How Is Space Quantum Technology Enabled – and Is It Really Necessary? (from a Satcom Operator's Perspective)

Thomas Laurent

11/12.10..2023

EPIC Technology Meeting on Industrial Quantum Photonics Technology

Company overview

We are a disruptive new European company to launch the 1st truly global low latency point-to-point connectivity network of LEO (Low-Earth-Orbit) satellites.

- Founded in March 2022
- Headquarters in Munich, branch office including Berlin
- International & diverse team
- Currently approx. 70 employees

Unique Value Propositions

We will provide B2B customers the ability to **securely** connect any points on the globe with ultra-low latency and high bandwidth.

Content

RIVADA SPACE NETWORKS

1. **Challenges**
2. **Our approach to build #TheOuternet**
3. **Comparisons**
4. **Conclusions**
5. **Confessions**
6. **Recommendations**

Challenge

Quantum Internet

- Challenges:
  - ➢ Exponential photon loss in fiber channels
  - ➢ Cloning or amplifying is not allowed for qubits

Photon rate:

10GHz ⟹	9.5GHz ⟹	1Hz ⟹	10^{-10}Hz
Fiber length:	1km	500km	1000km

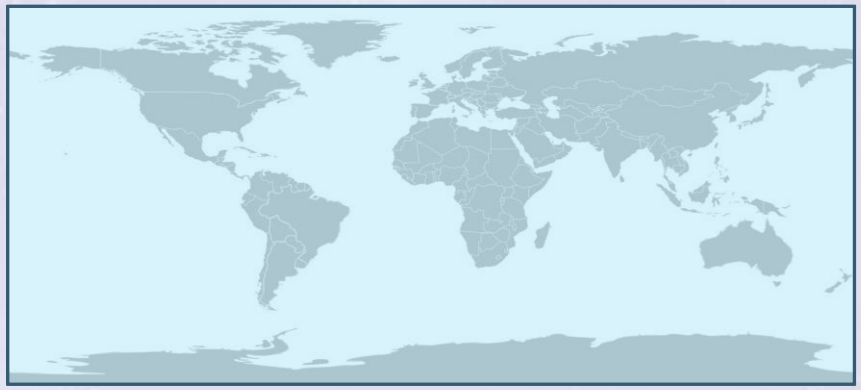
⇩

One photon in 300 years!

ZONG-QUAN ZHOU, USTC | ULTRA-LONG LIVED OPTICAL STORAGE WITH RARE-EARTH MEMORIES INSQT WORKSHOP 3

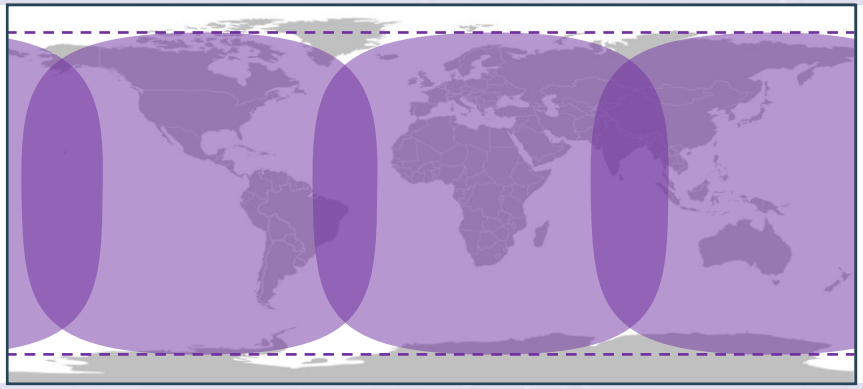
A Different Satellite Network – Truly Global

RSN LEO
Global



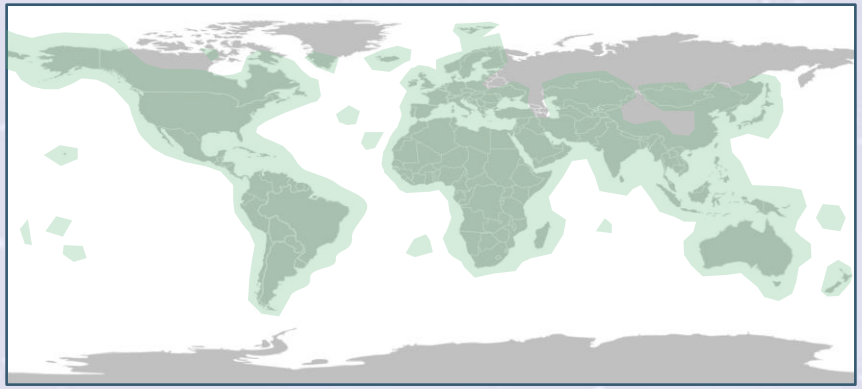
- Truly global coverage
- Pole-to-pole
- Open oceans
- Independent of terrestrial infrastructure

GEO
Up to 60-70° lat.



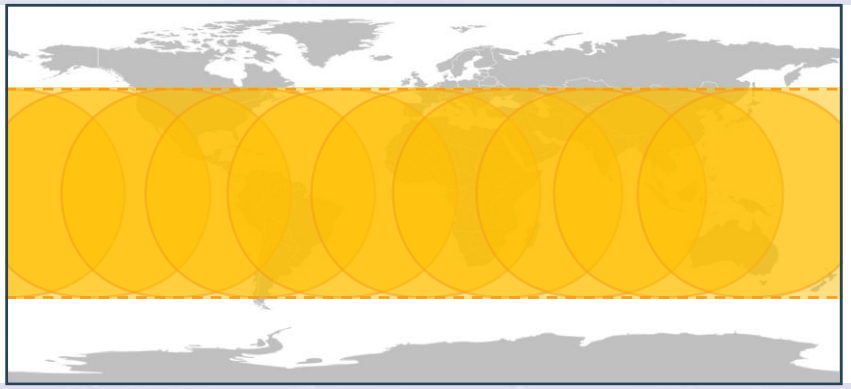
- Only up to 60-70° latitude
- Low elevation angles in high latitudes
- Obstruction issues

Other LEO
Gateway-limited

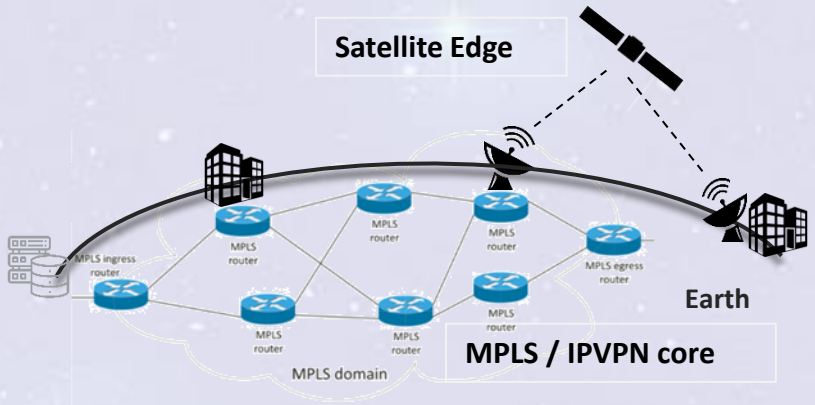


- Coverage only with a gateway in sight
- Most of oceans unreachable
- Reliance on land-based infrastructure (gateways and optical fiber)

MEO
Up to 50° lat.

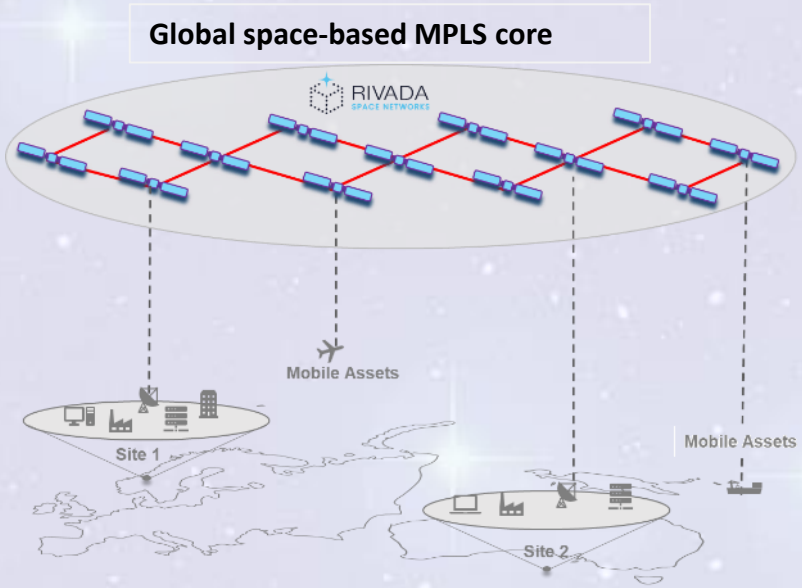


- Only up to 50° latitude
- Low elevation angles in mid to high latitudes
- Obstruction issues



Network Edge over Satellite

- Applicable to all existing and currently planned GEO, MEO, other LEO satellite solutions
- Mostly satellite link serves as (last-mile) local-loop only
- 90% of network connectivity is terrestrial IP VPN or MPLS at best
- Same security and data sovereignty issues as terrestrial IPVPN / MPLS

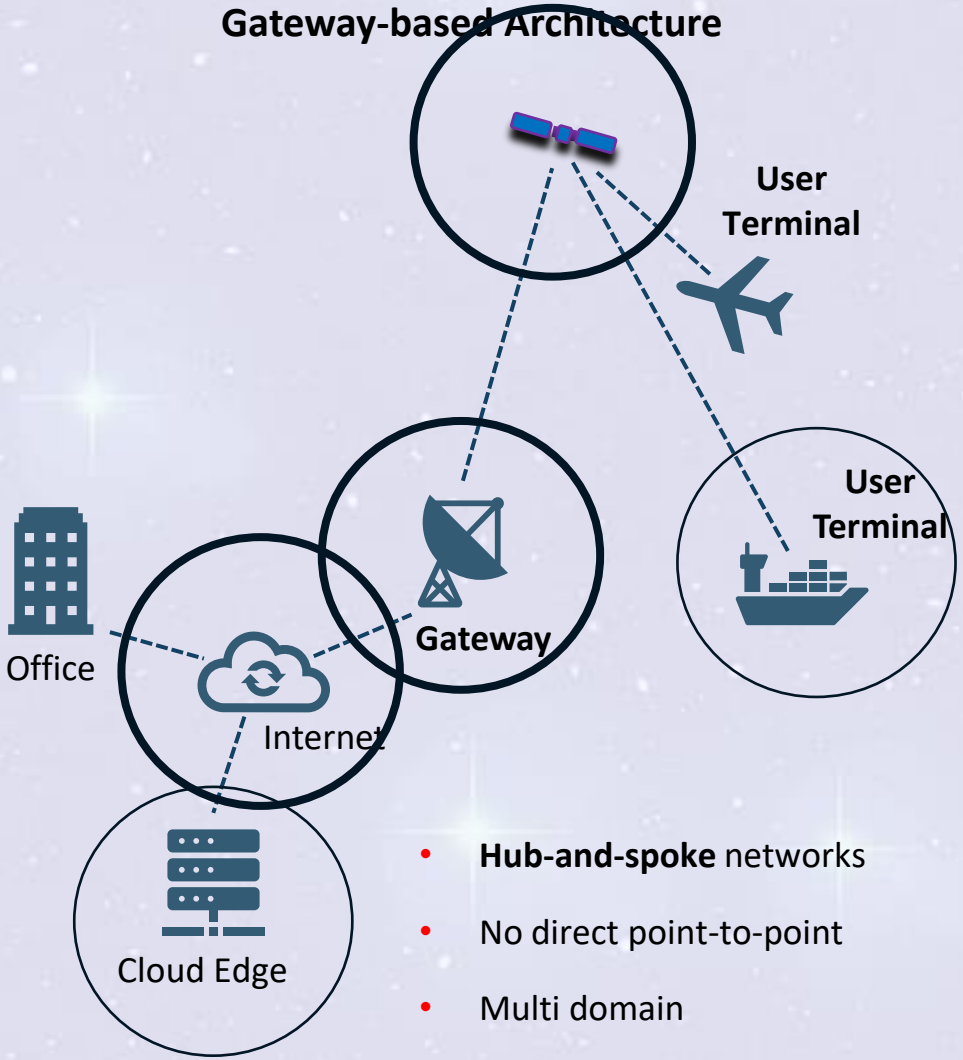


MPLS Core in the Sky

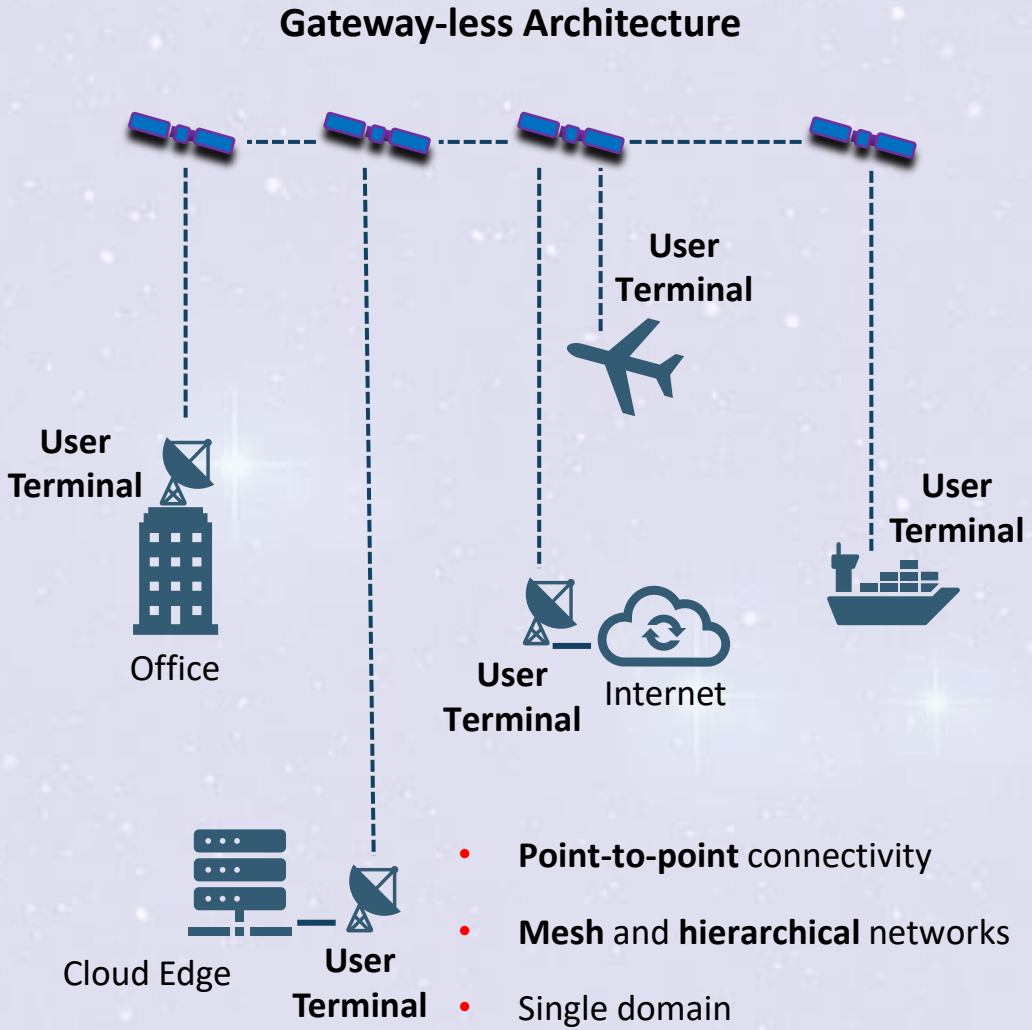
- Full end-to-end MPLS
- Owned and managed by single provider (Rivada Space Networks)
- Earth-to-space local loop feeds directly into space-based MPLS
- Global uniform access to mobile and fixed sites
- Certification as MEF Ethernet service provider allows rapid integration

This is a solution to offer integrated core and edge connectivity over a single private network

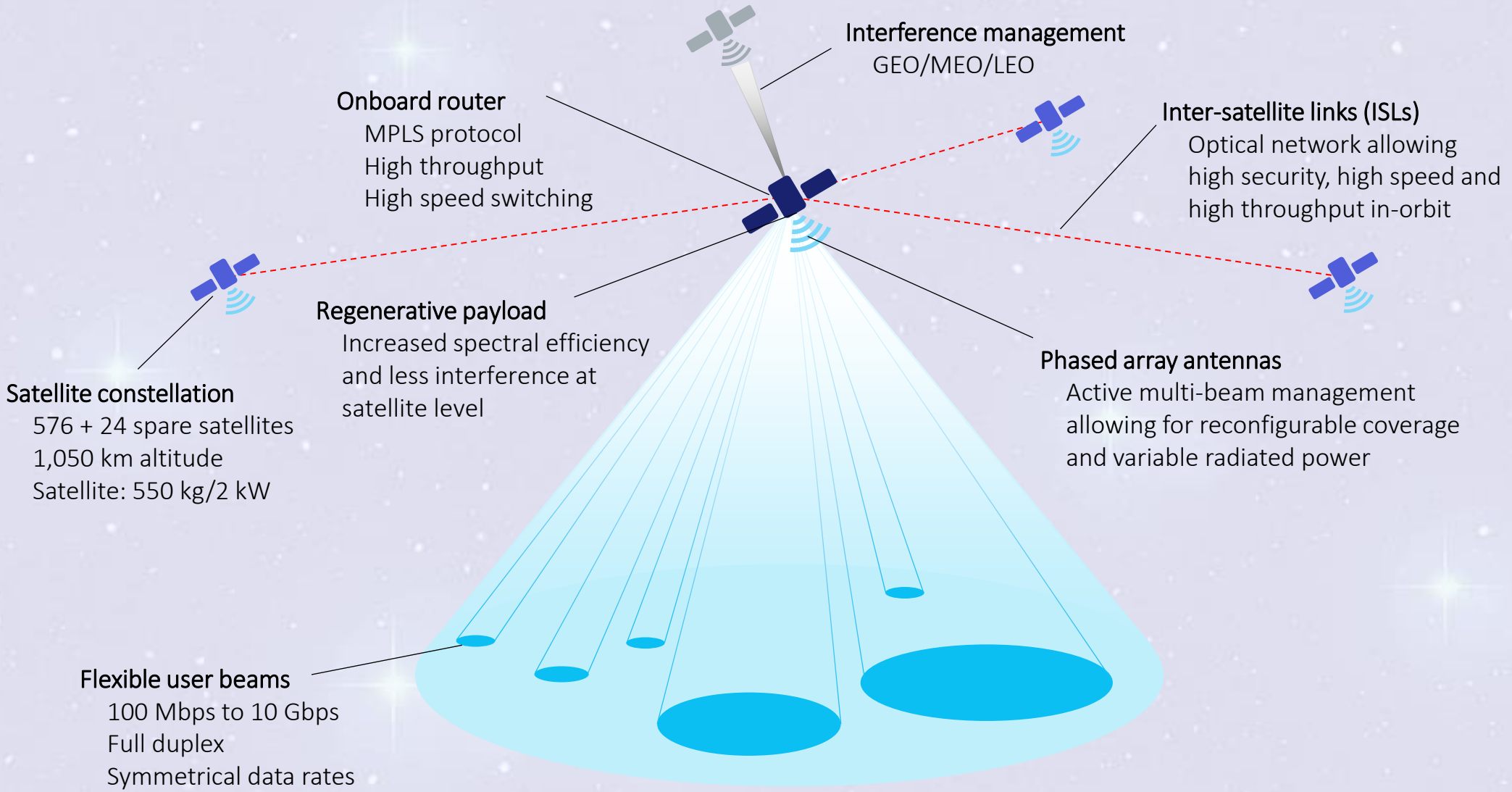
The Dawn of Gateway-less Architecture



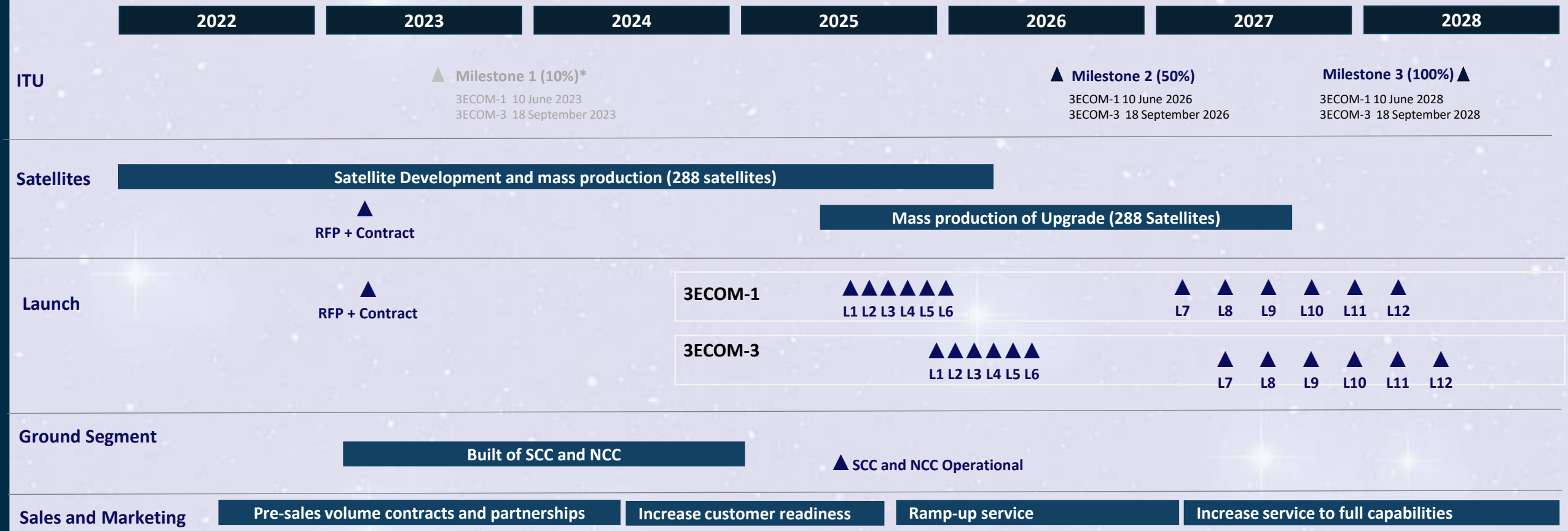
- **Hub-and-spoke** networks
- No direct point-to-point
- Multi domain



- **Point-to-point** connectivity
- **Mesh** and **hierarchical** networks
- Single domain


Interference management
GEO/MEO/LEO
Onboard router
MPLS protocol
High throughput
High speed switching
Inter-satellite links (ISLs)
Optical network allowing high security, high speed and high throughput in-orbit
Satellite constellation
576 + 24 spare satellites
1,050 km altitude
Satellite: 550 kg/2 kW
Regenerative payload
Increased spectral efficiency and less interference at satellite level
Phased array antennas
Active multi-beam management allowing for reconfigurable coverage and variable radiated power
Flexible user beams
100 Mbps to 10 Gbps
Full duplex
Symmetrical data rates

Project Timeline and Schedule 2022-2028



* ITU waived Milestone 1

Conclusion on *Is It Really Necessary?*

RIVADA SPACE NETWORKS

- **In extending reach, quantum repeater / quantum memory is key**
- **still a long way in climbing up the TRLs (Technology Readiness Level)**
- **when on Sats, never underestimate deployment time**
- **commercial success is in the application, not technology**

Confession

RIVADA SPACE SIGNS AGREEMENT WITH SPEQTRAL TO DEVELOP ULTRA-SECURE COMMUNICATIONS

Rivada Space Networks introducing a new low Earth orbit constellation. Credit: Rivada Space Networks

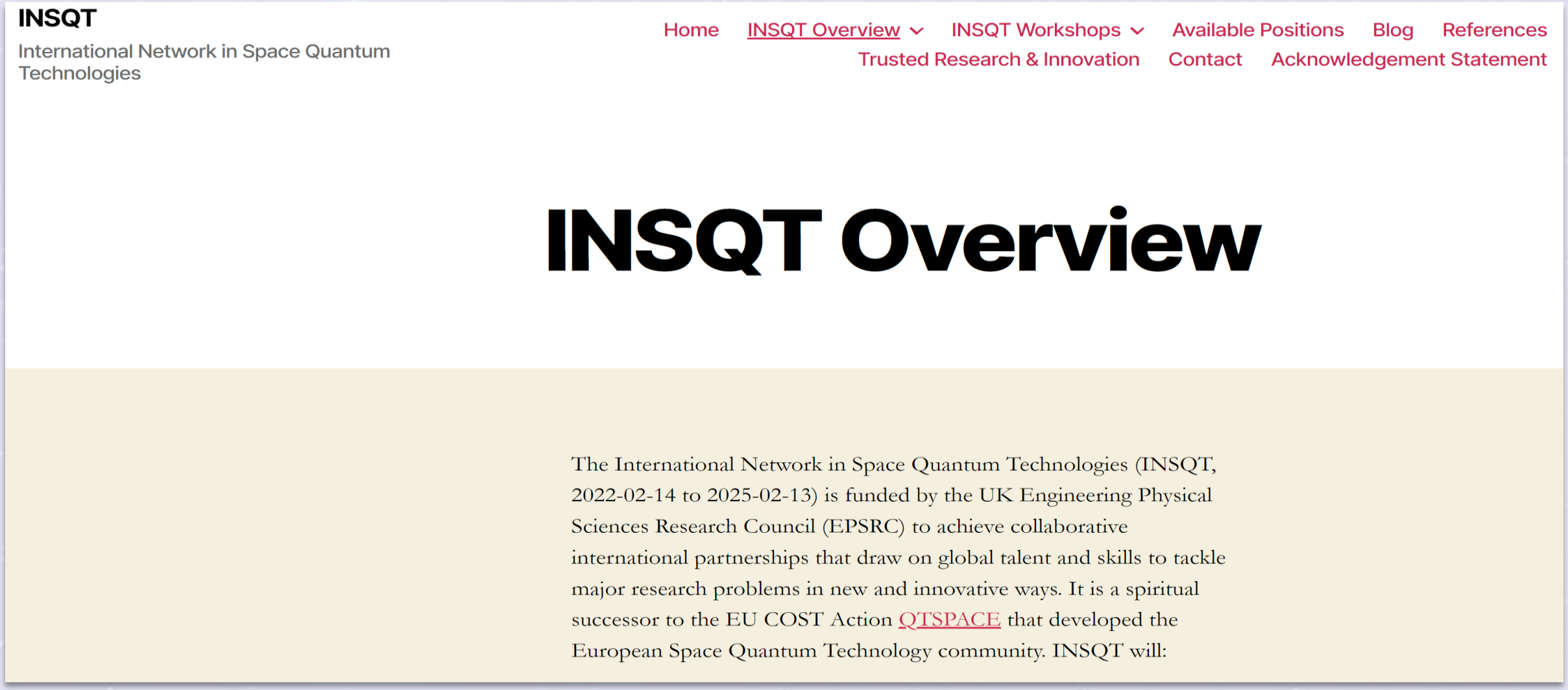
Edinburgh / Seoul,20 October 2022. – Global network company Rivada Space Networks, has signed a partnership agreement with quantum-secure communications systems provider SpeQtral to advance secure, global connectivity for governments and enterprises, Rivada said.

Rivada Space Networks (RSN) has signed a partnership agreement with **SpeQtral**, an emerging company in the area of in quantum-secure communications systems. The two companies announced the deal, Oct. 19.

Via Satellite/Freepik illustration

RSN is partnering with SpeQtral to demonstrate the technical compatibility of adding a QKD encryption layer to enhance the security of communications over LEO satellite constellations. In 2024, RSN will start the launch of its 300 satellite laser-connected constellation with four precursor satellites and SpeQtral will launch its QKD satellite, SpeQtral-1. This will allow RSN and SpeQtral to jointly establish quantum-secure data links over the RSN precursor satellites and validate both the space and ground station terminals required for QKD-enabled encrypted traffic on the RSN's constellation.

Recommendation



INSQT

International Network in Space Quantum Technologies

Home | INSQT Overview | INSQT Workshops | Available Positions | Blog | References | Trusted Research & Innovation | Contact | Acknowledgement Statement

INSQT Overview

The International Network in Space Quantum Technologies (INSQT, 2022-02-14 to 2025-02-13) is funded by the UK Engineering Physical Sciences Research Council (EPSRC) to achieve collaborative international partnerships that draw on global talent and skills to tackle major research problems in new and innovative ways. It is a spiritual successor to the EU COST Action QTSPACE that developed the European Space Quantum Technology community. INSQT will:

Thank you!