Minimization of Service Interruption during Core Network Failure

Motivations, Use Cases and Proposal

China Telecom

Motivations (1/4)

In 5G system, ensuring the availability of communication service is critical.

We have TS 22.261 – Clause 6.31 Minimization of Service Interruption. The requirements listed in this clause provide the 5GS with the capability to mitigate interruption of service.

- 6.31.2.2 Disaster Condition
- 6.31.2.3 Disaster Roaming

However, TS 22.261 only considers one mitigation scenario:

- Network selection followed by registration as a Disaster Inbound Roamer

It is requested to include enhanced mitigation services to cover two failure scenarios/use cases:

- Multi operator core network (MOCN)
- National roaming

It is noted that any core network failure that includes the UDR, UDM and AUSF network functionality is excluded as user authentication is required for disaster mitigation services.

Motivations (2/4)

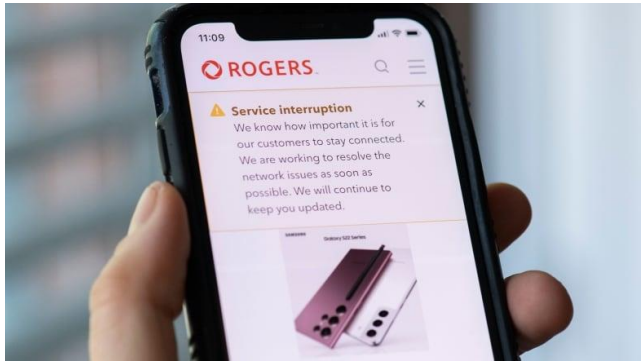
There are increasing number of core network failures reported worldwide, suggesting that the current backup mechanism/network redundancy is NOT sufficient.

1. OP1 (July 2022)

OP1 experienced a **19-hour nationwide service outage** affecting more than **12 million users**. The cause was a **network system failure** following **a maintenance update in the core network**, which caused some routers to malfunction. A similar outage occurred in April 2021 which was attributed to a **software update**.

Impact including:

- Failed debit transactions
- Unable to use 911 services
- Computer system issues experienced by public transport agencies



(Source: https://en.wikipedia.org/wiki/2022_Rogers_Communications_outage)
(Figure source: Graham Hughes/The Canadian Press)

Motivations (3/4)

2. OP2 (July 2022)

The network failure occurred when a router for voice calls was replaced during regular maintenance, with repair work triggering a **concentration of traffic** that led the company to reduce user access. During that time, the carrier experienced **a cascade of technical problems** that further prolonged the connection difficulties. The core network failure turned out to be an **86-hour service disruption**.

Impact including:

- of the around 1,300 observation stations nationwide, about 550 had stopped transmitting data
- medical facilities were unable to communicate with on-call doctors and drivers who were delivering pulse oximeters to coronavirus patients
- Banking, logistics, etc…

(Source: https://asia.nikkei.com/Business/Telecommunication/KDDI-finally-restores-mobile-service-after-86-hour-failure)
(Figure source: https://www.japantimes.co.jp/news/2022/07/04/business/corporate-business/kddi-network-disruption-resolved/)

Motivations (4/4)

3. OP3 (Oct 2021)

A **29-hour service interruption** was caused by a **malfunction** during work on OP3's network of electronic payment equipment installed in services such as taxis and vending machines.
(Source: https://www.japantimes.co.jp/news/2021/11/26/business/corporate-business/ntt-ministry-order/)

4. OP4 (June 2021)

OP4 reports that **fire at the operator's premises disrupted its core network** and put its entire network in the country out of service.
(Source: https://www.commsupdate.com/articles/2021/06/09/orange-services-disrupted-after-fire-destroys-core-network/)

5. China Telecom (Nov 2021)

China Telecom experienced an **8-hour service outage** due to **software bugs**. The **primary NF was down** first and the traffic was directed to the secondary NF. However, software bugs caused the **secondary NF down** as well.

There is an ongoing list of service outages caused by core network failures. Therefore, it is an urgent issue for 3GPP to support enhanced mitigation services during core network failures.

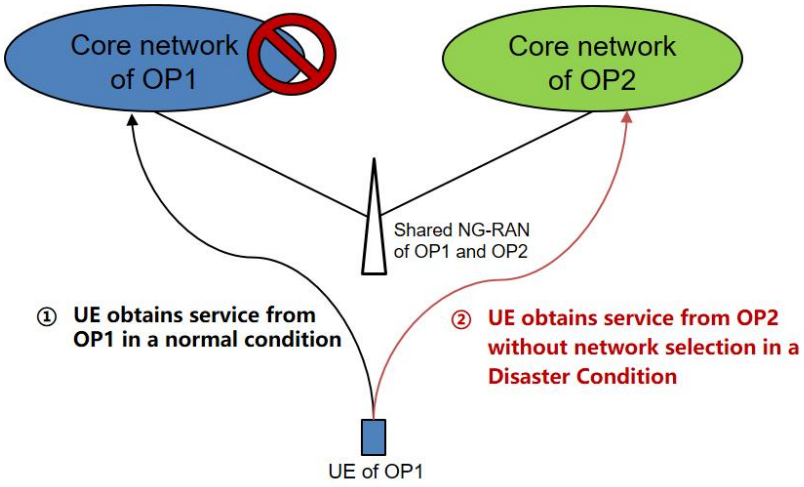
Use Cases (1/2)

➢ Use case #1: The mitigation service in MOCN

With MOCN deployment, multiple operators share the RAN. When a network cannot provide communication service to its users due to core network failures, its users can be switched to one of the cooperative operators serving as the backup core network.

➢ **Gap analysis:**
Network selection required in Disaster Roaming does not need to be performed.

➢ **New requirement #1 in clause 6.31.2.1 TS 22.261:**
Subject to regulatory requirements or operator's policy, 3GPP system shall be able to support a UE of a given PLMN to obtain connectivity service (e.g. voice call, mobile data service) from another PLMN without the need for the user to perform network selection when a Disaster Condition applies to the PLMN that it has been served by, and these two PLMNs have a shared RAN configuration.



Use Cases (2/2)

➢ Use case #2: The mitigation service in national roaming

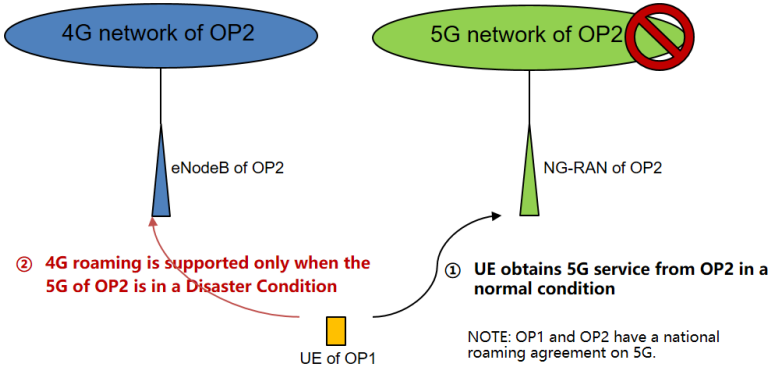
National roaming is allowed in some regions to accelerate 5G rollout. If the roaming agreement is only available for 5G service, users cannot access the 4G network provided by the partners of their home network operator (i.e. LA/TA in the forbidden list). If 5G service is disrupted and the HPLMN has no 4G coverage in the disaster area, 4G national roaming shall be allowed.

➢ **Gap analysis:**

The PLMN that provides mitigation service is not in the forbidden PLMN list of a UE as the UE can obtain 5G service from it based on the national roaming agreement. However, the UE is not allowed to obtain 4G service from the PLMN.

➢ **New requirement #2 in clause 6.31.2.1 TS 22.261:**

Subject to regulatory requirements or operator's policy, 3GPP system shall enable a UE registering on a 5G VPLMN which has a national roaming agreement with the UE's 5G HPLMN to obtain connectivity service (e.g. voice call, mobile data service) from the EPC of the same VPLMN for the area where a Disaster Condition applies and no other PLMN is available except for this VPLMN.



Proposal

This document proposes to add two new service requirements in TS 22.261 for enhanced disaster mitigation services during core network failure.

It is noted that any core network failure that includes the UDR, UDM and AUSF network functionality is excluded as user authentication is required for disaster mitigation services.

- Subject to regulatory requirements or operator's policy, 3GPP system shall be able to support a UE of a given PLMN to obtain connectivity service (e.g. voice call, mobile data service) from another PLMN without the need for the user to perform network selection when a Disaster Condition applies to the PLMN that it has been served by, and these two PLMNs have a shared RAN configuration.

- Subject to regulatory requirements or operator's policy, 3GPP system shall enable a UE registering on a 5G VPLMN which has a national roaming agreement with the UE's 5G HPLMN to obtain connectivity service (e.g. voice call, mobile data service) from the EPC of the same VPLMN for the area where a Disaster Condition applies and no other PLMN is available except for this VPLMN.

THANKS

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