



6GNTN

ADDITIONAL EUROPEAN PERSPECTIVE NON-TERRESTRIAL NETWORK (NTN) IN 6G 20 MINUTES

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*The content of this document does not necessarily reflect
the views of all the 6G-NTN consortium partners*

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Facts and figures



Addressing call: "[SNS-2022-STREAM-B-01-03: Communication Infrastructure Technologies and Devices](#)"



Overall goal: Develop an NTN component fully integrated with the 6G infrastructure able to provide enhanced Mobile BroadBand (eMBB) and Ultra Reliable Low Latency (URLL) services to vertical industries and consumers terminals in outdoor and light indoor conditions.



Targeted TRL: 2 - 4



Duration: 36 months



Project duration: 1 January 2023 – 31 December 2025

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6G-NTN project has become the flagship R&I project for **developing the 6G NTN component** and **driving its standardization** phase in 3GPP as part of Rel-20+

- Satellite **connectivity to smart phones and IoT devices** (D2D) in frequency bands **up to 8 GHz**
 - enhanced performances compared to 5G (data rate, coverage, throughput, ..)
- Satellite **connectivity to vehicle/building mounted devices** (Flat Panel Antenna) in frequency bands **above 10 GHz** (e.g. Ku, Ka, Q/V band).
 - Terminal (SWAP) adapted to vehicles from the automotive, public safety, transport (aeronautic, railways, drone, maritime), utilities, agriculture and media & entertainment sectors are assumed.

Improved user experience

- **Improved service continuity** over the coverage
 - Enhanced NTN/TN mobility/multi connectivity especially in connected mode
- **Improved coverage**
 - Provision of emergency services (at least SMS) via satellite in light indoor/in vehicle conditions
 - Mobility in sub-urban/dense forest (i.e. several hundred ms fading duration)
- **Support of device diversity**
 - Handheld/IoT, vehicle/drone mounted
- **Improved data rate/throughput**

Improved network capabilities

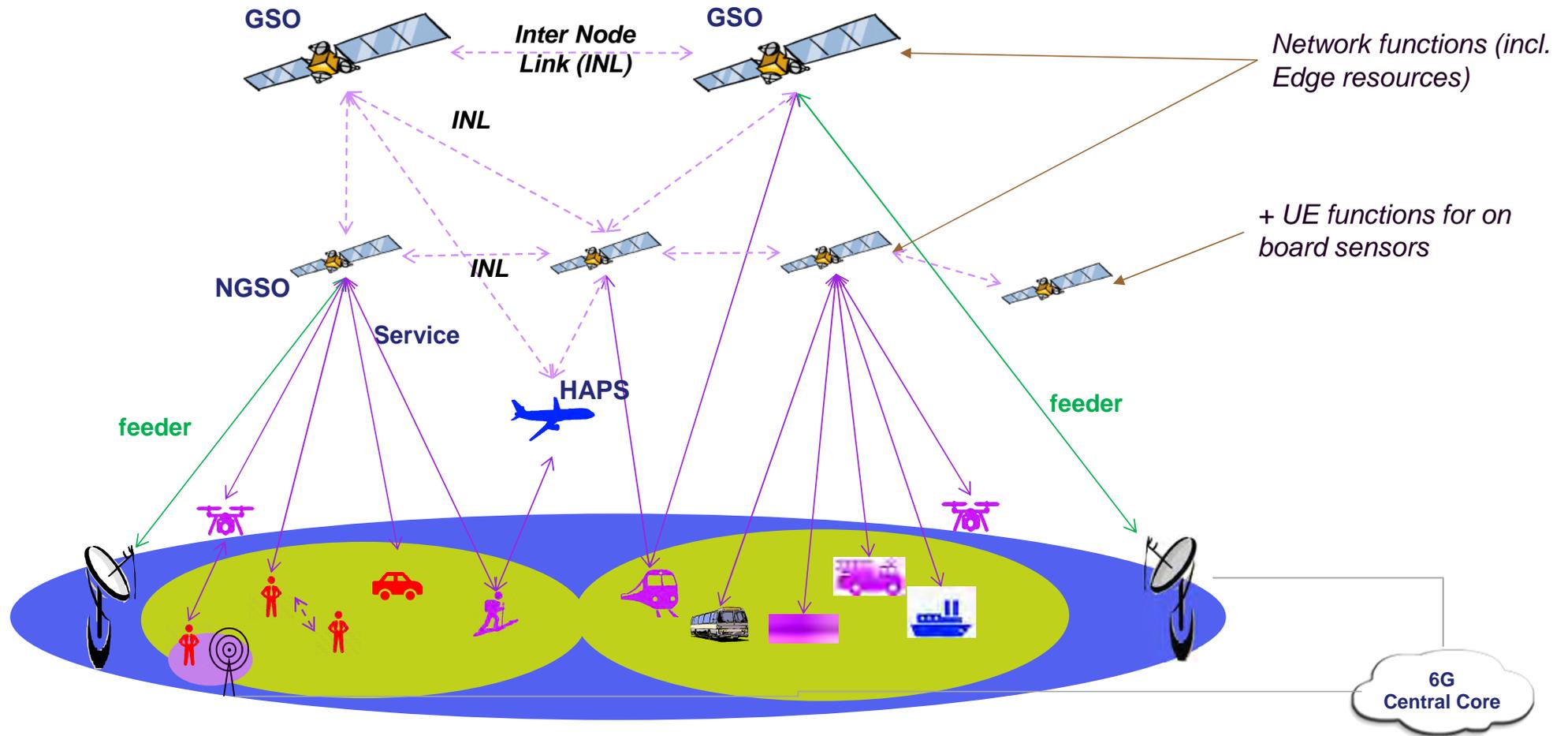
- **Resiliency**
 - GNSS independent operation on the satellite network (i.e. initial access, ..)
 - GNSS independent capability for the UE to determinate its location
 - Service continuity with respect to a temporary failure of a given node (e.g. NGSO, GSO, HAPS, TN node);
 - Fast set-up of an autonomous network over a specific region via satellite (with ISL) and/or HAPS with no or intermittent connectivity to core networks (e.g. for crisis response)
- **Sustainability**: Minimise overall consumption
 - Energy based access network selection: under traffic or zero traffic conditions
- **Overall spectrum usage efficiency**
 - Multi access technology spectrum coexistence (i.e. NTN/TN)

Possible performances



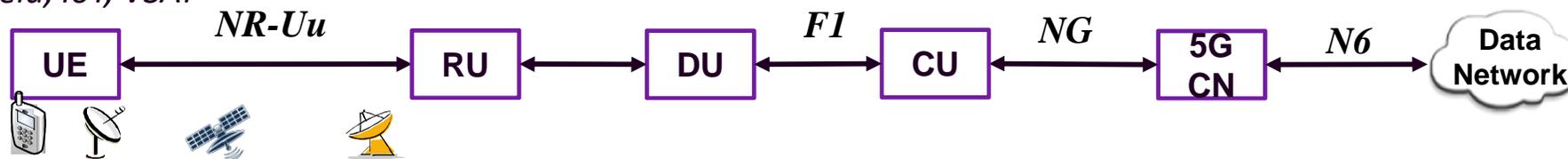
Target service performances	NTN in 5G (As per 3GPP &/or ITU-R IMT2020 satellite requirements)	NTN in 6G
Peak data rate (DL/UL) wrt smartphones & low cost IoT devices	1/0.1 Mbps (Outdoor only) @ up to 3 km/h	Outdoor conditions: Tens of Mbps @ up to 250 km/h Light indoor/in car conditions: At least Short Message Service capability
Peak data rate (DL/UL) wrt Vehicle or drone (flying and surface) mounted devices	[50/25] Mbps @ up to 250 km/h (with 60 cm aperture)	Hundreds of Mbps (Outdoor only) @ up to 250 km/h (with <20 cm equivalent aperture)
Peak data rate (DL/UL) wrt Large Aeronautic, maritime platforms mounted devices	[50/25] Mbps @ up to 1000 km/h	Thousands of Mbps (Outdoor only) @ up to 1200 km/h (with <60 cm equivalent aperture)
Location service (target accuracy and acquisition time) in outdoor conditions only	respectively 1 meter and < 100 seconds (reliability through Network verification)	respectively 100 meter (TBC) @ 95% reliability through RAT dependent positioning method
Coverage	Outdoor only	Maximum Coupling Loss able to address light indoor/In car

NTN Architecture: 3D Network Concept

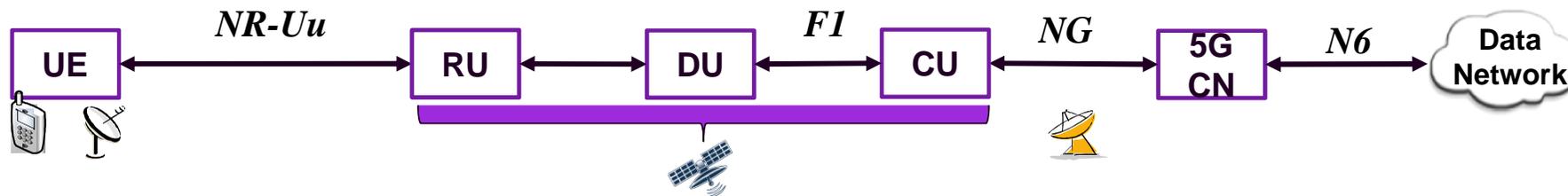


NTN architecture and mapping on space segment (1)

Handheld, IoT, VSAT



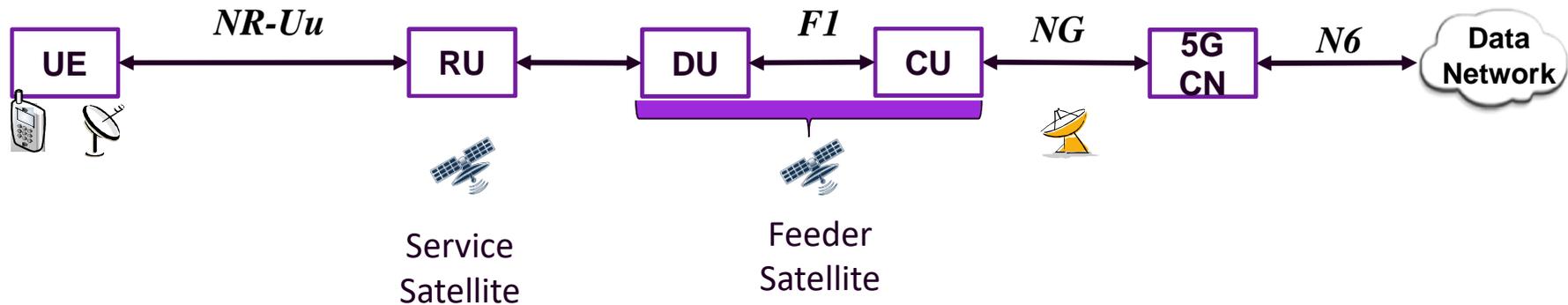
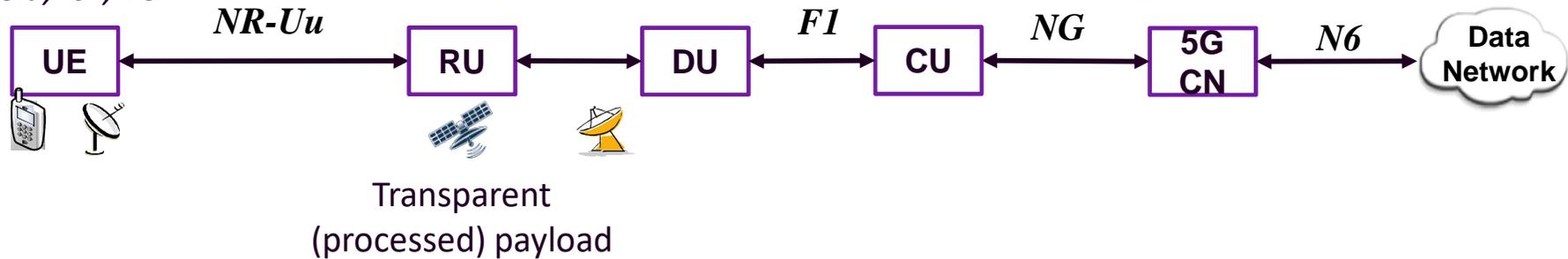
Transparent (RF)
payload



Regenerative payload

NTN architecture and mapping on space segment (2)

Handheld, IoT, VSAT



6G radio interface: NTN related enablers (1/2)



Spectrum efficient and flexible waveform optimized for both terrestrial and non-terrestrial network components

Candidate radio interface features	Rationale
Multi carrier waveform enhancements	<ul style="list-style-type: none">▪ OFDM evolution offering relaxed synchronization requirements.▪ Supporting UE without GNSS capabilities (also referred as « GNSS free operation »).▪ Mitigating specific satellite constraints: Reduce the Peak-to-Average Power Ratio (PAPR) on the downlink to maximize the spectral efficiency in case of reduced number of channels in a single on board amplifier.
Advanced modulation, coding and multiple access schemes	<ul style="list-style-type: none">▪ Minimizing error rate performance under low SNR conditions.▪ Enabling the support of extended Maximum Coupling Loss to mitigate challenging radio link conditions (e.g. to overcome building penetration loss).
Design flexible UL/DL framing structure	<ul style="list-style-type: none">▪ Adapt the frame structure to satellite Orbit, frequency range etc...▪ Reduce the overhead penalty since there are quasi no multi-paths in satellite propagation channel.

6G radio interface: NTN related enablers (2/2)



Candidate radio interface features	Rationale
Design appropriate robust reference signals for enhanced positioning	<ul style="list-style-type: none"> Support reliable (i.e. trusted) network based solution for accurate and fast response Positioning, Navigation and Timing (PNT) service. Potential narrow-band synchronization signals could be also designed, where the PRS resources could be defined over multiple slots.
Support of broadcast and multicast	<ul style="list-style-type: none"> Leverage the large coverage area of satellites
Enablers for Artificial Intelligence driven radio resource control	<ul style="list-style-type: none"> Increase the “goodput” of a radio link through dynamic optimisation of the radio interface configuration (e.g. Modulation, coding, power, signal occupancy, interleaving depth, HARQ) according to the radio link conditions
Spectrum sharing between TN and NTN	<ul style="list-style-type: none"> Revise the methodology of coexistence study and RF/RRM specification, and potentially consider adjacent channel coexistence between TN and NTN.
New spectrum	<ul style="list-style-type: none"> Some additional MSS allocations may be granted at the WRC-2027 as per agenda items 1.12, 1.13 and 1.14. Moreover, some additional bands such as Q/V bands should be considered for broadband connectivity.
FDD and TDD support	<ul style="list-style-type: none"> Adapted to paired and unpaired spectrum

The Consortium





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THANKS
