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**Telecommunication management;**
**Fault Management (FM)**
**for mobile networks that include virtualized network functions;**
**Procedures**
**(3GPP TS 28.516 version 17.0.0 Release 17)**

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# Contents

# Foreword

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1 presented to TSG for information;

2 presented to TSG for approval;

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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

# 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 specifies the Fault Management procedures for 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 32.111-2: "Telecommunication management; Fault Management; Part 2: Alarm Integration Reference Point (IRP) Information Service (IS)".

[3] ETSI GS NFV-IFA 008 (V2.1.1): "Network Functions Virtualisation (NFV); Management and Orchestration; Ve-Vnfm Reference Point - Interface and Information Model Specification".

[4] 3GPP TS 28.515: "Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Requirements".

[5] 3GPP TS 28.500: "Telecommunication management; Management concept, architecture and requirements for mobile networks that include virtualized network functions".

# 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 [5] 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 [5].

## 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 [5] 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 [5].

| | |
|---|---|
| VM | Virtual Machine |
| VNFC | Virtualized Network Function Component |
| vNIC | virtual Network Interface Card |
| vPORT | virtual Port |

# 4 Fault Management procedures

## 4.1 Introduction

The overview of alarm data flow procedures in context of NFV is showed as Figure 4.1-1 3GPP view of FM data flows.

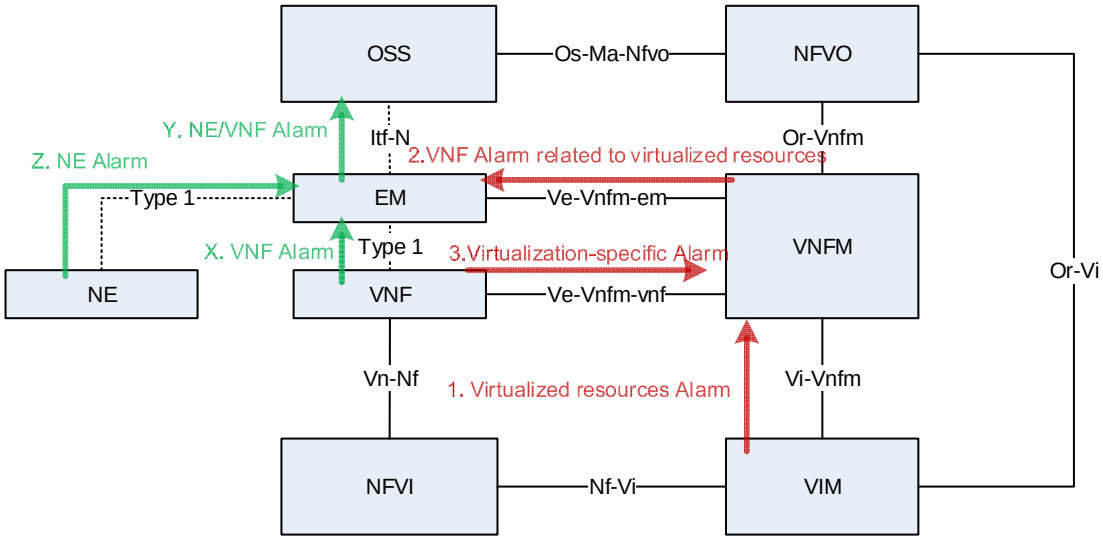


**Figure 4.1-1: 3GPP view of alarm data flows for NE/VNF**

The alarm data flow and the alarm mapping of VNF instance application alarm and VNF instance related virtualized resource alarm are described as below:

- Flow-1 VIM reports virtualized resources alarm data to VNFM (out of scope of the present document).
- Flow-2 VNFM sends VNF alarm data related to virtualized resources (mapped to VNF instance, correlated or not-correlated) to EM.
- Flow-3 VNF reports virtualization-specific alarm data to VNFM.
- Flow-X Via 3GPP Type 1 interface VNF instance reports VNF instance application alarm data and virtualization-specific alarm data to EM.
- Flow-Z Via 3GPP Type 1 interface non-virtualized NEs report alarm data to EM.
- Flow-Y Via 3GPP Itf-N EM sends the following: VNF instance application alarm data and virtualization-specific alarm data (received via Flow-X), VNF alarm data related to virtualized resources (received via Flow-2),non-virtualized NE alarm data (received via Flow-Z), and/or correlated VNF instance alarm data.

EM may make the alarm correlation based on information contained in Flow-X, Flow-Z and Flow-2, using the same VNF/VNFC instance identifier based on the VNF instance alarm data related to virtualized resource and VNF instance application alarm data. EM may report the correlated VNF instance alarm data to NM.

NM may make the alarm correlation based on information contained in Flow-X, Flow-Y, Flow-Z and Flow-2, using the same VNF/VNFC instance identifier based on the VNF instance alarm data related to virtualized resource and VNF instance application alarm data.

The procedures listed in clause 4, as some of all the possibilities, are not exhaustive.

# 4.2 NE alarm correlation in the context of NFV

## 4.2.1 NE alarm correlation made by EM in the context of NFV

When a new failure occurs from the virtualized resource and it impacts the corresponding NE application, EM can make the alarm correlation based on the virtualized resource failure report sent from VNFM and VNF application alarms.

The figure 4.2.1-1 illustrates the procedure of EM makes NE alarms correlation in a mobile network that includes virtualized network functions.

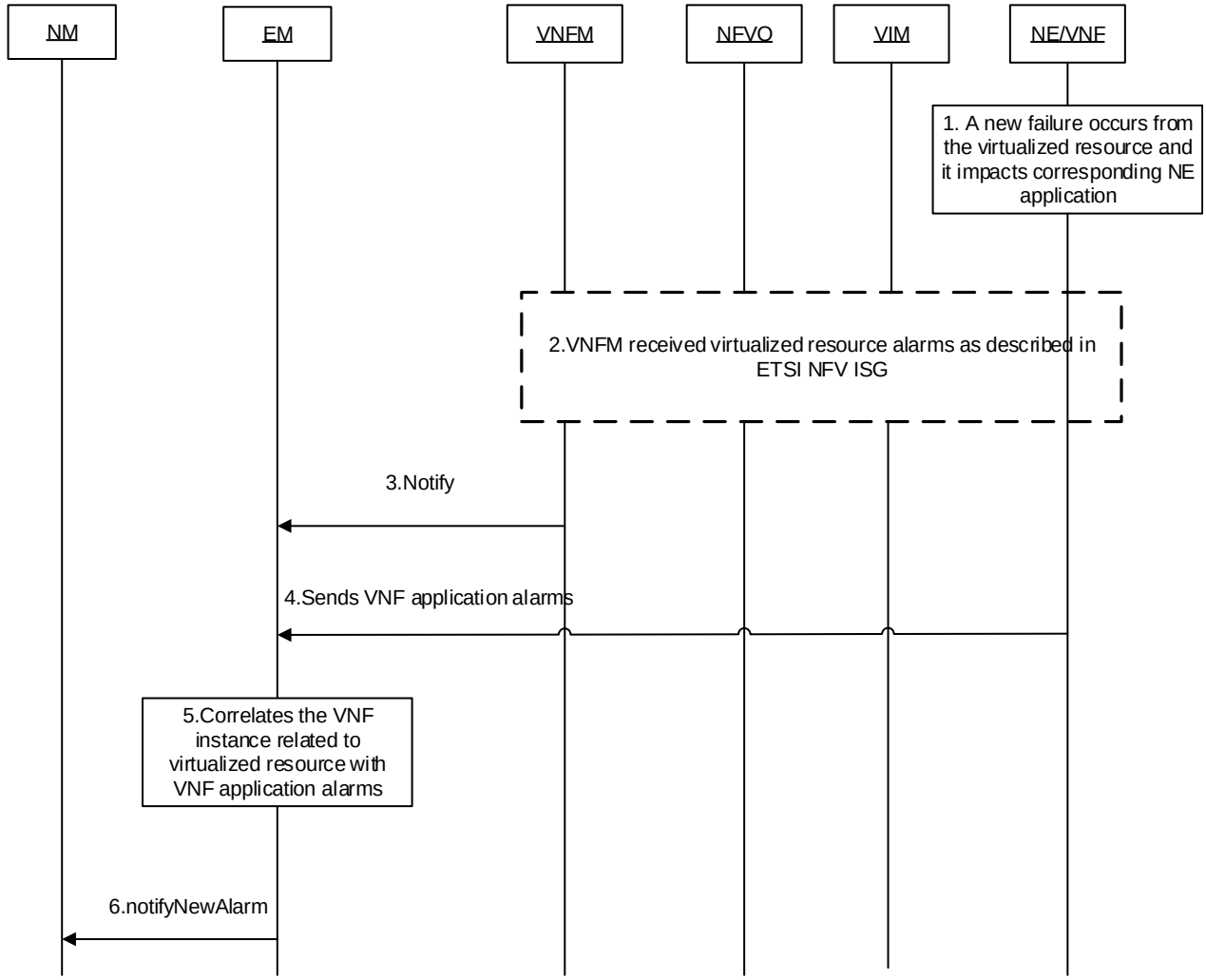


**Figure 4.2.1-1: Procedure of NE alarm correlation made by EM in the context of NFV**

1) A new failure occurs from the virtualized resource and it impacts the corresponding NE application.

2) VNFM received virtualized resource alarms as described in ETSI NFV ISG.

3) VNFM sends VNF instance alarms related to virtualized resource to EM. The VNF and/or VNFC alarms related to virtualized resource include AlarmId, affected VNF identifier, affected VNFC identifiers, and FaultDetails which provides additional information about the virtualized resource fault, for example the resource identifier which causes the fault (e.g. VM identifier, vNIC identifier or vPORT identifier). The Alarm information element see clause 9.3.4 of [3].

4) NE/VNF sends VNF application alarms to EM through proprietary interface, the corresponding VNF instance identifier and/or VNFC identifier should be included.

NOTE: There is no sequence restriction on EM receives VNF instance alarms related virtualized resource and EM receives VNF application alarms.

5) EM correlates the received VNF instance alarms related to virtualized resource with the received VNF application alarms.

6) EM sends the correlated alarm information to NM over Itf-N. The alarm information that carries correlated alarm information is specified in TS 32.111-2 [2].

### 4.2.2 NE alarm correlation made by NM in the context of NFV

When a new failure occurred from the virtualized resource and it impacts corresponding NE application, NM can make the alarm correlation based on the virtualized resource failure report sent from VNFM and VNF application alarms.

The figure 4.2.2-1 illustrates the procedure of NM makes NE alarms correlation in a mobile network that includes virtualized network functions.

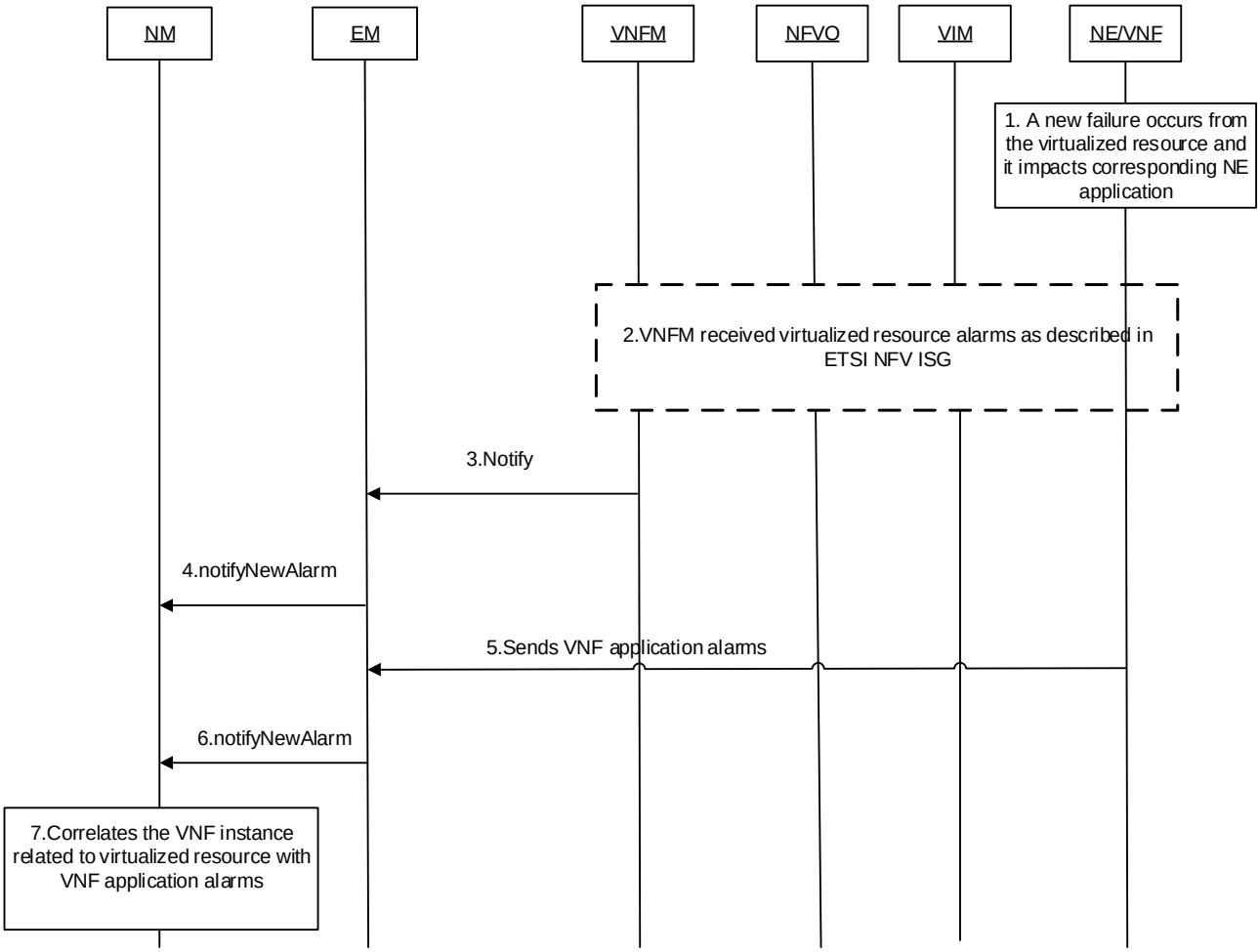


**Figure 4.2.2-1: Procedure of NE alarm correlation made by NM in the context of NFV**

1) A new failure occurs from the virtualized resource and it impacts corresponding NE application.

2) VNFM receives virtualized resource alarms as described in [3].

3) VNFM sends VNF instance alarms related to virtualized resource to EM. The VNF and/or VNFC alarms related to virtualized resource include AlarmId, affected VNF identifier, affected VNFC identifiers, and FaultDetails which provides additional information about the virtualized resource fault, for example the resource identifier which causes the fault (e.g. VM identifier, vNIC identifier or vPORT identifier). The Alarm information element see clause 9.3.4 of [3].

4) EM sends VNF instance alarms related to virtualized resource to NM.

5) NE/VNF sends VNF application alarms to EM through proprietary interface, the corresponding VNF instance identifier and/or VNFC identifier should be included.

6) EM sends VNF application failure report of a NE to NM over Itf-N. The information in the failure report sees alarm information in TS 32.111-2 [2].

NOTE: There is no sequence restriction on EM receives VNF instance alarms related virtualized resource and NM receives VNF application failure report.

7) Based on the VNF instance alarms related to virtualized resource sent from VNFM and VNF application failure report, NM makes the alarm correlation.

# 4.3 Virtualization-specific aspect failure detection and notification

## 4.3.1 Virtualization-specific aspect failure detection and notification by VNFM

The figure 4.3.1-1 illustrates the procedure of notifying the EM about a virtualization-specific failure of a virtualized network function when virtualization-specific aspect failure detection and notification by VNFM.

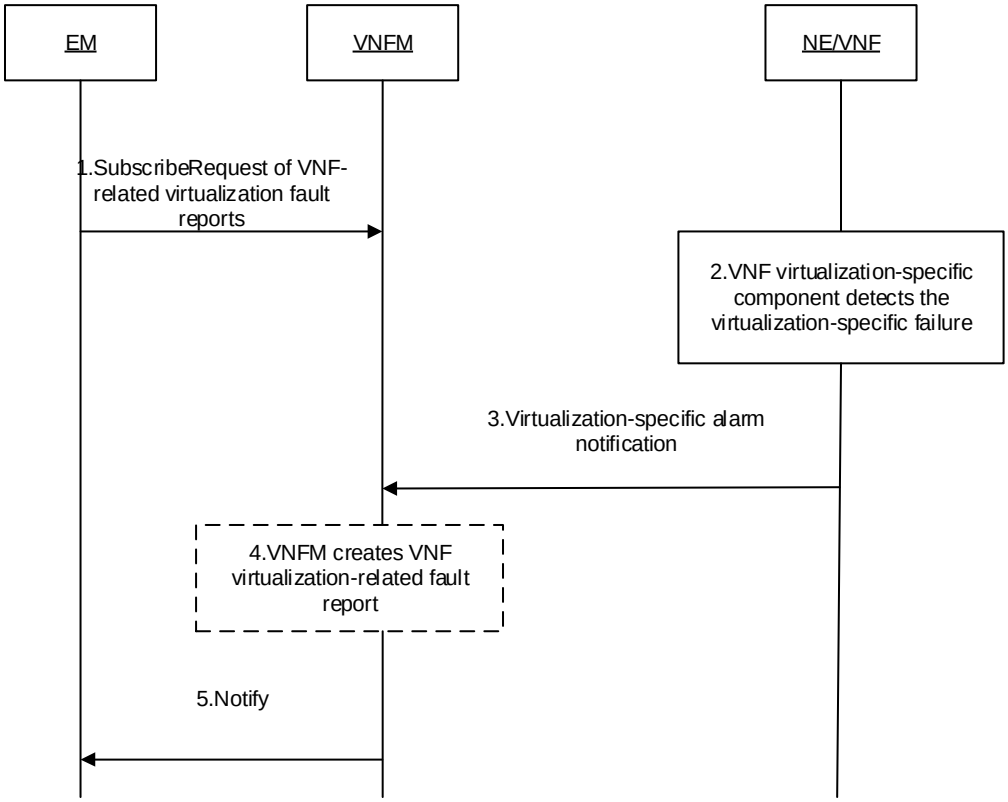


**Figure 4.3.1-1: Procedure of virtualization-specific aspect failure detection and notification by VNFM**

1) EM subscribes to VNF-related virtualization fault reports.

2) A new virtualization-specific failure occurs and is detected by VNF virtualization-specific component.

3) VNF sends virtualization-specific fault notification to VNFM.

4) VNFM creates VNF virtualization-related fault report as described in ETSI NFV ISG.

5) VNFM sends VNF instance alarms generated due to changes in the state of virtualized resources used by the VNFs and their constituent VNFC instances to EM. The VNF and/or VNFC alarms related to virtualized resources include AlarmId, affected VNF identifier, affected VNFC identifiers, and FaultDetails which provides additional information about the fault, for example the resource identifier which causes the fault (e.g. VM identifier, vNIC identifier or vPORT identifier). The Alarm information element see clause 9.3.4 of [3].

### 4.3.2 Virtualization-specific aspect failure detection and notification by EM

The figure 4.3.2-1 illustrates the procedure of notifying the EM about a virtualization-specific failure of a virtualized network function.

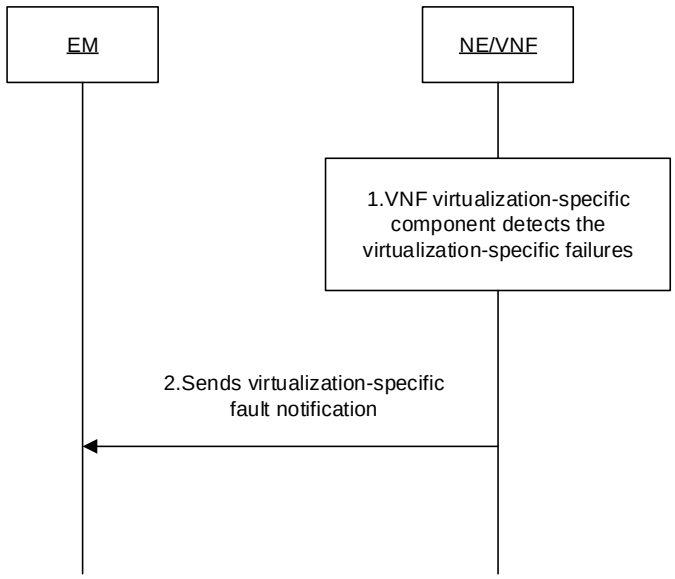


**Figure 4.3.2-1: Procedure of virtualization-specific aspect failure detection and notification by EM**

1) A new virtualization-specific failure occurs and is detected by VNF virtualization-specific component.

2) VNF sends virtualization-specific fault notification to EM through proprietary interfaces, the corresponding VNF instance identifier and/or VNFC identifier should be included.

# 4.4 VNF Healing with operation request to VNFM by EM through Ve-Vnfm-em

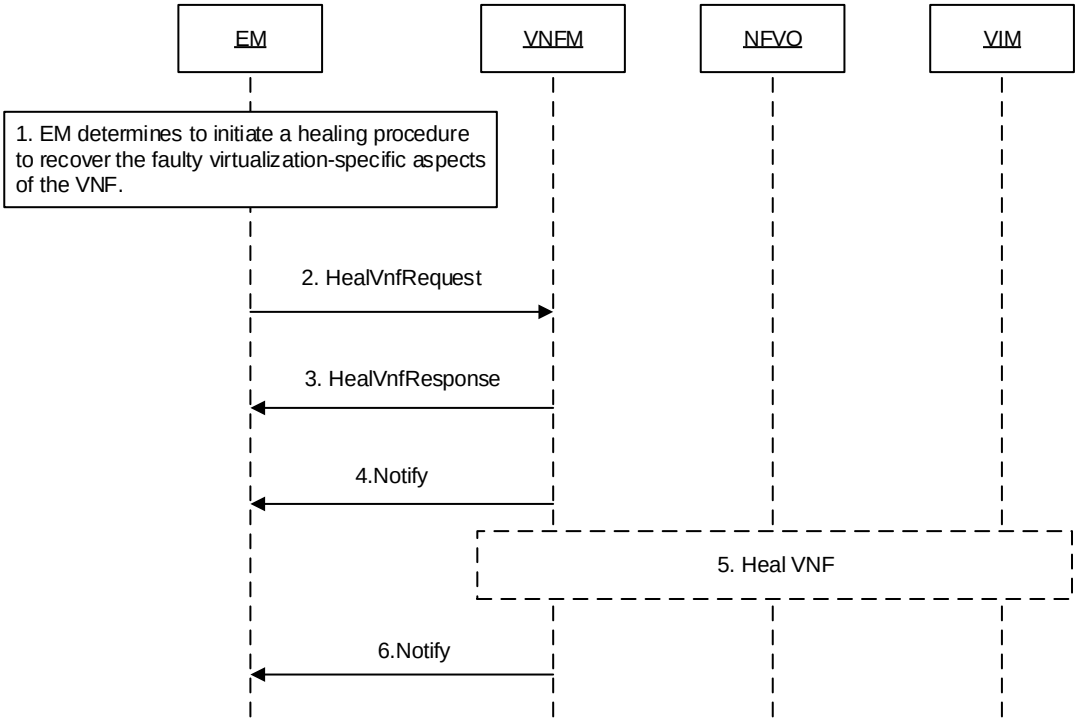


**Figure 4.4-1: Procedure of VNF Healing through operation request to VNFM by EM**

1) EM determines to initiate a healing procedure to recover the faulty virtualization-specific aspects of the VNF.

2) EM sends to VNFM a *HealVnfRequest*with input parameters `vnfInstanceId`, `vnfcInstanceId`, `cause`, `additionalParam`, and `healScript` to heal the VNF instance (see clause 7.2.10.2 of [3]).

3) VNFM sends to EM a *HealVnfResponse* acknowledging the request with parameter `lifecycleOperationOccurrenceId` providing the identifier of the VNF lifecycle operation occurrence (see clause 7.2.10.3 of [3]).

4) VNFM sends to EM a *Notify* (see clause 7.3.3 of [3]) carrying a `VnfLifecycleChangeNotification` information element with attributes `vnfInstanceId`, `lifecycleOperationOccurrenceId`, `operation` = "HealVnf", and `status` = "start" to indicate the start of the VNF healing execution (see clause 9.5.2.3 [3]).

5) VNFM executes the healing, see clause 7.2.10 of [3].

6) VNFM sends to EM a *Notify* (see clause 7.3.3 [3]) carrying a `VnfLifecycleChangeNotification` information element, with attributes `vnfInstanceId`, `lifecycleOperationOccurrenceId`, `operation` = "HealVnf", `notificationType` = "result" to indicate the end and the result of the VNF healing execution. Depending on the result, additional parameters `affectedVnfc`, `affectedVirtualLink`, and `affectedVirtualStorage` provide information about the VNFC, VL and virtualised storage resources affected during the lifecycle operation (see clauses 9.5.2.3 of [3]).

# Annex A (informative): Change history

| Change history | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2018-06 | SA#80 | SP-180417 | 0001 | 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** |

# History

| Document history | | |
|---|---|---|
| V17.0.0 | April 2022 | Publication |
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