



# ETSI Conference on Non-Terrestrial Networks, A Native Component of 6G

## Session 1: 6G Non- Terrestrial Network Concept

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03/04/2024



# 3GPP defined Non-Terrestrial Network: Overview

3GPP NTN: the **first and true global and open standard for all SatComs** (any device, orbit, service, frequency bands, beam size/type) and **supported by the 3GPP eco system** (satellite, mobile and vertical stakeholders)

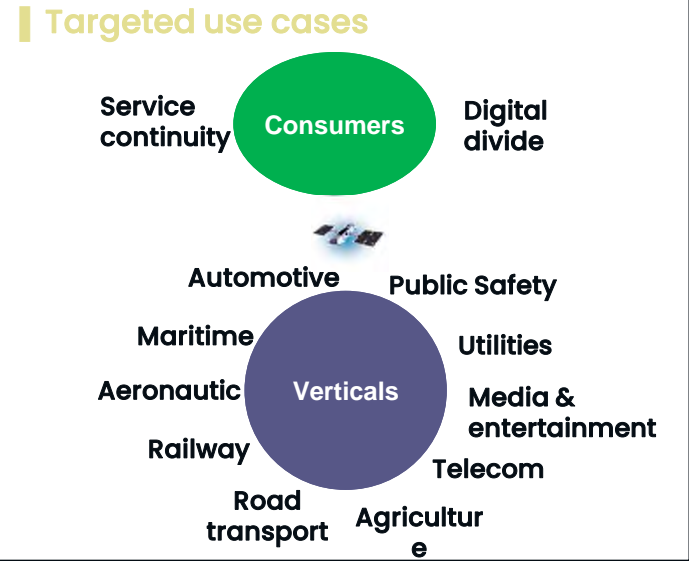
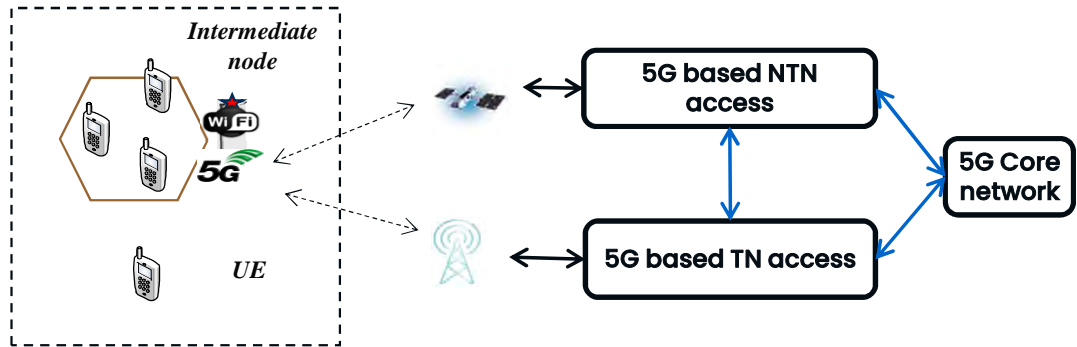
**NTN added value wrt TN: service continuity and reinforced reliability/availability**

- 3 NTN reference scenarios wrt terminal types:
- **IoT devices** (Narrowband: hundreds of kbps) in < 7 GHz
  - **Smartphones/vehicle** (Wideband: few Mbps) in < 7 GHz
  - **Flat panel antenna terminal** on moving platforms (Broadband: hundreds of Mbps) in > 10 GHz

Radio Access Network: *mobility across the access technologies*

Indirect connectivity

Direct connectivity



Common 5G technology framework to best manage (Perf., QoS, Security, Slicing) across the access technologies

# 3GPP NR-NTN roadmap

*In red: to be confirmed*

Releases	15	16	17	18	19
Completion date (Core part for RAN1)	June 2018	Dec 2019	June 2022	March 2024	June 2025
Service requirements	5G NTN Use cases and service requirements				GNSS free operation, mesh connectivity
System architecture		Study key issues	Definition of the enablers for the support of Satellite	-	Dual steer (GSO/NGSO, TN/NTN) Mesh connectivity
Radio Access network aspects	Channel model for 0.5 – 100 GHz	Study key issues	Support of NGSO/GSO, Earth fixed/moving beams	Verified UE location, UL coverage enh, mobility enh	DL coverage enh, broadcast, UL capacity enh, 4G TN/5G NTN mobility, Regen payload (gNB) Channel bandwidth < 5 MHz
Targeted terminals	-	-	Smart phones (23 dBm)	Fixed VSAT for GSO/NGSO, Mobile VSAT only for GSO	RedCAP UE, High power Tx UE (Smart phones + vehicle mounted) <b>Mobile VSAT for NGSO ?</b>
Frequency bands	-	-	S, L bands in FDD mode	Extended L band, Ka band in FDD mode	<b>Ku band in FDD mode ?</b> <b>Other bands in FR1 range ?</b>



# 3GPP IoT-NTN roadmap

*In red: to be confirmed*

Releases	17	18	19	20
Completion date (Core part)	June 2022	March 2024	June 2025 <span>EjM5</span>	-
Service requirements			Store and forward	-
System architecture	-	Discontinuous coverage	Store and forward	-
Radio Access network aspects	Support of NGSO/GSO, Earth fixed/moving beams,	mobility enh Performance enh Discontinuous coverage	Store & Forward Uplink capacity enhancements Further Mobility enhancements Support of TDD spectrum <span>EiM6</span> ? <span>EjM7</span>	-
Targeted terminals	Power class 3 devices (23 dBm)	-	High power Tx UE	-
Frequency bands	S, L bands in FDD mode	Extended L band	L band in TDD mode ?	-

## Diapositive 4

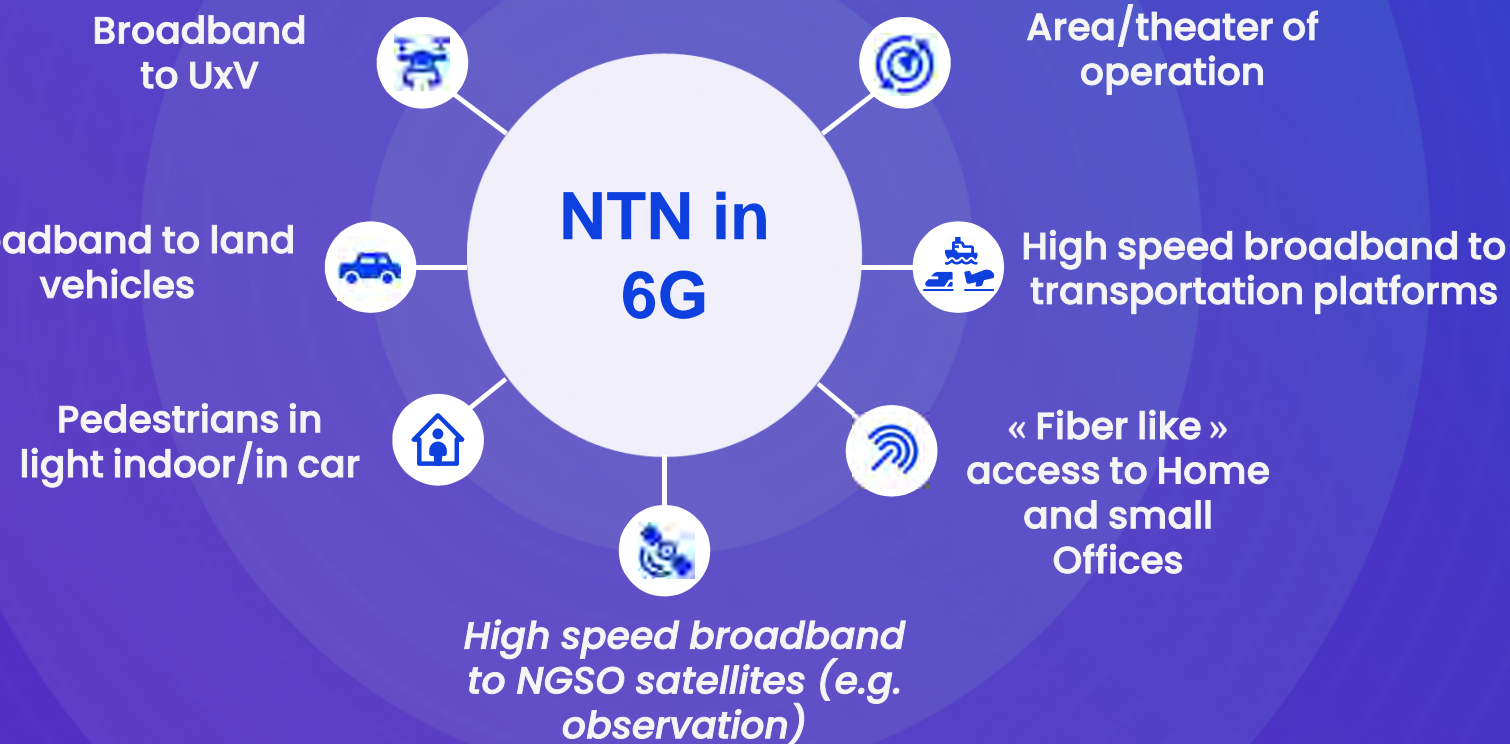
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**EjM5** to be updated. This is only for RAN1  
El jaafari Mohamed; 25/03/2024

**EjM6** Support of TDD operation.  
El jaafari Mohamed; 25/03/2024

**EjM7** It is not yet clear whether we will push for TDD operation support or HD FDD payload  
El jaafari Mohamed; 25/03/2024

# NTN in 6G: an evolution of NTN in 5G enabling new roles / capabilities / connectivity scenarios



NTN contribution to 6G => ubiquitous and resilient service

From service to user centric design approach

Star (NTN -UE) & mesh (UE – NTN - UE) connectivity

Sustainability





Compact and self-tracking FPA for vehicle/UxV mounted devices



**GNSS free operation**



Seamless NTN/TN service continuity



Reliable, high accuracy and low latency determination of UE location



UE – NTN – UE or Local access – NTN – Local access (without feeder)

## Enabling FEATURES For NTN in 6G



Autonomous private network (NTN+TN) operation over a specific area



Smart NTN/TN combination for sustainability and resilience



Multi tenant non-terrestrial network infrastructure



NTN/TN Spectrum coexistence optimization

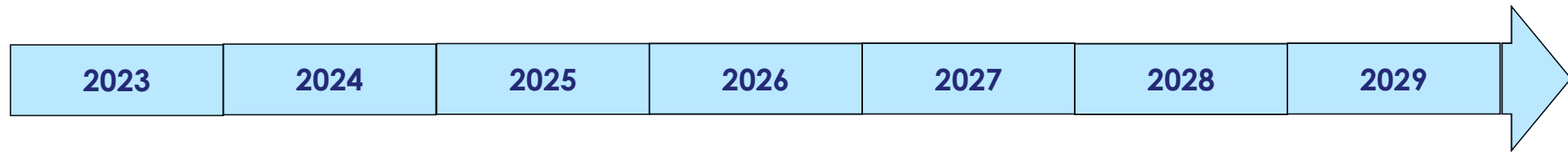


Integrated Sensing



# 6G TN & NTN: 3GPP and ITU-R

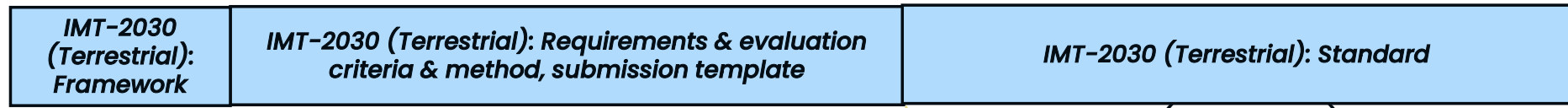
TN = Terrestrial Network  
NTN = Non Terrestrial Networks (Satellite, HAPS)



3GPP



ITU-R  
WP5D



IMT2030 (terrestrial)  
requirements

ITU-R  
WP4B



IMT2030 (satellite)  
requirements





## Spectrum

Frequency bands that may be considered for respectively 5G and 6G non-terrestrial networks:

Services	NTN in 5G (Currently)	NTN in 6G
<b>Narrow/Wideband connectivity to smartphones, vehicle/drone mounted &amp; low cost IoT devices</b>	FR1: FSS and MSS allocations in L & S bands	FR1: same as 5G-NTN + additional satellite service allocations in FR1 band
<b>Broadband+ connectivity to vehicle/drone mounted devices and to large Aeronautic, maritime platforms</b>	Above 10 GHz: FSS and MSS allocations in Ka band	Above 10 GHz: same as 5G-NTN + additional satellite service allocations in Ku and Q/V bands



## Some take aways on NTN in 6G: key requirements

### Evolution of 5G

Support the efficient coexistence between 6G NTN and NR 5G operating in the same licensed frequency band

### NTN a native component

- NTN friendly radio interface from Rel-21 -> Unified Radio interface
- enabling “operational” integration between TN & NTN
- Main focus on vertical markets : Automotive, Drones, Transportation, public safety, agriculture, media & entertainment

Leveraging existing 5G NTN based space segments should be possible to the maximum extent

## Some references

▪ « 3GPP Non-Terrestrial Network: A Global Standard for Satellite Communication Systems », Special Issue of the International Journal of Satellite Communications and Networking, Pages: 217–301, Edited by Mohamed El Jaafari and Nicolas Chuberre, published by Wiley, May/June 2023,

- <https://onlinelibrary.wiley.com/toc/15420981/2023/41/3>



▪ « 5G Non-Terrestrial Networks » by Prof. Alessandro Vanelli-Coralli, Mohamed El Jaafari, Nicolas Chuberre, Gino Masini, Alessandro Guidotti, published by Wiley-IEEE Press, 12th January 2024

- <https://www.amazon.co.uk/5G-Non-Terrestrial-Networks-Vanelli-Coralli/dp/1119891159>



Congratulations to the 2023 Satellite Technology of the Year winner, GSOA, European Space Agency - ESA, EchoStar Corporation, Thales, INMARSAT, Intelsat and Individual Contributors - 3GPP NTN Standards!

