

Global Satellite Communications

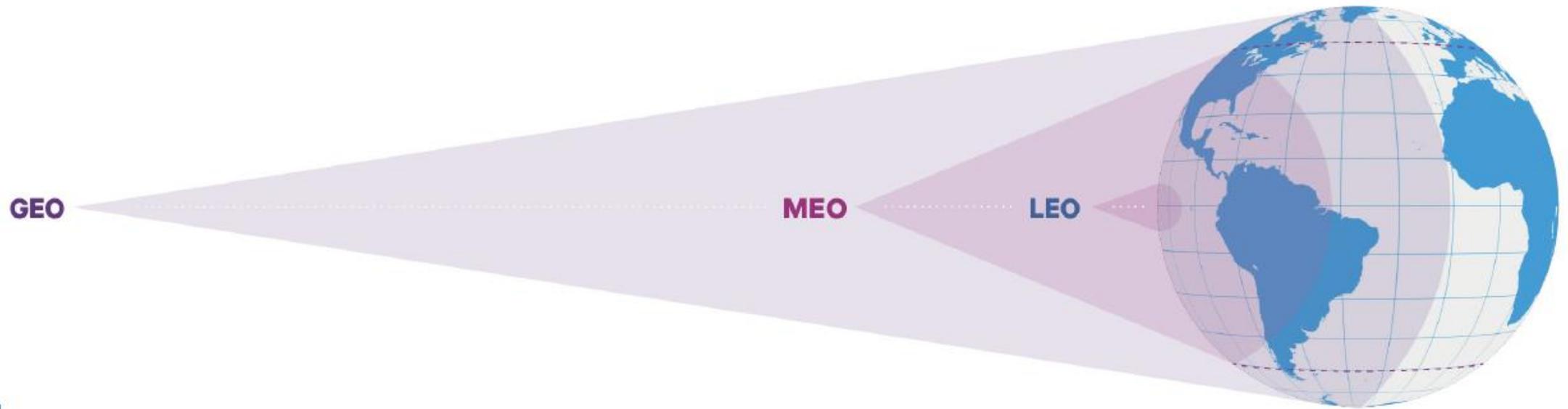
Market Dynamics and
Technology Roadmap



Agenda

- Satellite Orbits Overview: LEO, MEO, GEO
- Technology & Performance Comparison
- Market Trends & Demand Drivers
- Industry Shift: Multi-Orbit & Hybrid Networks
- The Rise of Direct-to-Device (D2D)
- What the Future Holds

Satellite Orbits: The Big Picture



Satellite Orbits: The Big Picture

	GEO (36,000km)	MEO (5,000-20,000km)	LEO (500-1,200km)
Altitude latency ¹	High	Low	Very low
Earth coverage	Very large	Large	Small
Satellites required	Three	Six	Hundreds
Data gateways	Few fixed	Regional flexible	Local numerous
Antenna speed	Stationary	1-hour slow tracking	10-minute fast tracking

Advantages	High throughput (HTS) technologies enable basic broadband internet applications	Proven low latency comparable to terrestrial networks, offers fibre-equivalent performance	Claims support for high-frequency trading, virtual gaming, and high-performance computing applications
	Fewer satellites over very large fixed geographical areas	Simple equatorial orbit covers 96% of global population	Smaller, lower power satellites batch-launched more cheaply than GEO
Disadvantages	High altitude and distant ground networking impacts latency-sensitive applications	Dual tracking antennas required to maintain continuous connectivity	Very complex tracking and ground network, plus complete constellation must be in place before service starts
	Signal power losses require larger satellites and antennas	Inclined plane orbits needed to cover high latitudes	Unproven business model, risky technology, and space debris risk

GEO GEOSTATIONARY EARTH ORBIT

• Key Characteristics

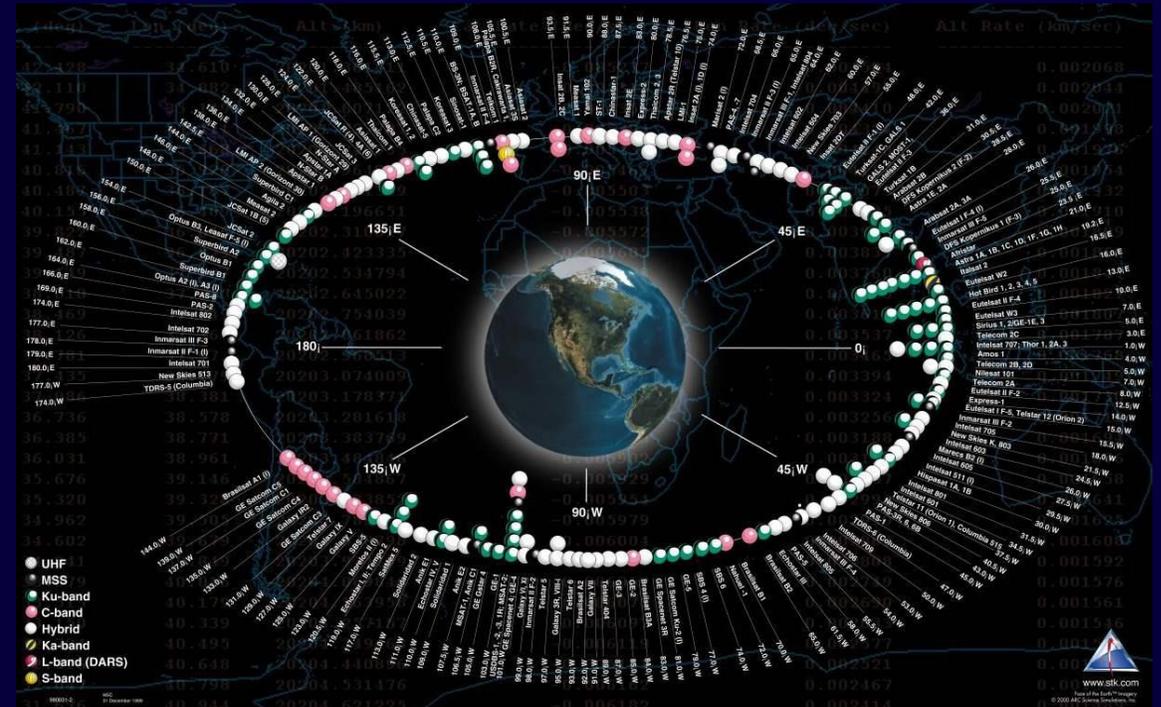
- ~36,000 km altitude
- Fixed coverage over one-third of Earth
- High latency, very wide coverage

• Strengths

- Broadcast & media distribution
- Government & critical infrastructure
- Mature ecosystem and reliability

• Limitations

- High latency (~600 ms)
- Limited mobility performance
- High launch and replacement cost

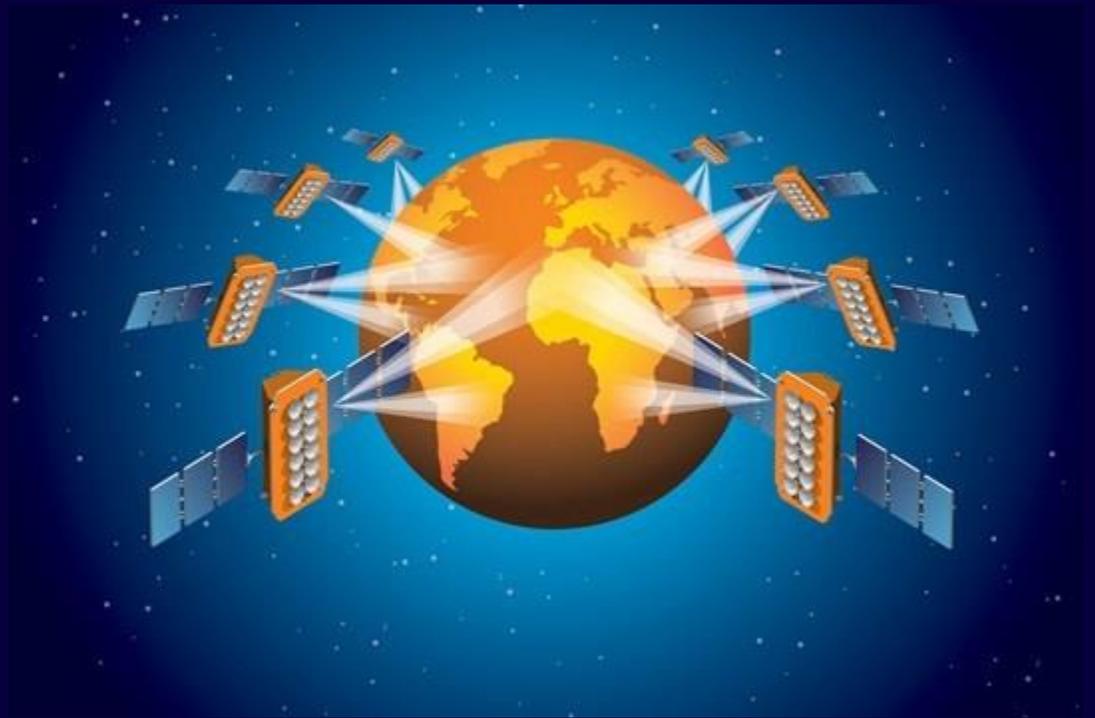


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MEO MEDIUM EARTH ORBIT

- **Key Characteristics**
 - ~8,000–20,000 km altitude
 - Moderate latency
 - Global coverage with fewer satellites
- **Strengths**
 - Better latency than GEO
 - Strong for maritime, aviation, trunking
 - Predictable coverage patterns
- **Challenges**
 - Higher complexity than GEO
 - Smaller ecosystem than LEO

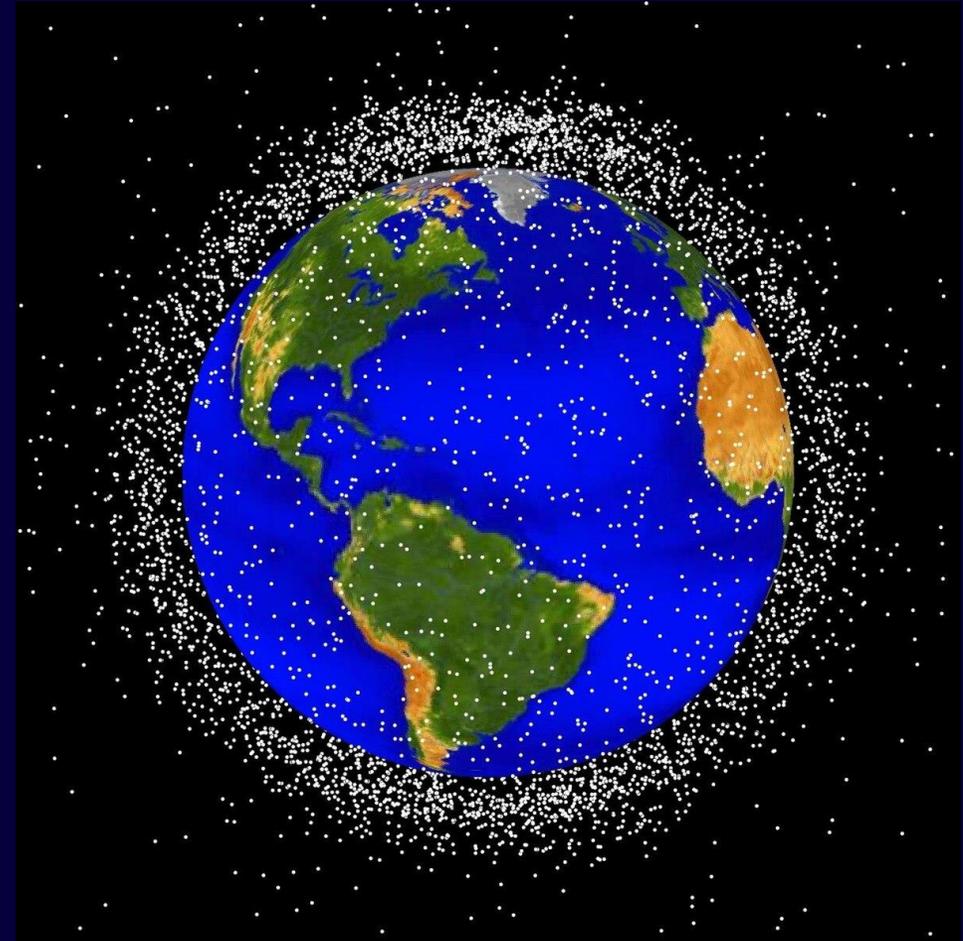


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LEO LOW EARTH ORBIT : The Disruptor

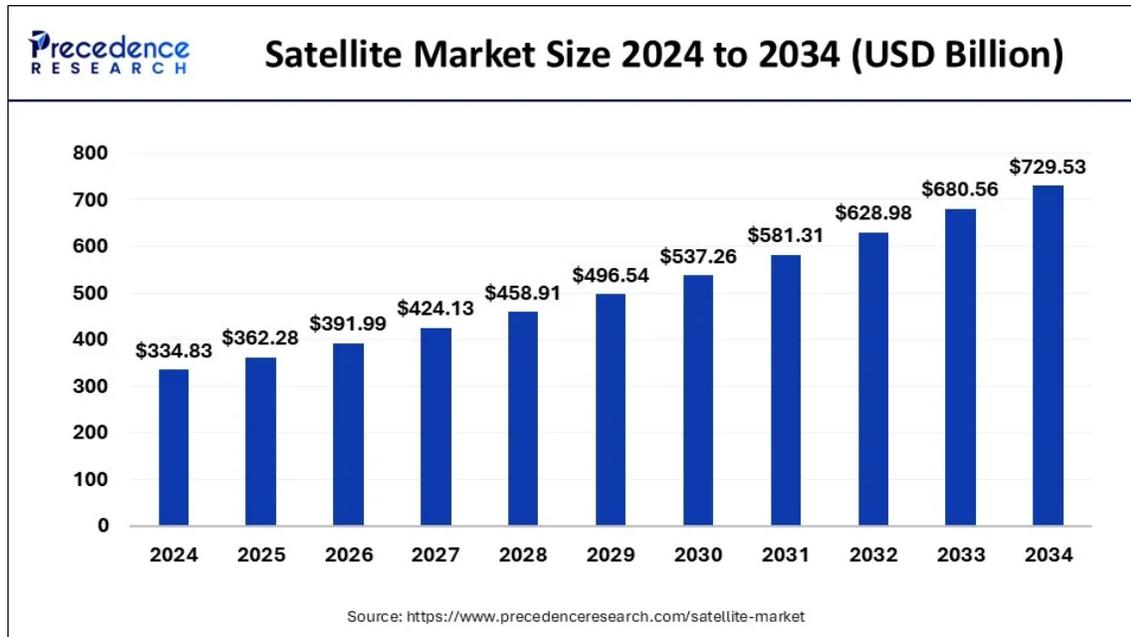
- **Key Characteristics**
 - ~500–2,000 km altitude
 - Very low latency
 - Massive constellations
- **Strengths**
 - Fiber-like latency
 - Excellent for mobility & broadband
 - Global reach including remote areas
- **Challenges**
 - High CapEx & replenishment cycles
 - Network complexity
 - Spectrum and regulatory pressure



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Market Trends Driving Change



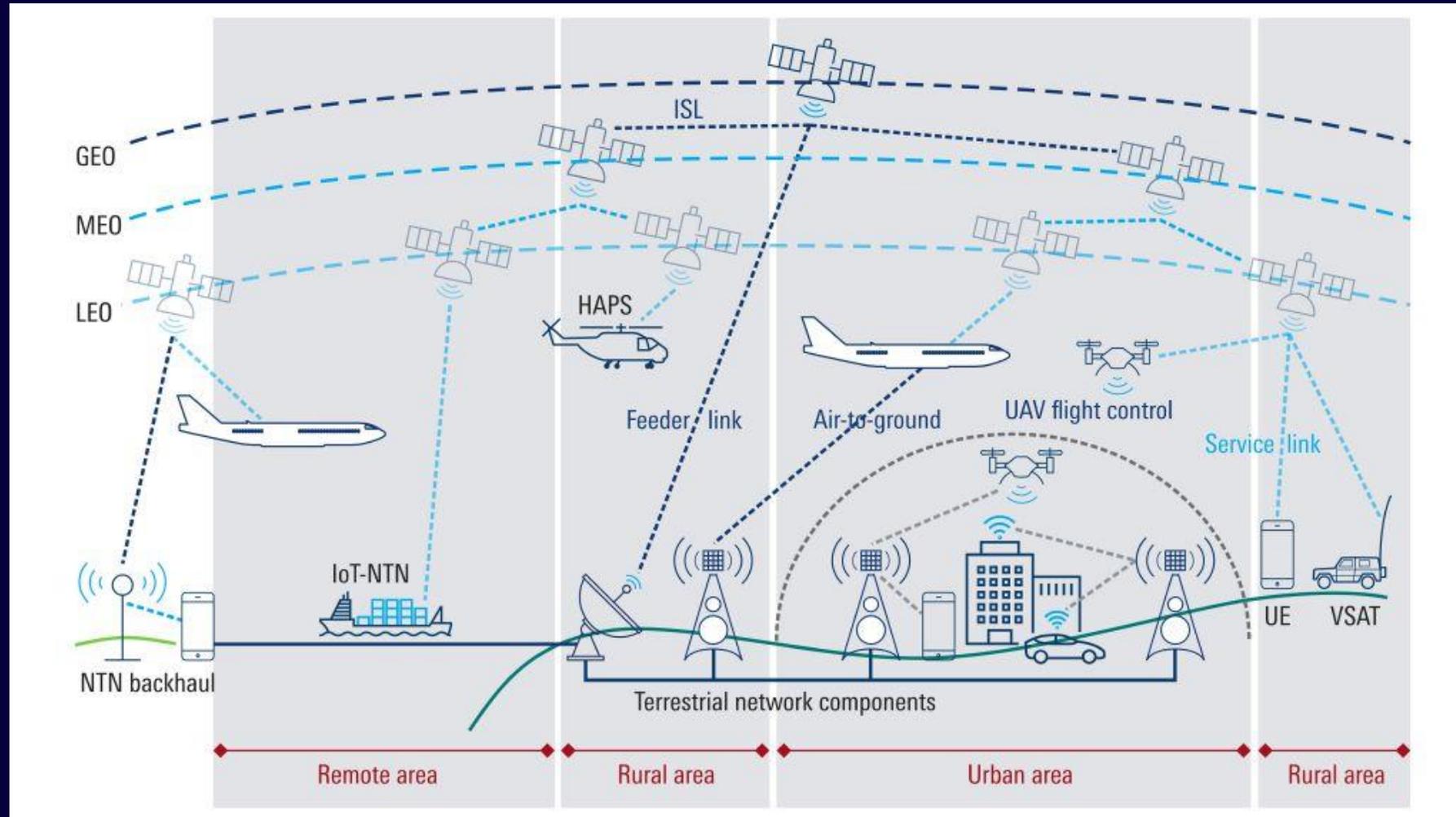
- Explosive growth in data consumption
- Mobility (air, sea, land) driving demand
- Government focus on sovereignty & resilience
- Demand for low-latency applications
- Integration with terrestrial 5G networks

Market Direction: From Single Orbit to Multi-Orbit

- No “one-orbit-fits-all” anymore
- Operators and customers adopting **multi-orbit strategies**
- Seamless switching between LEO / MEO / GEO
- Satellites becoming part of **integrated networks**, not standalone systems

The future is hybrid and software-defined

The Role of 5G & NTN

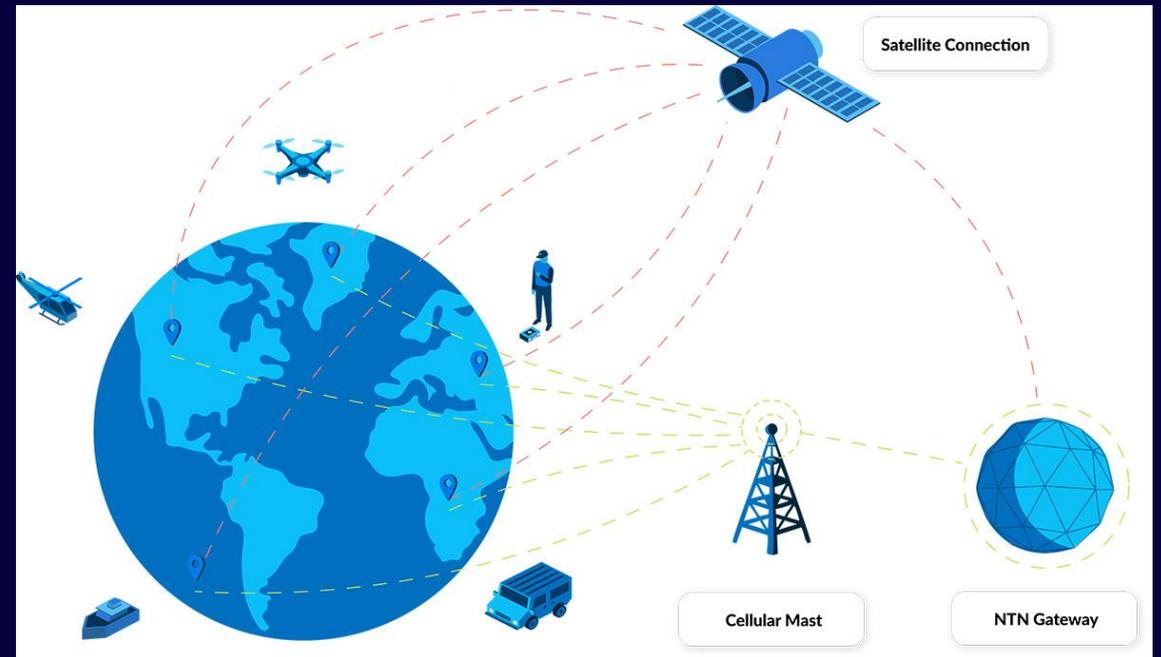


The Role of 5G & NTN

- Satellites integrated into 5G standards (NTN)
- Convergence of satellite and terrestrial networks
- Satellites as an extension of mobile networks
- Foundation for Direct-to-Device services

What Is Direct-to-Device (D2D)?

- Direct satellite connection to **standard smartphones**
- No VSAT, no terminals, no external antennas
- Initially messaging → voice → data
- **Early Use Cases**
- Emergency services
- Remote areas
- IoT and critical alerts



Why D2D Is a Game Changer

- Massive addressable market (billions of devices)
- New revenue models for operators & MNOs
- Improved coverage without terrestrial rollout
- Strategic importance for governments and regulators

Challenges for Direct-to-Device

- Spectrum coordination with mobile networks
- Limited bandwidth per user
- Power constraints on satellites
- Regulatory and licensing complexity
- Commercial models still evolving

The Future Outlook

- Multi-orbit constellations as standard
- Seamless satellite-terrestrial roaming
- Gradual expansion of D2D capabilities
- Satellites becoming a native part of telecom infrastructure
- Strong growth in government, mobility, and IoT markets

Convergence & Co-existence



Non-Terrestrial Networks

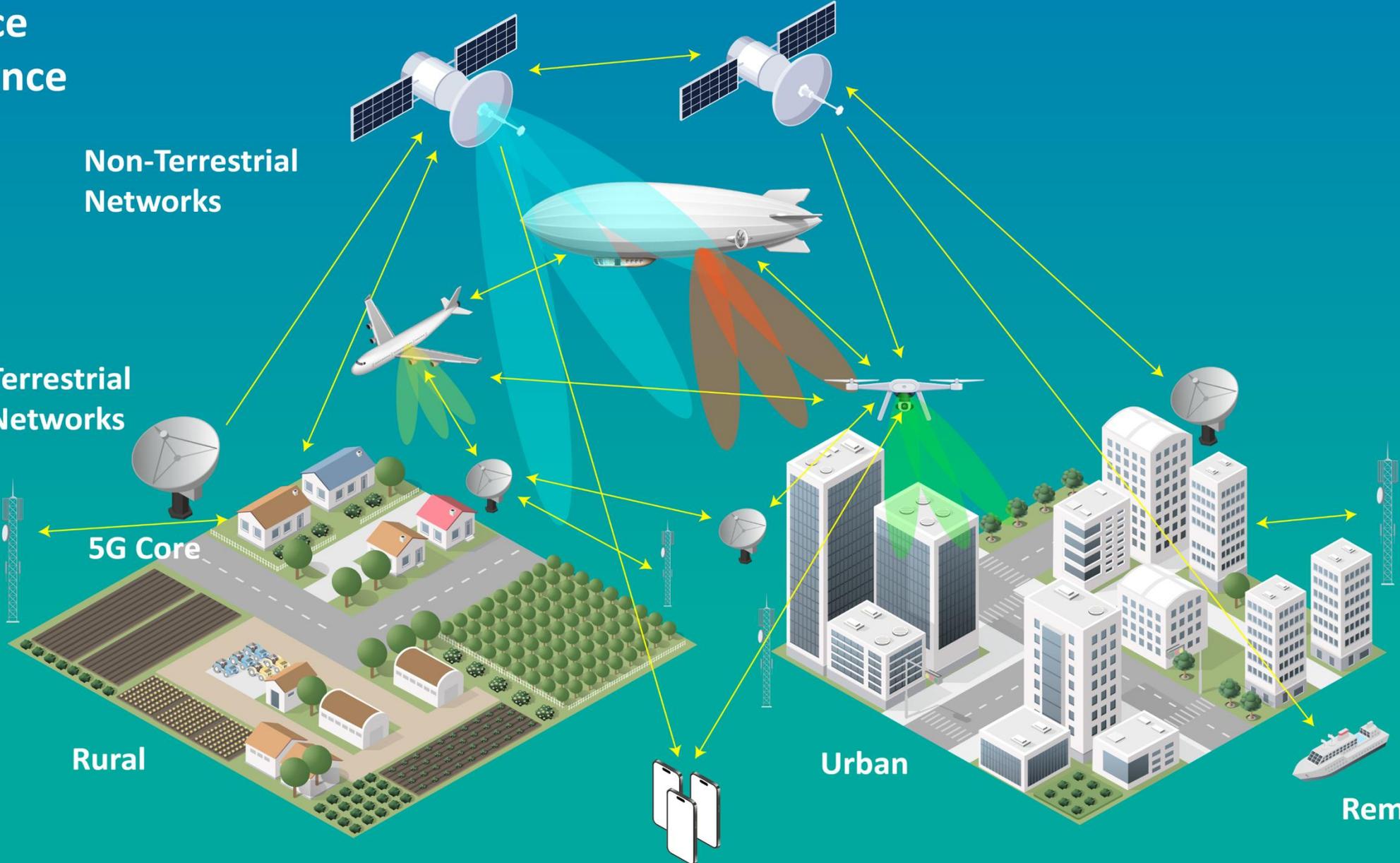
Terrestrial Networks

5G Core

Rural

Urban

Remote



Key Takeaways

- GEO, MEO, and LEO each remain relevant
- Market is moving toward hybrid, multi-orbit networks
- Direct-to-Device is incremental but inevitable
- Satcom is shifting from niche to mass-market connectivity

Thank you!

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Any questions