



NTN Evolution into 6G for IMT-2030 Use Cases

Global Satellite Operators Association
(GSOA)

SWS_240008

3GPP Stage 1 Workshop on IMT2030 Use Cases

Rotterdam, NL
08 - 10 May 2024



The global CEO-driven association representing the entire satellite industry



GSOA provides a platform for collaboration between member companies **involved in the satellite ecosystem globally and a unified voice for the sector**

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SAUDI NET LINK

SES

SKY Perfect JSAT
Corporation

SPACEBRIDGE

speedcast

ST Engineering
iDIRECT

SMW
SWEDISH MICROWAVE AB

talia

telenor | satellite

TELESAT

TELESPAZIO
a LEONARDO and THALES company

Telstra

ThalesAlenia
Space
a Thales / Leonardo company

THURAYA

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ULTISAT
A Speedcast Company

Viasat

اليه سات
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By 2030.....

More than 500 million people will connect via Satcom, twice as many as today

Global socio-economic benefits of Satcom will exceed \$250 billion

Today's society relies on
connectivity

Terrestrial infrastructure
is limited and leaves
a **connectivity gap**

Satcom bridges gap
& provides universal and meaningful
connectivity to all

4G & Before

5G & 5G Advanced

6G & Beyond

Satellite Networks

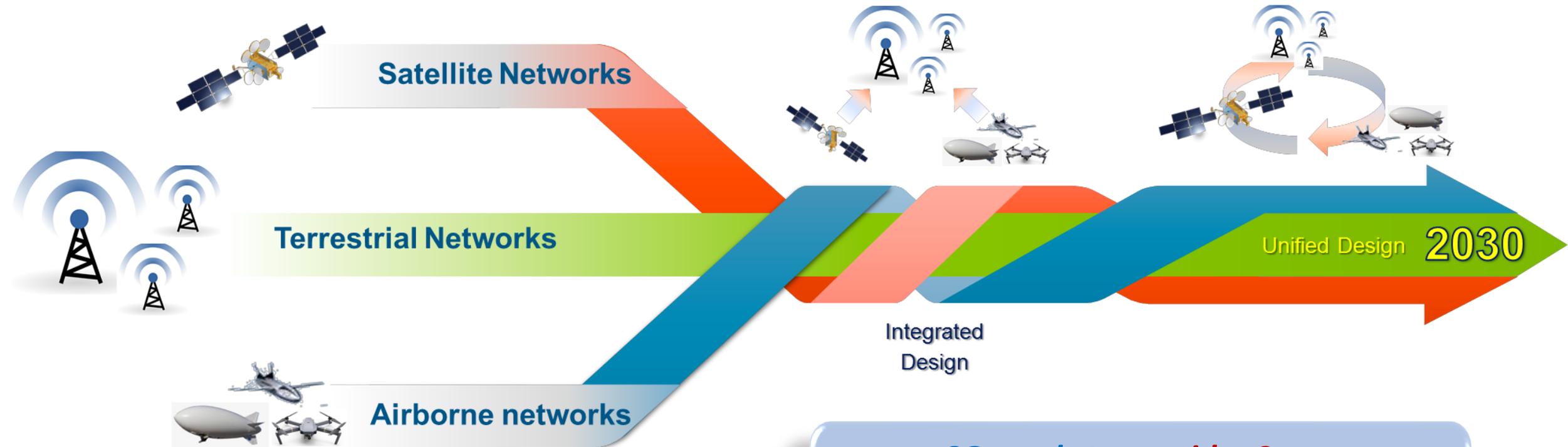
Terrestrial Networks

Airborne networks

Integrated Design

Unified Design 2030

6G needs to consider Space from beginning in definition of new protocols and network architecture



NTN has been recognized as a 'pivotal' element of



- The NTN component is expected to contribute to the “ubiquitous and resilient connectivity” use case of the 6G system.
- The NTN component is also expected to enhance the sustainability of 6G by enabling reduction of the overall energy consumption of the system including the user equipment.
- The NTN component shall be designed to support smooth integration with terrestrial MNOs networks at network and service management level.
- The NTN component connectivity needs to be integrated with the existing/planned terrestrial mobile connectivity. The transition between both types of networks or components should be seamless.
- The perceived latency shall be as low as possible for high Quality of Experience.

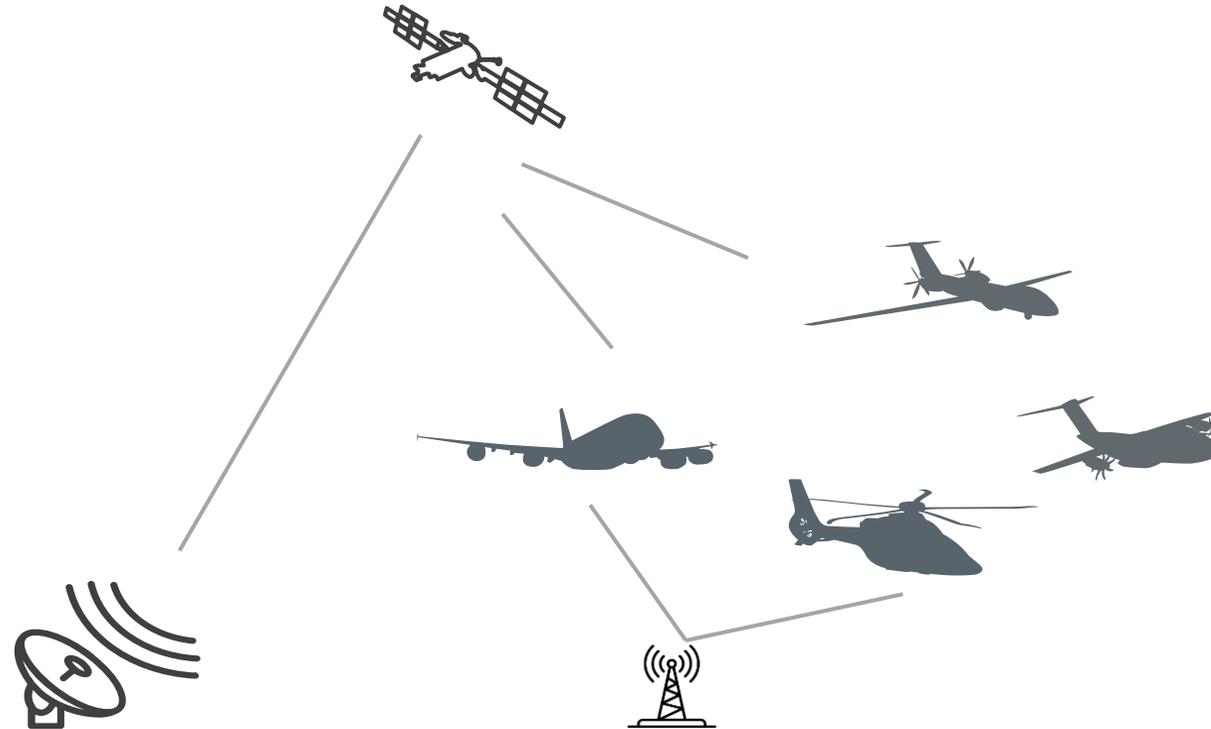
Connectivity for the Aviation Industry



Market

Airborne Satcom market size is projected to grow to \$10B by 2032

Enhancement of passenger experience and modernization of ATM are key drivers



Functions

Passenger Communication

Airlines and Airport Operations

Air Traffic Management (ATM)

Aeroconnectivity provides digital data communication between the aircrafts and the ground

Truly global and ubiquitous connectivity can be provided by satellites only

Seamless Air Alliance (SAA) is leading global inflight connectivity and aims at promoting the aviation requirements for future connectivity solutions including 3GPP (5G/6G). www.seamlessalliance.com

Aviation Connectivity Challenges & Objectives



Enable **seamless and continuous connectivity** service on board our aircrafts



Natively integrate TN and NTN with improved capacity, resilience and security



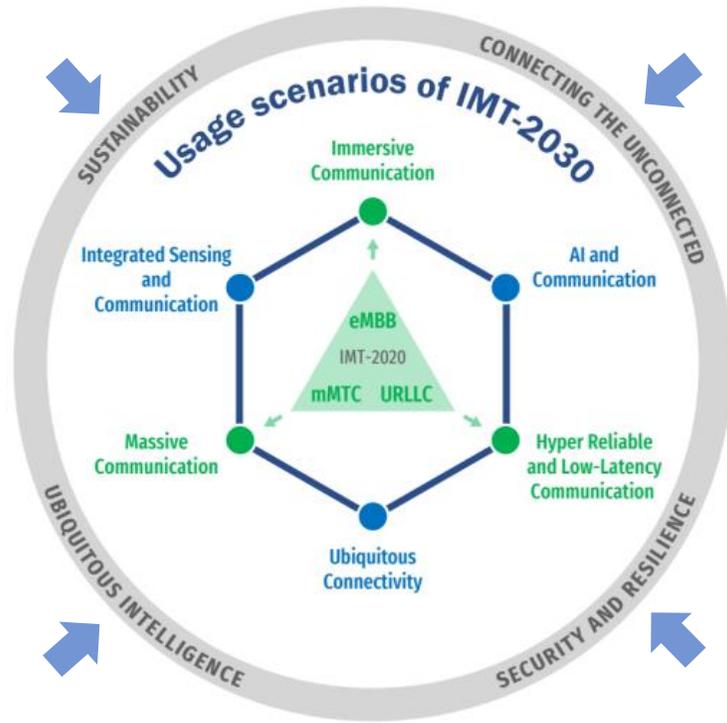
Enable Wideband & Broadband connectivity to **Mobile VSAT** in FR2 enabled by NGSO and GSO satellites



Foster development of an open ecosystem (**universal modem with standard chipset & ESA Antenna technology**)



Aviation Industry objective is to defragment the connectivity ecosystem, favor interoperable solutions and standardize Aircraft Terminal and Services by leveraging 6G NTN technology



Connecting the Unconnected; Security and Resiliency; Ubiquitous Intelligence; Sustainability

- ✓ Global Coverage: Satellites provide broad coverage, reaching remote and underserved areas without land-based infrastructure, connecting people in rural regions, on ships, and in aircraft
- ✓ Global Ubiquitous Connectivity for Airborne/Maritime: Satellites offer continuous connection for planes, ships, and other moving platforms -- enhancing safety, navigation, and passenger services.
- ✓ Resilience and Redundancy: Satellite networks provide strong backup during emergencies like natural disasters, cyberattacks, or infrastructure problems. This boosts overall network reliability.
- ✓ IoT Connectivity: Satellites connects IoT devices across vast areas, gathering data for analysis providing valuable insights, also benefiting agriculture, environmental monitoring, asset management and more.
- ✓ Low Latency Communication: Advancements in satellite/NTN holds the promise of reducing latency -- vital for real-time applications such as telemedicine and autonomous vehicles.

Source: Recommendation ITU-R M.2160-0 (11/2023),
"Framework and overall objectives of the future development of IMT for 2030 and beyond"

Immersive Communication

- Direct connectivity to smartphones/wearable devices in light indoor/in car scenarios
- High speed broadband connectivity to transportation platforms (Trains, aircraft, vessels)
- Fast set-up of connectivity to an area/theater of operation (for utilities and public safety)

Artificial Intelligence and Communication

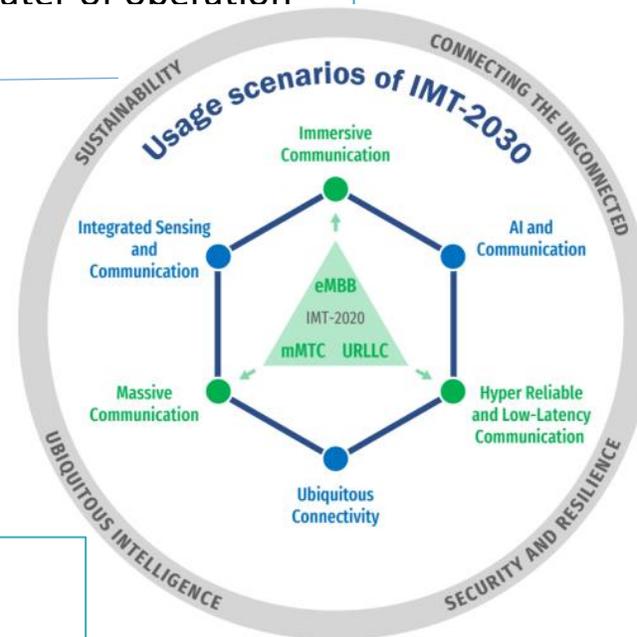
- Content distribution for media applications

Integrated Sensing and Communication

- Safety critical applications
- JSAC (Joint Sensing & Communications)

Hyper Reliable and Low-Latency Communication

- PNT augmentation to enhance accuracy, reliability, and resilience of location-based services, where GNSS is an issue
- Low latency service over long distance



Usage scenarios and overarching aspects of IMT-2030

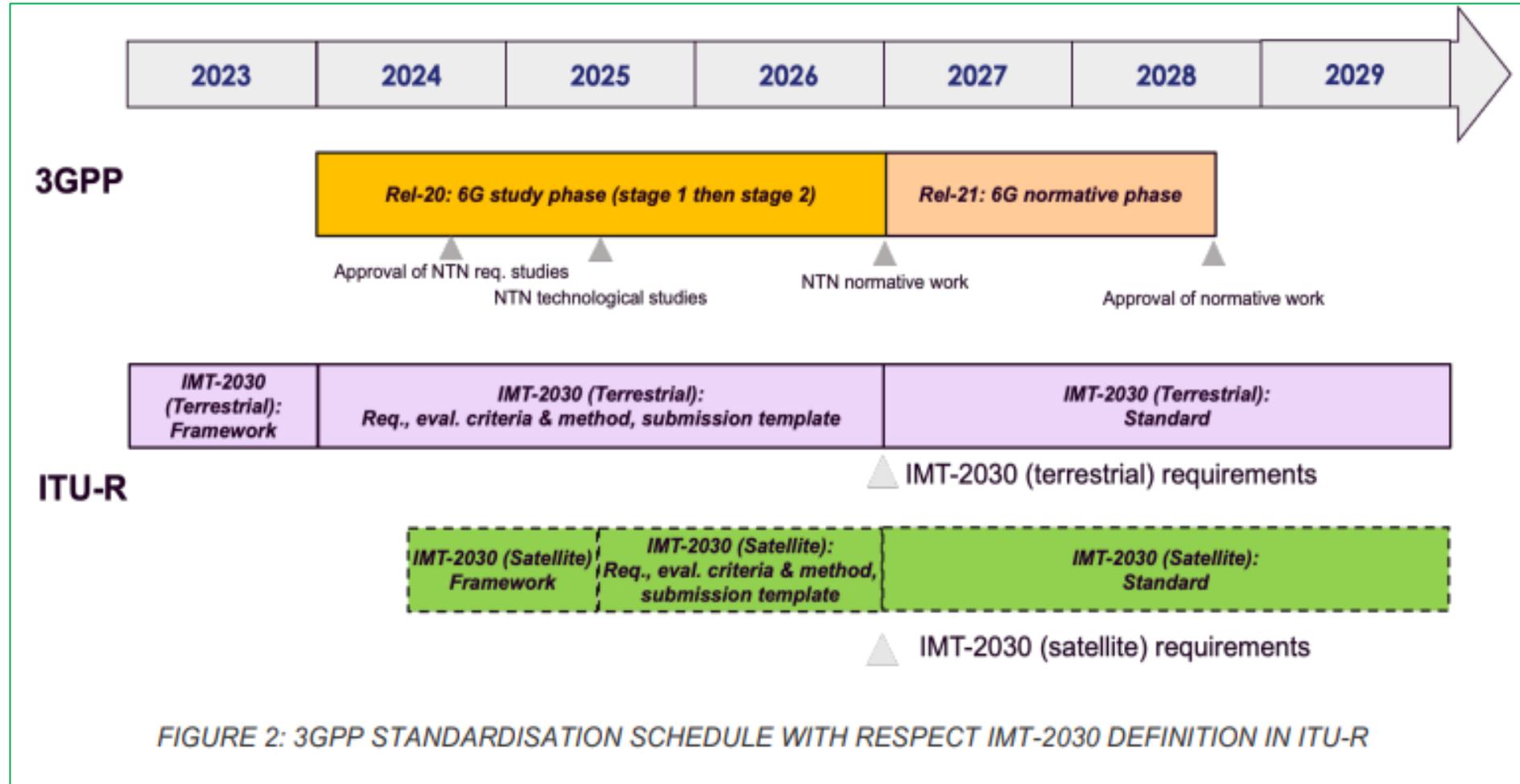
Massive Communication

- Data collect from a wide area (e.g. utilities, agriculture, public safety)

Ubiquitous Connectivity

Broadband connectivity to:

- land vehicles
- drones (or UxV)
- homes and small offices
- aircrafts



Source: white paper "Vision on Non-Terrestrial Networks in 6G system (or IMT-2030) USE CASES, REQUIREMENTS, AND POSSIBLE STANDARDIZATION APPROACH, A PERSPECTIVE FROM THE 6G-NTN PROJECT", <https://www.6g-ntn.eu/download/vision-on-non-terrestrial-networks-in-6g-system-or-imt-2030>

Matrix of industry initiatives/areas of interest led by satellite network operators for the different deployment scenarios:

| | Narrowband connectivity to IoT devices (NTN-IoT in FR1) | | Narrowband/Broadband connectivity to handheld devices (NTN-NR in FR1) | Broadband connectivity to non-handheld devices (VSAT) (NTN-NR in above 10 GHz Band) | |
|---------------------|---|--|---|---|---|
| Space Segment | Re-use of existing GSO | NGSO | NGSO | GSO | NGSO |
| Operators | EchoStar Viasat-Inmarsat TerreStar Solutions | Sateliot EchoStar OmniSpace Viasat-Inmarsat | EchoStar OmniSpace Viasat-Inmarsat SES | Intelsat Eutelsat-Oneweb Viasat-Inmarsat SES | Intelsat Eutelsat-Oneweb Viasat-Inmarsat SES |
| Timeline Indication | 2023-2025 | 2024-2029 | 2026-2029 | | |

Recognizing the pivotal importance of NTN to realizing the full potential of 6G, GSOA strongly recommends:

- Ensure native integration of satellite component in 6G to maximize impact and benefits.
- Prioritize NTN in Rel-20 study phase and Rel-21 normative phase on 6G.
- Maximize efforts towards a unified NTN/TN ecosystem.



The building blocks for satellite-terrestrial integration have been put in place with 5G. 6G will build on these to deliver unified networks with inbuilt ubiquity, continuity, scalability & resilience.

Source: Satellite Communications and their role in enabling 6G
<https://gsoasatellite.com/wp-content/uploads/6G-Paper-GSOA.pdf>

6G-NTN: Use cases, approach, and proposed KPIs for satellite



USE CASES

- Consumer Handheld Connectivity and Positioning in Remote Areas
- Enterprise Direct Communication over Satellites
- Continuous Bi-Directional Data Streams in High Mobility
- Maritime Coverage for Search and Rescue Coast Guard Intervention
- Urban Air Mobility (Air Taxi)
- Autonomous Power Line Inspection Using Drones
- Adaptation to PPDR or Temporary Events

6G APPROACH: NATIVE INCLUSION OF SATELLITE COMPONENTS

- Common TN/NTN technology framework (architecture and protocols) with no specific add-ons to support NTN.
- Rel. 20: NTN included in the baseline 6G study items.
- Rel. 21: NTN included in the first normative 6G work items endorsing the inclusion of satellite radio components as part of 6G, targeting the most prominent mass market and corresponding access networks.
- Subsequent releases could elaborate on additional improvements to address further needs.

| Service performance | Target requirements (under consolidation) |
|--|---|
| Peak data rates (UL/DL, in Mbps, outdoors): | |
| • Handheld | >Tens of Mbps |
| • Vehicle or drone (flying and surface), speed >250 km/h, antenna aperture <20 cm | >Hundreds of Mbps |
| • Large platform Aeronautical/maritime platforms, speed >1200 km/h, antenna aperture <60 cm | >Thousands of Mbps |
| Location service in outdoor conditions, network-based, 95% reliability | |
| • Accuracy | <1 m |
| • Acquisition | <1 s |
| Coverage: to be consolidated according to frequency bands, propagation conditions, and channel models, etc. | Outdoors, indoors & in cars |
| Reliability: defined as success probability of transmitting a data packet within a specific period assuming the service is available. | >99.999% |
| Latency: to be addressed with propagation delay of satellite in Low Earth Orbit. Round trip time can vary from 4 msec - 300 km altitude, 90 deg. elevation angle to 50 msec - 1500 km, 10 deg. elevation angle, for instance. | Consistent with IMT-2030 terrestrial Radio Interface (both control & user planes) |
| Connection density | >1000 per km ² |



THANK YOU!

For more information contact GSOA on
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