Where is satellite going to move the day after tomorrow?

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Knowledge for Tomorrow

Background

But what after 2020?

- **Future network** architectures will be based upon those already proposed and being implemented for **5G based on the 3GPP** standards

- **Satellites** are now fully engaged in the **5G story** → by 2020 demonstration of integrated satellite-terrestrial 5G networks:
  - Full virtualisation of ground segment—gateways and terminals
  - Integration into the 5G core network
  - Network slicing ease the convergence of satellite elements in an end to end 5G demonstration.
  - Integrated content delivery to the network edge with multicast and caching
  - Service delivery to moving platforms such as aircraft, ships and fast trains

A methodology towards possible answers

- The SatCom WG within Networld 2020 has collected possible outlook from its members
- Questionnaire distributed to academia and industry about:

  - **Future services**
  - **Ground segment evolution**
  - **Space segment evolution**
  - **New protocols and architectures**
  - **Convergence of terrestrial and satellite networks**

- Several views and opinions, but just a common statement:

  - Urgency to move closer to terrestrial infrastructures
  - To have a unique delivery platform composed of heterogeneous technologies
  - Satellite is not expected to interface to 5G, but has to be one of the technology pillars of the 5G ecosystem

Main ingredients…

- **Services/application**:
  - Support to intelligent transportation systems (ship, car, aircraft)
  - Mobile broadband multi-play services
  - Mobile edge computing and fog-based architectures

- **Protocol/architectures**
  - Unique network management paradigm through SDN
  - Cloud-assisted networking functions
  - Autonomous networking functions through AI
  - Quantum key distribution

- **Ground segment**:
  - (smart) user terminals and gateways operating in Q/V/W frequency bands
  - Feeder links in free-space optics technology with advanced cloud mitigation techniques (optimised handover management)
  - SDR and cognitive radio
  - Gateway coordination and network management through SDN
  - Advanced interference mitigation and distributed resource allocation schemes

- **Space segment**:
  - Integrated space data highway (LEO/GEO/MEO/HAPs)
  - Megaconstellations with FSO ISLs
  - Onboard caching with large storage capacity

But formidable challenges….

- **Virtualising** the space segment and integration into the end to end network:
  - The challenge is to find the most efficient distribution of functions between the space and the ground systems given the constraints of the space segment and support integrated network management.

- **Integrating** a complete space network:
  - The challenge is how best to connect these within an overall 5G/6G, featuring **constellations** as well as **mobile networks operating in millimetre** bands

- Providing **coverage** as well as **resilience**:
  - Current terrestrial networks alone cannot provide both coverage as well as resilience to offer all services with the reliability and availability that users require. The challenge is how satellite integration can provide this.

- Providing **secure** framework including **cyber security**, quantum communication for the integrated satellite/terrestrial networks
  - The challenge is how to provide a unified security framework provided that different verticals and technologies show different requirements and partial solutions to security (silos-like)

Some take-home lessons

- Satellite is living an age rich of revolutions and evolutions (megaconstellations, Q/V band exploitation, fiber in the sky, connected sky, etc.)

- Satellite is paving the way towards to space data highway

- Convergence of satellite and terrestrial infrastructures is necessary to provide high coverage and resiliency

- Coordination of different network assets calls for advanced orchestration and network management functions

- Secure content delivery requires important efforts to meet requirements of mobile multicast broadband delivery

- Need for standardisation actions to increase satellite market opportunities and reach the economy of scale that will drive cost down