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# Foreword

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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 Management and orchestration of networks, as identified below:

TS 28.545: Management and orchestration; Fault Supervision (FS)

# 1 Scope

The present document specifies use cases and requirements for fault supervision of 5G networks and network slicing.

# 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; Management services".

[3]        3GPP TS 28.541: "Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3".

[4]        3GPP TS 28.516: "Fault Management (FM) for mobile networks that include virtualized network functions; Procedure".

# 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 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].

## 3.2 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].

| | |
|---|---|
| FS | Fault Supervision |
| ME | Managed Element |
| MnS | Management Service |
| NSI | Network Slice Instance |
| NSSI | Network Slice Subnet Instance |
| VNF | Virtualized Network Function |
| VNFC | Virtualized Network Function Component |

# 4 General

## 4.1 Overview

### 4.1.1 Alarm related services

The following management services are needed for fault supervision:

**Table 4.1.1: Management services for fault supervision**

| Management Service | Description |
|---|---|
| Fault supervision data report service for NSI | To support the consumer to get NSI alarm data. |
| Fault supervision data control service for NSI | To support the consumer to control NSI alarm data. |
| Fault supervision data report service for NSSI | To support the consumer to get NSSI alarm data. |
| Fault supervision data control service for NSSI | To support the consumer to control NSSI alarm data. |
| Fault supervision data report service for NF | To support the consumer to get NF instance alarm data. |
| Fault supervision data control service for NF | To support the consumer to control NF instance alarm data. |

# 5 Specification level requirements

## 5.1 Use cases

### 5.1.1 Report alarm notifications of NSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| **Goal** | To report NSI alarm notifications. | |
| **Actors and Roles** | An authorized consumer of fault supervision data report service for NSI. | |
| **Telecom resources** | Network slice instance | |
| **Assumptions** | N/A | |
| **Pre-conditions** | An NSI is deployed<br>An authorized consumer has subscribed the alarm notifications of an NSI<br>The producer of fault supervision data report service for NSI has subscribed the alarm notifications of the NSI constituents. | |
| **Begins when** | A failure or severe performance degradation of NSI is detected. | |
| **Step 1 (M)** | The producer of fault supervision data report service for NSI collects alarm information of NSSIs and/or NF instances associated with the NSI as well as other information if needed. | |
| **Step 2 (M)** | The producer of fault supervision data report service for NSI sends the alarm notification to its authorized consumer when a new alarm notification is generated and this alarm notification satisfies the filter condition if exists. | |
| **Ends when** | The authorized consumer receives the alarm notification of the NSI or the authorized consumer unsubscribes the alarm notifications of the NSI or the NSI is terminated. | |
| **Exceptions** | In case any of the mandatory steps in the use case fails | |
| **Post-conditions** | The authorized consumer receives the alarm notification of the NSI | |
| **Traceability** | REQ-FSDR_NSI-FUN-1, REQ-FSDR_NSI-FUN-4, REQ-FSDR_NSI-FUN-9 | |

## 5.1.2 Subscription of alarm notifications of NSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To subscribe NSI alarm notifications | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NSI. | |
| Telecom resources | Network slice instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSI is deployed | |
| Begins when | An authorized consumer wants to subscribe the alarm notifications of an NSI | |
| Step 1 (M) | The authorized consumer sends request to the producer of fault supervision data report service for NSI to subscribe alarm notifications of an NSI. | |
| Step 2 (M) | The producer of fault supervision data report service for NSI sends the response of the completion of the subscription to the authorized consumer. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | In case any of the mandatory steps in the use case fails. | |
| Post-conditions | The alarm notifications of an NSI have been subscribed by the authorized consumer. | |
| Traceability | REQ-FSDR_NSI-FUN-2 | |

## 5.1.3 Unsubscription of alarm notifications of NSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To unsubscribe NSI alarm notifications | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NSI. | |
| Telecom resources | Network slice instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSI is deployed<br>An authorized consumer has subscribed the alarm notifications of an NSI from a producer of fault supervision data report service for NSI. | |
| Begins when | The authorized consumer wants to unsubscribe the alarm notifications of an NSI. | |
| Step 1 (M) | The authorized consumer sends request to the producer of fault supervision data report service for NSI to unsubscribe alarm notifications of an NSI. | |
| Step 2 (M) | The producer of fault supervision data report service for NSI sends the response of the completion of the unsubscription to the authorized consumer. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | In case any of the mandatory steps in the use case fails. | |
| Post-conditions | The alarm notifications of the NSI has been unsubscribed by the authorized consumer. | |
| Traceability | REQ-FSDR_NSI-FUN-3 | |

## 5.1.4 Get alarm list of NSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To get alarm list of NSI. | |
| Actors and Roles | An authorized consumer of the fault supervision data report service for NSI. | |
| Telecom resources | Network slice instance | |
| Assumptions | N/A | |
| Pre-conditions | The NSI has been deployed. The producer of the fault supervision data report service for NSI is in operation. | |
| Begins when | The authorized consumer decides to get the alarm list of an NSI. | |
| Step 1 (M) | The authorized consumer requires the producer of the fault supervision data report service for NSI to report the alarm list of the NSI. | |
| Step 2 (M) | The Producer of the fault supervision data report service for NSI sends the alarm list to the the authorized consumer. The alarm list contains the alarm(s) which satisfy the filter condition if exists. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The authorized consumer has got the alarm list of the NSI. | |
| Traceability | REQ-FSDR_NSI-FUN-5, REQ-FSDR_NSI-FUN-6 | |

## 5.1.5 Acknowledge alarms of NSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To acknowledge one or multiple alarms of NSI. | |
| Actors and Roles | An authorized consumer of the fault supervision data control service for NSI. | |
| Telecom resources | Network slice instance | |
| Assumptions | N/A | |
| Pre-conditions | The NSI has been deployed. The producer of the fault supervision data control service for NSI is in operation. | |
| Begins when | The authorized consumer decides to acknowledge one or multiple alarms of an NSI. | |
| Step 1 (M) | The authorized consumer sends the request to the producer of the fault supervision data control service for NSI to acknowledge one or multiple alarms of the NSI. | |
| Step 2 (M) | The producer of the fault supervision data control service for NSI acknowledges the alarms based on the request. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The alarms of the NSI have been acknowledged. | |
| Traceability | REQ-FSDC_NSI-FUN-1 | |

## 5.1.6 Clear alarms of NSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To clear one or multiple alarms of NSI. | |
| Actors and Roles | An authorized consumer of the fault supervision data control service for NSI. | |
| Telecom resources | Network slice instance | |
| Assumptions | N/A | |
| Pre-conditions | The NSI has been deployed.<br>The producer of the fault supervision data control service for NSI is in operation. | |
| Begins when | The authorized consumer decides to clear one or multiple alarms of an NSI. | |
| Step 1 (M) | The authorized consumer sends the request to the producer of the fault supervision data control service for NSI to clear one or multiple alarms of the NSI. | |
| Step 2 (M) | The producer of the fault supervision data control service for NSI clears the alarms based on the request. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The alarms of the NSI have been cleared. | |
| Traceability | REQ-FSDC_NSI-FUN-2 | |

## 5.1.7 Report alarm notifications of NSSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To report NSSI alarm notifications. | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NSSI. | |
| Telecom resources | Network slice subnet instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSSI is deployed<br>An authorized consumer has subscribed the alarm notifications of an NSSI.<br>The producer of fault supervision data report service for NSSI has subscribed the alarm notifications of NSSI constituents. | |
| Begins when | A failure or severe performance degradation of NSSI is detected. | |
| Step 1 (M) | The producer of fault supervision data report service for NSSI collects alarm information of constituent NSSIs and/or NF instances associated with the NSSI as well as other information if needed. | |
| Step 2 (M) | The producer of fault supervision data report service for NSSI sends the alarm notification to its authorized consumer when a new alarm notification is generated and this alarm notification satisfies the filter condition if exists. | |
| Ends when | An authorized consumer receives the alarm notification of an NSSI or the authorized consumer unsubscribes the alarm notifications of the NSSI or the NSSI is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails. | |
| Post-conditions | The authorized consumer receives the alarm notification of the NSSI | |
| Traceability | REQ-FSDR_NSSI-FUN-1, REQ-FSDR_NSSI-FUN-4, REQ-FSDR_NSSI-FUN-9 | |

## 5.1.8 Subscription of alarm notifications of NSSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To subscribe NSSI alarm notifications | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NSSI. | |
| Telecom resources | Network slice subnet instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSSI is deployed | |
| Begins when | An authorized consumer wants to subscribe the alarm notifications of an NSSI | |
| Step 1 (M) | The authorized consumer sends request to the producer of fault supervision data report service for NSSI to subscribe alarm notifications of an NSSI. | |
| Step 2 (M) | The producer of fault supervision data report service for NSSI sends the response of the completion of the subscription to the authorized consumer. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | In case any of the mandatory steps in the use case fails. | |
| Post-conditions | The alarm notifications of an NSSI have been subscribed by the authorized consumer. | |
| Traceability | REQ-FSDR_NSSI-FUN-2 | |

## 5.1.9 Unsubscription of alarm notifications of NSSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To unsubscribe NSSI alarm notifications | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NSSI. | |
| Telecom resources | Network slice subnet instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSSI is deployed. An authorized consumer has subscribed the alarm notifications of an NSSI from the producer of fault supervision data report service for NSSI. | |
| Begins when | An authorized consumer wants to unsubscribe the alarm notifications of an NSSI. | |
| Step 1 (M) | The authorized consumer sends request to the producer of fault supervision data report service for NSSI to unsubscribe alarm notifications of an NSSI. | |
| Step 2 (M) | The producer of fault supervision data report service for NSSI sends the response of the completion of the unsubscription to the authorized consumer. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | In case any of the mandatory steps in the use case fails. | |
| Post-conditions | The alarm notifications of the NSSI has been unsubscribed by the authorized consumer. | |
| Traceability | REQ-FSDR_NSSI-FUN-3 | |

## 5.1.10 Get alarm list of NSSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To get alarm list of NSSI. | |
| Actors and Roles | An authorized consumer of the fault supervision data report service for NSSI. | |
| Telecom resources | Network slice subnet instances | |
| Assumptions | N/A | |
| Pre-conditions | The NSSI has been deployed. The producer of the fault supervision data report service for NSSI is in operation. | |
| Begins when | The authorized consumer decides to get the alarm list of an NSSI. | |
| Step 1 (M) | The authorized consumer requires the producer of the fault supervision data report service for NSSI to report the alarm list of the NSSI. | |
| Step 2 (M) | The producer of the fault supervision data report service for NSSI sends the alarm list to the the authorized consumer. The alarm list contains the alarm(s) which satisfy the filter condition if exists. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The authorized consumer has got the alarm list of the NSSI. | |
| Traceability | REQ-FSDR_NSSI-FUN-5, REQ-FSDR_NSSI-FUN-6 | |

## 5.1.11 Acknowledge alarms of NSSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To acknowledge one or multiple alarms of NSSI. | |
| Actors and Roles | An authorized consumer of the fault supervision data control service for NSSI. | |
| Telecom resources | Network slice subnet instance | |
| Assumptions | N/A | |
| Pre-conditions | The NSSI has been deployed. The producer of the fault supervision data control service for NSSI is in operation. | |
| Begins when | The authorized consumer decides to acknowledge one or multiple alarms of an NSSI. | |
| Step 1 (M) | The authorized consumer sends the request to the producer of the fault supervision data control service for NSSI to acknowledge one or multiple alarms of the NSSI. | |
| Step 2 (M) | The producer of the fault supervision data control service for NSSI acknowledges the alarms based on the request. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The alarms of the NSSI have been acknowledged. | |
| Traceability | REQ-FSDC_NSSI-FUN-1 | |

## 5.1.12 Clear alarms of NSSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To clear one or multiple alarms of NSSI. | |
| Actors and Roles | An authorized consumer of the fault supervision data control service for NSSI. | |
| Telecom resources | Network slice subnet instance | |
| Assumptions | N/A | |
| Pre-conditions | The NSSI has been deployed. The producer of the fault supervision data control service for NSSI is in operation. | |
| Begins when | The authorized consumer decides to clear one or multiple alarms of an NSSI. | |
| Step 1 (M) | The authorized consumer sends the request to the producer of the fault supervision data control service for NSSI to clear one or multiple alarms of the NSSI. | |
| Step 2 (M) | The procedure of the fault supervision data control service for NSSI clears the alarms based on the request. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The alarms of the NSSI have been cleared. | |
| Traceability | REQ-FSDC_NSSI-FUN-2 | |

## 5.1.13 Report alarm notifications of NF instance

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To report NF instance alarm notifications. | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NF. | |
| Telecom resources | Network function instance | |
| Assumptions | N/A | |
| Pre-conditions | An NF is deployed An authorized consumer has subscribed the alarm notifications of an NF instance. | |
| Begins when | A failure or severe performance degradation of NF instance is detected. | |
| Step 1 (M) | The producer of fault supervision data report service for NF sends the alarm notification to its authorized consumer when a new alarm notification is generated and this alarm notification satisfies the filter condition if exists. | |
| Ends when | An authorized consumer receives the alarm notification of the NF instance or the authorized consumer unsubscribes the alarm notifications of the NF instance or the NF instance is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails. | |
| Post-conditions | The authorized consumer receives the alarm notification of the NF instance | |
| Traceability | REQ-FSDR_NF-FUN-1, REQ-FSDR_NF-FUN-5, REQ-FSDR_NF-FUN-11 | |

## 5.1.14 Subscription of alarm notifications of NF instance

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To subscribe NF instance alarm notifications | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NF. | |
| Telecom resources | Network function instance | |
| Assumptions | N/A | |
| Pre-conditions | An NF is deployed | |
| Begins when | An authorized consumer wants to subscribe the alarm notifications of an NF instance | |
| Step 1 (M) | The authorized consumer sends request to producer of fault supervision data report service for NF to subscribe alarm notifications of an NF instance. | |
| Step 2 (M) | The producer of fault supervision data report service for NF sends the response of the completion of the subscription to the authorized consumer. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | In case any of the mandatory steps in the use case fails. | |
| Post-conditions | The alarm notifications of an NF instance have been subscribed by the authorized consumer. | |
| Traceability | REQ-FSDR_NF-FUN-3 | |

## 5.1.15 Unsubscription of alarm notifications of NF instance

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To unsubscribe NF instance alarm notifications | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NF. | |
| Telecom resources | Network function instance | |
| Assumptions | N/A | |
| Pre-conditions | An NF is deployed<br>An authorized consumer has subscribed the alarm notifications of an NF instance from a producer of fault supervision data report service for NF. | |
| Begins when | An authorized consumer wants to unsubscribe the alarm notifications of an NF instance. | |
| Step 1 (M) | The authorized consumer sends request to the producer of fault supervision data report service for NF to unsubscribe alarm notifications of an NF instance. | |
| Step 2 (M) | The producer of fault supervision data report service for NF sends the response of the completion of the unsubscription to the authorized consumer. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | In case any of the mandatory steps in the use case fails. | |
| Post-conditions | The alarm notifications of the NF instance has been unsubscribed by the authorized consumer. | |
| Traceability | REQ-FSDR_NF-FUN-4 | |

## 5.1.16 Get alarm list of NF instance

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To get alarm list of NF instance. | |
| Actors and Roles | An authorized consumer of the fault supervision data report service for NF. | |
| Telecom resources | Network function instances | |
| Assumptions | N/A | |
| Pre-conditions | The NF instance has been deployed.<br>The producer of the fault supervision data report service for NF is in operation. | |
| Begins when | The authorized consumer decides to get the alarm list of an NF instance. | |
| Step 1 (M) | The authorized consumer requires the producer of the fault supervision data report service for NF to report the alarm list of the NF instance. | |
| Step 2 (M) | The producer of the fault supervision data report service for NF sends the alarm list to the the authorized consumer. The alarm list contains the alarm(s) which satisfy the filter condition if exists. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The authorized consumer has got the alarm list of the NF. | |
| Traceability | REQ-FSDR_NF-FUN-6, REQ-FSDR_NF-FUN-8 | |

## 5.1.17 Acknowledge alarms of NF instance

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To acknowledge one or multiple alarms of NF instance. | |
| Actors and Roles | An authorized consumer of the fault supervision data control service for NF. | |
| Telecom resources | Network function instance | |
| Assumptions | N/A | |
| Pre-conditions | The NF instance has been deployed.<br>The producer of the fault supervision data control service for NF is in operation. | |
| Begins when | The authorized consumer decides to acknowledge one or multiple alarms of an NF instance. | |
| Step 1 (M) | The authorized consumer sends the request to the producer of the fault supervision data control service for NF to acknowledge one or multiple alarms of the NF instance. | |
| Step 2 (M) | The producer of the fault supervision data control service for NF acknowledges the alarms based on the request. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The alarms of the NF instance have been acknowledged. | |
| Traceability | REQ-FSDC_NF-FUN-1 | |

## 5.1.18 Clear alarms of NF instance

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To clear one or multiple alarms of NF instance. | |
| Actors and Roles | An authorized consumer of the fault supervision data control service for NF. | |
| Telecom resources | Network function instance | |
| Assumptions | N/A | |
| Pre-conditions | The NF instance has been deployed.<br>The producer of the fault supervision data control service for NF is in operation. | |
| Begins when | The authorized consumer decides to clear one or multiple alarms of an NF instance. | |
| Step 1 (M) | The authorized consumer sends the request to the producer of the fault supervision data control service for NF to clear one or multiple alarms of the NF instance. | |
| Step 2 (M) | The procedure of the fault supervision data control service for NF clears the alarms based on the request. | |
| Ends when | All the steps identified above are successfully completed. | |
| Exceptions | One of the steps identified above fails. | |
| Post-conditions | The alarms of the NF instance have been cleared. | |
| Traceability | REQ-FSDC_NF-FUN-2 | |

## 5.1.19 Notify changed alarms of NSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify changed alarms of NSI. | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NSI. | |
| Telecom resources | Network slice instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSI is deployed<br>An authorized consumer has subscribed the notifications of an NSI. | |
| Begins when | A change of `perceivedSeverity` attribute value (except to the value "Cleared") in `AlarmInformation` in `AlarmList` of NSI is detected. | |
| Step 1 (M) | The producer of fault supervision data report service for NSI generates a changed alarm notification. | |
| Step 2 (M) | The producer of fault supervision data report service for NSI sends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the changed alarm notification of the NSI or the authorized consumer unsubscribes the notifications of the NSI or the NSI is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the changed alarm notification of the NSI | |
| Traceability | REQ-FSDR_NSI-FUN-7 | |

## 5.1.20 Notify changed alarms of NSSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify changed alarms of NSSI. | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NSSI. | |
| Telecom resources | Network slice subnet instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSSI is deployed<br>An authorized consumer has subscribed the notifications of an NSSI. | |
| Begins when | A change of `perceivedSeverity` attribute value (except to the value "Cleared") in `AlarmInformation` in `AlarmList` of NSSI is detected. | |
| Step 1 (M) | The producer of fault supervision data report service for NSSI generates a changed alarm notification. | |
| Step 2 (M) | The producer of fault supervision data report service for NSSI sends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the changed alarm notification of the NSSI or the authorized consumer unsubscribes the notifications of the NSSI or the NSSI is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the changed alarm notification of the NSSI | |
| Traceability | REQ-FSDR_NSSI-FUN-7 | |

## 5.1.21 Notify changed alarms of NF instance

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify changed alarms of NF instance. | |
| Actors and Roles | An authorized consumer of fault supervision data report service for NF. | |
| Telecom resources | Network function instance | |
| Assumptions | N/A | |
| Pre-conditions | An NF instance is deployed<br>An authorized consumer has subscribed the notifications of an NF instance. | |
| Begins when | A change of `perceivedSeverity` attribute value (except to the value "Cleared") in `AlarmInformation` in `AlarmList` of NF instance is detected. | |
| Step 1 (M) | The producer of fault supervision data report service for NF generates a changed alarm notification of the NF instance. | |
| Step 2 (M) | The producer of fault supervision data report service for NF sends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the changed alarm notification of the NF instance or the authorized consumer unsubscribes the notifications of the NF instance or the NF instance is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the changed alarm notification of the NF instance | |
| Traceability | REQ-FSDR_NF-FUN-9 | |

## 5.1.22 Notify cleared alarms of NSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify cleared alarms of NSI. | |
| Actors and Roles | An authorized consumer of fault supervision data control service for NSI. | |
| Telecom resources | Network slice instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSI is deployed<br>An authorized consumer has subscribed the notifications of an NSI. | |
| Begins when | An alarm clearing of the NSI is detected. | |
| Step 1 (M) | The producer of fault supervision data control service for NSI generates a cleared alarm notification. | |
| Step 2 (M) | The producer of fault supervision data control service for NSI sends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the cleared alarm notification of the NSI or the authorized consumer unsubscribes the notifications of the NSI or the NSI is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the cleared alarm notification of the NSI | |
| Traceability | REQ-FSDR_NSI-FUN-8 | |

## 5.1.23 Notify cleared alarms of NSSI

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify cleared alarms of NSSI. | |
| Actors and Roles | An authorized consumer of fault supervision data control service for NSSI. | |
| Telecom resources | Network slice subnet instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSSI is deployed<br>An authorized consumer has subscribed the notifications of an NSSI. | |
| Begins when | An alarm clearing of the NSSI is detected. | |
| Step 1 (M) | The producer of fault supervision data control service for NSSI generates a cleared alarm notification. | |
| Step 2 (M) | The producer of fault supervision data control service for NSSI sends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the cleared alarm notification of the NSSI or the authorized consumer unsubscribes the notifications of the NSSI or the NSSI is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the cleared alarm notification of the NSSI | |
| Traceability | REQ-FSDR_NSSI-FUN-8 | |

## 5.1.24 Notify cleared alarms of NF instance

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify cleared alarms of NF instance. | |
| Actors and Roles | An authorized consumer of fault supervision data control service for NF. | |
| Telecom resources | Network function instance | |
| Assumptions | N/A | |
| Pre-conditions | An NF instance is deployed<br>An authorized consumer has subscribed the notifications of an NF instance. | |
| Begins when | An alarm clearing of NF instance is detected. | |
| Step 1 (M) | The producer of fault supervision data control service for NF generates a cleared alarm notification of the NF instance. | |
| Step 2 (M) | The producer of fault supervision data control service for NF sends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the cleared alarm notification of the NF instance or the authorized consumer unsubscribes the notifications of the NF instance or the NF instance is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the cleared alarm notification of the NF instance | |
| Traceability | REQ-FSDR_NF-FUN-10 | |

## 5.1.25 Notify acknowledgement state change of NSI alarms

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify acknowledgement state change of NSI alarms. | |
| Actors and Roles | An authorized consumer of fault supervision data control service for NSI. | |
| Telecom resources | Network slice instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSI is deployed<br>An authorized consumer has subscribed the notifications of an NSI. | |
| Begins when | An acknowledgement state change of the NSI alarms is detected. | |
| Step 1 (M) | The producer of fault supervision data control service for NSI generates an acknowledgement state change notification. | |
| Step 2 (M) | The producer of fault supervision data control service for NSI sends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the acknowledgement state change notification of the NSI or the authorized consumer unsubscribes the notifications of the NSI or the NSI is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the acknowledgement state change notification of the NSI | |
| Traceability | REQ-FSDC_NSI-FUN-4 | |

## 5.1.26 Notify acknowledgement state change of NSSI alarms

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify acknowledgement state change of NSSI alarms. | |
| Actors and Roles | An authorized consumer of fault supervision data control service for NSSI. | |
| Telecom resources | Network slice subnet instance | |
| Assumptions | N/A | |
| Pre-conditions | An NSSI is deployed<br>An authorized consumer has subscribed the notifications of an NSSI. | |
| Begins when | An acknowledgement state change of the NSSI alarms is detected. | |
| Step 1 (M) | The producer of fault supervision data control service for NSSI generates an acknowledgement state change notification. | |
| Step 2 (M) | The producer of fault supervision data control service for NSSI sends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the acknowledgement state change notification of the NSSI or the authorized consumer unsubscribes the notifications of the NSSI or the NSSI is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the acknowledgement state change notification of the NSSI | |
| Traceability | REQ-FSDC_NSSI-FUN-4 | |

## 5.1.27 Notify acknowledgement state change of NF instance alarms

| Use case stage | Evolution/Specification | <<Uses>> Related use |
|---|---|---|
| Goal | To notify acknowledgement state change of NF instance alarms. | |
| Actors and Roles | An authorized consumer of fault supervision data control service for NF. | |
| Telecom resources | Network function instance | |
| Assumptions | N/A | |
| Pre-conditions | An NF instance is deployed<br>An authorized consumer has subscribed the notifications of an NF instance. | |
| Begins when | An acknowledgement state change of the NF instance alarms is detected. | |
| Step 1 (M) | The producer of fault supervision data control service for NF generates an acknowledgement state change notification of the NF instance. | |
| Step 2 (M) | The producer of fault supervision data control service for NFsends the generated notification to its authorized consumer if this notification satisfies the filter condition if exists. | |
| Ends when | The authorized consumer receives the acknowledgement state change notification of the NF instance or the authorized consumer unsubscribes the notifications of the NF instance or the NF instance is terminated. | |
| Exceptions | In case any of the mandatory steps in the use case fails | |
| Post-conditions | The authorized consumer receives the acknowledgement state change notification of the NF instance | |
| Traceability | REQ-FSDC_NF-FUN-4 | |

## 5.2 Requirements

## 5.2.1 Requirements for fault supervision data report service for NSI

**REQ-FSDR_NSI-FUN-1** The fault supervision data report service for NSI shall have the capability to provide alarm notifications of an NSI to its authorized consumer.

**REQ-FSDR_NSI-FUN-2** The fault supervision data report service for NSI shall have the capability to allow its authorized consumer to subscribe the alarm notifications of an NSI.

**REQ-FSDR_NSI-FUN-3** The fault supervision data report service for NSI shall have the capability to allow its authorized consumer to unsubscribe the alarm notifications of an NSI.

**REQ-FSDR_NSI-FUN-4** The fault supervision data report service for NSI shall have the capability to allow its authorized consumer to provide the filter for alarm notifications.

**REQ-FSDR_NSI-FUN-5** The fault supervision data report service for NSI shall have the capability to provide the alarm list of an NSI.

**REQ-FSDR_NSI-FUN-6** The fault supervision data report service for NSI shall have the capability to allow its authorized consumer to provide the filter for the alarms.

**REQ-FSDR_NSI-FUN-7** The fault supervision data report service for NSI shall have the capability to provide changed alarm notifications of an NSI to its authorized consumer.

**REQ-FSDR_NSI-FUN-8** The fault supervision data report service for NSI shall have the capability to provide cleared alarm notifications of an NSI to its authorized consumer.

**REQ-FSDR_NSI-FUN-9** The fault supervision data report service for NSI shall have the capability to provide new generated alarm notifications of an NSI to its authorized consumer.

## 5.2.2 Requirements for fault supervision data control service for NSI

**REQ-FSDC_NSI-FUN-1** The fault supervision data control service for NSI shall have the capability to satisfy the request to acknowledge one or multiple alarms of an NSI.

**REQ-FSDC_NSI-FUN-2** The fault supervision data control service for NSI shall have the capability to satisfy the request to clear one or multiple alarms of an NSI.

**REQ-FSDC_NSI-FUN-3** Void.

**REQ-FSDC_NSI-FUN-4** The fault supervision data control service for NSI shall have the capability to provide acknowledgement state change notifications of an NSI to its authorized consumer.

## 5.2.3 Requirements for fault supervision data report service for NSSI

**REQ-FSDR_NSSI-FUN-1** The fault supervision data report service for NSSI shall have the capability to provide alarm notifications of a network slice subnet instance to its authorized consumer.

**REQ-FSDR_NSSI-FUN-2** The fault supervision data report service for NSSI shall have the capability to allow its authorized consumer to subscribe the alarm notifications of an NSSI.

**REQ-FSDR_NSSI-FUN-3** The fault supervision data report service for NSSI shall have the capability to allow its authorized consumer to unsubscribe the alarm notifications of an NSSI.

**REQ-FSDR_NSSI-FUN-4** The fault supervision data report service for NSSI shall have the capability to allow its authorized consumer to provide the filter for alarm notifications.

**REQ-FSDR_NSSI-FUN-5** The fault supervision data report service for NSSI shall have the capability to provide the alarm list of an NSSI.

**REQ-FSDR_NSSI-FUN-6** The fault supervision data report service for NSSI shall have the capability to allow its authorized consumer to provide the filter for the alarms.

**REQ-FSDR_NSSI-FUN-7** The fault supervision data report service for NSSI shall have the capability to provide changed alarm notifications of an NSSI to its authorized consumer.

**REQ-FSDR_NSSI-FUN-8** The fault supervision data report service for NSSI shall have the capability to provide cleared alarm notifications of an NSSI to its authorized consumer.

**REQ-FSDR_NSSI-FUN-9** The fault supervision data report service for NSSI shall have the capability to provide new generated alarm notifications of an NSSI to its authorized consumer.

## 5.2.4 Requirements for fault supervision data control service for NSSI

**REQ-FSDC_NSSI-FUN-1** The fault supervision data control service for NSSI shall have the capability to satisfy the request to acknowledge one or multiple alarms of an NSSI.

**REQ-FSDC_NSSI-FUN-2** The fault supervision data control service for NSSI shall have the capability to satisfy the request to clear one or multiple alarms of an NSSI.

**REQ-FSDC_NSSI-FUN-3** Void.

**REQ-FSDC_NSSI-FUN-4** The fault supervision data control service for NSSI shall have the capability to provide acknowledgement state change notifications of an NSSI to its authorized consumer.

## 5.2.5 Requirements for fault supervision data report service for NF

**REQ-FSDR_NF-FUN-1** The fault supervision data report service for NF shall have the capability to provide alarm notifications of a network function instance to its authorized consumer.

**REQ-FSDR_NF-FUN-2** The fault supervision data report service for NF shall have the capability to provide alarm notifications of virtualized resources correlated with an NF instance to its authorized consumer.

**REQ-FSDR_NF-FUN-3** The fault supervision data report service for NF shall have the capability to allow its authorized consumer to subscribe the alarm notifications of an NF instance.

**REQ-FSDR_NF-FUN-4** The fault supervision data report service for NF shall have the capability to allow its authorized consumer to unsubscribe the alarm notifications of an NF instance.

**REQ-FSDR_NF-FUN-5** The fault supervision data report service for NF shall have the capability to allow its authorized consumer to provide the filter for alarm notifications.

**REQ-FSDR_NF-FUN-6** The fault supervision data report service for NF shall have the capability to provide the alarm list of an NF instance.

**REQ-FSDR_NF-FUN-7** The fault supervision data report service for NF shall have the capability to provide the alarm list of virtualized resources correlated with an NF instance.

**REQ-FSDR_NF-FUN-8** The fault supervision data report service for NF shall have the capability to allow its authorized consumer to provide the filter for the alarms.

**REQ-FSDR_NF-FUN-9** The fault supervision data report service for NF shall have the capability to provide changed alarm notifications of an NF instance to its authorized consumer.

**REQ-FSDR_NF-FUN-10** The fault supervision data report service for NF shall have the capability to provide cleared alarm notifications of an NF instance to its authorized consumer.

**REQ-FSDR_NF-FUN-11** The fault supervision data report service for NF shall have the capability to provide new generated alarm notifications of an NF instance to its authorized consumer.

## 5.2.6 Requirements for fault supervision data control service for NF

**REQ-FSDC_NF-FUN-1** The fault supervision data control service for NF shall have the capability to satisfy the request to acknowledge one or multiple alarms of an NF instance.

**REQ-FSDC_NF-FUN-2** The fault supervision data control service for NF shall have the capability to satisfy the request to clear one or multiple alarms of an NF instance.

**REQ-FSDC_NF-FUN-3** Void.

**REQ-FSDC_NF-FUN-4** The fault supervision data control service for NF shall have the capability to provide acknowledgement state change notifications of an NF instance to its authorized consumer.

# 6 Fault Supervision management services components

## 6.1 Management services for network slice fault supervision

The management services for network slice fault supervision are listed in table 6.1-1.

**Table 6.1-1: Management services for network slice fault supervision**

| Management service | MnS Component Type A | MnS Component Type B | MnS Component Type C | Note |
|---|---|---|---|---|
| FS Data Report for NSI | Following operations and notifications defined in TS 28.532[2]: getAlarmList subscribe unsubscribe notifyNewAlarm notifyAlarmListRebuilt notifyChangedAlarm | NSI information model defined in TS 28.541[3] | Alarm information defined in TS 28.532[2] | This management service enables its consumer to get NSI alarm data. |
| FS Control for NSI | Following operations and notifications defined in TS 28.532[2]: acknowledgeAlarms clearAlarms notifyAckStateChanged notifyClearedAlarm unacknowledgeAlarms | NSI information model defined in TS 28.541[3] | Alarm information defined in TS 28.532[2] | This management service enables its consumer to control NSI alarm data. |

## 6.2 Management services for network slice subnet fault supervision

The management services for network slice subnet fault supervision are listed in table 6.2-1.

**Table 6.2-1: Management services for network slice subnet fault supervision**

| Management service | MnS Component Type A | MnS Component Type B | MnS Component Type C | Note |
|---|---|---|---|---|
| FS Data Report for NSSI | Following operations and notifications defined in TS 28.532[2]:<br>getAlarmList<br>subscribe<br>unsubscribe<br>notifyNewAlarm<br>notifyAlarmListRebuilt<br>notifyChangedAlarm | NSSI information model defined in TS 28.541[3] | Alarm information defined in TS 28.532[2] | This management service enables its consumer to get NSSI alarm data. |
| FS Control for NSSI | Following operations and notifications defined in TS 28.532[2]:<br>acknowledgeAlarms<br>clearAlarms<br>notifyAckStateChanged<br>notifyClearedAlarm<br>unacknowledgeAlarms | NSSI information model defined in TS 28.541[3] | Alarm information defined in TS 28.532[2] | This management service enables its consumer to control NSSI alarm data. |

## 6.3 Management services for network function fault supervision

The management services for network function fault supervision are listed in table 6.3-1.

**Table 6.3-1: Management services for NF fault supervision**

| Management service | MnS Component Type A | MnS Component Type B | MnS Component Type C | Note |
|---|---|---|---|---|
| FS Data Report for NF | Following operations and notifications defined in TS 28.532[2]:<br>getAlarmList<br>subscribe<br>unsubscribe<br>notifyNewAlarm<br>notifyAlarmListRebuilt<br>notifyChangedAlarm | NF(s)/ME(s) information model defined in TS 28.541 and TS 28.541[3] | Alarm information defined in TS 28.532[2] | This management service enables its consumer to get NF alarm data. |
| FS Control for NF | Following operations and notifications defined in TS 28.532[2]:<br>acknowledgeAlarms<br>clearAlarms<br>notifyAckStateChanged<br>notifyClearedAlarm<br>unacknowledgeAlarms | NF(s)/ME(s) information model defined in TS 28.541 and TS 28.541[3] | Alarm information defined in TS 28.532[2] | This management service enables its consumer to control NF alarm data. |

# 7 Alarm loss detection

The present document does not specify methods for a management service consumer to detect alarm loss. The use of alarmId to detect alarm loss is an arrangement made between management service producer and management service consumer. The use of such arrangement is outside the scope of the present document. For example, management service producer may use integer sequence (e.g. 1, 2, 3, 4, 5, …) as alarmId instances for its alarms. Based on this knowledge, the management service consumer can detect alarm loss.

The present document does not specify how a management service producer can determine if management service consumer has received alarms correctly.

The present document does not specify methods for a management consumer and a management service producer to recover alarm loss. The only mechanism recommended to deal with alarm loss is the use of getAlarmList operation. The present document does not specify conditions under which the management service consumer should invoke this operation.

# 8 Virtualized resource alarm correlation

The authorized MnS consumer request VNF application alarms and VNF instance alarms related to virtualized resource from MnS producer by consuming the fault supervision MnS. MnS producer obtain the VNF application alarms (including affected VNF/VNFC instance identifier and detailed VNF alarm information) from the VNF, and the VNF instance alarms related to virtualized resource (including affected VNF/VNFC instance identifier and detailed NFVI/VM alarm information) received from the VNFM. Based on the above obtained alarms, MnS producer can correlate the VNF application alarms and the VNF and/or VNFC alarms related to virtualized resource according to affected VNF instance identifier and/or VNFC instance identifiers. The detailed procedure for virtualized resource alarm correlation procedure see corresponding procedure of NE alarm correlation made by EM in the context of NFV described in TS 28.516[4] and the MnS producer act as the role of EM.

The authorized MnS consumer requests NSSI alarms including alarm reports related to virtualized resource by consuming the fault supervision MnS. The MnS producer should collect alarm report related to virtualized resource according to affected VNF instance identifier corresponding to the NF instance in the NSSI.

# 9 Procedures for fault supervision management services

## 9.1 Alarm subscription and notification

The Figure 9.1-1 illustrates procedures of alarm subscription, supervision and notification for MOI(s).
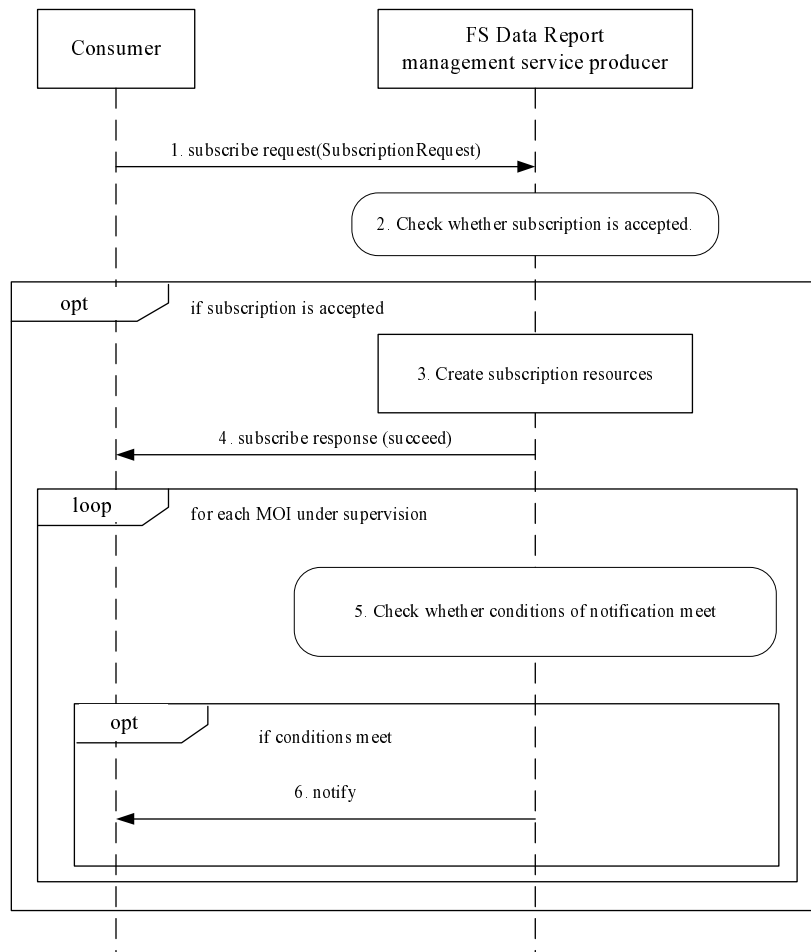
**Figure 9.1-1 Procedures for MOI alarm subscription, supervision and notification**

1. The authorized consumer sends subscribe request to FS Data Report management service producer to establish subscription to alarm notifications. The authorized consumer includes subscriber's URI and filter in the subscribe request message.

2. The FS Data Report management service producer checks whether the subscribe request is accepted.

3. If the subscription is accepted, the FS Data Report management service producer creates the subscription resources for the subscriber. If the subscribe request requires the FS Data Report management service producer to collect new types of alarm from the constituent MOI(s), it includes the new alarm type and identifier of MOI into the filter and acts as consumer to request the subscription operation for each constituent MOI.

4. When FS Data Report management service producer successfully creates the subscription resources, it sends success response to authorized consumer.

5. For each MOI under fault supervision monitored, FS Data Report management service producer supervises if the conditions are matched by new or changed alarm(s) as indicated in filter in subscribe request, including the received alarm notification of constituent MOI(s). When the FS Data Report management service producer receives the alarms of the constituent MOI(s), it generates the alarm information for the subscription or adds them to the correlated notification related to the alarm information for the subscription.

6. The FS Data Report management service producer notifies the alarms to the authorized consumer.

# Annex A (informative): Change history

<table>
<tr><td colspan="8" align="center"><strong>Change history</strong></td></tr>
<tr><th>Date</th><th>Meeting</th><th>TDoc</th><th>CR</th><th>Rev</th><th>Cat</th><th>Subject/Comment</th><th>New version</th></tr>
<tr><td>2018-09</td><td>SA#81</td><td></td><td></td><td></td><td></td><td>Upgrade to change control version</td><td>15.0.0</td></tr>
<tr><td>2018-12</td><td>SA#82</td><td>SP-181045</td><td>0001</td><td>1</td><td>F</td><td>Correction for Requirements of Fault Supervision (FS) Service</td><td>15.1.0</td></tr>
<tr><td>2020-07</td><td>SA#88-e</td><td>SP-200501</td><td>0006</td><td>1</td><td>F</td><td>Update clause 8 virtualized resource alarm correlation</td><td>15.2.0</td></tr>
</table>

# History

| Document history | | |
|---|---|---|
| V15.0.0 | October 2018 | Publication |
| V15.1.0 | April 2019 | Publication |
| V15.2.0 | August 2020 | Publication |
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