THALES
Building a future we can all trust

5G & Non-Terrestrial Networks
IET London Local Network

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Thales Overview

Over **81000** employees

68 Countries Global presence

1 bn €

Self-funded R&D*

* Does not include externally financed R&D

Sales in 2021

16,2bn €

Thales's Mission

Sensing & data gathering

Data transmission & storage

Data processing & decision making

Digital Identity and Security

Defence and Security

Aerospace

Space

Ground Transportation

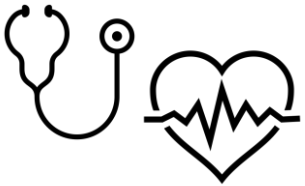
We help customers master decisive moments by providing the right information at the right moment

Mobile comms through the decades

5G vertical markets examples

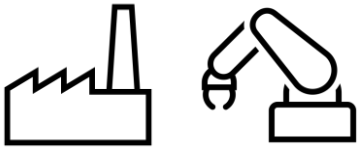
automotive

media



eHealth

agriculture



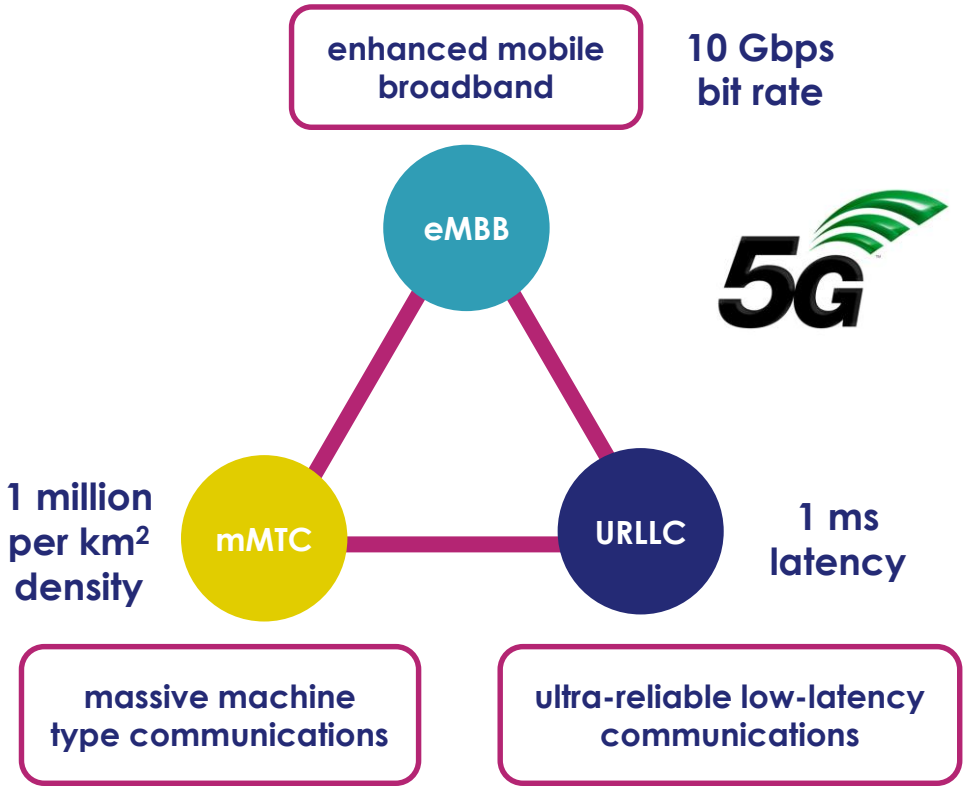
manufacturing

smart cities

energy

public safety

5G overview

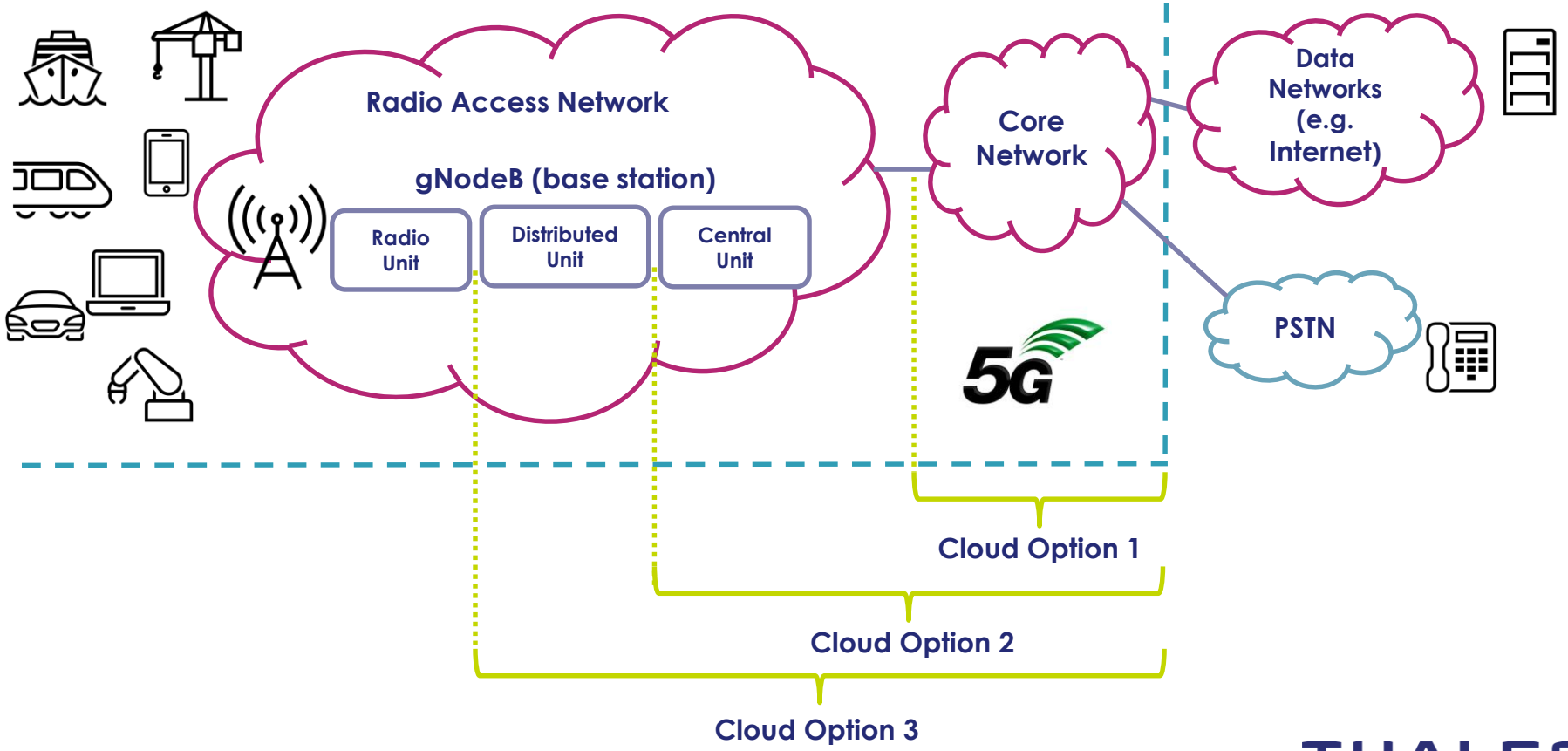


- Vision presented by ITU in 2015
- Followed by 3GPP standardisation

standardisation is key

not all aspects for given connection!

5G architecture & deployment



Features and technologies

New Radio (NR) Air Interface

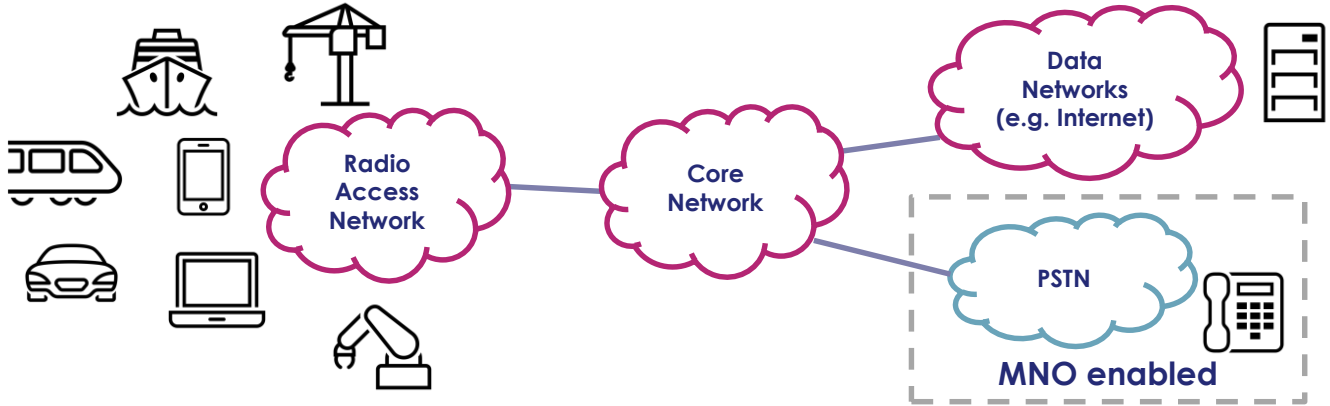
- **scalable OFDM** more flexible numerology
- **flexible slot-based framework** low latency, URLLC
- **advanced channel coding** LDPC & polar
- **massive MIMO** increased coverage & capacity
- **mmWave** up to 100 GHz

Networking

- **network function virtualisation (NFV)**
- **software defined networking (SDN)**
- **service based architecture**
- **HTTP/2 signalling** REST API
- **network slicing**
- **Ethernet**

- **private networks**
- **multi-access edge computing (MEC)**
- **non-terrestrial networks**
- **enhanced security**
- **vehicle to everything (V2X)**
- **location services**

5G public vs private networks in general



Public

- publicly accessible
- Mobile Network Operator (MNO)
- wide coverage: country, region, city
- public telephone number system

Private

- closed network (to public access)
- stand-alone or slice through MNO public network
- limited coverage: e.g. ports, factories, offices
- own telephone number system unless network integrated with MNO

Spectrum is everything

Ofcom shared access licences

- Low power (250 mW EIRP); multiple base stations within 50 m radius
- Medium power (5 W EIRP); single base station; rural areas
- Indoor/outdoor

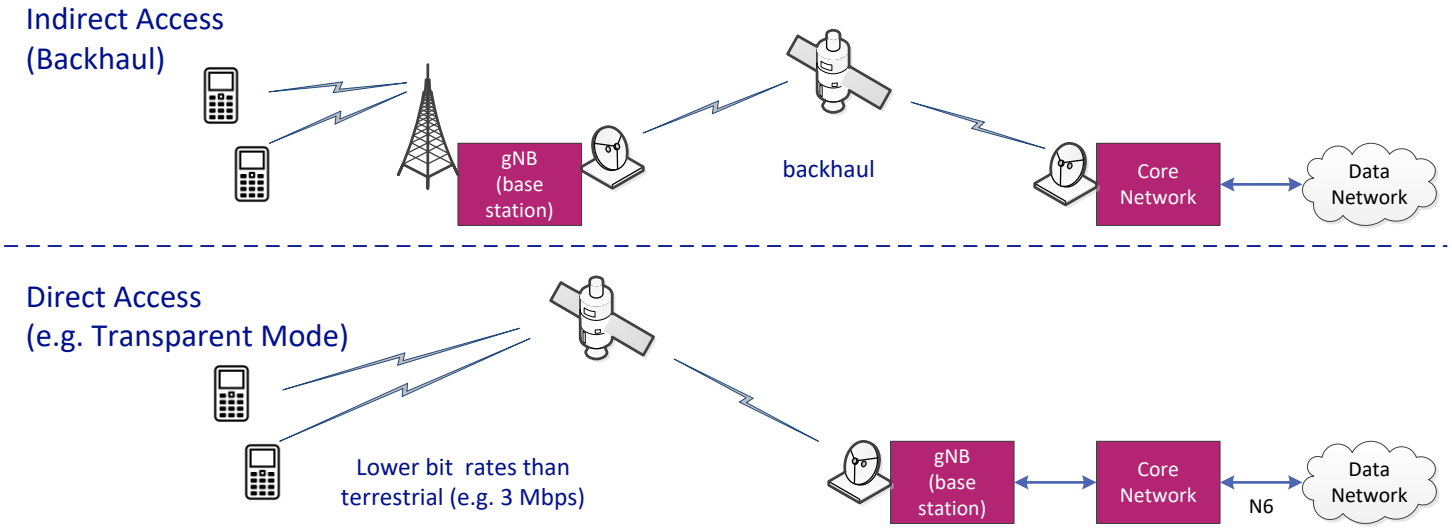
Frequency	Bandwidths	Notes
1781.7 to 1785 MHz *paired with* 1876.7 to 1880 MHz	2 x 3.3 MHz	
2390 to 2400 MHz	10 MHz	
3800 to 4200 MHz	10, 20, 30, 40,50, 60, 80 and 100 MHz	
24.25 to 26.5 GHz	50, 100 and 200 MHz	Indoor low power only

Non-Terrestrial Networks (NTN) drivers & systems

Increased coverage

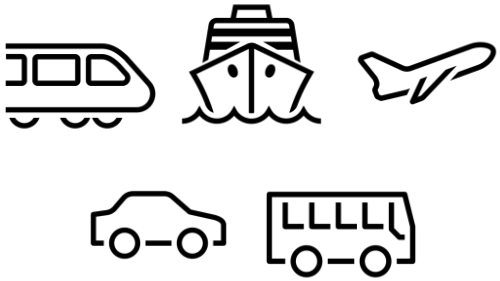
- Rural users in developing countries
- Mobile 'not-spots' with established users
- Vertical markets

Promise of a single air interface for satellite systems

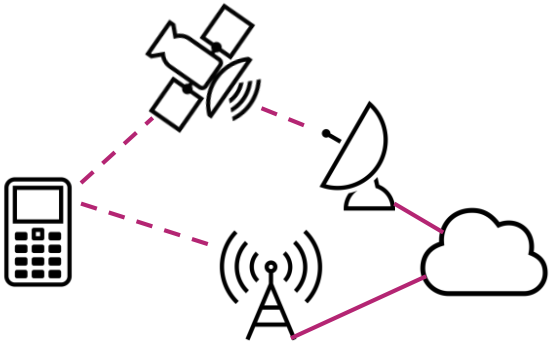


NTN and some potential use cases

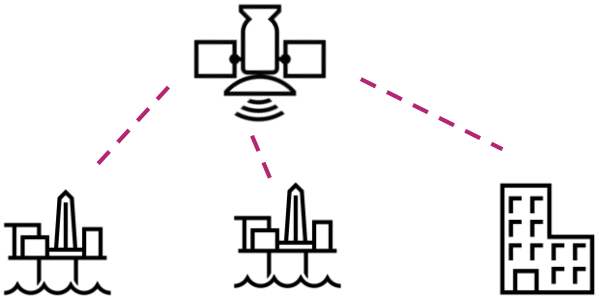
service ubiquity



service continuity, e.g. mobile platforms



multi-link networks



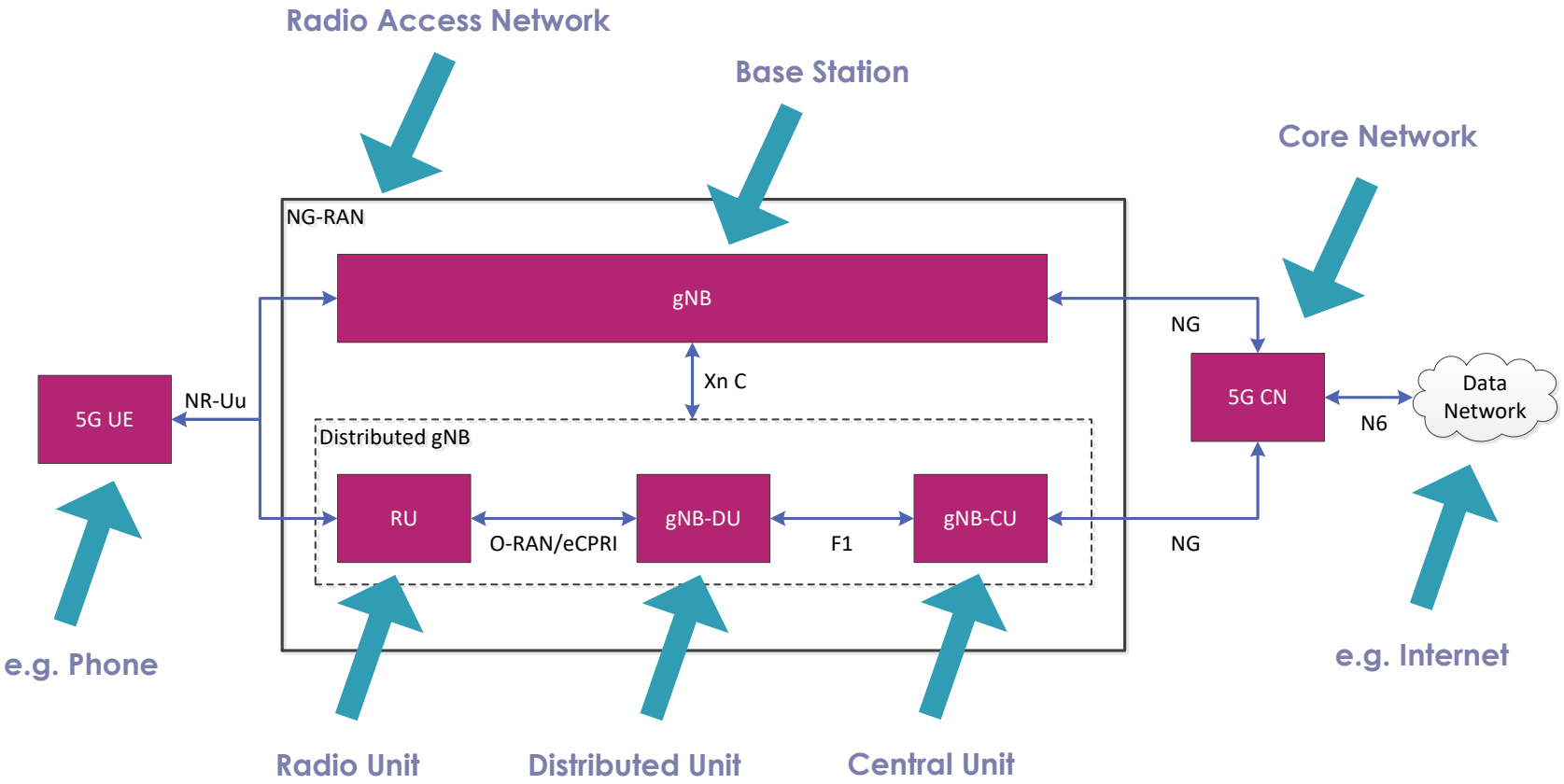
network island connectivity

5G-NTN Platforms

Platform	Altitude (km)	Bent pipe Round-trip Delay[1] (ms)	Max Tangential Velocity	Number for global coverage
Aerial Vehicle (UAV, HAPS)	~ 8 to 50	~ 3	15 m/s	N/A (localised only)
Low Earth Orbit (LEO) satellites	~ 600 to 1500	~ 28 to 50	7 km/s	hundreds to thousands
Medium Earth Orbit (MEO) satellites	~ 10000	~190	5 km/s	tens
Geostationary Earth Orbit (GEO) satellites	35786	~ 540	0 km/s	~four (polar regions not covered)

Note 1: Low elevation UE and gateway scenario

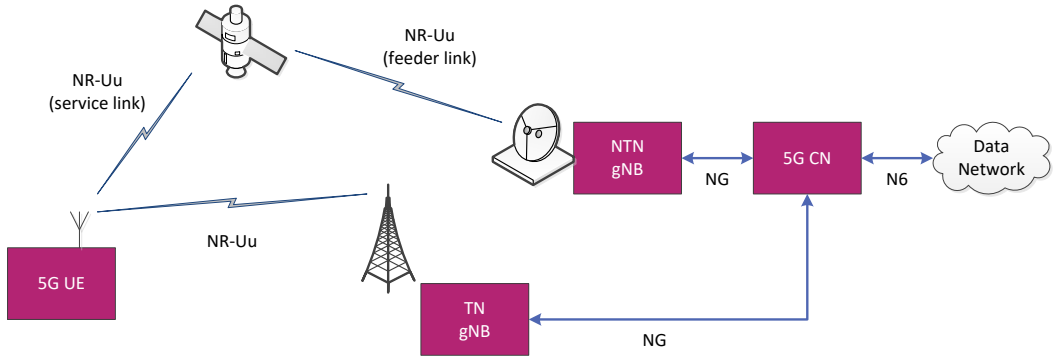
5G main components and interfaces



Direct Access NTN architectures (1)

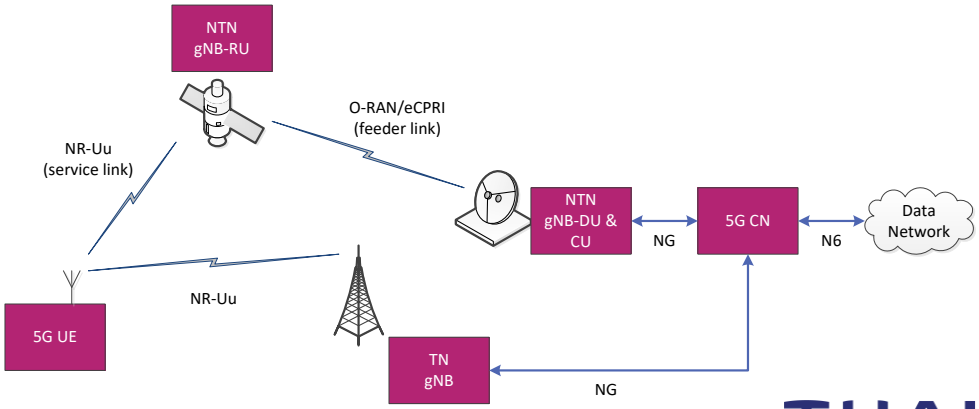
Transparent Mode

- 'bent pipe'



Radio Unit on satellite

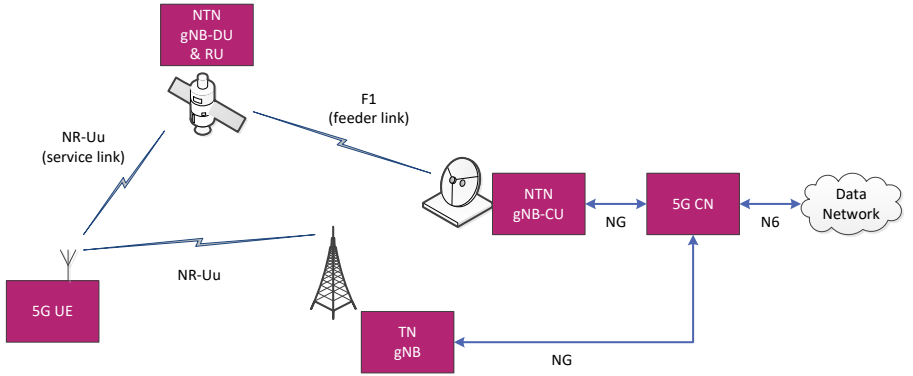
- Good cost vs performance
- High-performance feeder link



Direct Access NTN Architectures (2)

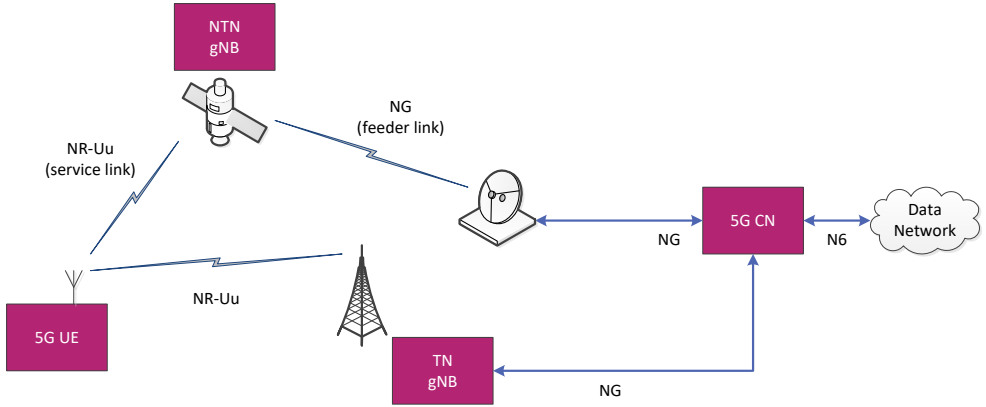
Distributed Unit and Radio Unit on satellite

- Latency reduction at lower layers

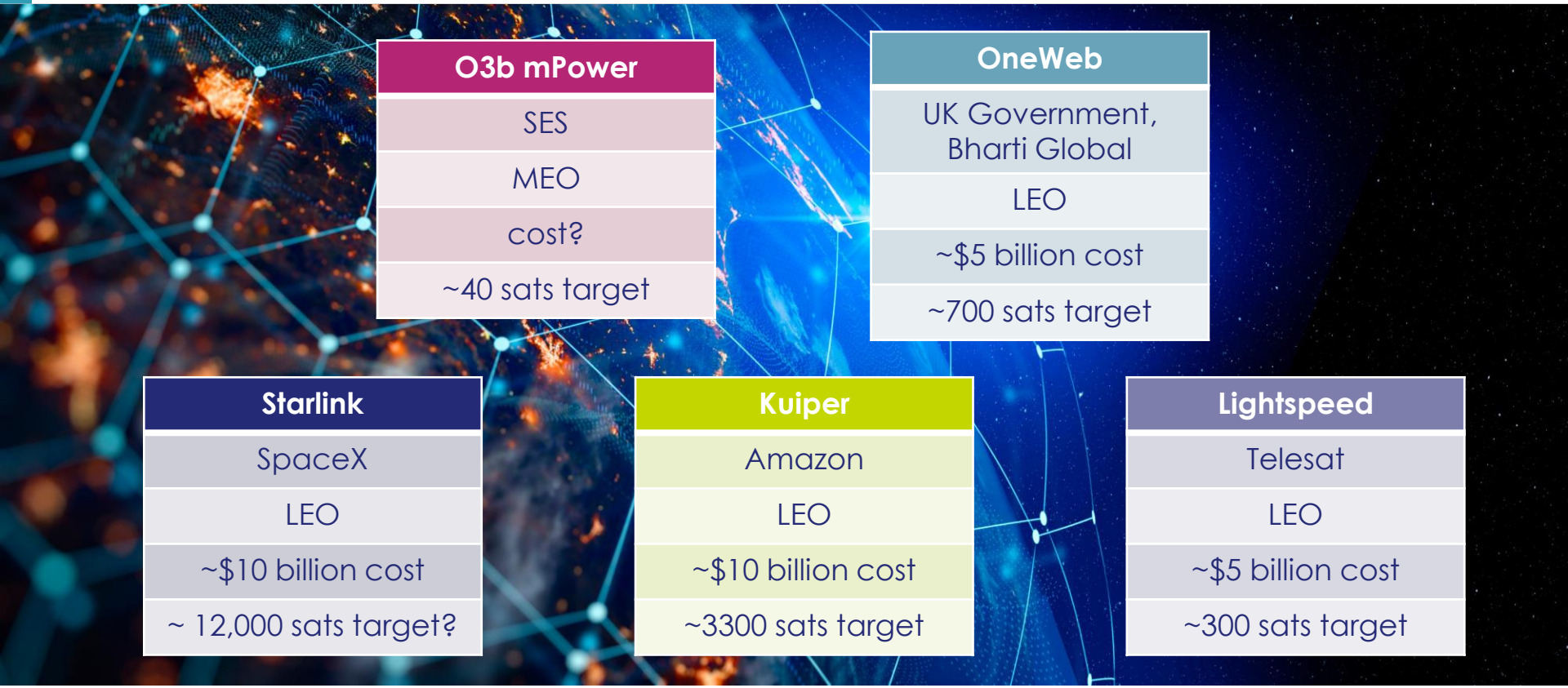


Full gNB (base station) on satellite

- Latency reduction for gNB



New systems potentially suitable for backhaul



O3b mPower
SES
MEO
cost?
~40 sats target

OneWeb
UK Government, Bharti Global
LEO
~$5 billion cost
~700 sats target

Starlink
SpaceX
LEO
~$10 billion cost
~ 12,000 sats target?

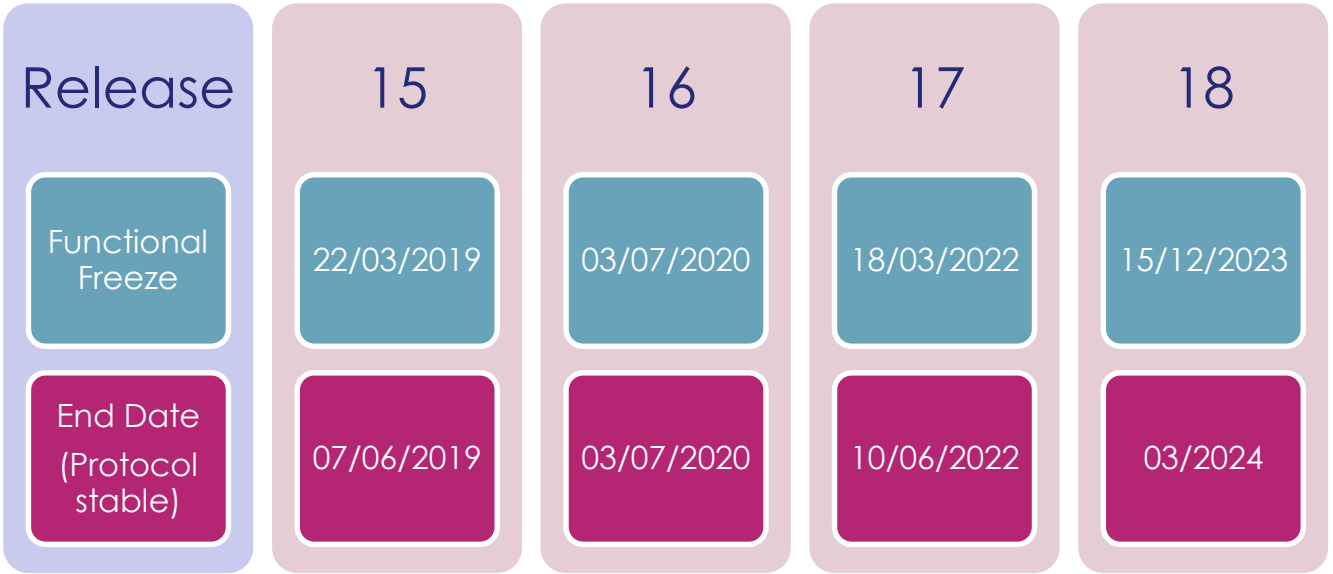
Kuiper
Amazon
LEO
~$10 billion cost
~3300 sats target

Lightspeed
Telesat
LEO
~$5 billion cost
~300 sats target

Near-term direct access systems (not all 5G-NTN standard)

SpaceMobile	Lynk	Omnispace
AST	Lynk Global	Omnispace & Lockheed Martin
LEO	LEO	LEO & MEO
~$2 billion cost?	~$? million	claims low cost
~170 sats target	~5,000 sats target	~200 sats target
Vodafone, Rakuten, AT&T	Aliv, Telecel Centrafrique, Unitel, Telikom, bmobile	5G-NTN stds

3GPP Releases



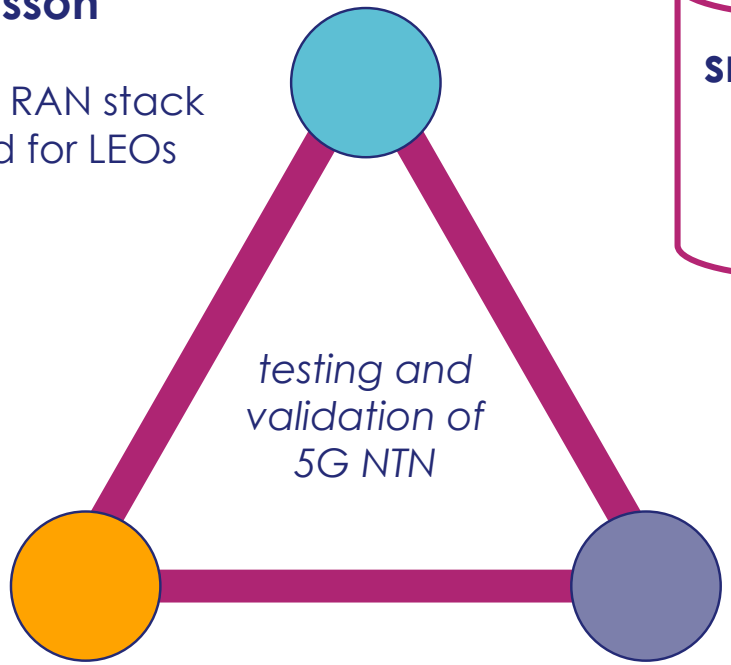
Source: https://www.3gpp.org/specifications/67-releases (retrieved 18/09/2022)

July 2022: Ericsson, Qualcomm and Thales take 5G into space

Ericsson

5G virtual RAN stack modified for LEOs

smartphone-use-case focused
direct access



Qualcomm

5G smartphones for NTN access

Thales

5G radio satellite payload for LEOs

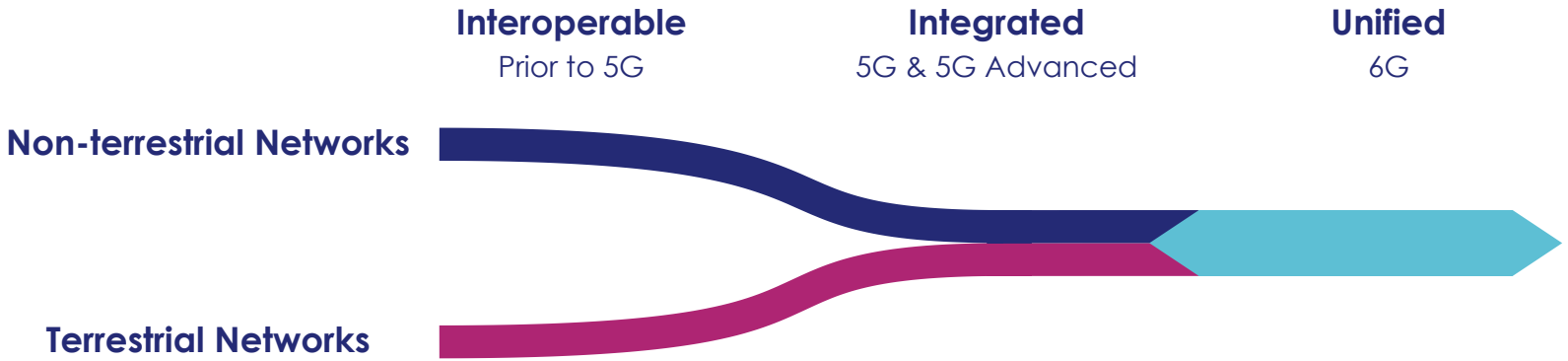
Conclusions

5G expected to be transformative

New applications & vertical markets

5G-NTN takes transformation further

Alternative backhaul solutions
Followed by direct access



Thales engaged in 6G research