Workshop on Spectrum and Regulatory Issues in Preparation of WRC-23

The Challenges of Satellite Providers in a 5G and Beyond World

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12 September 2022

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Satellite and 5G: Ubiquity, Resilience, and Reliability

Satellite Integration into the 5G Infrastructure

The conditions for maximizing the successful integration of satellite networks into the 5G infrastructure include:

- Interoperability of satellite network solutions with the 5G network management system, allowing a third party (e.g., mobile network operator or service provider) to interface with the satellite network. This also includes visualization of satellite communication elements as unconventional, virtualized resources on 5G end-to-end services
- Integration of satellite communications systems into the 5G core network to provide secure end-to-end 5G services to and through satellite terminals
- Multivendor interoperability between elements (e.g., terminals and radio access networks [RAN] for satellite 5G network solutions)
- Technology commonality of satellite network solutions with cellular network solutions and the economy of scales, allowing cost reduction and increased product diversity (e.g., devices with common chipset capabilities), particularly in new spectrum deployments like S-band

Satcom: An Integral Part of the 5G Ecosystem

Wide-area coverage and lower vulnerability to physical attacks and natural disasters allow space-based networks to:

- Facilitate the rollout of 5G service in areas that cannot be covered by terrestrial networks (e.g., isolated/remote areas, aircraft/vessels)
- Upgrade the performance of limited terrestrial networks in a cost-effective manner in underserved areas (e.g., suburban/rural areas)
- Reinforce 5G service availability by providing service continuity for M2M/IoT devices or connectivity and autonomy of intelligent cars with software updates on moving platforms (e.g., passenger vehicles, aircraft, ships, high-speed trains, buses)
- Ensure service anywhere, especially for critical communications, future railway train communications, and maritime communications
- Enable 5G network scalability by providing efficient global multicast/broadcast coverage resources for data delivery
- Create a reliable and ubiquitous communication system that is both highly secure and economically viable

The Satellite Industry As Part of the 5G World

- No single communications technology can form a ubiquitous global network – it requires both terrestrial and non-terrestrial delivery systems
- As recognized by 3GPP, satellite is a critical element of 5G globally. There will always be places where terrestrial fiber/microwave backhaul is not available and where satellite provides the most cost-effective—if not the only—connectivity path for direct to subscriber and backhaul communications.
- High availability of the global network demands that there be redundant connectivity paths employing alternate technologies, e.g., failure of the primary terrestrial link.
- The overall architecture calls for hybrid solutions of terrestrial/satellite technologies in a variety of orbits (GSOs, LEOs and MEOs) to reach the full potential of universal connectivity no matter where on the planet.

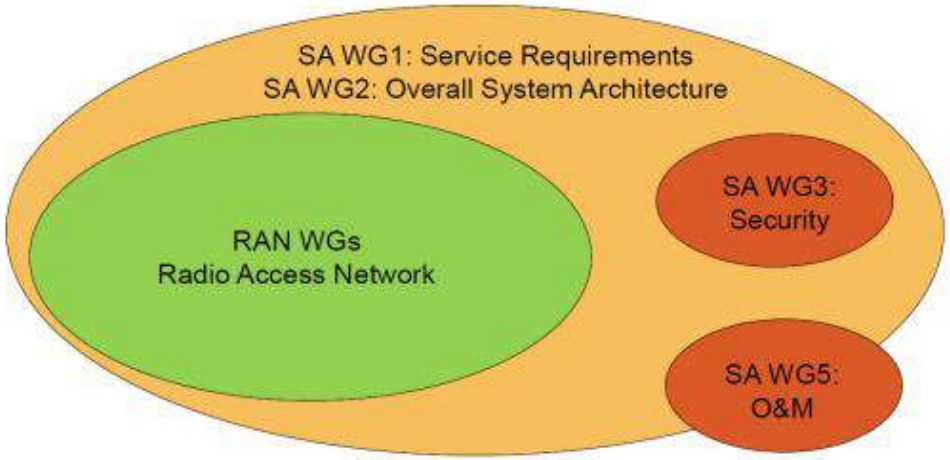
3GPP: Mandatory Satcom Involvement

Standardization approach for integration of satellite into 5G is defined in 3GPP through

- SA (SA1 and SA2): Introduction of backhauling in standards (Ref 3GPP TR. 22.822); definition of satellite positioning
- CT: Contribution on satellite characteristics to be considered when designing 5G Core Network Protocol
- RAN: Study of satellite as standard 3GPP access (with the possibility of using 5G NR as satellite air interface), including identifying relevant frequency bands

3GPP: Mandatory Satcom Involvement

The work split within 3GPP



Project Co-ordination Group (PCG)

TSG RAN Radio Access Network	TSG SA Service & Systems Aspects	TSG CT Core Network & Terminals
RAN WG1 Radio Layer 1 spec	SA WG1 Services	CT WG1 MM/CC/SM (Iu)
RAN WG2 Radio Layer 2 spec Radio Layer 3 RR spec	SA WG2 Architecture	CT WG3 Interworking with external networks
RAN WG3 Iub spec, Iur spec, Iu spec UTRAN O&M requirements	SA WG3 Security	CT WG4 MAP/GTP/BCH/SS
RAN WG4 Radio Performance Protocol aspects	SA WG4 Codec	CT WG6 Smart Card Application Aspects
RAN WG5 Mobile Terminal Conformance Testing	SA WG5 Telecom Management	
RAN WG6 Legacy RAN radio and protocol	SA WG6 Mission-critical applications	

Satellite Use Cases

- **Satellite-based solutions will be fluidly integrated into next-generation access technologies, enabling a broad range of use cases where the benefits of satellite can be leveraged**
- **Satellite features, both from GSO and non-GSO systems, will provide suitable platforms to support 5G backhaul communications, as well as a wide range of solutions providing seamless communication services**
- **Broad classes of use cases that are immediately identifiable are:**
    - Direct to consumer
    - Trunking
    - Backhaul
    - Communications on the move
    - Hybrid multiplay
    - Reliability/disaster recovery
    - IoT/M2M

The Satellite Industry and Increased Spectrum Efficiency

- We are at an exciting time – more innovation and investment in space for communications has resulted in increased competition and greater demand from users.
- The communications satellite industry has responded by creating a variety of solutions (fixed and mobile services) in multiple orbits (LEOs, MEOs and GEOs).
- With this innovation, satellite operators have responded by creating more spectrally efficient, technologically advanced networks than ever before (using technologies such as spot beams and increasing spectrum reuse)

Need for Long Term Access to Adequate Spectrum

- Even with increased efficiency, like all technologies, satellite networks need long term access to adequate spectrum
- Satellite networks are a long-term investment
- Changing the spectrum environment or reducing access to spectrum negatively impacts consumers and economic viability of networks
- Satellite networks, like all wireless services, have increasing demands for consumers for higher speeds and capacity; current spectrum allocations cannot meet them
- Governments must ensure long term access to key frequency bands (e.g., Ku, Ka, V, Q and E) and access to new bands (e.g., 17.3-17.7 GHz)

Space Sustainability

- Space is a scarce resource; increased use by mega-constellations, small satellites, space tourism and more, threatens this resource
- The Satellite Operators have urged governments through the GSOA to take action now to ensure a long-term sustainable space. 2021-09-SSA-Paper.pdf (gsoasatellite.com). I agree.
- Space-faring nations must come together to develop a global technology neutral, flexible framework to ensure the long-term sustainability of our space framework before it is too late

A Modern Regulatory Regime

- **In order to enable the number of new technologies and services, regulators must continually review and update their regulatory regimes.**
  - **Blanket licenses:** it is critical that a single license for a large number of identical satellite terminals with a reasonable one-time fee be available for satellite operators to accelerate deployment of services.
  - **Reasonable fees:** high spectrum and regulatory fees result in less-affordable services for the citizens
  - **Service quality requirements:** must take into consideration satellite technology inherent benefits and constraints
  - **Access to Universal Service Funds:** avoid technical discrimination in USF-funded projects

Conclusion

- As innovation continues in the satellite marketplace and its place in 5G and beyond technologies continues to grow, it is imperative that regulators act accordingly
- Access to adequate and protected spectrum is critical to meet growing commercial demands
- Long-term space sustainability must be created or we will lose access to this precious resource for future generations
- Regulations must be unbiased and ensure that all technologies can be used where they are needed to accelerate bridging the digital divide

Thank You!

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