10th Anniversary

GISC 2026

Global ICT Standards Conference 2026

"Towards a Space-Based Hyper-Connected Era: Next Generation Satellite Communication Vision and Strategy."

Some views on Non-Terrestrial Networks (NTN) in 6G

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ICT Standards and Intellectual Property:
Shaping the Physical AI

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Abstract

Views about the evolution of NTN in the context of 6G and highlight the changes compared to NTN in 5G enter the content

ICT Standards

Views about the evolution of NTN in the context of 6G and highlight the changes compared to NTN in 5G: new services, capabilities, increased performances

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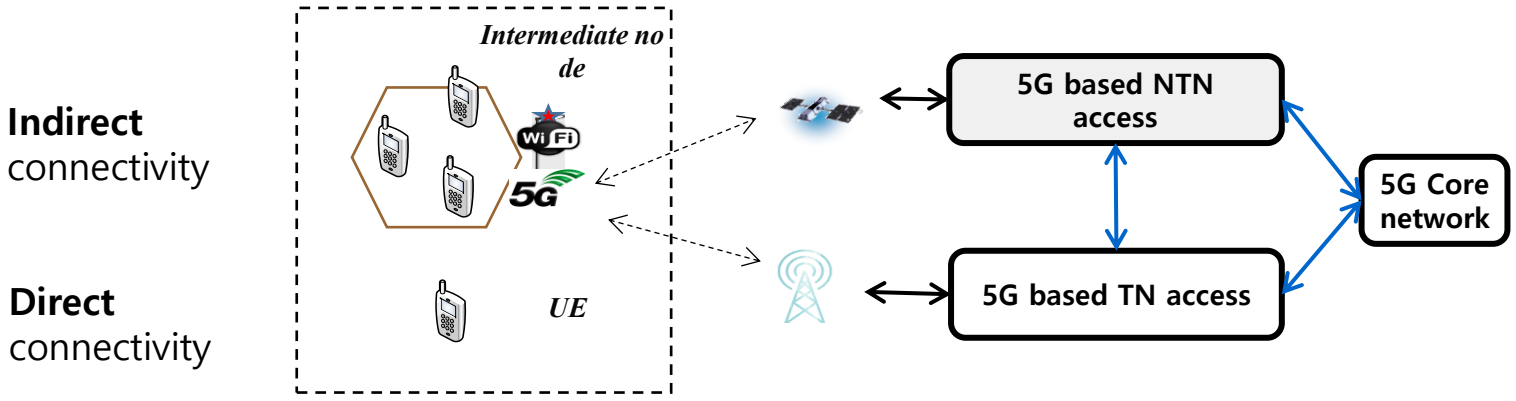
01 NTN in 5G

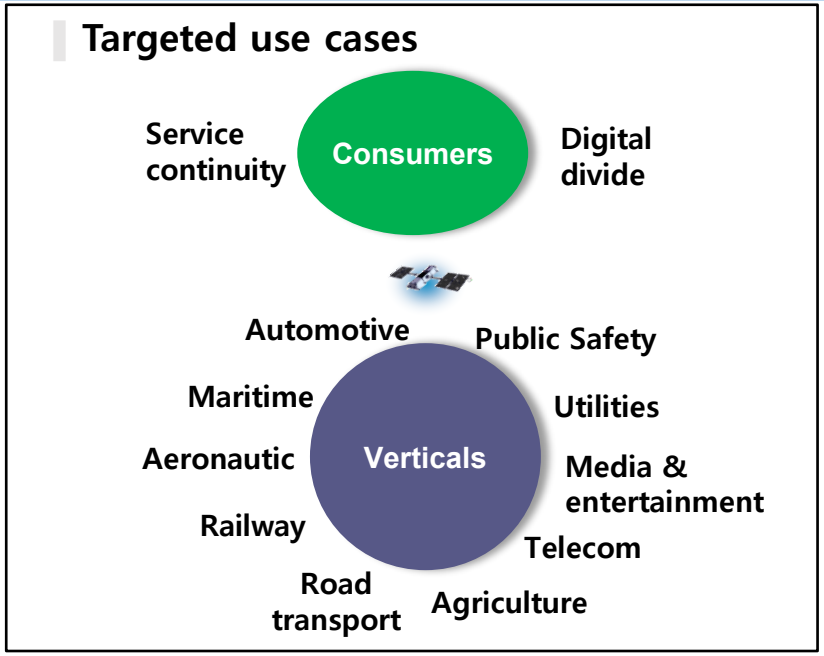
3GPP NTN: the **first and true global and open standard for all SatComs** (*any device, orbit, service, frequency bands, beam size/type*) and **supported by the 3GPP eco system** (satellite, mobile and vertical stakeholders)

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*



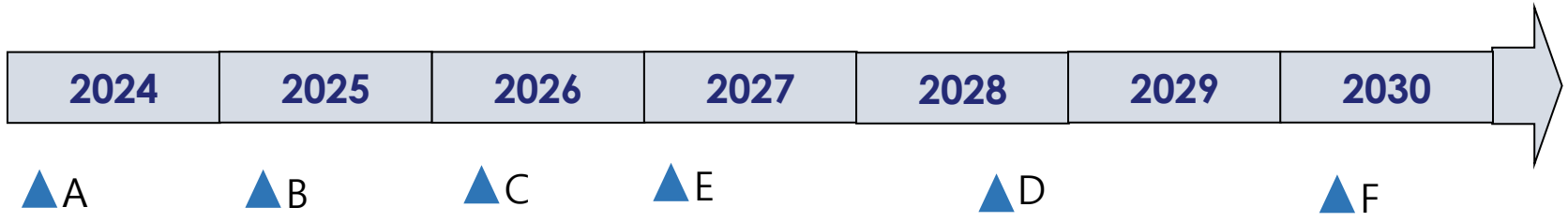


Common 5G technology framework to best manage (Perf., QoS, Security, Slicing) across the access technologies

3GPP NTN technology is being rolled-out

Deployment scenarios	A	B	C	D	E	F
Service	Messaging, voice, narrowband data			Wideband	Broadband	
NTN Radio Access Technology	IoT-NTN	IoT-NTN	IoT-NTN	NR-NTN	NR-NTN	NR-NTN
Orbit	GSO	NGSO	NGSO	NGSO	GSO	NGSO
Duplex mode	FDD	FDD	TDD	FDD	FDD	FDD
Payload	Transparent	Transparent/Regenerative			Transparent	Regenerative
Bands	Below 7.125 GHz (e.g. L/S bands)				Above 10 GHz (e.g. Ku/Ka band)	
Targeted devices	Internet of Things & Smartphones (D2D)			Smartphones (D2D)	Fixed and Mobile VSAT	

Earliest service opening for each scenario (and related 3GPP releases)



- **(Non) Geostationnary** Earth orbiting satellites
- T**ransparent payload architecture**

- Addressing identified specific NTN issues
  - **delays & Doppler: Extended & variable**
  - **Radio cells: Wide, possibly moving, possibly cross borders.**
  - **Propagation impairments: channel, payload**
  - **Spectrum: satellite service allocated frequency bands (< 6GHz, >10 GHz)**
  - **Service continuity between Terrestrial Network and NTN.**

Implicit compatibility to support HAPS (High Altitude Platform Station) and ATG (Air To Ground) scenarios

UEs with/with out GNSS capabilities

FDD/TDD

Earth fixed Tracking area



Highlights of 3GPP normative activities for NR-NTN in 5G/5G advanced

Areas	Rel-17	Enhancements in Rel-18, 19	Rel-20
Service requirements	Support of Direct to smartphones/IoT devices and broadband	IMS UE-SAT-UE, Emergency communication (text based via GEO), Resilient notification,	IMS call via GEO, non IMS UE-SAT-UE
System architecture	5G core support NR-NTN access	NR-NTN for satellite backhaul, Store and forward (S&F), IMS based UE-SAT-UE	Non IMS based UE-SAT-UE, Voice call over NB-IoT via GEO Ultra Low Bit Rate Voice codec
Radio Access network aspects	UL time and frequency synchronisation, UL/DL Timing relationship, Enhanced HARQ, Polarisation signalling for VSAT, …	Network Verified UE location, UL coverage enh, mobility enh (NTN/NTN and NTN/TN mobility), DL coverage enh, broadcast, UL capacity enh, 4G TN/5G NTN idle mode mobility, Regenerative payload (gNB)	GNSS resilient NR-NTN Physical Layer operation 4G TN/5G NTN connected mode mobility Semi-persistent scheduling for DL/UL data transmission for voice packets
Spectrum	Below 7.125 GHz (FR1-NTN numerology): L, S bands in FDD mode	Below 14.5 GHz (FR1-NTN numerology): other L/S, Ku, extended L bands in FDD mode, L band in TDD mode Above 10.0 GHz (FR2-NTN numerology): Ku, Ka band in FDD mode	HD-FDD mode and Carrier Aggregation
Targeted terminals	FR1-NTN: Smartphone/IoT Devices (PC1: 23 dBm)	FR1-NTN: RedCAP UE, High Power UE (handheld, non handheld) FR2-NTN: Fixed VSAT for GSO/NGSO, Mobile VSAT only for GSO	FR1-NTN: High Power UE (handheld), HD-FDD FR2-NTN: Mobile VSAT for NGSO, HD-FDD

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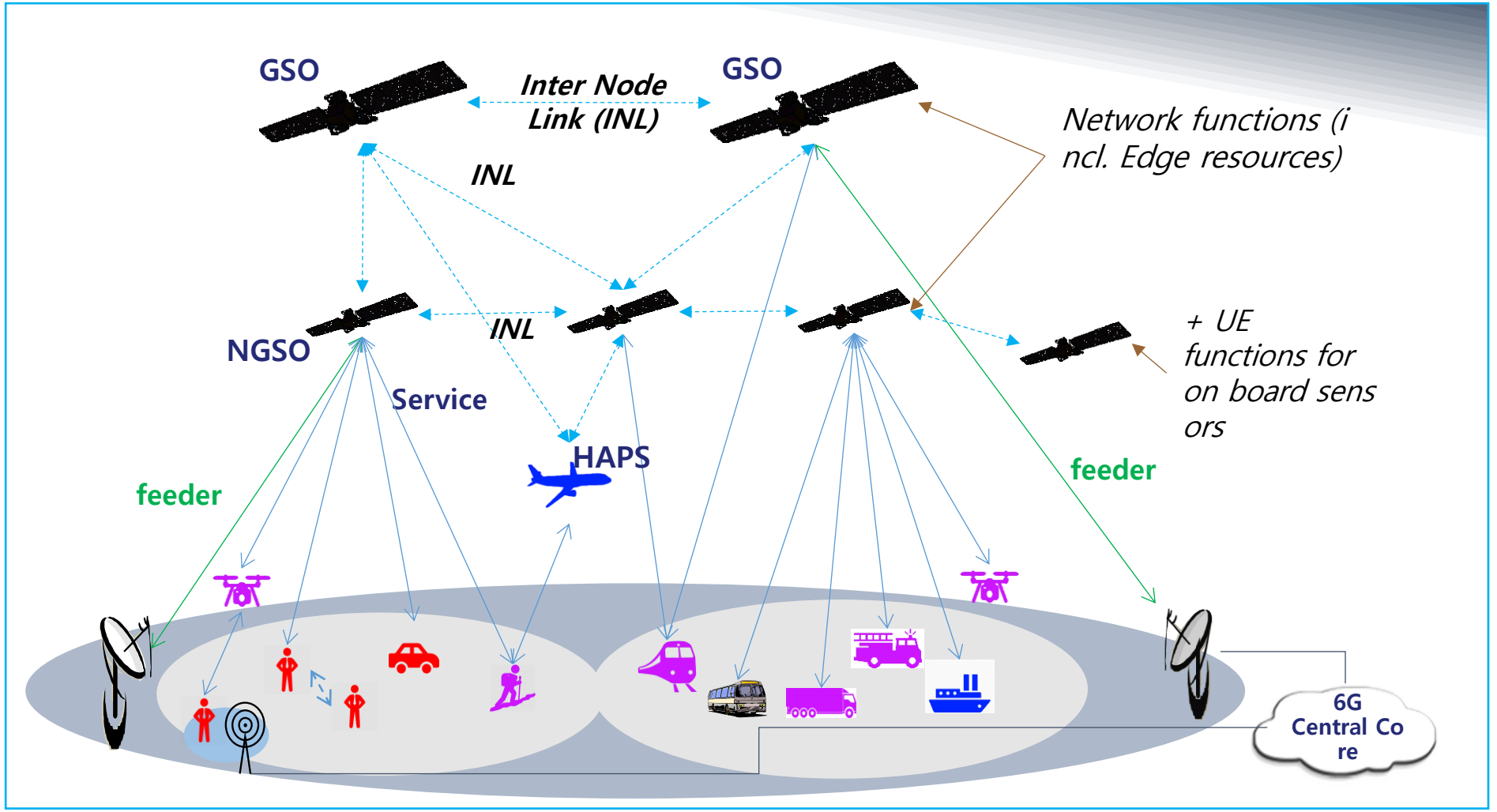
02 Towards NTN in 6G

1/ **Direct connectivity to S mart phones and IoT devic es** < 7.125 GHz
Markets: Consumers

2/ **Broadband connectivity t o vehicle/building mounted devices** (Flat Panel Antenna) > 10 GHz
Markets: automotive, public safety, transport, utilities, agr iculture and media & enterta inment

3/ 3D network concept

4/ Towards Telecom, Navigati on, Observation convergence



6G-NTN : Potential new capabilities

PNT: Positioning Navigation and Timing
ICAS: Integrated Communication and Sensing

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 adverse propagation conditions (e.g. 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**
- E.g. MIMO ?

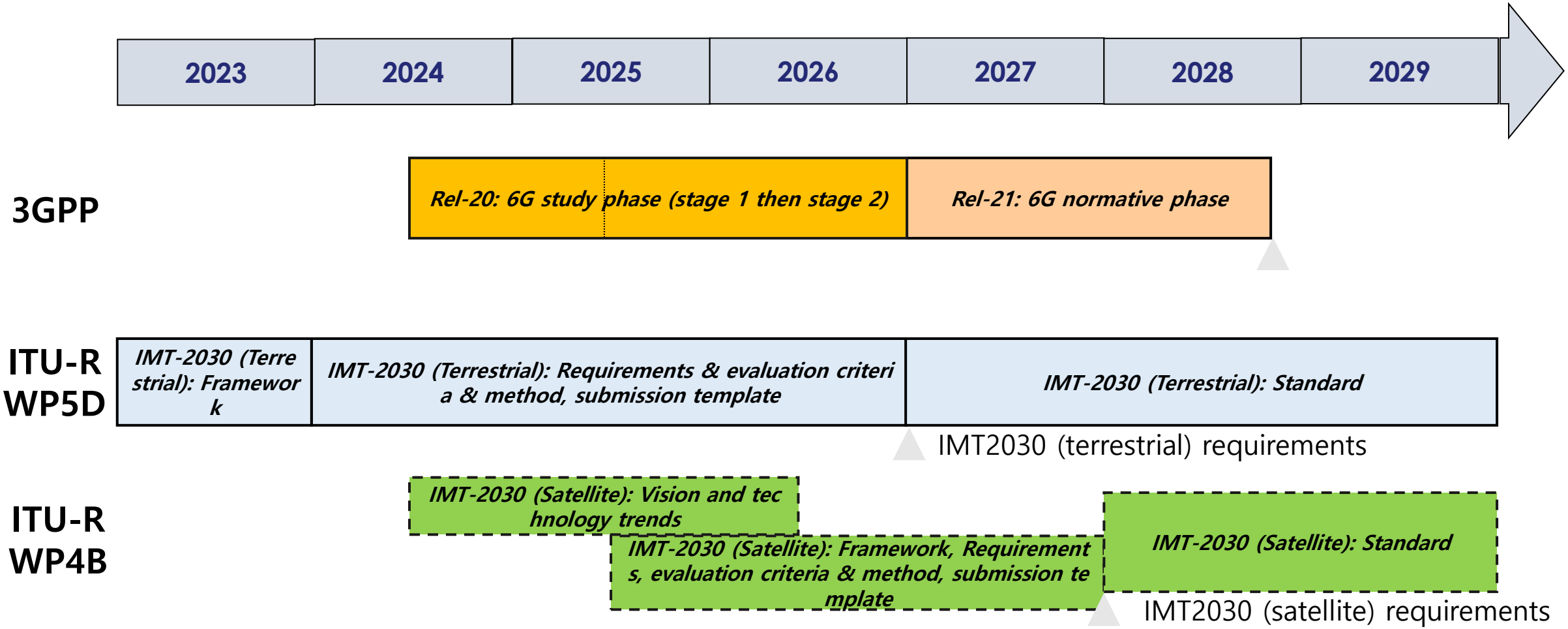
Improved network capabilities

- **Resiliency**
  - GNSS independent access operation and PNT service
  - Service continuity with respect to temporary failure of a given node (e.g. NGSO, GSO, HAPS, TN node);
  - Fast set-up of an autonomous NTN over a specific region with no or intermittent connectivity to core networks (e.g. for crisis response)
- **Sustainability**: Minimise overall energy consumption
  - Energy based access network selection: under traffic or zero traffic conditions
- **Overall spectrum usage efficiency**
  - Enhanced spectrum coexistence (i.e. NTN/TN)
  - Flexible duplex mode: FDD, TDD, HD-FDD
- **Integrated Communication and Sensing (ICAS)**
- **Orbits**
  - VLEO (300 to 600 km altitude), multi orbit
- **Artificial Intelligence**
  - For dynamic channel adaptation, efficient resource scheduling and management, autonomous operation and maintenance,

6G-NTN : Possible performance targets

Target service performances	NTN in 5G (As per 3GPP &/or ITU-R IMT 2020 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: several of Mbps @ up to 250 km/h Adverse propagation conditions (e.g. light indoor): At least Messaging 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)	~50 Mbps (Outdoor only) @ up to 250 km/h (e.g. 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	Hundreds of Mbps (Outdoor only) @ up to 1500 km/h (e.g. 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)	From 3-5 to 100 meter (TBC) @ 95% reliability through RAT dependent positioning method
Coverage	Outdoor only	Increased maximum Coupling Loss able to address adverse propagation conditions (e.g. light indoor/In car)

3GPP and ITU-R timelines for 6G



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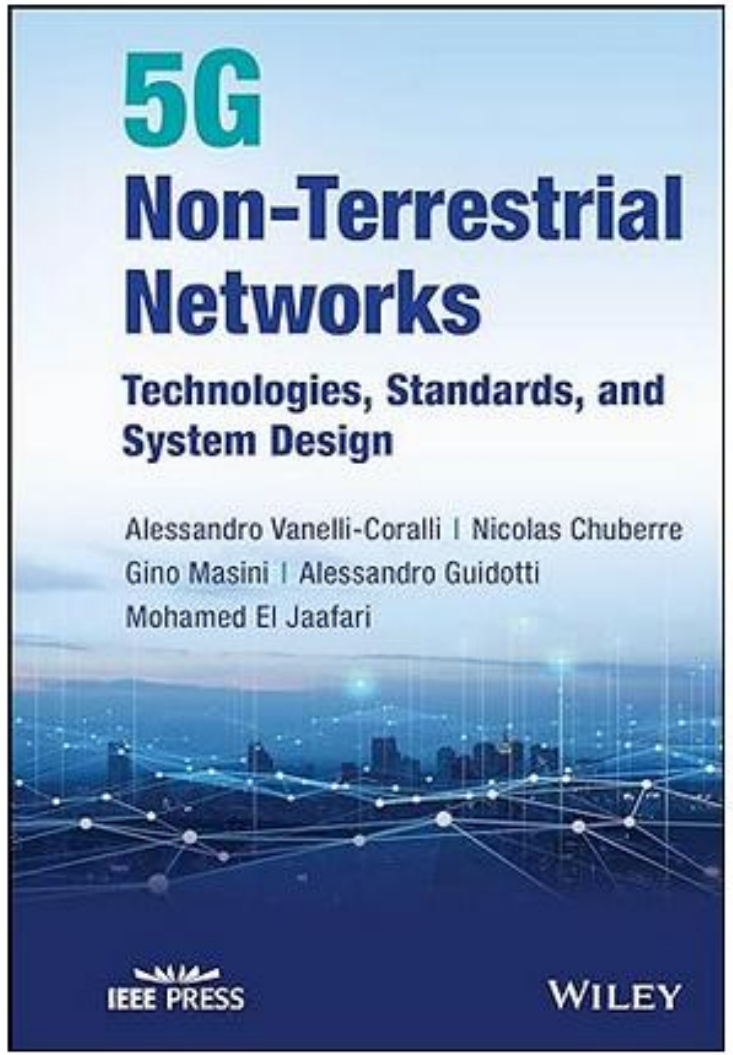
03 Conclusion

- Key Takeaways
  - 3GPP has defined enablers for 5G system to support most satellite network deployment scenarios
  - Satellite eco system has started to deploy 5G NTN based satellite networks
  - 3GPP is starting to work on 6G system aiming at supporting from day one, b oth terrestrial and non terrestrial network components

- Next Steps
  - At stakes,
    - definitions of further enhancements to optimise performances of 5G sate llite networks
    - Smooth migration from 5G-NTN to 6G NTN for in orbit/soon to be launch ed satellites

Some references

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- Thank you -

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