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| 3rd Generation Partnership Project;  Technical Specification Group Core Network and Terminals;  Study on MINT support in EPS for 5G-only national roaming UE;  (Release 19 ) | |
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# 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 aspect for service requirements defined by SA WG1 under SA1 work item MINT\_Ph2 (Minimization of Service Interruption Phase 2), as specified in 3GPP TS 22.011 [X] and 3GPP TS 22.261 [Y] clause 6.31.

# 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".

[X] 3GPP TS 22.011: "Service accessibility".

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

# 3 Definitions of terms and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 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 TR 21.905 [1].

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

# 4 Architectural Assumptions and Requirements

## 4.1 Architectural Assumptions

The following architectural assumptions apply:

- Disaster roaming service is supported for a UE in EPS only if the PLMN of the EPS provides services for 5G-only national roaming UEs (in 5GS) and there is a disaster roaming agreement between that PLMN and the HPLMN of the UE.

- The NG-RAN nodes of the operator with disaster condition are assumed to be non-operational.

- In principle, the disaster inbound roamers can receive the same services in a PLMN providing disaster roaming services as non-disaster inbound roamers can receive in the PLMN providing disaster roaming services, subject to agreement between HPLMN of the UE and the PLMN providing disaster roaming services, regulations of the country, and constraints of the PLMN providing disaster roaming services.

- Architecture defined in 3GPP TS 23.501 [Y] is used as basis of architecture for supporting minimization of service interruption in EPS that provides services for 5G-only national roaming UEs.

- Notification of disaster condition to the EPS providing disaster roaming services is out of scope of 3GPP.

## 4.2 Architectural Requirements

The system shall satisfy the stage-1 requirements in 3GPP TS 22.261 [Y] clause 6.31.

The solution developed to support MINT in EPS for a 5G-only national roaming UE should use existing mechanisms specified for Rel-17 MINT as far as possible.

# 5 Key Issues

## 5.1 Key Issue #1: Notification of disaster condition to the UE

### 5.1.1 Description

According to 3GPP TS 22.261 [Y] clause 6.31.2.1:

*Subject to regulatory requirements, operator's policy or UE capabilities, the 3GPP system shall be able to support a UE, with 5G-only national roaming access to a VPLMN, to* *obtain 4G connectivity service from that VPLMN in the area where a Disaster Condition applies.*

When a disaster condition applies to a particular PLMN, the UE accessing that PLMN via the 5G-only national roaming before the disaster condition or the UE selecting that PLMN via the 5G-only national roaming when the disaster condition applies, shall be able to obtain the information that the disaster condition applies to the PLMN.

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

- How to deliver the information on the disaster condition of a PLMN to the UE;

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

## 5.2 Key Issue #2: Indication of accessibility from EPS to the UE

### 5.2.1 Description

According to 3GPP TS 22.261 [Y] clause 6.31.2.1:

*Subject to regulatory requirements, operator's policy or UE capabilities, the 3GPP system shall be able to support a UE, with 5G-only national roaming access to a VPLMN, to obtain 4G connectivity service from that VPLMN in the area where a Disaster Condition applies.*

When a disaster condition applies to a particular 5G PLMN, the 4G PLMN may be able to provide disaster roaming service to the UE. In this case, the EPS shall indicate that it can accommodate the disaster inbound roamers from the PLMN with disater condition.

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

- How 4G PLMN indicates that it can accommodate disaster inbound roamer from the PLMN with disaster condition; and

- What information can be provided to potential disaster inbound roamers.

## 5.3 Key Issue #3: Attach to the 4G VPLMN without disaster condition in case of disaster condition

### 5.3.1 Description

When the UE of a 5G PLMN with disaster condition is notified of disaster condition, according to the conclusion of the Key Issue #1, and the UE selects the 4G VPLMN providing disaster roaming services, then the UE shall perform the attach procedure in order to be registered to the 4G VPLMN.

According to 3GPP TS 22.261 [Y] clause 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 the service requirement quoted, the disaster roaming 4G 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 an attach procedure initiated by inbound disaster roamer is performed;

- Which network functions or entities are involved for the attach procedure of disaster inbound roamers;

- How a disaster roaming 4G VPLMN can limit the area of service to inbound disaster roamers to the region where disaster condition applies.

## 5.4 Key Issue #4: PLMN selection when a "disaster condition" applies for the 5G-only national roaming UE

### 5.4.1 Description

If the 5G-only national roaming 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 a 4G VPLMN in the list of "Forbidden PLMNs", and the 4G VPLMN indicates accessibility for the UE as described in Key Issue #2 "Indication of accessibility from other PLMNs without Disaster Condition to the UE", then the procedure how to change to the 4G VPLMN needs to be updated so that the UE selects the 4G VPLMN indicating accessibility for the UE.

In addition, if the 5G-only national roaming UE determines that a Disaster Condition applies as described in Key Issue #XA "Notification of Disaster Condition to the UE", a 4G VPLMN is not in the list of “Forbidden PLMNs ”, the 4G VPLMN is available, and the 4G VPLMN indicates accessibility for the UE as described in Key Issue #XC "Indication of accessibility from other PLMNs without Disaster Condition to the UE", the UE is allowed for 5G-only national roaming, whereas 4G RAT and potentially other RATs, are restricted due to the RAT restriction feature being enabled and indicated to the UE by the VPLMN, or the UE disabled E-UTRA capability in the VPLMN, or TAIs of all available 4G cells of the 4G VPLMN are forbidden, then we need to study how to enable the UE to select the 4G VPLMN to get access in the 4G RAT of the 4G VPLMN.

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

- If the 4G VPLMN is in the list of “Forbidden PLMNs”, then how to update PLMN selection procedure so that the UE selects the 4G VPLMN indicating accessibility for the UE in the Disaster Condition.

- If the 4G VPLMN is not in the list of “Forbidden PLMNs”, 4G RAT is restricted in the 4G VPLMN due to the RAT restriction feature, or the UE disabled E-UTRA capability in the 4G VPLMN, or TAIs of all available cells of the 4G VPLMN are forbidden, then how the UE and the network behave to enable the UE to select the 4G VPLMN to get access in the 4G RAT of the VPLMN.

## 5.5 Key Issue #5: RAT restriction under disaster conditions

### 5.5.1 Description

A UE is allowed for 5G-only national roaming, whereas a specific RAT e.g., 4G, is restricted due to the RAT restriction feature being enabled and indicated to the UE by the operator or due to network conditions. Since the UE is restricted to move to the 4G RAT, e.g., due to RAT restriction, and the UE is not allowed to remain connected to the 5G RAT due to the received disaster condition this creates an issue that needs to be solved.

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

- How the UE and the network behave for coordinating RAT restriction and disaster condition handling;

- How to handle RAT restriction under disaster condition;

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

## 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 [Y] clause 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 [Y] clause 6.31.2.3:

Disaster inbound roamers shall perform network reselection when a Disaster Condition has ended.

When a UE was camping on a 4G VPLMN offering disaster roaming service and was being served by the PLMN, the 4G network can notify disaster inbound roamers that the disaster condition is no longer applicable. When a UE is notified that disaster condition is no longer applicable, the UE shall try to perform network reselection in order to return to its 5G VPLMN.

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 4G VPLMN (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.

## 5.7 Key Issue #7: Prevention of signalling overload in the VPLMN providing disaster roaming services in EPS

### 5.7.1 Description

This key issue addresses the following service requirements of 3GPP TS 22.261 [Y] clause 6.31.2:

- *Subject to regulatory requirements, operator's policy or UE capabilities, the 3GPP system shall be able to support a UE, with 5G-only national roaming access to a VPLMN, to obtain 4G connectivity service from that VPLMN in the area where a Disaster Condition applies.*

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

When a disaster condition applies, UEs of the VPLMN providing 5G-only national roaming access with disaster condition that are located in the area where the disaster condition applies will attempt to register on the VPLMN providing disaster roaming services in EPS to obtain service. This could cause a large number of UEs to migrate from the VPLMN providing 5G-only national roaming access with disaster condition, to the VPLMN providing disaster roaming services in EPS, and attempt registration at around the same time, leading to signalling overload in the VPLMN providing disaster roaming services in EPS due to the massive influx of roamers. Consequently, mechanisms are needed to prevent signalling overload in the VPLMN providing disaster roaming services in EPS.

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

- How to distribute the subscribers of the VPLMN providing 5G-only national roaming access with disaster condition between the PLMNs providing disaster roaming service in the area where the disaster condition applies. The PLMNs providing disaster roaming service include the VPLMN providing disaster roaming services in EPS, and potentially other VPLMN(s) providing disaster roaming services in 5GS already supported by Rel-17 MINT;

- How to stagger the arrival of UEs in the VPLMN providing disaster roaming services in EPS;

- How to enable the VPLMN providing disaster roaming services in EPS to efficiently prevent disaster inbound roamers from attempting attach on the PLMN when the PLMN can no longer accept disaster inbound roamers due to congestion; and

- How to enable the VPLMN providing disaster roaming services to efficiently prevent congestion on the ESM level that can be caused by ESM signalling generated by disaster inbound roamers. The existing overload control mechanisms (e.g., NAS level congestion control) should be considered.

As a baseline the mechanism already established for Rel-17 MINT mechanism including the specified timer for MINT, e.g., the disaster roaming wait range, should be reused as much as possible.

## 5.8 Key Issue #8: Prevention of signalling overload by returning UEs in the VPLMN providing 5G-only national roaming access

### 5.8.1 Description

This key issue addresses the following service requirement of 3GPP TS 22.261 [Y] clause 6.31.2:

*- Subject to regulatory requirements, operator's policy or UE capabilities, the 3GPP system shall be able to support a UE, with 5G-only national roaming access to a VPLMN, to obtain 4G connectivity service from that VPLMN in the area where a Disaster Condition applies.*

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

When a disaster condition is no longer applicable, all UEs which are currently served by the VPLMN providing disaster roaming services in EPS and are currently in EMM-IDLE mode will perform PLMN reselection and return to the VPLMN providing 5G-only national roaming access that was previously with disaster condition. This could cause a large number of UEs to attempt registration at around the same time, leading to signalling overload in the VPLMN providing 5G-only national roaming access due to the massive return of UEs. Consequently, means are needed to prevent signalling overload in the VPLMN providing 5G-only national roaming access.

For UEs that are currently in EMM-CONNECTED mode, EPS to 5G interworking procedures need to be performed in a way that does not lead to signalling overload in the VPLMN providing 5G-only national roaming access.

The following question is expected to be studied within this key issue:

- How to stagger the return of UEs to the VPLMN providing 5G-only national roaming access.

As a baseline the mechanism already established for Rel-17 MINT mechanism including the specified timer for MINT, e.g., the disaster return wait range, should be reused as much as possible.

# 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** |
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