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**pCR Title: Pseudo-CR on <IMS Voice Call using GEO satellite access>**

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*Abstract: This document provides a Text Proposal for the use of IMS voice call using GEO satellite access.*

**1. Introduction**

This contribution is to provide a use case with gap analysis, potential requirements for IMS voice call using GEO satellite access.

**2. Reason for Change**

Supporting IMS voice call using GEO satellite access is very important and useful for customers.

**3. Conclusions**

Use case with potential requrements are introduced.

**4. Proposal**

It is proposed to agree the following changes to 3GPP TR 22.887 v0.0.0.

\* \* \* First Change \* \* \* \*

 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".

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[xa] 3GPP TS 22.261: "Service requirements for 5G system".

[xc] 3GPP TS 22.228: "Service requirements for the Internet Protocol (IP) Multimedia core network Subsystem".

[xd] ITU-T E.800: "Definitions of terms related to quality of service ".

[xe] ITU-T G.114: "One-way transmission time".

[xg] ITU-T G.107: "The E-model: a computational model for use in transmission planning "

[xh] 3GPP TS 26.131: "Terminal acoustic characteristics for telephony; Requirements".

[xx] X. Huang, W. Qi, X. Xia, Y. Sun, Z. Sun and M. Peng, "IoT NTN for Voice Services: Architectures, Protocols, and Challenges," in IEEE Network, 2024.

\* \* \* Next Change \* \* \* All New\* \* \*

# 5 Use cases

## 5.A Use case of IMS Voice Call Using GEO Access

### 5.A.1 Description

Using regular mobile phones to make voice calls via satellite access is becoming increasingly popular, especially due to the advantage satellites have in providing coverage in rural and remote areas [xx]. Satellite voice call services in 3GPP provide consistent network connectivity, accessible at any time and place, facilitating smooth communication across both terrestrial and satellite networks.

Since Release 17, GEO satellite access has been included in the 3GPP standards as an access technology for 5G, supporting all types of media like voice, data, and video by default [xa]. However, due to the unique challenges of GEO satellites—such as 35,786 km distance from the earth, around 285ms signal delays, and atmospheric attenuation—the data rates cannot be increased simply by expanding the bandwidth, which resulting in the services supported by Non-Geostationary Satellite Orbit (NGSO) may not be supported by GEO.

Voice calls using the IMS (IP Multimedia Subsystem) platform have been a standard feature since the 3GPP's Release 5 [xc]. Due to IMS's capability to support diverse multimedia services and ensure interoperability, several services have subsequently been added, including IMS emergency calls, messaging, group management, push-to-talk, and real-time communications. These enhancements have positioned IMS as a critical tool for connecting different operators and service providers. For example, voice calls can now be made across various types of access networks. However, when integrating IMS with GEO satellite access within the 3GPP framework, 3 main aspects impact the quality of experience:

* **One-way transmission delay aspect**: also known as mouth-to-ear delay, is the time from when a call is initiated to when it is heard. This delay significantly impacts the R score in the E-Model [xg], which assesses voice call quality. Managing this delay is key in network design to achieve higher R scores. The ITU-T recommends a maximum delay of 400 milliseconds for network planning [xe]. However, with GEO satellite access, the propagation delay is much longer than other technologies (285ms), necessitating careful calculation of the delay budget. This careful management is crucial when adapting IMS voice calls to GEO satellite access to ensure greater user satisfaction.
* **Codec bitrate aspect**: codec bitrate refers to a bit rate used to encode/decode human voice speech for digital transmission. The relationship between a codec and data rate is critical, as it determines how efficiency a voice speech can be transmitted in the digital communication systems. For many years, the focus for the development of 3GPP voice codecs was to improve voice quality for clean and impaired channels at keeping the data rate approximately constant.. For example, significant improvements regarding the audio quality have been made comparing the AMR codec, which supports bitrates ranging from 4.75 to 12.2 kbps, and the development of the 5G voice codec EVS, which delivers superior sound quality at bitrates between 5.9 and 128 kbps. In contrast, GEO satellite systems typically only support significantly lower data rates within the 3GPP framework.
* **Call setup time aspect**: call setup time refers to the interval between initiating a telephone call and the point at which the connection is established and both parties can begin communication. This metric is critical in both traditional telephony and modern IMS systems, as it heavily impacts user satisfaction and the perceived quality of the service. Shorter call setup times are particularly important as they can significantly improve the user experience. Advancements in 3GPP standards have led to network optimizations that reduce these delays and enhance processing speeds. However, incorporating GEO systems into these networks poses challenges, typically resulting in longer setup times due to the latency, limited achieved data rate inherent in GEO system.

Thus, this use case is designed to leverage the integration of IMS systems and GEO in 3GPP to enhance the quality of voice call services.

### 5.A.2 Pre-conditions



Fig. 5.A.2-1: mobile phone supports both terrestrial and GEO satellite access to support IMS voice

MNO-A employs its own GEO satellites or those of a satellite operator under service/roaming agreements to offer a IMS voice call service using GEO satellite access.

The GEO satellite access might involve a new satellite deployment or an existing GEO satellite system, as depicted in Fig. 5.A.2-1.

Tom uses a mobile phone that can connect to both terrestrial networks and the GEO satellite system. His phone is equipped with encoding and decoding technologies that compress and decompress human voice for transmission via GEO satellite access.

### 5.A.3 Service Flows

Step 1 (**Tom’s mobile phone subscribes to the IMS voice call service using GEO satellite access):** Tom resides in Mardiv and earns his living by leading a fishing team. Whenever he heads out to fish, he ensures to report his safety once he arrives at the fishing spot. To maintain communication, Tom currently uses two different devices: a satellite terminal for calling his family when terrestrial coverage is unavailable, and a regular mobile phone when within coverage. However, Tom is looking to streamline his communication setup by using a single mobile phone that works anywhere, anytime. MNO-A offers such a service, and Tom has opted into their IMS voice call service using GEO satellite access to stay connected seamlessly.

Step 2 (**Tom’s mobile phone registers to the IMS platform provided by MNO-A**):

MNO-A has upgraded its IMS platform to support the IMS voice call service using GEO satellite access. As with the existing IMS setup, Tom’s mobile phone must be registered with the IMS platform before he can access the service. During this registration process, the platform records details such as the capabilities of the mobile phone and access network information. To ensure he can use the IMS voice call service, Tom completes the registration, enabling his mobile phone to connect seamlessly through this enhanced IMS platform.

Step 3

Sub-scenario 1: (**Satellite MO call to a terrestrial network**): Tom calls his wife, who is in the city center of Male:

* Aware that he's using a satellite phone, Tom waits patiently for a while before the ringing tone starts.
* As the call is transmitted via satellite, the IMS platform transcodes the voice data stream between a codec that is suitable for low-bit rate transmission at the satellite MO side and a codec that is suitable for the terrestrial side.

Sub-scenario 2:(**Satellite MT call from a terrestrial network**): Tom’s mother, who is subscribed to MNO-B and located in Bangkok, calls Tom:

* MNO-B’s IMS platform communicates with MNO-A’s IMS platform to transfer the call request to Tom.
* MNO-A’s network locates Tom, paging him to reconnect to MNO-A’s IMS platform.
* Knowing she’s making a satellite phone call, Tom’s mother waits patiently a while before she hears the ringing tone.
* The IMS platforms transcodes the voice codec as in sub-scenario-1.
* During the call, Tom’s mother informs him about an approaching thunderstorm and advises him to head to the nearest safe harbor.

Sub-scenario 3 (**Satellite MO call to a satellite MT call**): Tom calls his friend Pasi, who also uses a mobile phone equipped with IMS voice service using GEO, to locate the nearest safety port as a thunderstorm approaches:

* The IMS platform does not need to transcode the codec since both mobile phones use the same low bit rate codec suitable for satellite communication.

### 5.A.4 Post-conditions

Thanks to this IMS voice call service using GEO satellite access, Tom can make an IMS voice call anywhere, anytime by using only one mobile phone.

### 5.A.5 Existing feature partly or fully covering use case functionality

**From TS 22.261:**

A 5G system providing service with satellite access shall be able to support GEO based satellite access with up to 285 ms end-to-end latency.

NOTE 1: 5 ms network latency is assumed and added to satellite one-way delay.

A 5G system with satellite access shall be able to support low power MIoT type of communications.

**From TS 22.228:**

IMS shall be capable to provide transcoding (at least for voice sessions) where needed when two UEs do not support a common codec.

IP multimedia sessions shall be able to support a variety of different media types. A set of media types shall be identified to ensure interoperability (e.g. default codec selection and header compression).

The IMS network and intermediate networks shall support codec negotiation across one or multiple interconnects to minimise transcoding (and preferably eliminate it) to provide the highest quality service to the user.

If two UEs, belonging to two IMS networks, do not support a common codec for voice service session, the network and/or intermediate networks shall be capable to provide transcoding functionality at the interconnection point.

### 5.A.6 Potential New Requirements needed to support the use case

#### 5.A.6.1 Potential Service Requirements

[P.R.5.A.6.1-1] A 5G system with GEO satellite access shall be able to provide IMS voice call service as defined in TS 22.228 [xc].

[P.R.5.A.6.1-2] The 5G system shall provide mechanisms to optimize IMS voice call setup considering the transmission data rate provided by the GEO satellite access technologies.

[P.R.5.A.6.1-3] The 5G system with GEO satellite access shall be able to support Lawful Interception for IMS voice.

services.

#### 5.A.6.2 Potential KPI Requirements

Editor’s Note: the potential KPI requirements are FFS.

\* \* \* End of Change \* \* \* \*