

The background is a solid blue color. On the right side, there is a large white circle containing a 3D abstract graphic of intertwined, flowing lines in shades of red, orange, and blue. A similar but smaller version of this graphic is positioned in the upper left quadrant, extending from the top edge of the slide.

NOKIA

# 3GPP Non-Terrestrial Networks

*BEREC workshop, May 22<sup>nd</sup>, 2024*

Mads Lauridsen, Nokia Standards  
[mads.lauridsen@nokia.com](mailto:mads.lauridsen@nokia.com)

# “Direct to device from space” flavors

Different ways of connecting a smartphone/IoT device to NTN

## SAT Proprietary

- Building proprietary satellite technology into the smartphone/device
- *“Legacy” NTN-specific spectrum*

## Pre Rel17 3GPP

- NTN for existing 3GPP devices (not Rel17+ NTN-capable devices)
- Requires network compensation for NTN-specifics like Doppler and timing drifts
- *Terrestrial spectrum*

## 3GPP Rel17 / 18 / 19

- Support of NR & NB-IoT/eMTC
- Includes handhels and VSATs
- First NB-IoT devices available
- *3GPP NTN-specific spectrum*
  - ~1.6 GHz (L-band; n253-n255)
  - ~2 GHz (S-band; n256)
  - ~30 GHz (Ka-band; n510-n512)

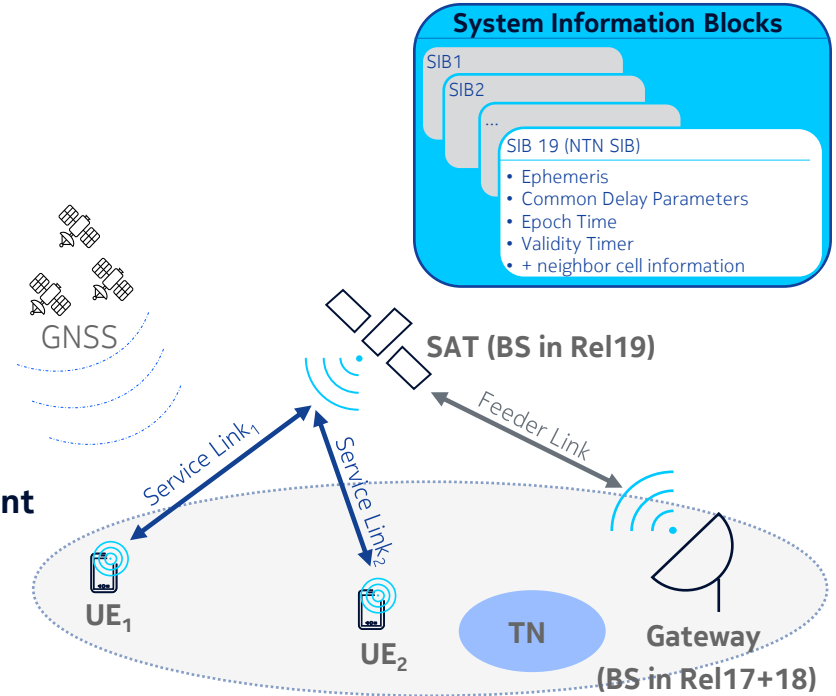
**Evolution path (incl. 6G)**



# 3GPP-based NTN release 17-19

**Standardized enhancements of 5G/IoT** lead to **performance improvements** (throughput, capacity, mobility, battery life, ...)

- UE is responsible for **time/frequency synchronization**
- PHY/MAC layers & core enhanced for large delays
- System information defines **satellite assistance info**
  - Serving and neighbor NTN cells
  - Information on TN coverage within NTN cells
- Mobility schemes rely on **deterministic satellite movement**
  - Conditional handover, RACH-less, satellite switch with unchanged PCI



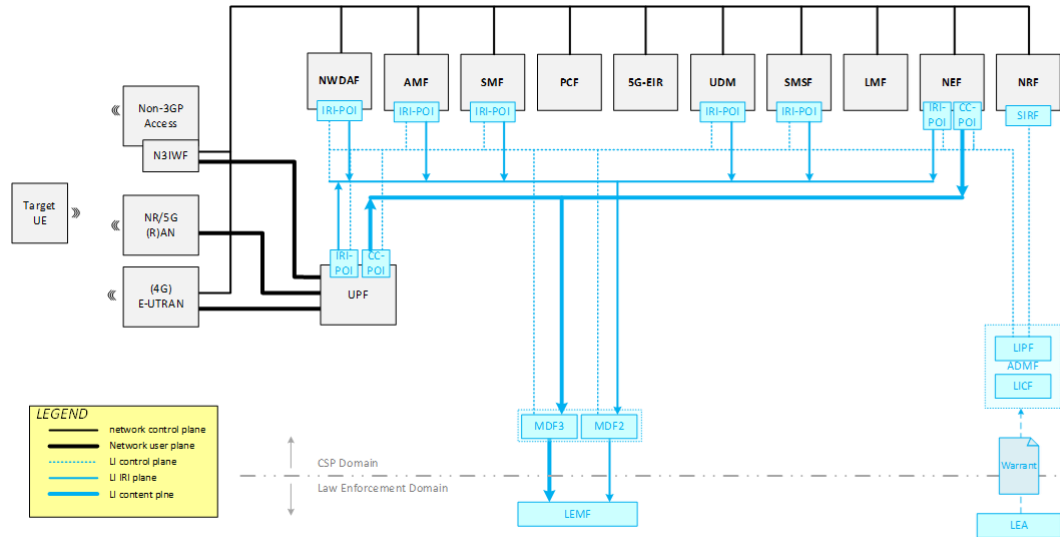
# NTN service in Europe

**3GPP provides an evolution path for satellite communication with enhanced performance, but per-country deployments in Europe poses (regulatory) challenges?**

Beam size versus country size/border shape



Lawful Intercept implies the CN is in the country being served?



TS 33.127 Figure 6.2-2: 5G core-anchored LI architecture



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