The alarm receiving system will be the one receiving/listening to alarms, acting as client.
3GPP support	Compliant
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0019	**New Alarm Notification** The Interface shall support the sending of an Alarm Notification when an alarm has been created or an alarm condition has been detected.
3GPP support	Compliant. notifyNewAlarm
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0020	**Notification on Alarm Change** The Interface shall support the sending of Attribute Value Change notification and/or State Change notifications when an alarm has been updated. The following modifications shall be reportable: addition of comments acknowledgement or un-acknowledgement of an alarm clearance of the alarm update of attributes
3GPP support	Compliant. notifyAckStateChanged, notifyClearedAlarm, notifyChangedAlarm, notifyComments
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0021	**Clear Event Transport** The interface shall support the sending of Clear events as State Change events.
3GPP support	Compliant. notifyClearedAlarm
Recommended 3GPP updates	None

4.6.3.2 Alarm Handling

R_TMF_RAM_BA_II_0022	**Alarm Creation** The Interface shall allow one OSS to create one or more alarm(s) on another OSS.
3GPP support	Supported via AlarmIRP/notifyNewAlarm
Recommended 3GPP updates	Note: 3GPP solution addresses interactions of management components across Itf-N/Itf-P2P, but can alo be applied to OSS/NM-layer internal interactions. If additional functionality is needed on NM-layer interactions (supported by agreed use cases and architectural definitions), such interaction should be defined in a separate interface specification.

R_TMF_RAM_BA_II_0023	**Alarm Update** The interface shall allow one OSS to update an alarm generated by another OSS. This is possible for all settable attributes.
3GPP support	Supported via AlarmIRP/notifyChangedAlarm and AlarmIRP/ notifyClearedAlarm/notifyNewAlarm TBD, needs more clarification Note that an alarm may only be updated or cleared by the OSS that created the alarm.
Recommended 3GPP updates	Note: 3GPP solution addresses interactions of management components across Itf-N/Itf-P2P, but can alo be applied to OSS/NM-layer internal interactions. If additional functionality is needed on NM-layer interactions (supported by agreed use cases and architectural definitions), such interaction should be defined in a separate interface specification.

R_TMF_RAM_BA_II_0024	**Comment an Alarm** The interface shall allow an OSS to add a comment to an alarm generated by another OSS.
3GPP support	Compliant. setComments.
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0025	**Change Alarm Correlation** The interface shall allow an OSS to request a change in the underlying alarms on a parent alarm from another OSS. This covers adding a new correlation (symptom or contributory) or removing one.
3GPP support	For 3GPP support refer to TR 32.832 11]
Recommended 3GPP updates	Refer to TR 32.832 [11] for details on how 3GPP is addressing Alarm Correlation and Root-cause Analysis. Note: 3GPP solution addresses interactions of management components across Itf-N/Itf-P2P, but can alo be applied to OSS/NM-layer internal interactions. If additional functionality is needed on NM-layer interactions (supported by agreed use cases and architectural definitions), such interaction should be defined in a separate interface specification.

R_TMF_RAM_BA_II_0026	**Change Root Cause Indication** The Interface shall allow an OSS to request a change to the diagnosis of a root cause in the alarm owning OSS. If accepted by the alarm owning system, this is subsequently reported as an Attribute Value Change event to other OSSs that have subscribed to such events.
3GPP support	For 3GPP support refer to TR 32.832 [11]
Recommended 3GPP updates	Refer to TR 32.832 [11] for details on how 3GPP is addressing Alarm Correlation and Root-cause Analysis. Note: 3GPP solution addresses interactions of management components across Itf-N/Itf-P2P, but can alo be applied to OSS/NM-layer internal interactions. If additional functionality is needed on NM-layer interactions (supported by agreed use cases and architectural definitions), such interaction should be defined in a separate interface specification.

R_TMF_RAM_BA_II_0027	**Clearing an Alarm** The Interface shall allow an OSS to clear an alarm generated by another OSS.
3GPP support	Compliant. clearAlarms
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0028	**UnClearing an Alarm** The Interface shall allow an OSS to unclear an alarm generated by another OSS.
3GPP support	Not Supported. Unclearing of alarms is likely to conflict with automatic clearing of alarms by the underlying systems.
Recommended 3GPP updates	None. Valid UC for unclear needs to be identified since a) after an alarm is cleared, the alarm is mostly likely removed and unclear alarm does not make sense; b) when OSS-1 generates an alarm and then generates a clear alarm, the other OSS-2 issues unclear of this alarm means OSS-1 keeps an active alarm which is already cleared. This is illogical. Note: if use of unclear is to preserve the historical alarm history, then it should be recognized that 3GPP has Notification Log for that purpose. The AlarmList is not intended for archiving information. Note: 3GPP solution addresses interactions of management components across Itf-N – 3GPP does not adress OSS/NM-layer internal interactions. Such interaction should be defined in a separate interface specification.

R_TMF_RAM_BA_II_0029	**Acknowledge an Alarm** The Interface shall allow an OSS to acknowledge an alarm generated by another OSS.
3GPP support	Compliant. acknowledgeAlarms
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0030	**UnAcknowledge an Alarm** The Interface shall allow an OSS to un-acknowledge an alarm generated by another OSS.
3GPP support	Compliant. unacknowledgeAlarms
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0031	**Alarm State Transition** An instance of an alarm entity must follow the state transition diagram (Note: diagram in TIP RAM BA)
3GPP support	Compliant in principle. Differences may result from acknowledgement functionality.
Recommended 3GPP updates	None Note: 3GPP has defined an alarm state diagram in 32.111-2 [11].

4.6.3.3 Alarm Administration

R_TMF_RAM_BA_II_0032	**Subscribe to Alarms** The Interface shall allow an OSS to subscribe to the alarms generated by other OSSs. This subscription includes State Changes and Attribute Value Changes that can be generated by the alarm owning OSS.
3GPP support	Compliant. Notification IRP
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0033	**Filter Alarm Subscription** The Interface shall allow an OSS to apply a filter to its subscription for alarms from another OSS. In particular, alarms can be filtered based on any set of alarm attributes.
3GPP support	Compliant. Notification IRP, subscribe, filter
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0034	**Modify an Alarm Filter** The interface shall allow an OSS to modify a filter with regard to a successful previous subscription for alarms. It can include adding or removing a filtering criteria.
3GPP support	Compliant. Notification IRP. changeSubscriptionFilter
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0035	**Unsubscribe to Alarms** The Interface shall allow an OSS to unsubscribe from the alarms generated by another OSS.
3GPP support	Compliant. Unsubscribe
Recommended 3GPP updates	None

4.6.3.4 Alarm Retrieval

R_TMF_RAM_BA_II_0036	**Retrieving all alarms** The Interface shall allow an OSS to request the alarm owning OSS to retrieve all alarms (not cleared or not acknowledged) present on the alarm owning OSS.
3GPP support	Compliant. getAlarmList.
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0037	**Filtered Alarm Retrieval** The Interface shall support requests to retrieve alarms of an alarm owning OSS. The request shall be able to filter on any set of alarm attributes.
3GPP support	Compliant. getAlarmList + filter parameter
Recommended 3GPP updates	None

R_TMF_RAM_BA_II_0038	**Alarm Count** The interface shall support requests to retrieve the count of alarms of an alarm owning OSS. The request shall be able to filter on any set of alarm attributes.
3GPP support	Compliant. getAlarmCount
Recommended 3GPP updates	None

5 Discussion of FM IF Standards Alignment Options

Full alignment. In case of full alignment, the compared sources become one. This is the ultimate target for the harmonization/alignment work in general i.e. one FM specification that fulfils all the requirements of compared sources. The full alignment, considering equally both requirements, would anyhow lead to a completely new interface. A new interface means a discontinuity point that leads to new implementation and new integration work thus increasing unnecessary the cost. This shall be avoided.

Partial alignment. Content and functionality wise a partial alignment can be done in many different ways e.g. both specifications would be updated with the missing main requirements of the other source or the updates are done per need/evaluation. The target is to have one FM interface that fulfils the requirements of converged network fault management thus one specification needs to be extended with the requirement set by the other specification. And to keep the changes in minimum the updates (adding new or changing existing items) needs to be done selectively and considering the base specification.

The FM alignment should minimize the cost factor both for the vendors and the operators. And provide a stable and technology independent FM interface solution for the converged networks. The target shall be one FM interface for converged networks. TIP FM interface work is ongoing currently will lead to a new interface. Whereas 3GPP Alarm IRP is stable, and has been stable for years already. The best way to do the FM alignment is to enhance the existing Alarm IRP to capture the main requirements of TMF TIP FM and define Alarm IRP to be the only FM interface for converged networks.

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6 Recommendations for FM IF Standards Alignment

This clause identifies the recommended changes based on comparison in clause 4 and harmonization options in clause 5. The main input to the recommended changes is the 3GPP FM and TIP RAM BA comparison in clause 4.6.

The recommendation is to change 3GPP Alarm IRP only. 3GPP Alarm IRP is a mature and stable interface and can be extended to support converged network fault management requirements with minor modifications.

This study identified two areas of enhancements for 3GPP alarm management interface capabilities:

- Improvement on alarm correlation and root cause analyzis
- NM-layer alarm management interface capabilities

Improvement on alarm correlation and root cause analyzis:

- Operator Top-10-Requirements [8] identified a deficiency in current Alarm management capabilities: alarm correlation and root cause analysis capabilities are missing. 3GPP has studied this topic and documented its analyzis and recommendation in TR 32.832 [11].

NM-layer alarm management interface capabilities:

- 3GPP Alarm IRP is usable also on NM-layer interactions (as sufficiently generic and providing required functionality for transfer and management of alarm information)
- 3GPP recommends that if additional functionality is needed on NM-layer interactions (supported by agreed use cases and architectural definitions), such interaction should be defined in a separate interface specification.

3GPP Alarm IRP (3GPP TS 32.111-x), with the recommendations listed above, will satisfy all the converged network FM requirements. The target is to provide only one FM solution without any competing solutions to eliminate silo management solutions. The planned TMF TIP FM interface would mean a partially duplicated FM interface as well as continuation of silo management. The recommendation to TMF TIP is to accept 3GPP Alarm IRP as their FM interface and not to develop a competing interface.

Annex A (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2010-05	SA-49	SP-100288	--	--	Presentation to SA for information	0.1.1	1.0.0
2011-03	SA-51	SP-110122	--	--	Presentation to SA for approval	1.5.0	2.0.0
2011-03	--	--	--	--	Publication	2.0.0	10.0.0