**3GPP TSG SA WG 1 Meeting #111 S1-253235r1**

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**Source: SoftBank Corp., NTT DOCOMO INC., KDDI Corporation**

**pCR Title: Explanation of High Altitude Platform Station (HAPS)**

**Draft Spec: 3GPP TR 22.870 V0.3.1**

**Agenda item: 8.1.1**

**Document for: Approval**

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*Abstract: At the previous SA1#110 meeting, several new use case proposals for High Altitude Platform Station (HAPS) were contributed. However, due to a lack of common understanding of HAPS, it was suggested that an explanatory document should first be provided to establish a baseline. Accordingly, this contribution summarizes the fundamentals of HAPS to facilitate the study of their use cases and potential requirements for 6G and proposes to include the texts in an Annex to TR 22.870.*

**1. Introduction**

Summary of the fundamentals of HAPS to facilitate the study of their use cases and potential requirements for 6G

**2. Reason for Change**

Adding the text proposals in an Annex part.

**3. Proposal**

It is proposed to agree the following changes to 3GPP TR 22.870 V0.3.1.

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

Annex X (Informative):  
Explanation of High Altitude Platform Station (HAPS)

## X.1 HAPS Fundamentals

High Altitude Platform Station (HAPS) is defined by the International Telecommunications Union (ITU) as *"a station on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth."* This operational altitude, within the stratosphere, allows a single platform to provide wide-area coverage, making it an ideal solution to complement traditional terrestrial networks, especially in remote and rural areas where people still lack reliable internet.

HAPS platforms are not a single technology but a system of systems. These systems are broadly divided into (a) Aviation Systems, which cover the flight vehicle, energy, and navigation, and (b) Service Systems, which include the communications payload and its connection to the core network. The most relevant aspects lie within the service systems, where familiar architectural principles are adapted for a stratospheric environment.

Overcoming gravity is a primary challenge, unlike for ground-based or satellite networks. Stratospheric flight is achieved through different types of flight vehicle systems, which can be broadly categorized into Heavier-than-Air (HTA) and Lighter-than-Air (LTA) platforms.

For HTA, these platforms function like conventional aircraft, using lateral velocity to generate lift. They offer excellent manoeuvrability and station-keeping capabilities. However, they are constrained by the high energy demand required to maintain flight and by limitations on payload weight.

In LTA, balloons are buoyant platforms that use lift gases, such as helium, to stay aloft. This design provides significant advantages in energy efficiency and payload capacity. Their main trade-offs are reduced manoeuvrability and station-keeping ability, although modern stratospheric balloons can achieve considerable navigation control by leveraging wind patterns at different altitudes. Airships combine the advantages of buoyancy from being lighter than air with the navigational benefits of lateral propulsion.

## X.2 HAPS in the communication ecosystem: Comparison with satellites

HAPS will be operating in the stratosphere at approximately 20 km altitude, that is much lower than satellites such as Low Earth Orbit (LEO) at 500+ km and Geostationary (GEO) at over 35,000 km. The fundamental difference is the propagation distance. A HAPS service link of 20 km is comparable to long-distance links in many terrestrial mobile networks. This proximity to Earth, combined with the favourable propagation conditions of an earth-sky link (free from ground clutter), is the key to its performance.

This translates mobile network performance compared to satellite-based direct-to-device (D2D) solutions as summarized in Table A.2-1:

Table A.2-1: Relative characteristics of GEO, LEO and HAPS

|  |  |  |  |
| --- | --- | --- | --- |
|  | **GEO Satellite** | **LEO Satellite** | **HAPS** |
| Altitude (km) | 35 786 | 300–1 200 | **≈ 20** |
| Typical RTT (ms) | ≥ 600 | 30–50 | **< 10** |
| Coverage radius (km) | ≈ 300 | 20–50 | **50–100** |
| User terminal | Dedicated handset | NTN capable handset Standard Cellular handset (some satellite systems) | **Standard cellular handset** |

## X.3 HAPS Use Cases and Technical Consideration

The operational characteristics of HAPS enable a range of applications where terrestrial or satellite systems face limitations. These use cases are supported by specific architectural and technological implementations.

### X.3.1 Base station on board HAPS

In this use case, the HAPS payload provides a service link directly to standard UEs, while a feeder link (backhaul) connects the HAPS to the ground network and onward to the core network. Similar to satellite communications, two types of payloads can be applied: (i) transparent (“bent-pipe”), where the platform relays RF signals without base-station processing, and (ii) regenerative, where some or all base-station functions are performed onboard to ease feeder-link capacity. The choice between these realizations is deployment-dependent and does not change the basic service/feeder-link concept.

ITU defined this station as HIBS (HAPS as IMT Base Station) and its World Radiocommunication Conference 2023 (WRC-23) formally identified the 700-900 MHz, 1.7 GHz, and 2.5 GHz bands for use by HIBS. This is in addition to the pre-existing 2.1 GHz identification providing flexibility for network operators to deploy services using existing mobile spectrum. 3GPP RAN confirmed that standard UEs can support HAPS deployments in these bands without requiring hardware modifications.

### X.3.2 Key Application Areas

In addition to base station on board HAPS, HAPS can be deployed for numerous applications:

* Public Safety and Disaster Relief: In the aftermath of natural disasters like earthquakes or floods, terrestrial infrastructure is often damaged or destroyed. HAPS can be rapidly deployed to restore communication for first responders and affected communities, enhancing situational awareness and supporting search and rescue efforts. They can provide the necessary Quality of Service (QoS) to prioritize traffic for emergency services.
* Backhaul for Terrestrial Networks: HAPS can serve as a backhaul solution for ground-based stations, especially in areas where fiber is unavailable or has been compromised. They can also be part of a multi-layered backhaul network in coordination with LEO and GEO satellites.
* Sensor Networks and IoT: HAPS are ideal for connecting vast networks of low-power sensors for various applications. This includes agriculture (crop/soil monitoring, livestock tracking) and environmental monitoring (early warnings for fires or floods).

Fixed Wireless Access: HAPS can provide high-speed broadband to greenfield areas where deploying terrestrial networks is not profitable. This is crucial for revitalizing rural areas and ensuring universal connectivity.

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