

Telefónica



Perspectives of a Mobile Operator concerning NTN

Tilo Heckmann, Technology Strategy Manager,
Technology Strategy and Innovations

Public



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Telefónica in Germany



8.224 billion

Euros revenue 2022



44.6 million

Mobile network customers*



2.4 million

Broadband lines*



7,250

Employees 2022

Our brands and partners

Own brands



Partner brands and service provider, MVNO*



Big Space

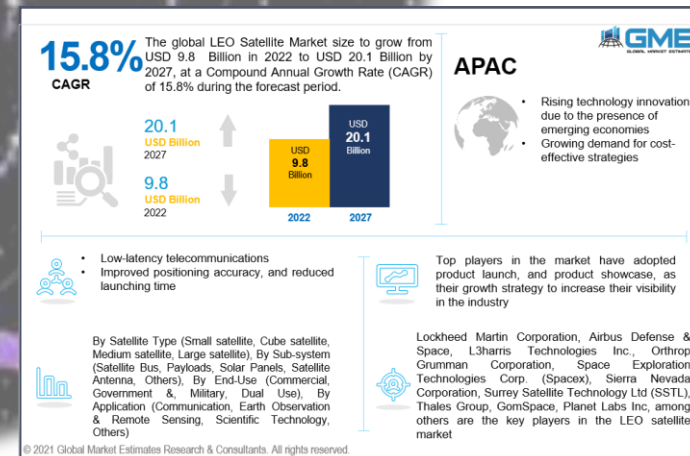
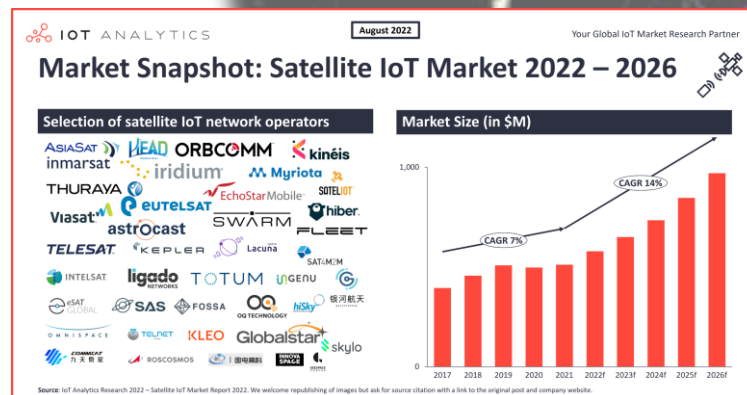
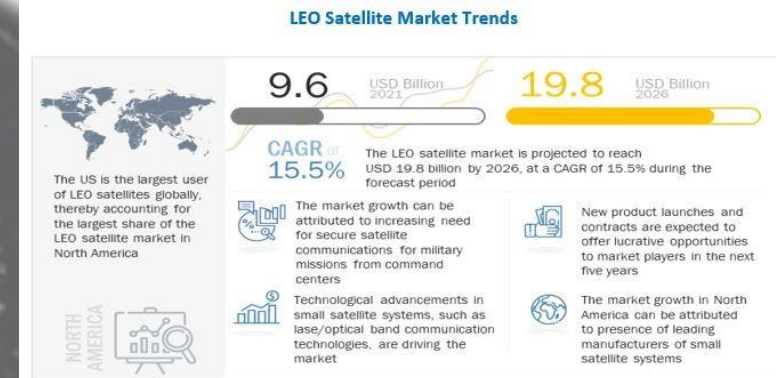
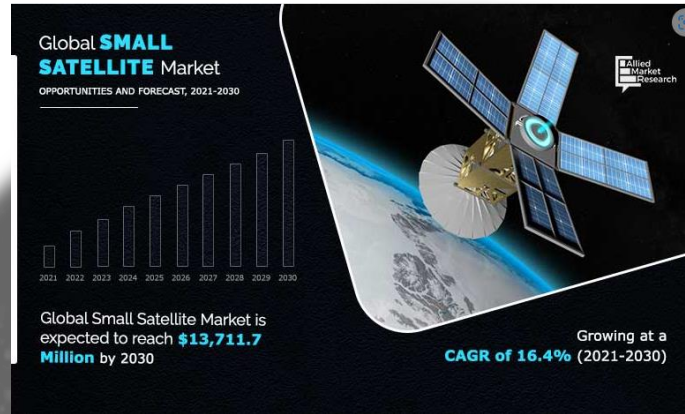
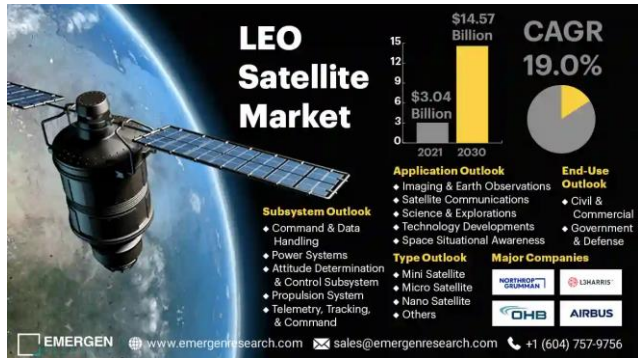
Observation, Development, Application

01

Why Satellite?



A lot of money is flowing into the development of cost-effective technologies. Extreme growth market forecasted



Satellite Connectivity in global context

Context

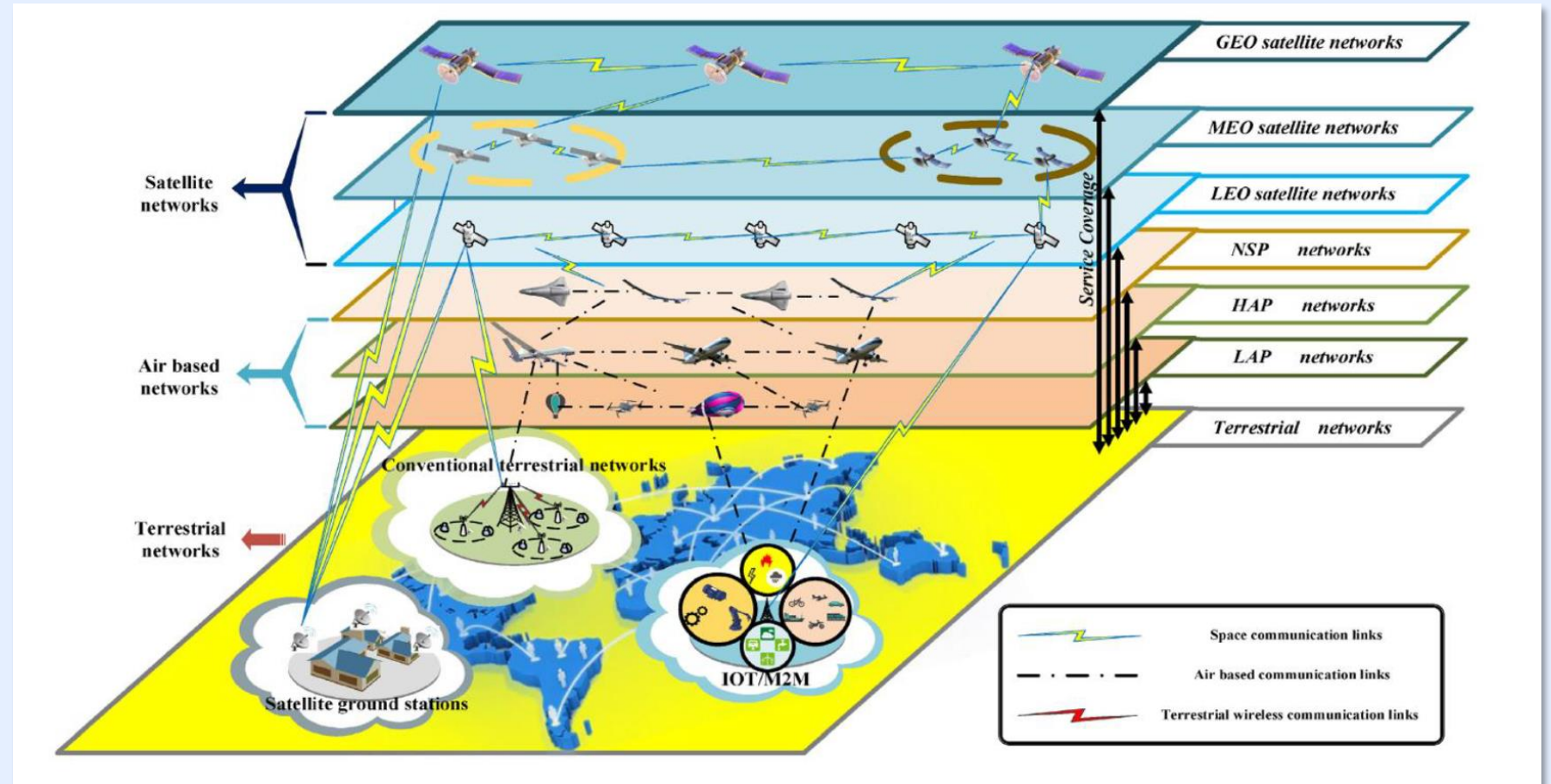
OneWeb started hype around LEO begun 2012. Followed by Starlink (SpaceX) and Kuiper (Amazon) in large scale.

Closed and vertical technical solutions

3GPP adopted satellites for 5G into standardisation

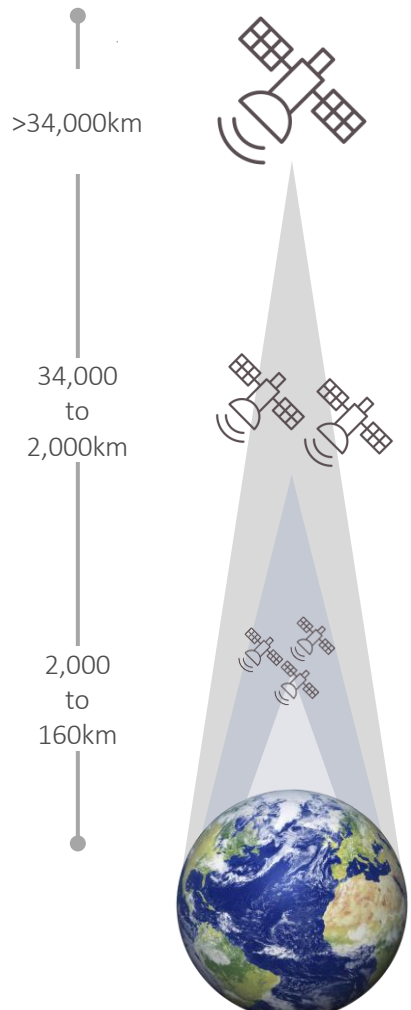
- Chance for scaling up and innovation
- Convergence of terrestrial with airborne and sat based service provision

Overview Non Terrestrial Networks - NTN



Source: HEUMEGA Study 30.6.2021

The evolution of satellite platforms and the emergence of LEO constellations will increase options to provide connectivity to difficult to reach areas



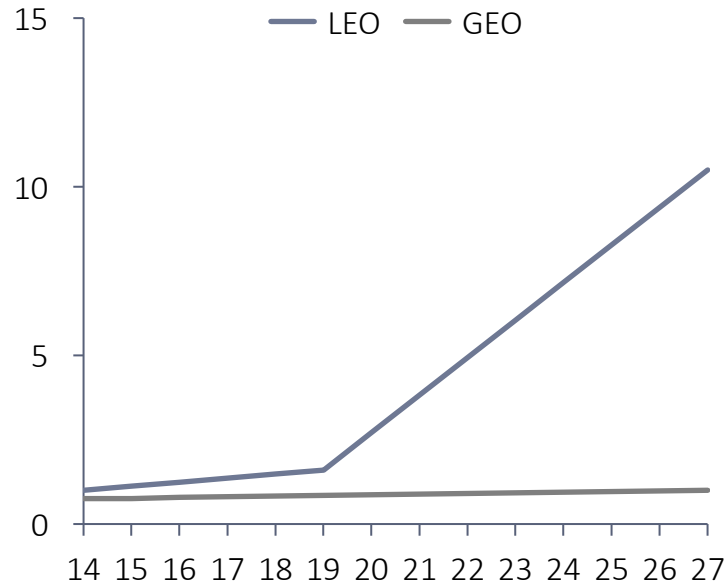
Category	Latency	Coverage	Key pros & cons
GEO <i>Geo-synchronous Earth Orbit</i>	~600ms	3-4 Satellites to provide global coverage (24h)	<ul style="list-style-type: none"> ✓ c.15 years lifetime ✗ Less technological upgrades due to longer lifetime ✗ Weak transmitted signal
MEO <i>Medium earth orbit</i>	~180ms	10-15 Satellites to provide global coverage (24h)	<ul style="list-style-type: none"> ✓ Cheaper control & mgmt systems than LEO, but more expensive than GEOs ✗ Weaker signal vs. LEO
<div style="border: 2px dashed green; padding: 5px; display: inline-block;"> Focus LEO <i>Low earth orbit</i> </div>	~30ms	Dozens or Hundreds of Satellites to provide global coverage (24h)	<ul style="list-style-type: none"> ✗ c.5 years lifetime – orbital degradation ✗ Only 10-30% of total capacity is marketable ✓ Lower satellite cost (300x cheaper than GEO) ✓ Better signal strength and lower latency

Additionally, emerging **high-altitude platforms** aim to provide connectivity and backhaul solutions with high autonomy drones flying at altitudes of 20-30 km

Notes: 1) Long time over non-populated areas

LEO satellites will represent ~90% of satellites in orbit by 2027, accounting for ~80% of total marketable capacity; space funding reached \$10bn in '21

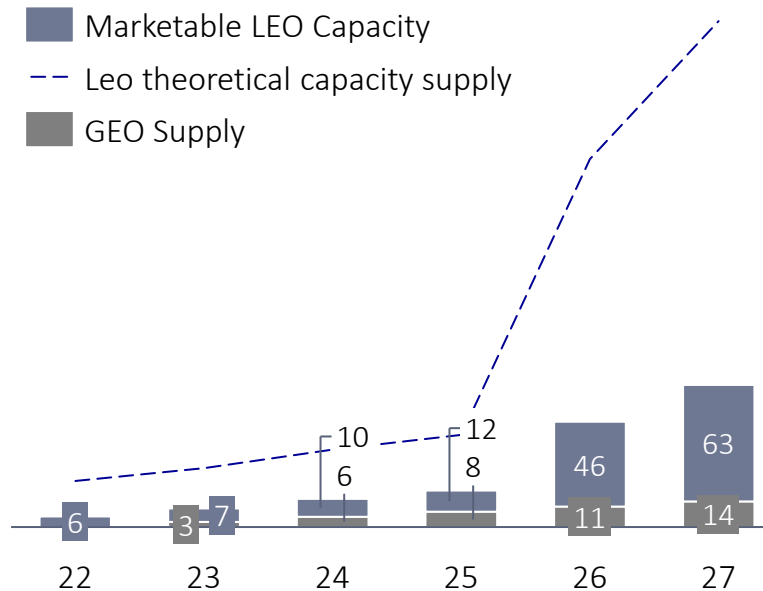
of communication satellites in orbit² – 000s



- Although it is a complex market, advancements in technology have made possible to design and launch **smaller, cheaper, and more powerful satellites**, reducing barriers to deploy large constellations

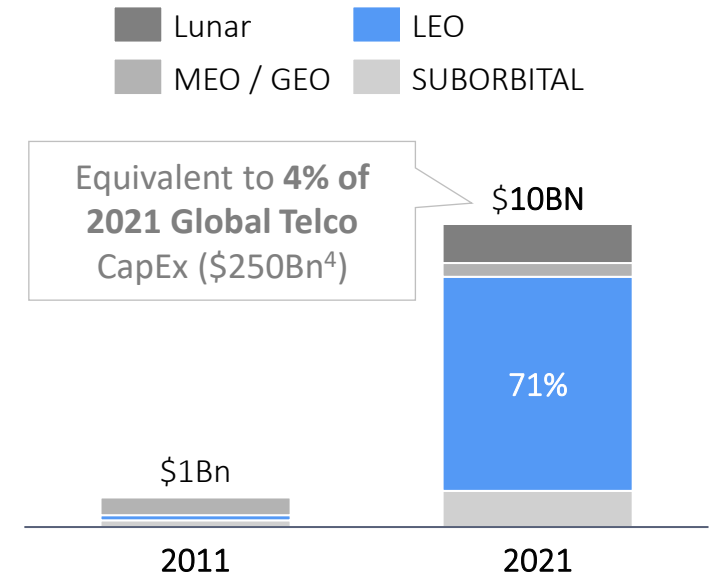
Notes: 1) GSMA; 2) NSR (An Analysys Mason company); 3) Mckinsey report "Space: Investment shifts from GEO to LEO and now beyond"; 4) According to UBS

Total satellite capacity² - Tbps



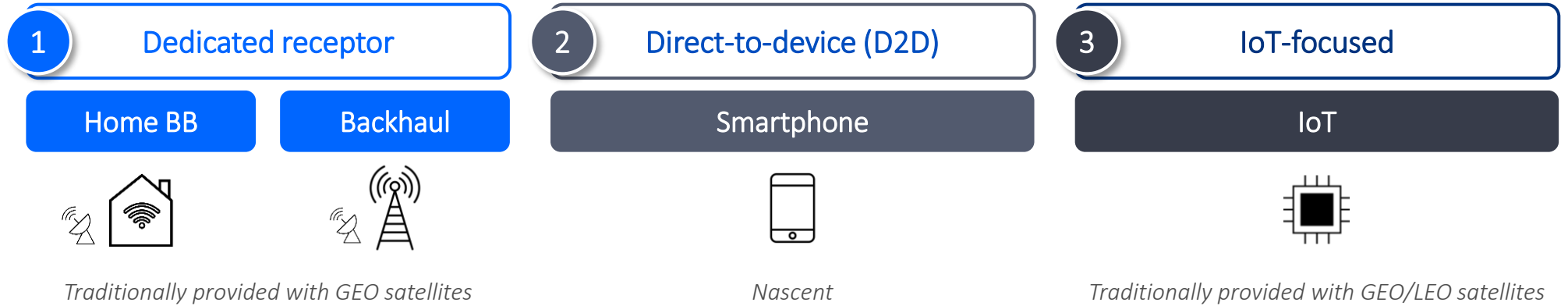
- Only 10-30% of LEO capacity is marketable
- New LEO constellations starting operation in 2026: Starlink and OneWeb 2nd Generations, and Kuiper (Amazon)

Private-sector funding in space companies³ - %



- Private-sector funding in space-related companies reached **\$10bn in 2021** (mainly driven by LEO)
- Multiple projects running in **parallel: Uncertainties** around tech, costs and demand imply it is unlikely that all of them will succeed

Service approaches: Broadband, Direct-to-device for mobile and IoT-focused

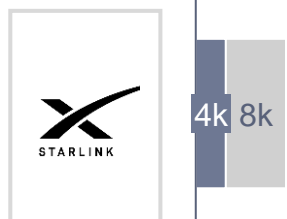


Main use cases	Broadband (B2C, B2B) for underserved areas & backhaul	Messaging, voice, & basic mobile data in future	Sensing, asset tracking	
Spectrum	Satellite bands	Satellite bands	MNO	Mainly Satellite bands
Main LEO players	Starlink Gen1, Kuiper, OneWeb	Globalstar-Apple, Iridium-Qualcomm	AST, Lyrk, Starlink Gen2	Orbcomm, Swarm (Starlink) ¹ , Kinéis, Astrocast, Sateliot
Potential role for Telefónica	Sales Channel for FBB coverage (although Starlink selling mainly D2C) Client of satellite backhaul	Unclear role in B2C mobile as OEMs (Apple) deal directly with satellite providers	Sales Channel for coverage expansion Spectrum licensing	Sales Channel for coverage expansion in IoT services Spectrum licensing

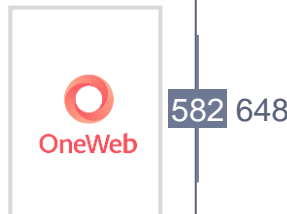
Starlink, with 4k satellites in orbit and ~1m users is the undisputed leader broadband connectivity services, however, its capacity is limited

Top players

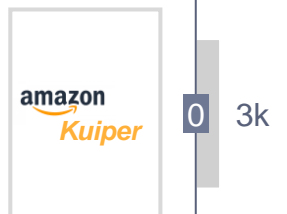
Player #of sats Key facts and recent news



D2C FBB access in remote areas and backhaul



Connectivity for carriers and enterprise



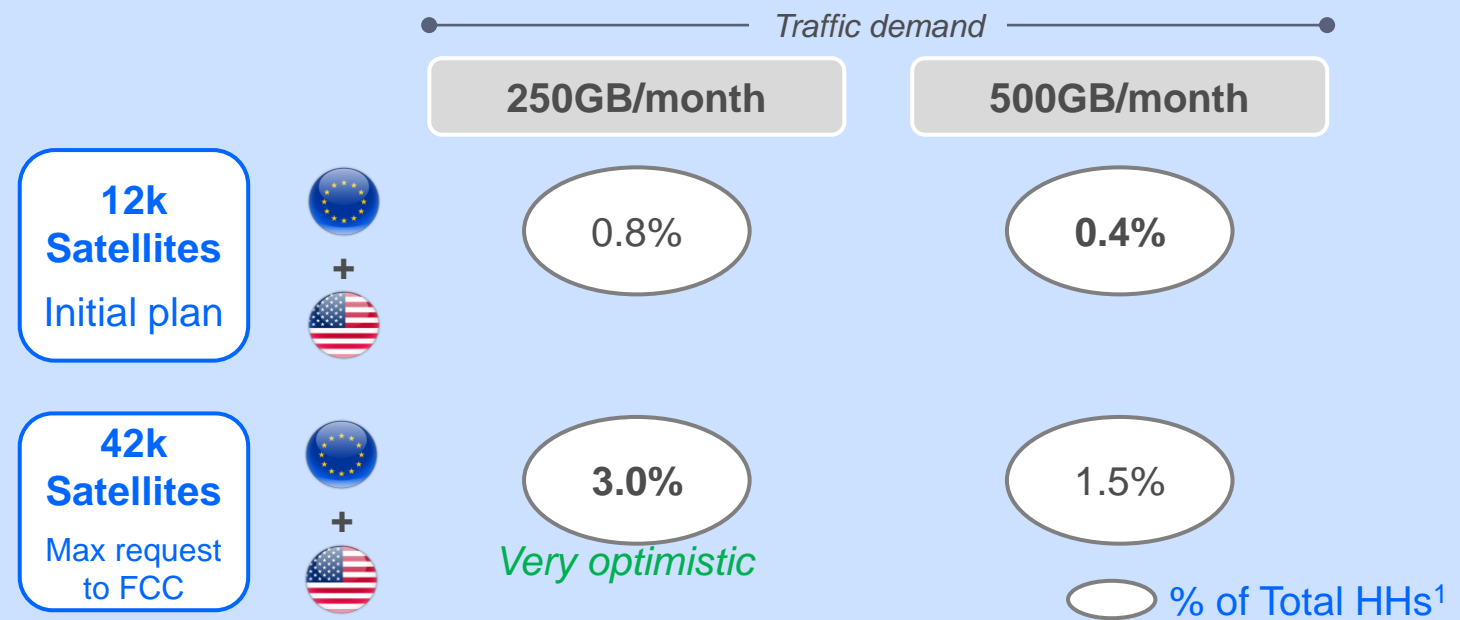
FBB access in remote areas, ground mobility & IoT, high-bandwidth B2B services

■ Launched ■ Planned

Starlink capacity is limited, suitable for underserved/remote areas only

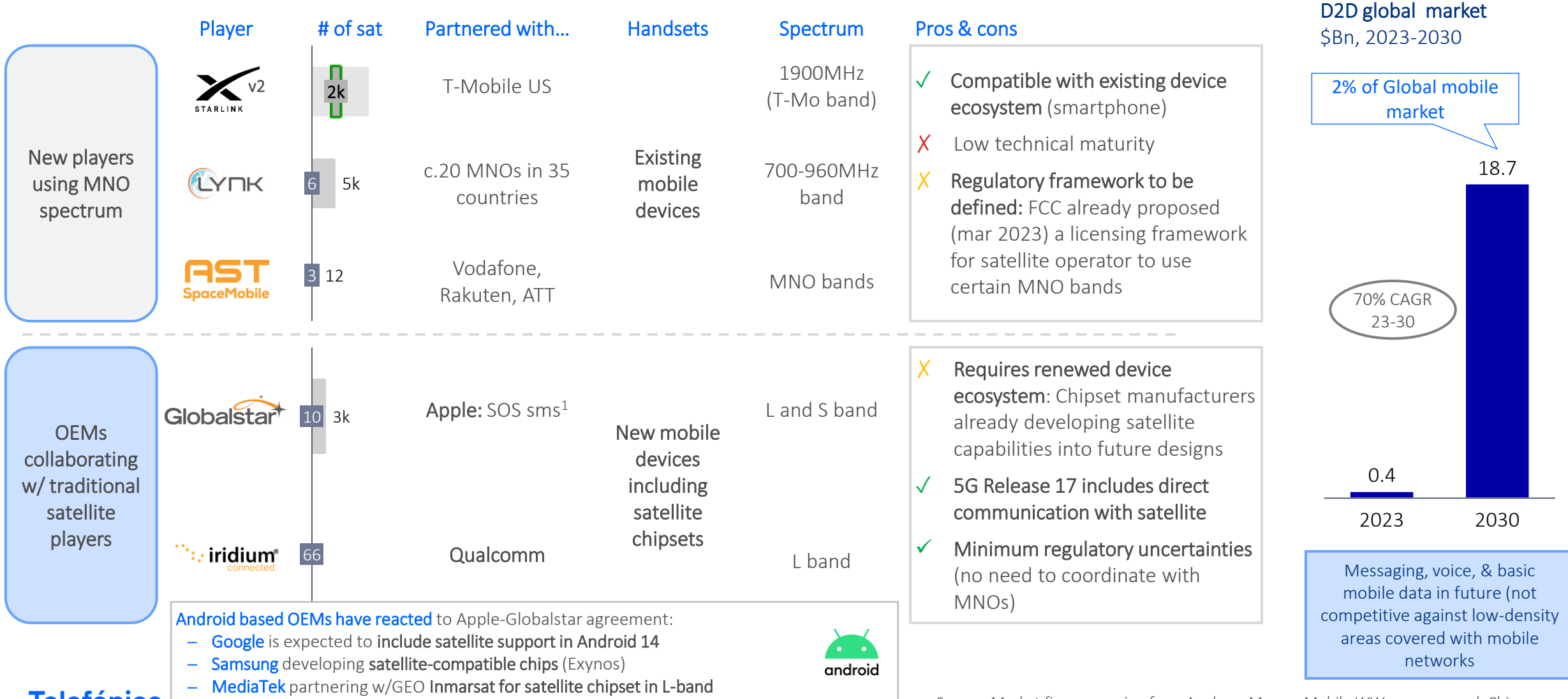
"It's great for very low to maybe medium-sparsity situations, but it's not good for high-density situations" (Elon Musk)

Capacity analysis scenarios show Starlink can serve between 0.4% - 3.0%³ of UE + USA households



Source: Credit Suisse: Space – Searching for Gross Profit Dollars (oct 2022), internal analysis; 1) According to World bank, EU accounts for 197m of HHs, while USA accounts for 143m; 2) Base data consumption (Internal) assumes 1.5 Mbps per user at peak hour (c.250GB/month), while bull data consumption (from Credit Suisse) assumes 3.0 Mbps per user at peak hour (c.500GB/month); 3) Satellite capacity improvements will be offset by traffic increase

Nascent D2D reach ~\$19Bn in 2030 and follows 2 trends: emerging players using MNO spectrum and OEMs collaborating w/ traditional satellite players



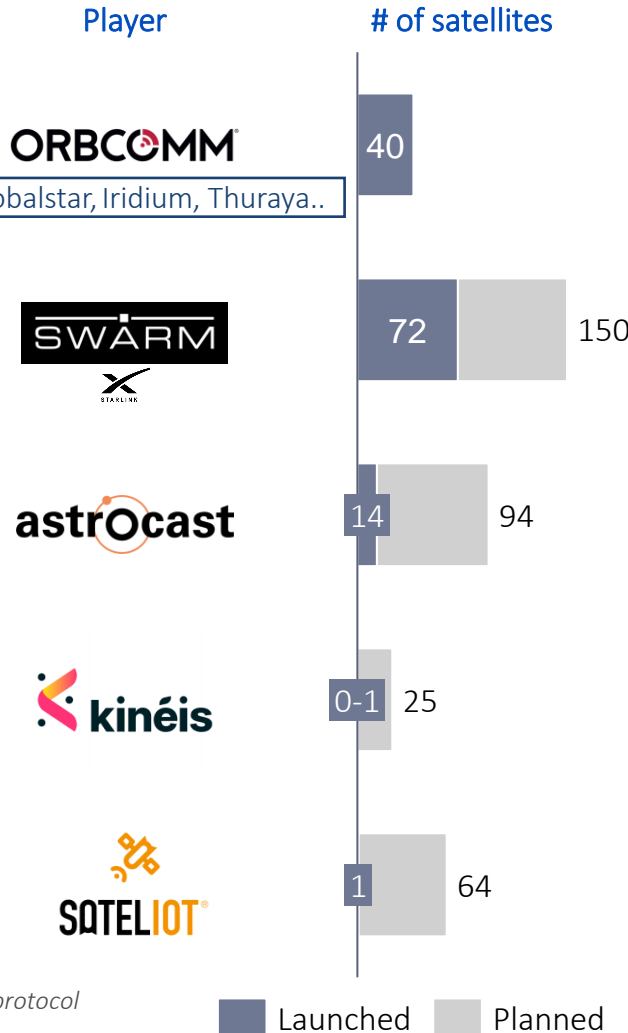
Technology evolution is enabling better economics in Satellite IoT services (growing @14% CAGR 22-25), but from a very low base currently

Better economics driven by:

- Nanosats: Potentially as cheap as \$100k per satellite and with rapid deployment
- LEO configuration and tailored communication protocols that optimize service and cost for low bandwidth and low-energy consumption devices

+ Traditional

+ Emerging



Key facts and recent news

Traditional player with +1.7m connected devices and service in +160 countries
Acquired by PE GI Partners in 2021 for c.\$1.1Bn

Acquired by SpaceX in 2021
Nanosatellites with proprietary chipset
Partnership with Vodafone

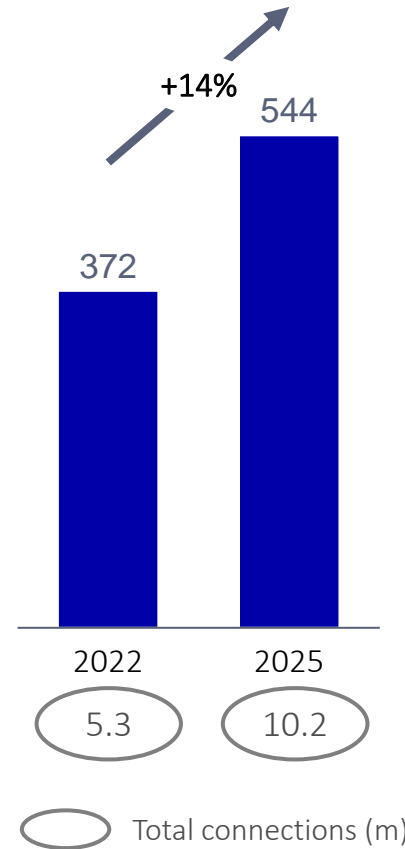
Nanosatellites with proprietary chipset
Thuraya invested \$17.5m in Apr 2023

Nanosatellites with proprietary chipset
Partnership with Bouygues
Last funding (Feb '20) at a valuation of \$ 111m

Launched first 5G-standard¹ LEO sat (15/4/23)
Funded by Qualcomm, Cellnex, Indra

Other players such as Echostar, Lacuna Space using terrestrial wireless standards

Satellite IoT-focused market
Global revenues \$m, 2022-2025



Source: Market figures based on Omdia; 1) using NB-IoT protocol

5G in Space

3GPP treibt Entwicklung voran

02

Satellite communication develops rapidly, creating new opportunities for vertical or horizontal partnerships



Achieve service continuity

- IoT Services
- In remote and rural areas
- Direct-to-device (D2D)*

Note: * Direct-to-device: Connection from satellite to handheld/smartphone without any terrestrial base station in between



Expand broadband connectivity services

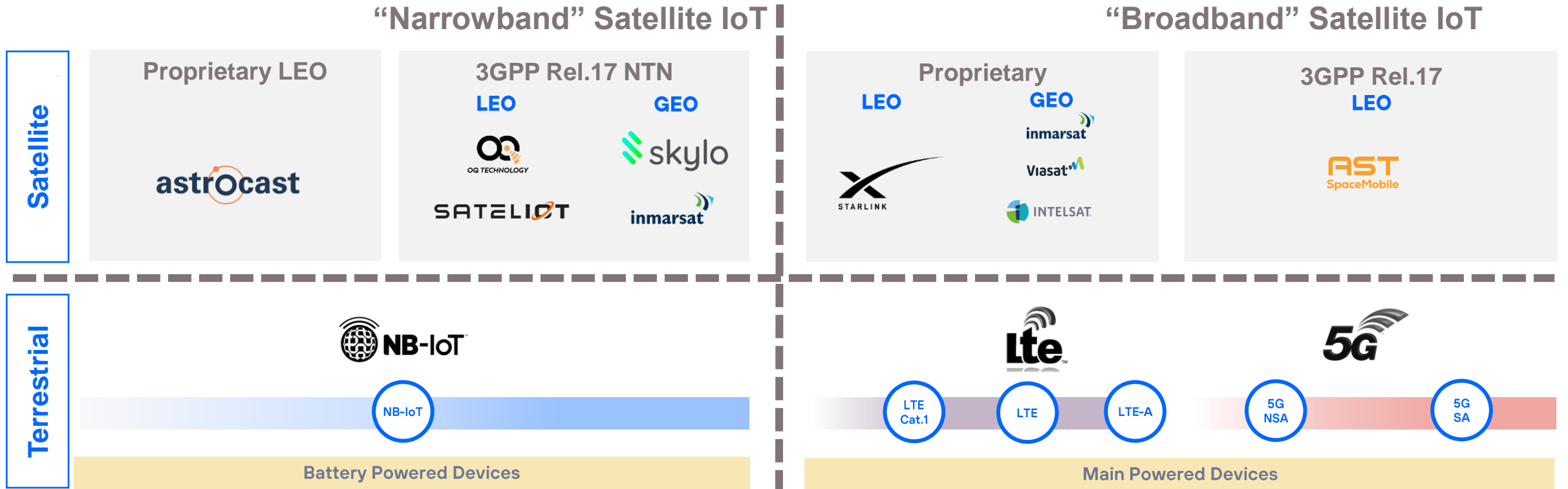
- Fixed access
- SD-WAN



Deploy rapidly in case of interruption or natural disaster

- Backup connection to radio towers
- Mobile radio tower (MRT)

Satellite Players and O₂ Business Partners



Smart agriculture



Smart city



Predictive maintenance



Logistics & tracking



Wearables



Telematics



Drones

Service continuity, ubiquity and scalability are where satellite communication can create strong interplay with mobile networks



Partnerships

Test and certify capabilities from SatCom providers



R&D

Interact and influence international research and standardization activities



Monitoring

Keep track on regulation efforts and anticipate changes



Spectrum

Guiding principles into WRC 23 and 27

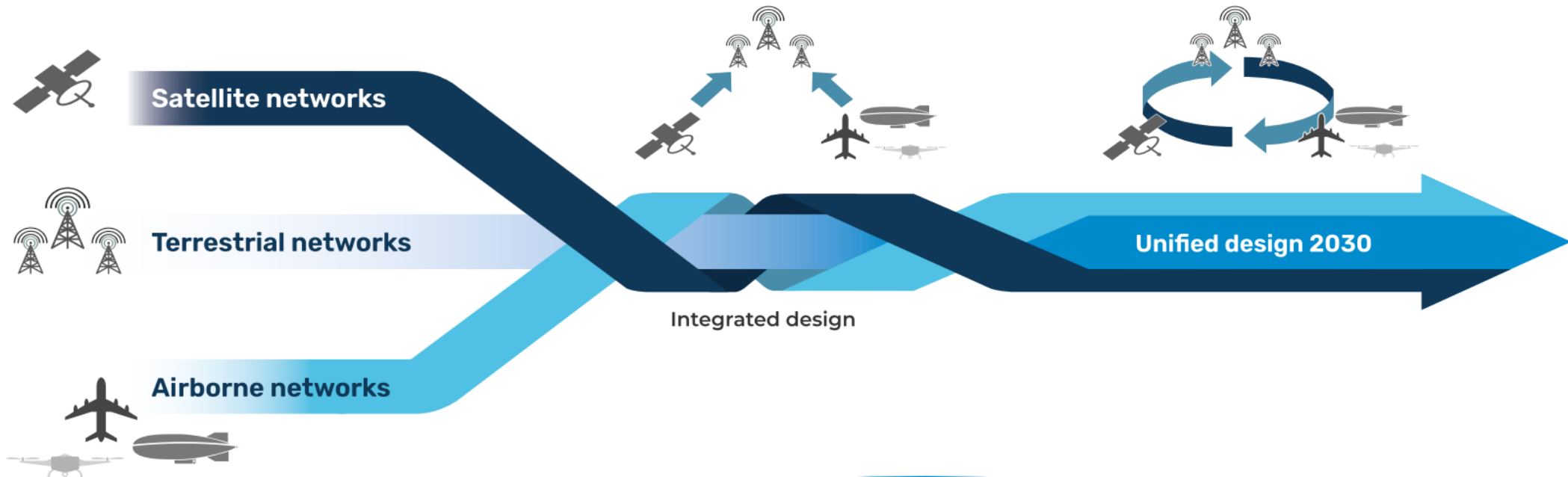
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What does the far future bring?

Which innovations will come with 6G?

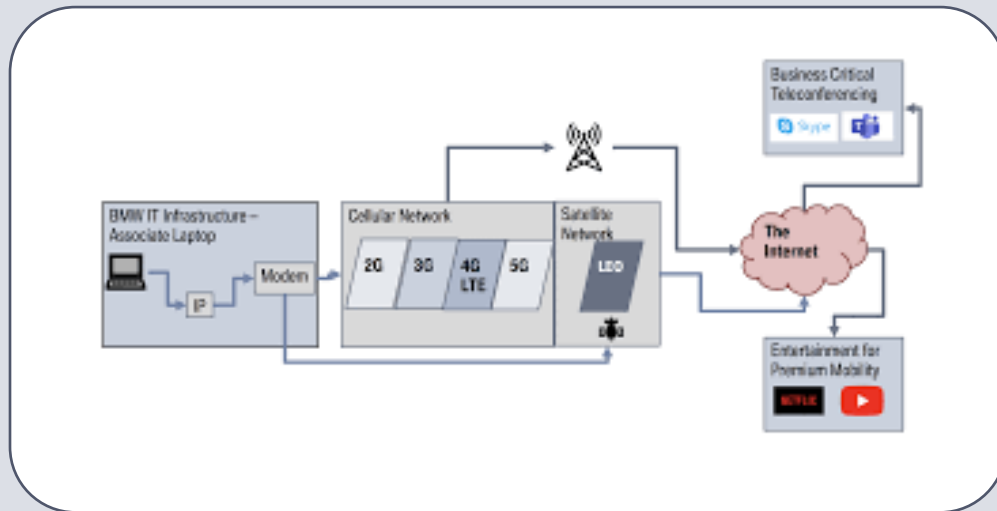
03

Telefónica Germany arbeitet heute schon aktiv an der Vorausbildung von technischen Voraussetzungen von 6G Netzen und Diensten



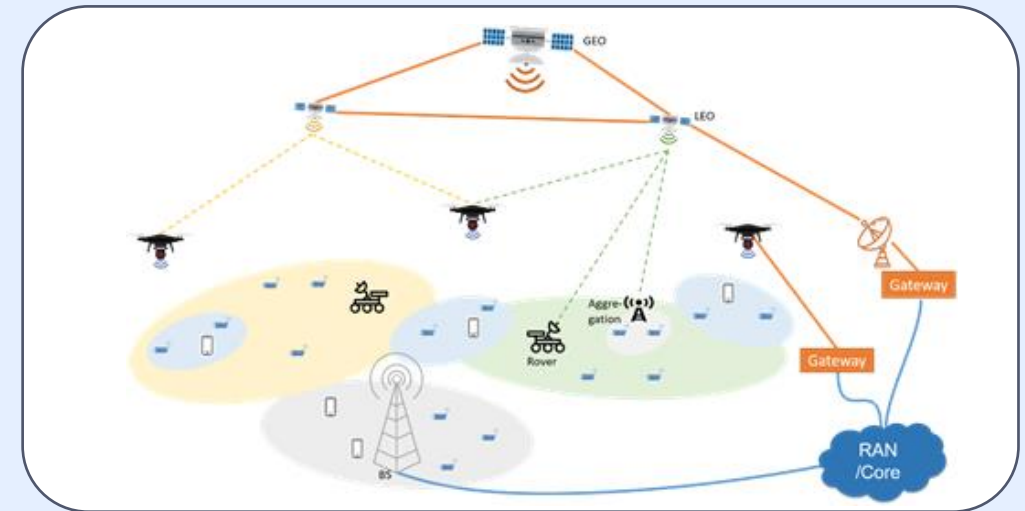
Since today's offerings represent vertical closed solutions, we are aiming for a unified service and 3D network model

Where are we today?



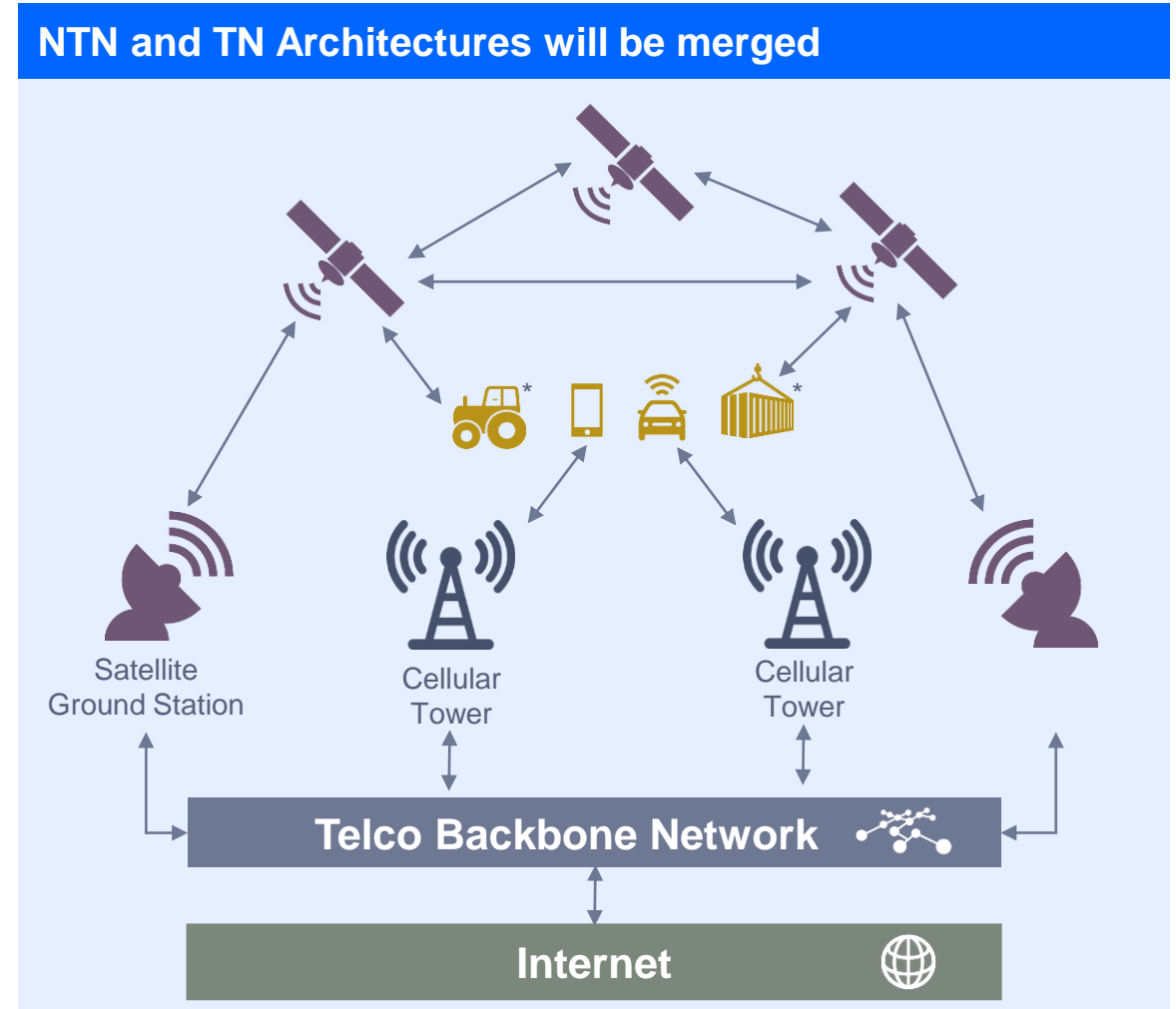
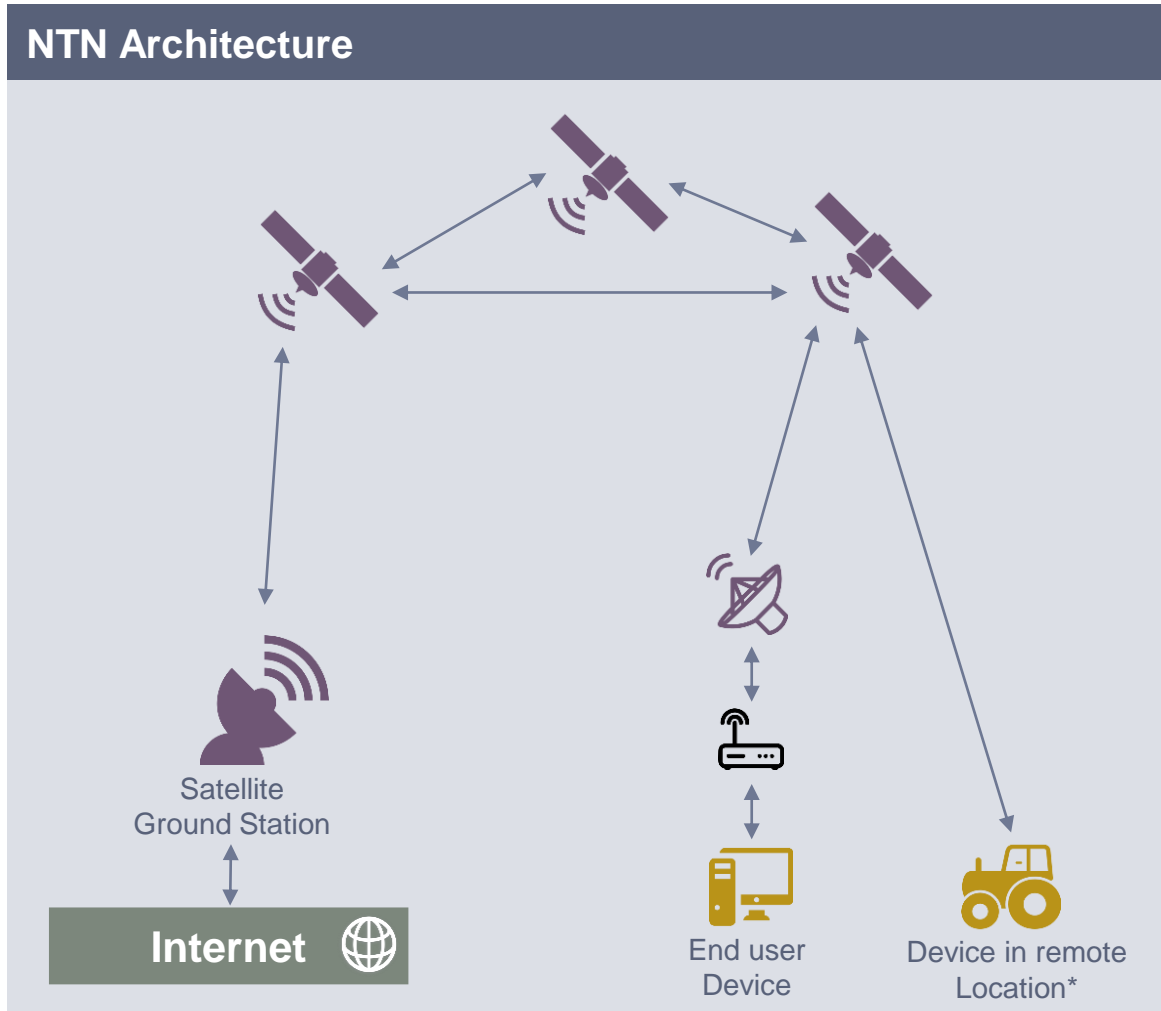
- Today's vertical communication enables OTT services
- However, a seamless service experience and harmonized subscription model is still a challenge
- Standardization paves the way

Vision



- Fully integrated addition to our service model - one device, one subscription
- Enables new horizontal whole-sale-buy business models at different levels
- In the long term, 6G is expected to enable a converged network experience

Technical integration of mobile communications and satellite networks is the medium-term goal of 3GPP



Telefónica

