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| Technical Report |
| 3rd Generation Partnership Project;Technical Specification Group Core Network and Terminals;Study on the support for minimization of service interruption; (Release 17) |
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Contents

Foreword 4

1 Scope 6

2 References 6

3 Definitions of terms, symbols and abbreviations 6

3.1 Terms 6

3.2 Symbols 6

3.3 Abbreviations 6

4 Architectural Assumptions and Requirements 7

4.1 Architectural Assumptions 7

4.2 Architectural Requirements 7

5 Key Issues 7

5.1 Key Issue #1: Notification of Disaster Condition to the UE 7

5.1.1 Description 7

5.2 Key Issue #2: Notification of applicability on Disaster Condition to PLMNs without Disaster Condition 8

5.2.1 Description 8

5.3 Key Issue #3: Indication of accessibility from other PLMNs without Disaster Condition to the UE 8

5.3.1 Description 8

5.4 Key Issue #4: Registration to the roaming PLMN without Disaster Condition in case of Disaster Condition 9

5.4.1 Description 9

5.5 Key issue #5: PLMN selection when a "Disaster Condition" applies 9

5.5.1 Description 9

5.6 Key Issue #6: Notification that Disaster Condition is no longer applicable to the UEs 10

5.6.1 Description 10

5.7 Key Issue #7: Prevention of signalling overload in PLMNs without Disaster Condition 11

5.7.1 Description 11

5.8 Key Issue #8: Prevention of signalling overload by returning UEs in PLMN previously with Disaster Condition 12

5.8.1 Description 12

5.X Key Issue #<X>: <Key issue title> 12

5.X.1 Description 12

6 Solutions 12

6.0 Mapping Solutions to Key Issues 13

6.X Solution #<X>: <Solution title> 13

6.X.1 Description 13

6.X.2 Impacts on existing nodes and functionality 13

7 Evaluations 13

8 Conclusions 13

Annex <X> (informative): Change history 14

# Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

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.

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

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

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

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

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

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

**can** indicates that something is possible

**cannot** indicates that something is impossible

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

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

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

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

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

In addition:

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

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

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

# 1 Scope

The present document is to study the stage 2 and the stage 3 aspects for service requirements defined by SA WG1 under SA1 work item MINT (Minimization of Service Interruption), as specified in 3GPP TS 22.011 [2] and 3GPP TS 22.261 [3].

# 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 22.011: "Service accessibility".

[3] 3GPP TS 22.261: "Service requirements for the 5G system; Stage 1".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

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

**PLMN with Disaster Condition:** A PLMN to which a Disaster Condition applies.

**PLMN without Disaster Condition:** A PLMN to which no Disaster Condition applies.

For the purposes of the present document, the following terms and definitions given in 3GPP TS 22.261 [3] apply:

**Disaster Condition**

**Disaster Inbound Roamer**

**Disaster Roaming**

## 3.2 Symbols

void

## 3.3 Abbreviations

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

# 4 Architectural Assumptions and Requirements

Editor's note: This clause will describe the architectural assumptions and requirements for the realization of Minimization of Service Interruption.

## 4.1 Architectural Assumptions

## 4.2 Architectural Requirements

# 5 Key Issues

Editor's note: This clause will describe the key issues for the realization of Minimization of Service Interruption.

## 5.1 Key Issue #1: Notification of Disaster Condition to the UE

### 5.1.1 Description

According to 3GPP TS 22.261 [3] subclause 6.31.2.2:

*The 3GPP system shall enable UEs to obtain information that a Disaster Condition applies to a particular PLMN or PLMNs.*

*NOTE: If a UE has no coverage of its HPLMN, then obtains information that a Disaster Condition applies to the UE's HPLMN, the UE can register with a PLMN offering Disaster Roaming service.*

According to 3GPP TS 22.261 [3] subclause 6.31.2.3:

*The 3GPP system shall provide means to enable that a Disaster Condition applies to UEs of a specific PLMN.*

When a Disaster Condition applies to a PLMN or PLMNs in an area, a UE is located in the area, and the PLMN is HPLMN of the UE or was selected by the UE, then the UE shall be able to obtain information that the Disaster Condition applies to the PLMN.

NOTE: The interactions between this Key Issue and the Key Issue #7 (Prevention of signalling overload in PLMNs without Disaster Condition) need to be considered, since preventing UEs from overloading the PLMN previously with Disaster Condition could have an impact on how the PLMNs without Disaster Condition are notified that the Disaster Condition no longer applies.

The following questions are expected to be studied within this Key Issue:

- How to deliver the information on the Disaster Condition of a PLMN in an area to the UE located in the area;

- Which network functions or entities are involved for the delivery of the information;

- Which PLMN(s) are responsible for the delivery of the information; and

- What kind of information should be delivered to the UE.

## 5.2 Key Issue #2: Notification of applicability on Disaster Condition to PLMNs without Disaster Condition

### 5.2.1 Description

According to 3GPP TS 22.261 [3] subclause 6.31.2.2:

*Subject to regulatory requirements or operator’s policy, the 3GPP system shall support a PLMN operator to be made aware of the failure or recovery of other PLMN(s) in the same country when the Disaster Condition is applies, or when the Disaster Condition is not applicable.*

*The 3GPP system shall support means for a PLMN operator to be aware of the area where Disaster Condition applies.*

When a Disaster Condition applies to a particular PLMN or PLMNs, the PLMN(s) without Disaster Condition in the same country shall be notified that Disaster Condition applies to PLMN(s) or Disaster Condition no longer applies. Also as per service requirement quoted above, the PLMN(s) in the same country can be made aware of the area where Disaster Condition applies.

The following questions are expected to be studied within this Key Issue:

- How to deliver the information on the Disaster Condition to the PLMNs without Disaster Condition;

- Who or which entity decides the Disaster Condition; and

- How to provide information on the area where Disaster Condition applies.

NOTE: The interactions between this Key Issue and the Key Issue #8 (Prevention of signalling overload by returning UEs in PLMN previously with Disaster Condition) need to be considered, since preventing UEs from overloading a PLMN previously with Disaster Condition could have an impact on how the PLMNs without Disaster Condition are notified that the Disaster Condition no longer applies.

## 5.3 Key Issue #3: Indication of accessibility from other PLMNs without Disaster Condition to the UE

### 5.3.1 Description

According to 3GPP TS 22.261 [3] subclause 6.31.2.3:

*The 3GPP system shall be able to provide a resource efficient means for a PLMN to indicate to potential Disaster Inbound Roamers whether they can access the PLMN or not.*

When a Disaster Condition applies to a particular PLMN or PLMNs, one or more PLMNs in the same country may be able to provide Disaster Roaming service to the UEs of a PLMN with Disaster Condition. In this case, the PLMN providing Disaster Roaming shall indicate that it can accommodate the Disaster Inbound Roamers from a PLMN with Disaster Condition.

The following questions are expected to be studied within this Key Issue:

- Which PLMN(s) are responsible for indicating their accesibility to Disaster Inbound Roamers;

- How other PLMN(s) than the PLMN with Disaster Condition indicate that they can accommodate Disaster Inbound Roamer; and

- What information can be provided to potential Disaster Inbound Roamers.

NOTE: The interactions between this Key Issue and the Key Issue #7 (Prevention of signalling overload in PLMNs without Disaster Condition) need to be considered, since preventing UEs from overloading a PLMN without Disaster Condition could have an impact on whether and how the PLMN indicates that it can accept Disaster Inbound Roamers.

## 5.4 Key Issue #4: Registration to the roaming PLMN without Disaster Condition in case of Disaster Condition

### 5.4.1 Description

When the UE of a PLMN with Disaster Condition is notified of Disaster Condition, according to conclusion of the Key Issue #1, and the UE selects the other PLMN providing Disaster Roaming service, then the UE shall perform the registration procedure in order to be registered to the PLMN. It is unclear how the Disaster Roaming PLMN authenticates the UE and how to collect charging information when the Disaster Condition applies.

According to 3GPP TS 22.261 [3] subclause 6.31.2.3:

*3GPP system shall be able to collect charging information for a Disaster Inbound Roamer with information about the applied disaster condition*

According to 3GPP TS 22.261 [3] subclause 6.31.2.2:

*The 3GPP system shall be able to support provision of service to Disaster Inbound Roamer only within the specific region where Disaster Condition applies.*

As per this service requirement quoted, the Disaster Roaming PLMN shall be able to consider the area of service to Disaster Inbound Roamers that is limited to the region where Disaster Condition applies.

The following questions are expected to be studied within this Key Issue:

- How a registration procedure initiated by Inbound Disaster Roamer is performed;

- How to authenticate Inbound Disaster Roamer during the registration procedure;

- Which network functions or entities are involved for the registration procedure of Disaster Inbound Roamers;

- How a Disaster Roaming PLMN can limit the area of service to Inbound Disaster Roamers to the region where Disaster Condition applies; and

- How and which function to collect charging information for a Disaster Inbound Roamer with information about the applied disaster condition.

## 5.5 Key issue #5: PLMN selection when a "Disaster Condition" applies

### 5.5.1 Description

If the UE determines that a Disaster Condition applies as described in Key Issue #1 "Notification of Disaster Condition to the UE", then the PLMN selection procedure needs to be updated so the UE avoids selecting the PLMN with Disaster Condition.

If the UE determines that a Disaster Condition applies as described in Key Issue #1 "Notification of Disaster Condition to the UE", there is no available PLMN except for PLMNs in the list of "Forbidden PLMNs", and one or more available PLMNs indicate accessibility for the UE as described in Key Issue #3 "Indication of accessibility from other PLMNs without Disaster Condition to the UE", then the PLMN selection procedure needs to be updated so that the UE selects one of the PLMNs indicating accessibility for the UE.

In addition, if there are more than one PLMN indicating accessibility for the UE, then PLMN selection procedure needs to be updated for selecting one of those PLMNs.

According to 3GPP TS 22.261 [3] subclause 6.31.2.3:

*The 3GPP system shall be able to provide means to enable a UE to access PLMNs in a forbidden PLMN list if a Disaster condition applies and no other PLMN is available except for PLMNs in the forbidden PLMN list.*

The following questions are expected to be studied within this key issue:

1) How the UE selects a PLMN if it is determined that a "Disaster Condition" applies;

a) If the UE determines that a Disaster Condition applies as described in Key Issue #1 "Notification of Disaster Condition to the UE", then how to update PLMN selection procedure so that the UE avoids selecting the PLMN with Disaster Condition.

b) If the UE determines that a Disaster Condition applies as described in Key Issue #1 "Notification of Disaster Condition to the UE", there is no available PLMN except for PLMNs in the list of "Forbidden PLMNs", and one or more available PLMNs indicate accessibility for the UE as described in Key Issue #3 "Indication of accessibility from other PLMNs without Disaster Condition to the UE", then how to update PLMN selection procedure so that the UE selects one of the PLMNs indicating accessibility for the UE.

c) if there are more than one PLMN indicating accessibility for the UE, then how to update PLMN selection procedure for selecting one of those PLMNs.

NOTE: The interaction between this Key Issue and Key Issue #7 (Prevention of signalling overload in PLMNs without Disaster Condition) should be considered, since preventing UEs from overloading a PLMN without Disaster Condition might have an impact on which PLMN the UEs should select.

2) How the UE handles the list of "forbidden PLMNs" when selecting a PLMN indicating accessibility for the UE in the bullet 1).

## 5.6 Key Issue #6: Notification that Disaster Condition is no longer applicable to the UEs

### 5.6.1 Description

According to 3GPP TS 22.261 [3] subclause 6.31.2.2:

*The 3GPP system shall be able to provide efficient means for a network to inform Disaster Inbound roamers that a Disaster Condition is no longer applicable.*

According to 3GPP TS 22.261 [3] subclause 6.31.2.3:

*Disaster Inbound Roamers shall perform network reselection when a Disaster Condition has ended.*

When a UE was camping on a PLMN offering Disaster Roaming service and was being served by the PLMN, the network can notify Disaster Inbound Roamers that Disaster Condition is no longer applicable. When a UE is notified that Disaster Condition is no longer applicable, the UE shall perform network reselection in order to return to its HPLMN.

The following questions are expected to be studied within this Key Issue:

- When and how to deliver the information that Disaster Condition is no longer applicable to Disaster Inbound Roamers;

- How to minimize interruption of the service receiving from Disaster Roaming PLMN (e.g. emergency service or high priority service) when the UE is notified that Disaster Condition is no longer applicable;

- How to remove the stored information on Disaster Condition from the UE’s storage; and

- How Disaster Inbound Roamer UEs perform network selection when notified that Disaster Condition is no longer applicable.

NOTE: The interactions between this Key Issue and the Key Issue #8 (Prevention of signalling overload by returning UEs in PLMN previously with Disaster Condition) need to be considered, since preventing UEs from overloading the PLMN previously with Disaster Condition could have an impact on how the UEs are notified that the Disaster Condition is no longer applicable.

## 5.7 Key Issue #7: Prevention of signalling overload in PLMNs without Disaster Condition

### 5.7.1 Description

According to 3GPP TS 22.261 [3] subclause 6.31.2.1:

*Subject to regulatory requirements or operator's policy, 3GPP system shall be able to enable a UE of a given PLMN to obtain connectivity service (e.g. voice call, mobile data service) from another PLMN for the area where a Disaster Condition applies.*

This means that when a Disaster Condition applies, all UEs of the PLMN with Disaster Condition that are located in the area where the Disaster Condition applies will look for another PLMN in that area and attempt to register on it to obtain service. This could cause a large number of UEs to migrate from the PLMN with Disaster Condition to another PLMN, and attempt registration at around the same time, leading to signalling overload in the other PLMN due to the massive influx of roamers. Consequently, mechanisms are needed to prevent signalling overload in the PLMNs without Disaster Condition. This is also reflected in the following service requirement of 3GPP TS 22.261 [3] subclause 6.31.2.3:

*The 3GPP system shall minimize congestion caused by Disaster Roaming.*

These mechanisms should additionally take into account the fact that a new Accesss Identity (Access Identity 3) to be used by Disaster Inbound Roamers was introduced in 3GPP TS 22.261 [3] subclause 6.22.2.2.

*Table 6.22.2.2-1: Access Identities*

|  |  |
| --- | --- |
| ***Access Identity number*** | ***UE configuration*** |
| *…* | *…* |
| *3*  | *UE for which Disaster Condition applies (note 4)* |
| *…* | *…* |
| *(…)**NOTE 4: The configuration is valid for PLMNs that indicate to potential Disaster Inbound Roamers that the UEs can access the PLMN. See clause 6.31.* |

The following questions are expected to be studied within this Key Issue:

- How to distribute the subscribers of the PLMN with Disaster Condition between the PLMNs without Disaster Condition available in the area where the Disaster Condition applies, so as to share the load as evenly as possible between the PLMNs without Disaster Condition;

- How to stagger the arrival of UEs in the PLMNs without Disaster Condition, so as to spread out registration attempts over time and keep the number of UEs attempting to register simultaneously within a manageable limit;

- How to use new Access Identity 3 for the purpose of Disaster Inbound Roamer access control and signalling overload prevention in the PLMNs without Disaster Condition;

- How to enable a PLMN without Disaster Condition to efficiently prevent Disaster Inbound Roamers from attempting registration on the PLMN when the PLMN can no longer accept Disaster Inbound Roamers due to congestion.

## 5.8 Key Issue #8: Prevention of signalling overload by returning UEs in PLMN previously with Disaster Condition

### 5.8.1 Description

According to 3GPP TS 22.261 [3] subclause 6.31.2.2:

*The 3GPP system shall be able to provide efficient means for a network to inform Disaster Inbound roamers that a Disaster Condition is no longer applicable.*

And according to 3GPP TS 22.261 [3] subclause 6.31.2.3:

*Disaster Inbound Roamers shall perform network reselection when a Disaster Condition has ended.*

This means that when a Disaster Condition is no longer applicable, all UEs of the PLMN that was previously with Disaster Condition which are currently served by another PLMN and are currently in 5GMM-IDLE mode will perform PLMN reselection and return to the PLMN that was previously with Disaster Condition. These UEs will then attempt to register to obtain service. This could cause a large number of UEs to migrate from PLMNs without Disaster Condition back to the PLMN which was previously with Disaster Condition, and attempt registration at around the same time, leading to signalling overload in the PLMN previously with Disaster Condition due to the massive return of UEs. Consequently, means are needed to prevent signalling overload in the PLMN previously with Disaster Condition. This is also reflected in the following service requirement of 3GPP TS 22.261 [3] subclause 6.31.2.3:

*The 3GPP system shall minimize congestion caused by Disaster Roaming.*

The following question is expected to be studied within this Key Issue:

- How to stagger the return of UEs to the PLMN previously with Disaster Condition, so as to spread out registration attempts over time and keep the number of UEs attempting to register simultaneously within a manageable limit.

## 5.X Key Issue #<X>: <Key issue title>

### 5.X.1 Description

# 6 Solutions

Editor's note: This clause will describe the candidate solutions for the key issues described in clause 5.

## 6.0 Mapping Solutions to Key Issues

Table 6.0-1: Mapping of Solutions to Key Issues

|  |  |
| --- | --- |
|  | Key Issues |
| Solutions | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  |  |  |  |  |  |  |  |  |

## 6.X Solution #<X>: <Solution title>

### 6.X.1 Description

### 6.X.2 Impacts on existing nodes and functionality

# 7 Evaluations

Editor's note: This clause will describe the evaluations on the solutions proposed in clause 6.

# 8 Conclusions

Editor's note: This clause will describe the conclusions for the key issues described in clause 5.

Annex <X> (informative):
Change history

|  |
| --- |
| **Change history** |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2010-11 | CT1#127e | C1-207563 |  |  |  | Draft skeleton provided in C1-207564 by the rapporteur. | 0.0.0 |
| 2020-11 | CT1#127e |  |  |  |  | Implementing the following p-CR agreed by CT1:C1-207564, C1-207630, C1-207646, C1-207647, C1-207648, C1-207649, C1-207650, C1-207684, C1-207685 | 0.1.0 |

Change history of this template:

|  |  |  |
| --- | --- | --- |
| 2001-07 | Copyright date changed to 2001; space character added before TTC in copyright notification; space character before first reference deleted. | 1.3.3 |
| 2002-01 | Copyright date changed to 2002. | 1.3.4 |
| 2002-07 | Extra Releases added to title area. | 1.3.5 |
| *2002-12* | *"TM" added to 3GPP logo.* | *1.3.6* |
| *2003-02* | *Copyright date changed to 2003.* | *1.3.7* |
| *2003-12* | *Copyright date changed to 2004. Chinese OP changed from CWTS to CCSA* | *14.0* |
| *2004-04* | *North American OP changed from T1 to ATIS* | *1.5.0* |
| *2005-11* | *Stock text of clause 3 includes reference to 21.905.*  | *1.6.0* |
| *2005-11* | *Caters for new TSG structure. Minor corrections.* | *1.6.1* |
| *2006-01* | *Revision marks removed.* | *1.6.2* |
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| *2010-02* | *3GPP logo changed for cleaner version, with tag line;LTE-Advanced logo line added; © date changed to 2010;editorial change to cover page footnote text;trade marks acknowledgement text modified;additional Releases added on cover page;proforma copyright release text block modified* | *1.8.0* |
| *2010-02* | *Smaller 3GPP logo file used.* | *1.8.1* |
| *2010-07* | *Guidance note concerning use of LTE-Advanced logo added.* | *1.8.2* |
| *2011-04-01* | *Guidance of use of logos on cover page modified; copyright year modified.* | *1.8.3* |
| *2013-05-15* | *Changed File Properties to MCC macro default.* *Removed R99, added Rel-12/13.**Modified Copyright year.**Guidance on annex X Change history.* | *1.8.4* |
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| *2015-12-03* | *Provision for LTE Advanced Pro logo Update copyright year to 2016* | *1.10.0* |
| *2016-03-08* | *Standarization of the layout of the Change History table in the last annex.(Unreleased)* | *1.11.0* |
| *2016-06-15* | *Minor adjustment to Change History table heading* | *1.11.1* |
| *2017-03-13* | *Adds option for 5G logo on cover* | *1.12.0* |
| *2017-05-03* | *Smaller 5G logo to reduce file size* | *1.12.1* |
| *2019-02-25* | *Replacement of frames on cover pages by in-line text.**Clarification of help text on when to use 5G logo.Removal of defunct keywords frame on page 2.Add Rel-16, Rel-17 options, eliminated earlier, frozen, Releases (cover page, below title)Corrections to some guidance text, addition of guidance text concerning automatic page headers under Word 2016 ff.Use of modal auxiliary verbs added to Foreword.More explicit guidance on Bibliography and Index annexes.Converted to .docx format.* | *1.13.0* |
| *2019-09-12* | *Cover page table outline shown dotted for ease of logo selection. (Author to hide outline after logo selection.) User now needs to delete whole table rows instead of individual cells, which proved to be tricky.**Change of style for "notes" in the Foreword to normal paragraphs.**Insertion of new bookmarks, correction of location of existing bookmarks. (To improve navigation.)**Improvements to guidance text.* | *1.13.1* |