



**LTE;
Telecommunication management;
Fault Management (FM) for mobile networks that include
virtualized network functions;
Requirements
(3GPP TS 28.515 version 19.0.0 Release 19)**



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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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Foreword

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

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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:

TS 28.515 "Fault Management (FM) for mobile networks that include virtualized network functions; Requirements".

TS 28.516 "Fault Management (FM) for mobile networks that include virtualized network functions; Procedures".

TS 28.517 "Fault Management (FM) for mobile networks that include virtualized network functions; Stage 2".

TS 28.518 "Fault Management (FM) for mobile networks that include virtualized network functions; Stage 3".

1 Scope

The present document (together with the relevant requirements described in [2], [3], [4] and [5]) specifies the requirements applicable to Fault Management (FM) of mobile networks that include virtualized network functions.

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 28.500: "Telecommunication management; Management concept, architecture and requirements for mobile networks that include virtualized network functions".
 - [3] 3GPP TS 32.101: "Telecommunication management; Principles and high level requirements".
 - [4] 3GPP TS 32.102: "Telecommunication management; Architecture".
 - [5] 3GPP TS 32.111-1: "Telecommunication management; Fault Management; Part 1: 3G fault management requirements".
 - [6] ETSI GS NFV-IFA 010 (V2.2.1): "Network Functions Virtualisation (NFV); Management and Orchestration; Functional Requirements Specification".
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3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and in 3GPP TS 28.500 [2] 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] or in 3GPP TS 28.500 [2].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and in 3GPP TS 28.500 [2] 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] or in 3GPP TS 28.500 [2].

VM	Virtual Machine
vNIC	virtual Network Interface Card
vPORT	virtual Port

4 Concepts and background

4.1 Fault Management in the context of NFV

Fault Management functionality traditionally includes fault detection, generation of alarms, clearing of alarms, alarm forwarding and filtering, storage and retrieval of alarms, correlation of alarms and events, alarm root cause analysis and fault recovery. With introduction of virtualized network functions (VNFs) into mobile networks, Fault Management functionality is distributed over different functional blocks. These different functional blocks may be located at different levels such as NFV Infrastructure (NFVI) level, NE level, NFV Management and Orchestration level and 3GPP network management level.

The decoupling of software from hardware by means of virtualization changes the way in which the faults were managed in non-virtualized NE deployments:

- Physical hardware faults of NFVI are detected by NFVI and corrected jointly with the support from NFV-MANO. Only information about those faults (e.g. faults corresponding to the virtualized resources) that affect the proper functioning of VNF needs to be provided to 3GPP management system.
- VNF-related virtualized resource fault information needs to be sent from NFV-MANO to 3GPP management system, and then 3GPP management system can take some necessary actions.
- VNF application fault information needs to be sent from the VNF instance to the corresponding 3GPP management system that is responsible for taking some necessary actions.
- VNF virtualization-specific fault information is detected by VNF and needs to be sent from the VNF instance to both the VNFM and the corresponding 3GPP management system so that they can take necessary actions accordingly.

5 Business level requirements

5.1 Requirements

REQ-NFV_FM-CON-1 The faulty virtualization-specific aspect of a virtualized network function shall be able to be recovered.

REQ-NFV_FM-CON-2 3GPP management system shall be able to get VNF application fault reports about a faulty NE.

REQ-NFV_FM-CON-3 3GPP management system shall be able to get VNF virtualization-related fault reports from NFV-MANO.

REQ-NFV_FM-CON-4 The content of the fault information from VNF application fault reports and VNF virtualization-related fault reports shall enable 3GPP management system to correlate VNF application fault(s) with VNF virtualization-related fault(s).

REQ-NFV_FM-CON-5 EM shall be able to send to VNFM a request to recover the faulty virtualization-specific aspect of a virtualized network function.

5.2 Actor roles

See actors and roles of each use case in clause 5.4.

5.3 Telecommunications resources

See telecom resources of each use case in clause 5.4.

5.4 High-level use cases

5.4.1 NE alarm correlation in the context of NFV

Use Case Stage	Evolution / Specification	<<Uses>> Related use
Goal	To correlate NE alarms in a mobile network that includes virtualized network functions.	
Actors and Roles	3GPP management system (EM, NM) correlates NE alarms. NFV MANO functional entity VNFM notifies virtualized resource alarms to 3GPP management system.	
Telecom resources	VNFM, 3GPP management system (EM, NM)	
Assumptions	- 3GPP management system can get VNF application alarms of the faulty NE, and - VNFM can get virtualized resource alarms and identify the corresponding VNF instance.	
Pre conditions	N/A	
Begins when	There is a new failure which may impact the virtualized resource and the corresponding NE application.	
Step 1 (M)	3GPP management system gets VNF application alarm(s) of a faulty NE. VNFM gets virtualized resource alarm(s) and notifies the corresponding VNF instance related virtualized resource alarm(s) to 3GPP management system.	
Step 2 (M)	Based on the virtualized resource alarm(s) sent from VNFM and those VNF application alarms reported from NE, 3GPP management system makes alarm correlation.	
Ends when	Ends when all mandatory steps identified above are successfully completed or when an exception occurs.	
Exceptions	One of the steps identified above fails.	
Post Conditions	The virtualized resource alarm(s) and VNF application alarm(s) are correlated by 3GPP management system.	
Traceability	REQ-MAMO_FM-CON-3, REQ-MAMO_FM-CON-4, REQ-MAMO_FM-CON-5	

5.4.2 NFVI Maintenance coordination

Use Case Stage	Evolution / Specification	<<Uses>> Related use
Goal	To avoid the unwanted impact to VNF application from NFVI maintenance	
Actors and Roles	NM, NFVO, VNFM, VIM	
Telecom resources	NFVO, VNFM VIM, NFVI	
Assumptions	There is an agreement that NFV-MANO system should get permission from NM before scheduled NFVI maintenance, managed by NFV-MANO, can start.	
Pre conditions	N/A	
Begins when	NFVO receives a notification from VIM informing about NFVI maintenance impacting the VRs (Virtualised Resources) that are used by a NS instance (e.g. the subordinative VNF instances and Virtual Links).	
Step 1 (M)	NFVO informs NM about the NFVI maintenance.	
Step 2 (M)	NM confirms the NFVI maintenance positively or not positively.	
Step 3 (M)	NFVO acts according to the response from NM.	
Ends when	Ends when all mandatory steps identified above are successfully completed or when an exception occurs.	
Exceptions	One of the steps identified above fails.	
Post Conditions	NFVI maintenance activity has been coordinated between NM and NFVO.	
Traceability	FFS	

6 Specification level requirements

6.1 Requirements

6.1.1 Requirements for Itf-N

REQ-NFV_FM_Itf-N-FUN-1 IRPAgent shall have the capability to send VNF application alarms to IRPManager.

REQ-NFV_FM_Itf-N-FUN-2 IRPAgent should have the capability to send VNF instance related virtualized resource alarms to IRPManager.

REQ-NFV_FM_Itf-N-FUN-3 The existing AlarmIRP should be reused as much as possible.

6.1.2 Requirements for Os-Ma-nfvo

None.

6.1.3 Requirements for Ve-Vnfm-em

REQ-NFV_FM_Ve-Vnfm-em-FUN-1 The Ve-Vnfm-em reference point shall support a capability allowing VNFM to notify EM the VNF and/or VNFC instance related virtualized resource failure reports, in which information (e.g. VM Identifier, vNIC/vPORT Identifier) of faulty VNF and/or VNFC instance is included.

REQ-NFV_FM_Ve-Vnfm-em-FUN-2 The Ve-Vnfm-em reference point shall support a capability allowing VNFM to notify EM and other authorized consumers who can play the role of EM, the virtualization-specific aspect failure reports, in which information of faulty VNF and VNFC instance(s) is included.

REQ-NFV_FM_Ve-Vnfm-em-FUN-3 The Ve-Vnfm-em reference point shall support the EM to send to VNFM a request to execute the VNF Healing of a virtualized network function indicating the corresponding healing procedure and VNFC instance(s).

REQ-NFV_FM_Ve-Vnfm-em-FUN-4 The Ve-Vnfm-em reference point shall support a capability allowing EM to subscribe/unsubscribe to VNF and VNFC instance related alarm notification provided by the VNFM.

6.1.4 Requirements for Ve-Vnfm-vnf

REQ-NFV_FM_Ve-Vnfm-vnf-FUN-1 The Ve-Vnfm-vnf reference point shall support the capability for the VNF virtualization-specific component to notify about faulty virtualization-specific aspects to VNFM.

6.2 Actor roles

See actors and roles of each use case in clause 6.4.

6.3 Telecommunications resources

See telecom resources of each use case in clause 6.4.

6.4 Use cases

6.4.1 NE alarm correlation in the context of NFV

Use Case Stage	Evolution / Specification	<<Uses>> Related use
Goal	To correlate NE alarms in a mobile network that includes virtualized network functions.	
Actors and Roles	EM or NM correlates NE alarms. VNFM notifies virtualized resource alarms to EM. EM sends VNF application failure reports and VNF instance related virtualized failure reports to NM.	
Telecom resources	NM, EM, VNFM	
Assumptions	3GPP management system (EM, NM) can get VNF application alarms of the faulty NE. VNFM can get virtualized resource alarms and identify the corresponding VNF instance.	
Pre conditions	N/A	
Begins when	There is a new failure which may impact the virtualized resource and the corresponding NE application.	
Step 1 (M)	EM sends VNF application failure reports of a fault NE to NM.	
Step 2 (M)	VNFM sends VNF instance related virtualized failure reports to EM, in which information of the failed VNF instance is included. EM reports VNF instance related virtualized failure reports to NM. NOTE: Sequence of step 1 and step 2 may be reversed.	
Step 3 (M)	Based on the virtualized resource failure reports sent from VNFM and VNF application alarms, EM or NM makes the alarm correlation.	
Ends when	Ends when all steps identified above are successfully completed or when an exception occurs.	
Exceptions	One of the steps identified above fails.	
Post Conditions	Failure reports of a faulty NE are reported and correlated by 3GPP management system.	
Traceability	REQ-NFV_FM_Itf-N-FUN-1, REQ-NFV_FM_Itf-N-FUN-2, REQ-NFV_FM_Ve-Vnfm-em-FUN-1	

6.4.2 VNF Healing through operation request to VNFM by EM

NOTE: In the context of this use case, VNF Healing [6] refers to corrective actions performed by the VNFM to recover a VNF which fails to perform as expected, and/or its VNFC instances and internal VNF Virtual Link(s), and it concerns the actions for which the VNFM is responsible, i.e., corrective action(s) toward virtualised resources, instantiation of VNFC, configuration of VNF deployment specific parameters, etc.

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To recover the faulty virtualization-specific aspect of a virtualized network function by executing a VNF Healing through an operation request to VNFM by EM and notify about the execution of the VNF healing through reference point Ve-Vnfm-em.	
Actors and Roles	EM requests the VNFM to execute the VNF healing based on the information included in the request.	
Telecom resources	EM. VNFM. VNF.	
Assumptions	EM is subscribed to VNF lifecycle change notifications from the VNFM.	
Pre-conditions	The subject VNF instance is not being healed at the moment.	
Begins when	A faulty virtualization-specific aspect of the VNF has been notified to EM.	
Step 1 (M)	EM determines that VNF Healing is needed.	
Step 2 (M)	EM requests the VNFM to execute the VNF Healing with indication of VNF Components to recover and indication of the healing procedure to execute with input parameters as required.	
Step 3 (O)	VNFM sends to EM a notification about the start of the VNF healing execution.	
Step 4 (M)	The VNFM executes the procedure to heal the VNF instance.	
Step 5 (M)	VNFM sends to EM a notification about the end and the result of the VNF Healing execution.	
Ends when	All the steps identified above are successfully completed.	
Exceptions	The VNF Healing procedure in step 4 fails.	
Post-conditions	The faulty virtualization-specific aspect of the VNF is recovered.	
Traceability	REQ-NFV_FM_Ve-Vnfm-em-FUN-3	

6.4.3 Virtualization-specific aspect failure detection and notification by VNFM

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To notify the EM about a virtualization-specific failure of a virtualized network function through Ve-Vnfm-em reference point.	
Actors and Roles	VNF virtualization-specific component.	
Telecom resources	EM. VNFM. VNF.	
Assumptions	- VNFM receives virtualised resource fault reports from VIM. - VNF application-specific fault is reported to the EM. - EM is subscribed to VNF-related virtualization fault reports from the VNFM.	
Pre-conditions	N/A	
Begins when	The virtualization-specific failure is detected by the VNF virtualization-specific component.	
Step 1 (M)	VNF virtualization-specific component sends virtualization-specific fault notification to VNFM over Ve-Vnfm-vnf reference point.	
Step 2 (M)	VNFM creates VNF virtualization-related fault report about the VNF and its VNF Components.	
Step 3 (M)	VNFM sends the VNF virtualization-related fault report to the EM over Ve-Vnfm-em reference point.	
Ends when	All the steps identified above are successfully completed.	
Exceptions		
Post-conditions	The EM is notified about the virtualization-specific failure of the subject VNF.	
Traceability	REQ-NFV_FM_Ve-Vnfm-vnf-FUN-1, REQ-NFV_FM_Ve-Vnfm-em-FUN-2	

6.4.4 Virtualization-specific aspect failure detection and notification by EM

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To notify the EM about a virtualization-specific failure of a virtualized network function.	
Actors and Roles	VNF virtualization-specific component	
Telecom resources	EM. VNFM. VNF.	
Assumptions	- VNF application-specific fault is reported to the EM. - EM is subscribed to VNF-related virtualization fault reports.	
Pre-conditions	N/A	
Begins when	The virtualization-specific failure is detected by the VNF virtualization-specific component.	
Step 1 (M)	VNF virtualization-specific component sends virtualization-specific fault notification to EM.	
Ends when	All the steps identified above are successfully completed.	
Exceptions		
Post-conditions	The EM is notified about the virtualization-specific failure of the subject VNF.	
Traceability		

6.4.5 NE alarm reporting in the context of NFV

Use Case Stage	Evolution / Specification	<<Uses>> Related use
Goal	To send or notify NE alarms in a mobile network that includes virtualized network functions.	
Actors and Roles	EM reports NE alarms to NM. NFV MANO functional entity VNFM notifies VNF instance alarms related to virtualized resource to 3GPP management system EM.	
Telecom resources	VNFM, EM, NM	
Assumptions	EM can detect VNF application alarms of the faulty NE, and VNFM can get virtualized resource alarms, identify the corresponding VNF instance and notify the corresponding VNF instance alarm to EM.	
Pre conditions	N/A	
Begins when	There is a failure which impacts the NE application and/or the corresponding virtualized resources.	
Step 1 (M)	EM detects VNF application alarm(s) of a faulty NE.	
Step 2 (M)	If there is virtualized resource alarm(s), VNFM notifies the corresponding VNF instance alarm(s) with related virtualized resource information to EM.	
Step 3 (M)	EM reports the NE application alarm(s) and/or the VNF instance alarm(s) sent from VNFM to NM over Itf-N.	
Ends when	Ends when all mandatory steps identified above are successfully completed or when an exception occurs.	
Exceptions	One of the steps identified above fails.	
Post Conditions	NE alarms are sent from EM to NM.	
Traceability	REQ-NFV_FM_Itf-N-FUN-3	

6.4.6 Virtualization-specific aspect failure notification by VNFM

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	To notify authorized consumer who can play the role of EM about virtualization-specific aspect alarms.	
Actors and Roles	The consumer	
Telecom resources	VNFM	
Assumptions	The consumer that requires the VNF-related virtualization fault information produced by VNFM, has a subscription to receive such information,	
Pre-conditions	N/A	
Begins when	VNFM is aware of a VNF virtualization-specific aspect problem.	
Step 1 (M)	VNFM creates an alarm record.	
Step 2 (M)	VNFM sends the alarm record to the consumer(s) which has subscribed to receiving such information.	
Ends when	All the steps identified above are successfully completed.	
Exceptions		
Post-conditions	The consumer(s) has received the virtualization-specific aspects failure information.	
Traceability	REQ-NFV_FM_Ve-Vnfm-em-FUN-2	

Annex A (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2017-06	SA#76	SP-170505	0001	-	F	Update text in the scope to align with other NFV TSs	14.1.0
2018-06	SA#80	SP-180417	0002	1	B	Scope extension to cover RAN	15.0.0
2020-07	-	-	-	-	-	Update to Rel-16 version (MCC)	16.0.0
2022-03	-	-	-	-	-	Update to Rel-17 version (MCC)	17.0.0
2024-04	-	-	-	-	-	Update to Rel-18 version (MCC)	18.0.0
2025-09	SA#109	-	-	-	-	Update to Rel-19 version (MCC)	19.0.0

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