



The market landscape for satellite 5G

Seminar with AccelerComm[™]

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5G standards and NTNs Geopolitical considerations Direct-to-handset 5G motivation and challenges Lessons from past efforts LEO broadband

Keys to success



Significant work has been undertaken in 3GPP to provide support for Non-Terrestrial **Networks**

- Primary focus has been on bands with existing authorizations for both terrestrial and satellite services (notably L/S-band and Ka-band)
 - Existing terrestrial bands without a satellite authorization have not seen similar standardization work
- Emphasis is on service continuity (e.g. airborne and maritime platforms), ubiquity (coverage in remote parts of a country) and scalability (multicast or broadcast content)
 - Ubiquity is the most important goal, though seamless roaming is unlikely to be achieved in the near term



TECHNICAL REPORT

Government-backed projects are likely to emerge in the EU and China to challenge US-based networks

- Due to focus on standardization and competition, these projects are more likely to be standards-driven
 - It remains to be seen whether such efforts will be completed in a timely fashion or if they will be commercially competitive with US constellations
- A geopolitical arms race is likely, just as Galileo and Beidou have sought to provide an alternative to the US GPS system





Direct-to-handset projects range from simple two-way messaging all the way up to full 5G

Globalstar (and Apple?)	Free emergency text messaging for future iPhones, using Globalstar satellites and spectrum, could expand to much larger free "global iMessage" in the future
SpaceX and T-Mobile	Second generation Starlink satellites will support messaging, voice and low speed data (total of 2-4Mbps per cell) using T-Mobile PCS spectrum
AST SpaceMobile	200+ large LEO satellites to provide 30Mbps 5G to smartphones using spectrum provided by mobile operator partners, including Vodafone, AT&T
Lynk	10 LEO satellites to test direct to smartphone SMS using terrestrial mobile spectrum
Omnispace	S-band satellite filings outside North America and Europe, seeking to develop LEO or MEO satellite system for direct-to-smartphone communications

Globalstar's approach builds on its existing custom SPOT air interface, while other systems may be more aligned with 5G standards as they intend to work with standard off-the-shelf smartphones.



Full 5G is needed to justify a paid-for solution in competition with free global iMessage

- Apple and Globalstar have significant ambitions for direct-to-handset messaging and Globalstar's partner has committed over \$500M to date to fund new satellites and gateways and as a down-payment for future two-way messaging services
 - We expect that any service would be offered for free as a way to boost sales of next gen iPhones
- Apple is sufficiently powerful that it could implement iMessage despite undermining carrier revenues: operators cannot simply refuse to carry the iPhone
- Rivals will need to offer more advanced 5G services to compete effectively





However, significant technical and financial risks remain in the most advanced projects

- The stability of novel large antennas in space is still to be proven, and the service quality remains to be seen
 - Financial constraints have pushed AST to scale down the size of its initial satellites, which could impact data rates and capacity
 - Alternative mechanisms for improving channel performance should be sought
- The FCC has not yet granted a license for AST to build a commercial system
- Lynk Global faces similar financial and regulatory challenges, while SpaceX/T-Mobile will also need regulatory approvals



AST SpaceMobile's BlueWalker-3

Source: https://twitter.com/AbelAvellan/status/1504920229868101639/photo/1



The bankruptcies of Iridium, Globalstar and other past MSS projects highlight the challenge for investors

- Both Iridium and later MSS projects such as Terrestar assumed that huge numbers of users would pay a modest premium for an "integrated cellular/satellite service"
- Inherent in these estimates was the assumption that the satellite service would work "like cellular outside cellular coverage"
 - But the service didn't live up to expectations, mainly due to the limitations of the communications channel
- Success of future commercial 5G offerings will depend on the provision of seamless service and how well standard smartphones will work



Terrestar US market size estimate 2009



The key driver of LEO broadband system design is the need for a cheap terminal

- An easy to install, low cost terminal is critical for any mass market ambitions, which will require a huge consumer market
 - Starlink lowered the altitude of the satellites to improve the link margin
 - Amazon and Starlink are both aiming for a <\$500 terminal
- In contrast, OneWeb and Telesat have outsourced terminal development, which may result in higher prices
 - Terminal developers are focused on adding value through multi-orbit support, though this may only represent a niche opportunity





Starlink Gen2 terminal

Vertical integration is essential for cost reduction and makes a standards-driven approach less critical

- There are major gains from increasing the number of satellites in orbit, which leads to reduced terminal cost and higher system capacity
 - Selling "best efforts" service to the consumer market is critical because available capacity varies as satellites move across the sky
- Both Starlink and Kuiper expect to build their own satellites to keep costs down
 - Starlink benefits hugely from access to cheap SpaceX launches
 - Integrated systems don't need to pursue a standards-driven approach
- The ultimate size of the consumer market for satellite broadband remains uncertain, and this will dictate how many satellites and systems are viable





There is no silver bullet for success, but finding a mass market will be key to justifying these huge investments

- New satellite constellations are attracting tens of billions of dollars of investment, driven by significant technology advances and confidence in the vision of billionaires such as Elon Musk and Jeff Bezos
 - Potential mass market opportunities exist in both direct-to-handset and consumer broadband
 - However, substantial technical, regulatory and commercial risks remain
- While some of these systems are likely to be built as closed, tightly optimized networks, others will rely on 5G standards because interoperability is an essential commercial or political goal
 - Systems like AST that intend to support unmodified 5G smartphones must align with 5G standards
 - Government-backed projects in the EU and China that want to provide an alternative to US commercial constellations like Starlink are likely to follow 5G standards in order to promote more widespread use of their systems

