3GPP NTN standardization: Status and Prospect (rel-17 & rel-18)

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11th Advanced Satellite Multimedia Conference

17th Signal Processing for Space Communications Workshop

6–8 September 2022

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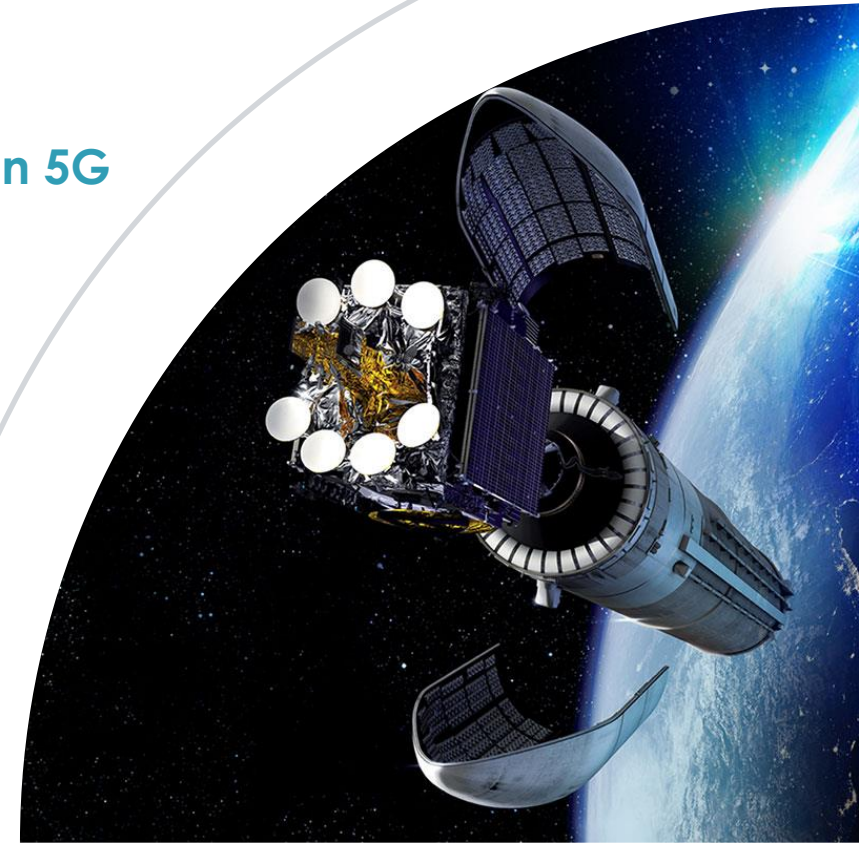
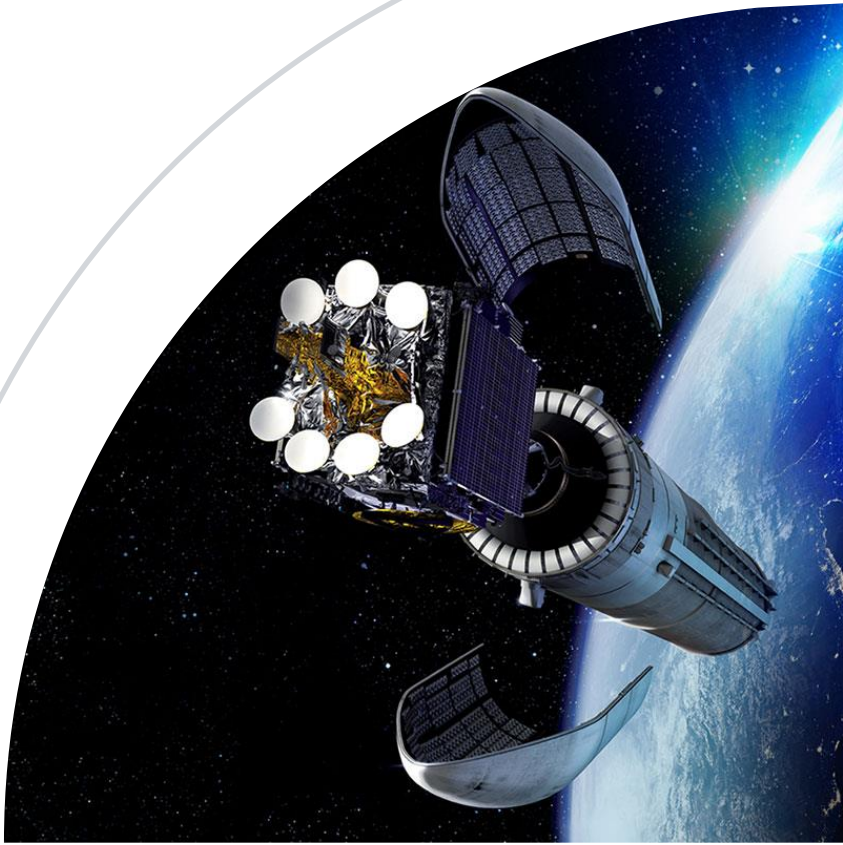
Agenda

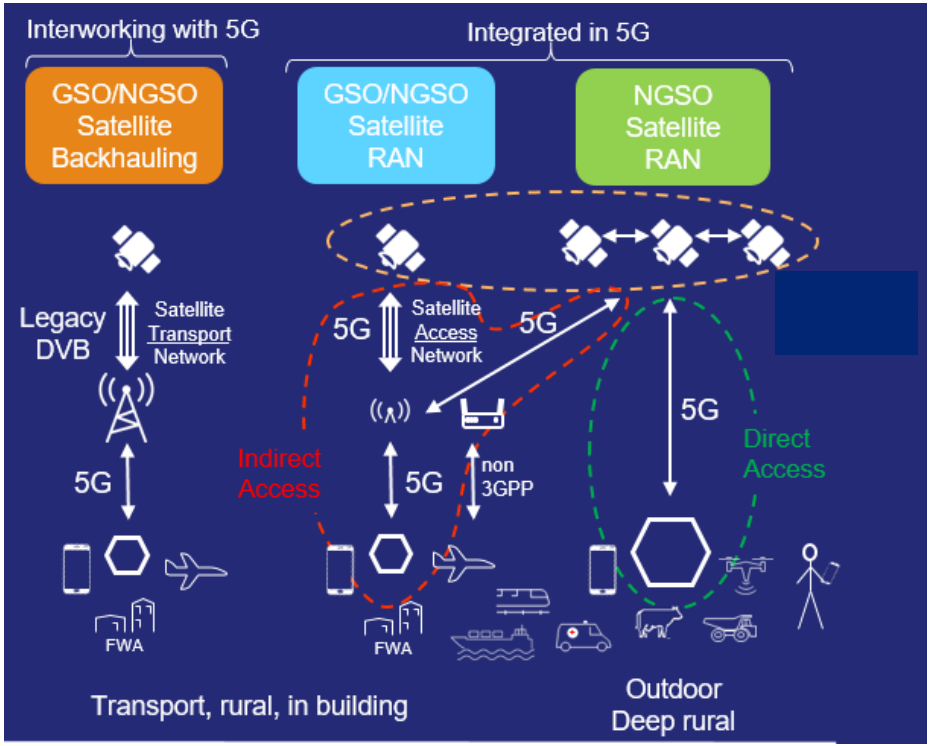
- Integration of Non Terrestrial Networks in 5G
- 3GPP NTN standard
- Satellite in 6G



Integration of NTN in 5G



Integration of NTN for both direct and indirect connectivity



- 5G NTN offers a complementing role to TN access
- Combine the NTN & TN for service continuity and reinforced reliability/availability

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

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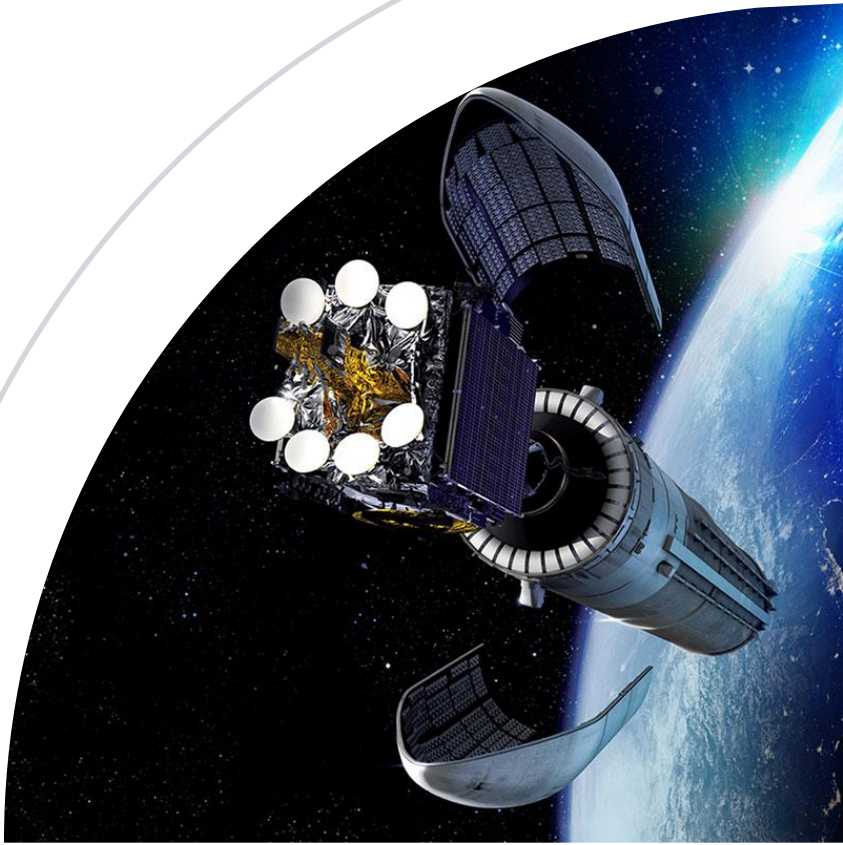
Scenarios and capabilities

	3GPP Release 17		3GPP Release 18
	Direct connectivity (< 7 GHz)		Indirect connectivity (above 10 GHz)
Targeted terminals	**IoT devices**	**handset (smart phones) and car/drone mounted devices**	**VSAT and/or ESIM**
Service	**Narrowband** **hundreds of kbps**	**Wideband** **few Mbps**	**Broadband** **hundred Mbps**
Orbit	GSO and NGSO	NGSO	GSO and NGSO
3GPP Radio interfaces	**4G NB-IoT/eMTC**	**5G New Radio**	**5G New Radio**
Example of applications	Professional : utilities (smart grids, water distribution, oil & gas), agriculture	Consumer market Professional markets : Automotive, public safety, utilities, agriculture, Defense	Professional markets: Telco (e.g. Backhaul), IPTV service providers, Satellite News Gathering, Transport (aeronautical, maritime, railway), public safety, defense

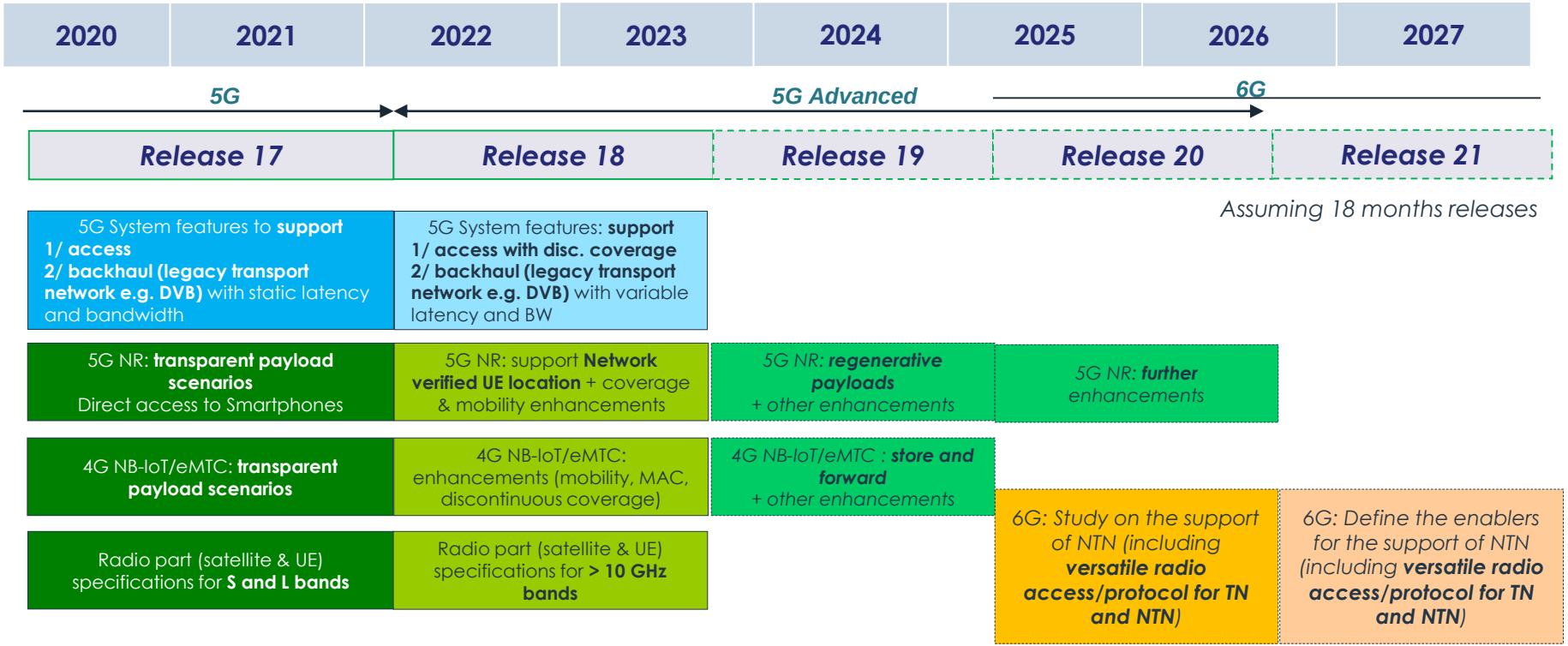
GSO = Geo Synchronous Orbit, NGSO = Non GSO, VSAT = Very Small Aperture Terminal, ESIM = Earth Station In Motion

3GPP technology applicable for all satellite networks: any orbit, any band,, any device, any service

3GPP NTN standard



NTN in 3GPP roadmap



3GPP NTN normative work in Release 17

- Addressing identified issues due to:
  - long propagation delays,
  - large Doppler effects,
  - Large and moving cells in NTN.

- Focusses on **transparent architecture**
- Covers both **Earth moving** and **Earth fixed** radio cells
- **Spectrum below 6GHz: MSS S-Band** and **L-Band**
- **UE NTN handheld** (smarthphone) with **GNSS capability**

NTN based on LEO and GEO with implicit compatibility to support HAPS (High Altitude Platform Station) and ATG (Air To Ground) scenarios

UEs with GNSS capabilities

FDD

Earth fixed Tracking

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NTN: 3GPP 5G/NR spec impact

RAN1: Physical layer

- Timing relationship
- UL time and frequency synchronization
- Enhancements on HARQ
- Polarization signaling for VSAT/ESIM

RAN3: Access network architecture

- Network Identity handling
- Registration Update and Paging Handling
- Cell Relation Handling
- Feeder Link Switch-Over (NGSO)
- Aspects Related to Country-Specific Routing

SA2: System level

- Mobility management with huge cell size
- UE location and support of regulated service
- QoS class for GEO satellite links
- Impact of satellite backhauling

RAN2: Access layer

- User Plane: RACH aspects, Other MAC aspects (e.g. HARQ), UP: RLC, PDCP
- System information broadcast
- Control Plane: Tracking Area Management, Idle/connected mode mobility, UE Location Service

RAN4: RF & RRM performance

- New bands
  - TN/NTN coexistence
  - Satellite Access Node, UE
- RRM: e.g. timing compensation (idle, connected mode), GNSS accuracy

CT1: Network protocols

- PLMN (re)selection
- NAS timers

NTN within Release 18 package - Overview

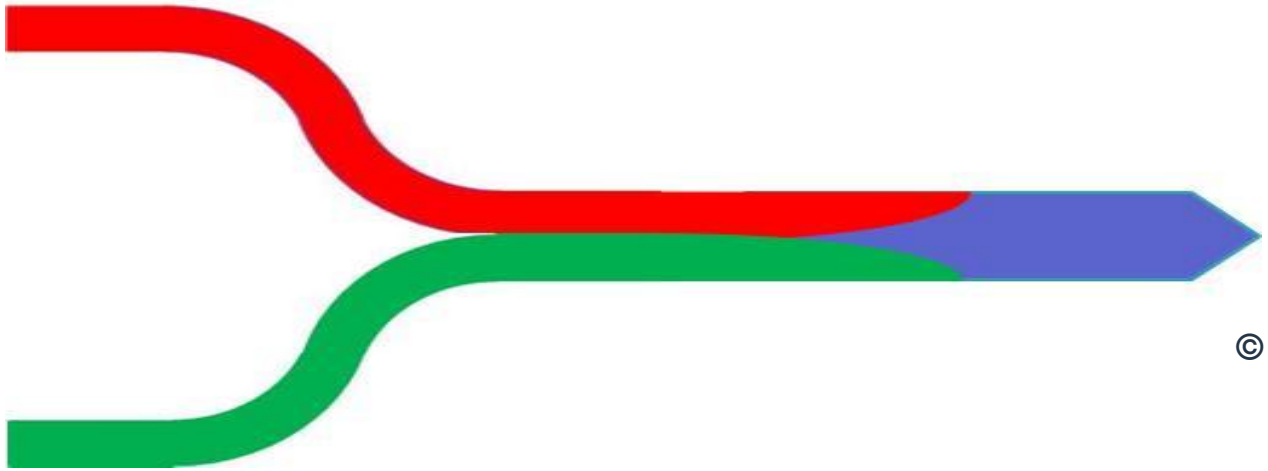
	NR-NTN	IoT NTN
RAN WGs	▪ NR-NTN deployment in above 10 GHz bands and support for VSAT NTN UE ▪ Network verified UE location to support regulatory services ▪ Coverage enhancements ▪ NTN-TN and NTN-NTN mobility and service continuity enhancements	▪ Disabling of HARQ feedback for IoT NTN ▪ Improved GNSS operations for IoT NTN ▪ Mobility enhancements ▪ Further enhancement to discontinuous coverage

As per RAN&SA#95-e decisions

Satellite in 6G

Satellite in 6G

Prior 5G	5G and 5G Advanced	6G
Interworking	**Integration**	**Unified**



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Design optimised independently for each network component	Design optimised for TN component Minimum impact to support the integration of Satellite for coverage & availability extension	Design optimised taking into account characteristics of both terrestrial and satellite components against a set of common goals

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Key Takeaways

Integration of satellite with mobile systems is now possible with 3GPP Release 17 NTN standard

This standard is the result of a joint effort between stakeholders of both mobile and satellite industry who both find benefits

- **Satellite added value for 3GPP:** global service continuity and resiliency
- **3GPP added value for satellite:** access a unified and large eco system and drive down the cost through economy of scale

This NTN standard is supported by Telecommunication User groups (Public safety, transport, automotive…) calling for

- **seamless combination** of satellite and mobile systems (Mobility, Multi connectivity)
- **support of all 5G features** (Slicing, energy saving, mobility, 3rd party network management, application & service platforms) across the access technologies

Paving the way to new business opportunities

Thank you

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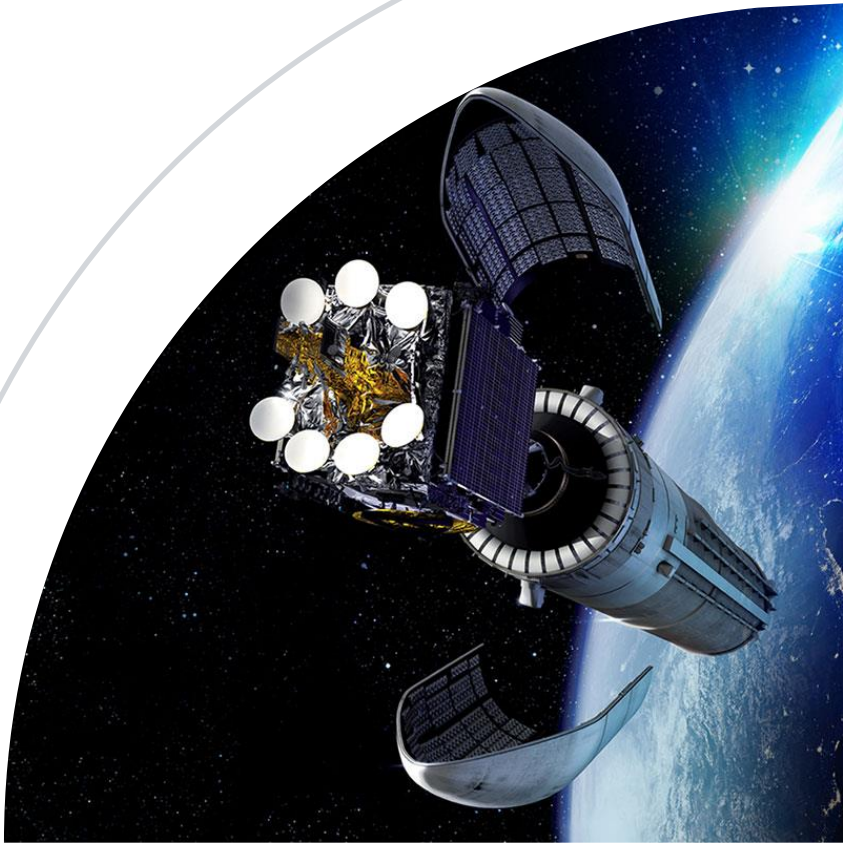
Work supported by the ESA funded Eager project: https://www.eagerproject.eu/



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