Low Latency Global Point-to-Point Connectivity Realised with Optical Intersatellite Links

A System Overview

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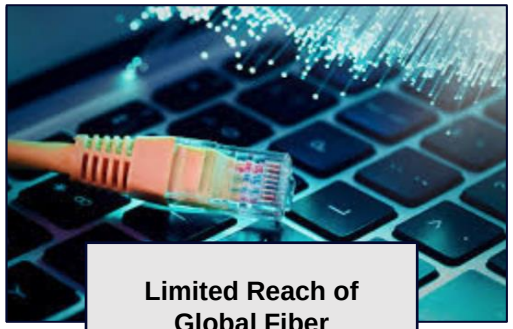
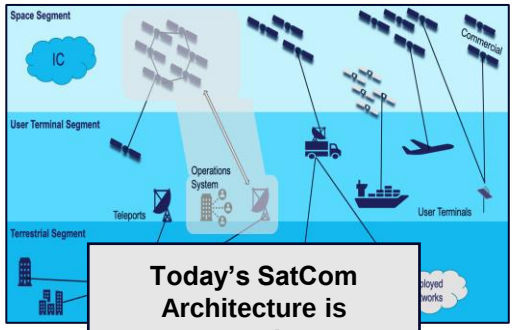
EPIC Meeting on Photonics at the Final Frontier at ESA

These are today's Data Communication Challenges

Well beyond Connecting the Unconnected, well beyond Satellite



Limited Reach of Global Fiber



Today's SatCom Architecture is Complex

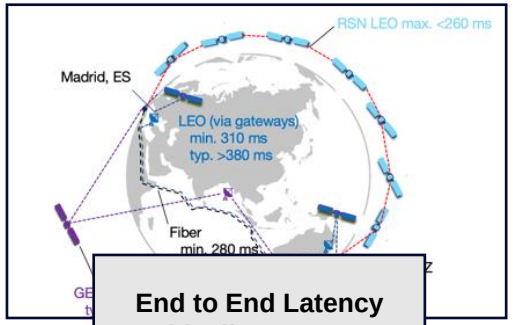
Polar Coverage of Geopolitical Importance

Growing Intelligence, Surveillance and Reconnaissance (ISR) Requirements

Fragmentation of Global Infrastructure

Data Dependency Tightening Implementation Times

Security, Security, Security



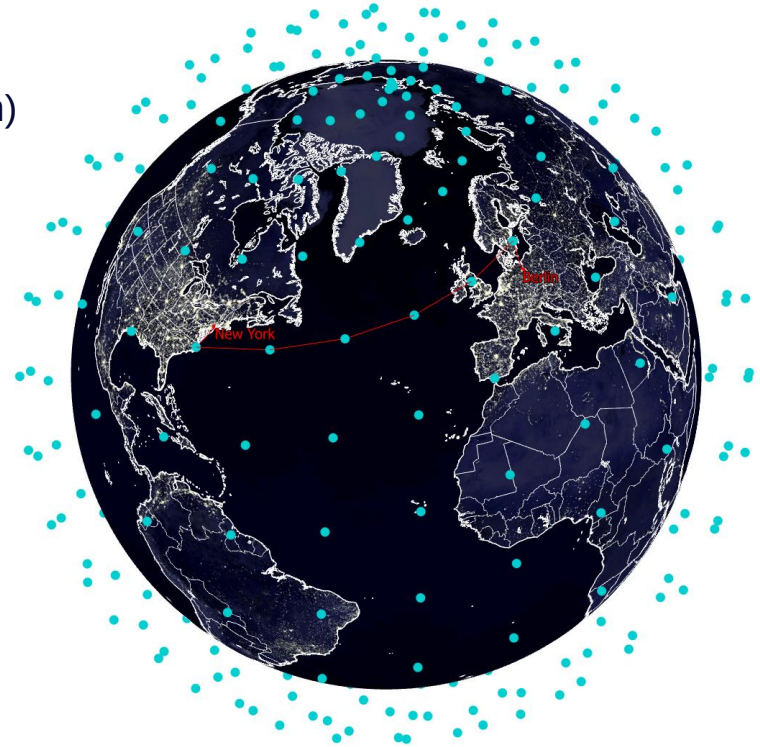
End to End Latency Critically Important

The world is looking for solutions - Rivada Space Networks is building it.

Our Constellation - Overview

Low Earth Orbit Satellite Constellation

- 2 x 300 = 600 satellites interconnected via laser links (ISL)
- Ka-Band frequencies (Liechtenstein spectrum)
- B2B and B2G connectivity services
- First satellite launch in 2025
- Service start in 2026



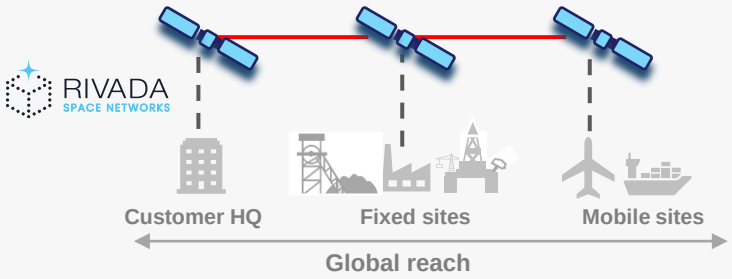
Value Proposition

- High data throughput
- Global point-to-point connectivity
- Ultra-low latency
- High security, data sovereignty
- Network transparency (MPLS)

Yet another Earth Orbit Constellation?

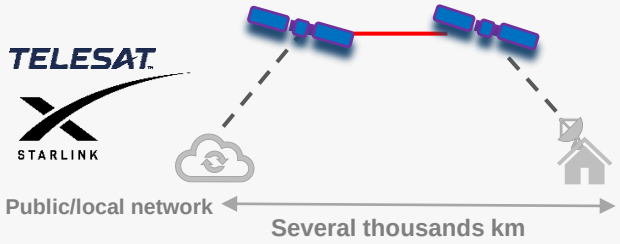
RIVADA SPACE NETWORKS

LEO Global End-to-end connectivity



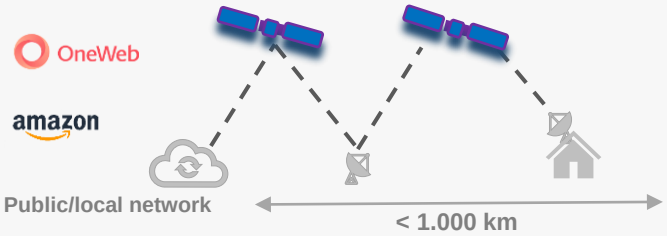
- Optimized for **Enterprise and Government applications**
- Point-to-point connectivity oriented
- Uses ISL for global premise-to-premise connectivity
- Full duplex symmetrical up- and downlink
- High data rates (from 100 Mbps to 10 Gbps per link)
- True global coverage (pole to pole, all oceans)

LEO Last-mile to gateway with laser extension



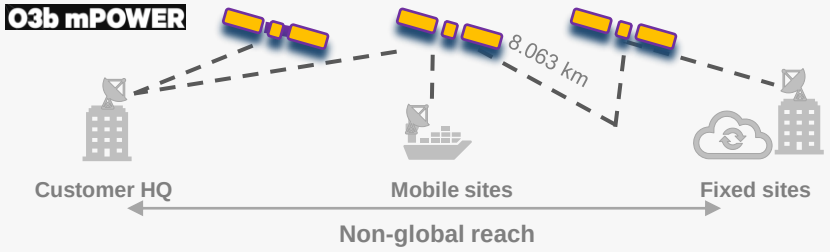
- Optimized for **consumer applications**
- Internet access oriented
- Uses ISL to extend reach of gateways
- Asymmetrical up- and downlink (download focused)
- Last mile connectivity to nearest Internet gateway
- No polar coverage, blind spots in the sea

LEO Last-mile to gateway



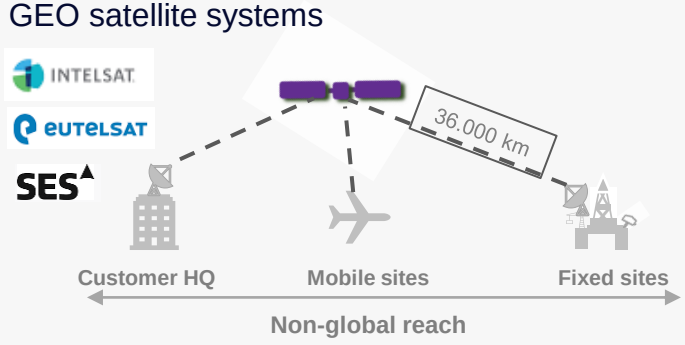
- Optimized for **consumer applications**
- Internet access oriented
- Gateway-hopping, no ISL
- Asymmetrical up- and downlink data rate
- Last mile connectivity to gateway
- No global coverage, no connection to most ocean areas

MEO satellite systems



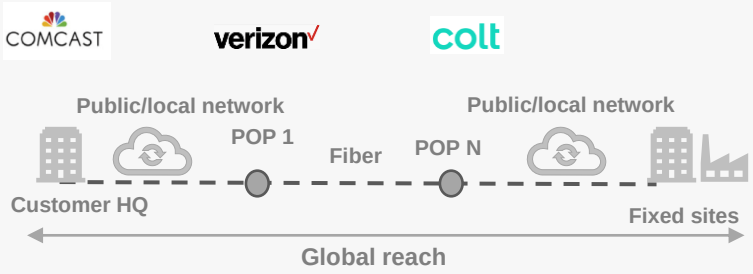
- Constraint **business applications**
- Asymmetrical up- and downlink data rate (~100 Mbps)
- Higher latency, lower service level, lower security
- No polar coverage

GEO satellite systems



- Optimized for **consumer applications**
- Last mile connectivity to nearest Internet gateway
- Beam hopping
- Asynchronous Up- and downlink data rate (>100 Mbps)
- No polar coverage

Terrestrial solutions (fiber, dark fiber)

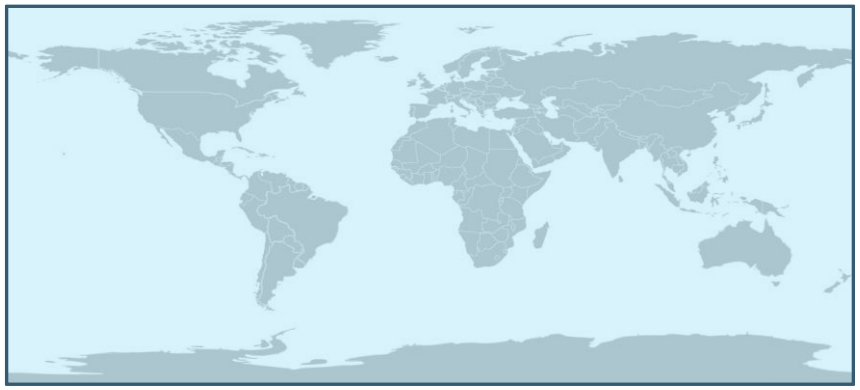


- Optimized for **business applications**
- Last mile connectivity to nearest Internet gateway
- Patchwork infrastructure
- Higher latency, lower service level, lower security

Our Value Proposition

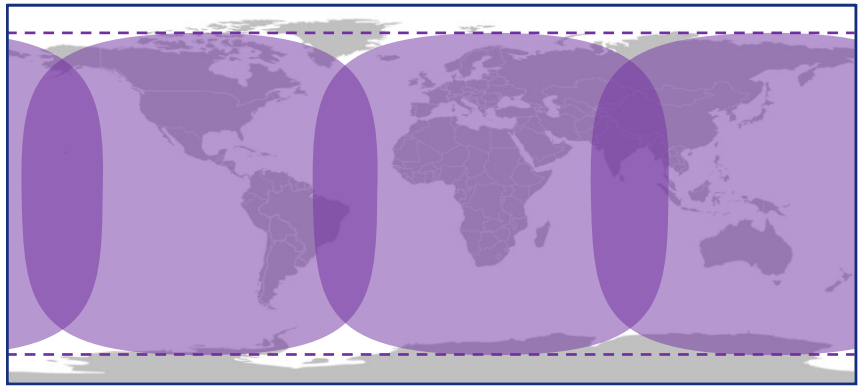
A Different Satellite Network – Truly Global

Rivada Space Networks LEO
Global



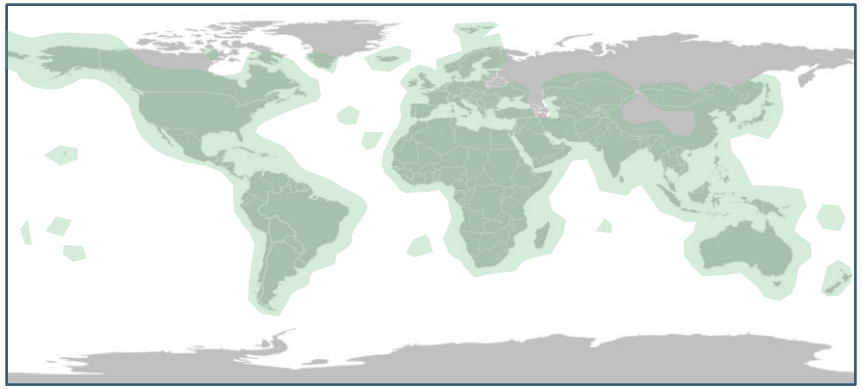
- Truly global coverage
- Pole-to-pole
- Open oceans
- Independent of terrestrial infrastructure

GEO
Up to 60-70° lat.



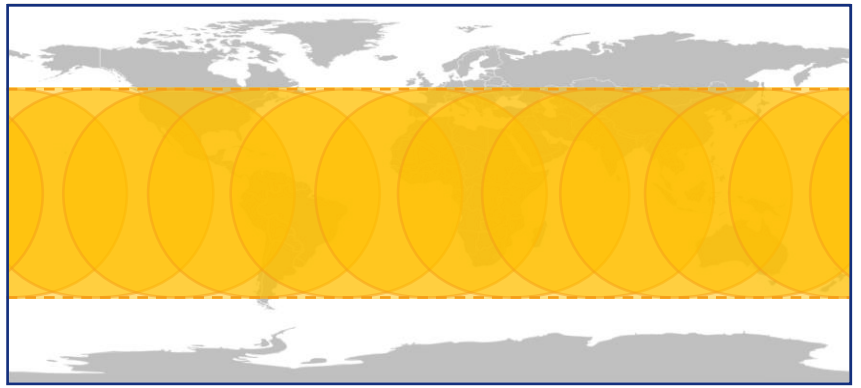
- Only up to 60-70° latitude
- Low elevation angles in high latitudes
- Obstruction issues

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

Ground Segment

Antenna Solutions: Purpose Fit for any Enterprise Applications

Smart User Terminals

- Modular design to provide various user classes (size, power and platform)
- Autonomous and smooth switching between beams or satellites, without loss of connection
- High-security using encryption on all space-to-ground links and support for additional user-level security protocols
- Variable QoS settings to support customers SLAs for priority, performance, capacity, data rates, and other service standards
- Potential integration with terrestrial systems (4G, 5G)

Active phased array antennas
For land mobile, maritime, aviation

Passive phased array antennas
For fixed locations up to 100 Mbps

Legacy technology antennas
For fixed locations with high throughput - Maritime, infrastructure, gateways

Space Segment

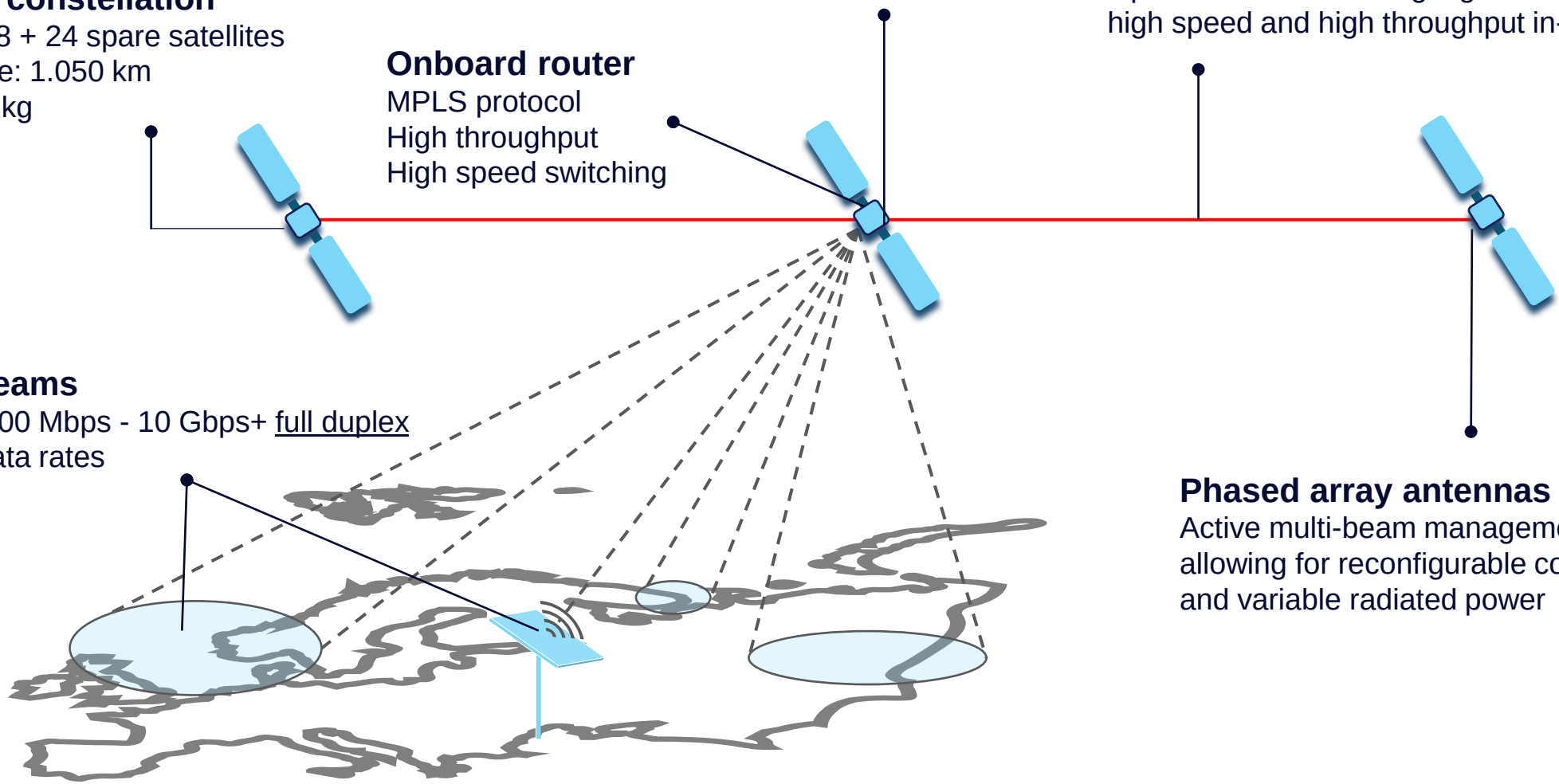
Core technologies

Regenerative payload
Increased spectral efficiency and less interference at satellite level

Satellite constellation
- 2 x 288 + 24 spare satellites
- Altitude: 1.050 km
- ~ 400 kg

Onboard router
MPLS protocol
High throughput
High speed switching

Intersatellite links
Optical network allowing high security, high speed and high throughput in-orbit



Flexible user beams
- Up-/downlink 100 Mbps - 10 Gbps+ full duplex
- Symmetrical data rates
- Ka-Band

Phased array antennas
Active multi-beam management allowing for reconfigurable coverage and variable radiated power

Value Proposition

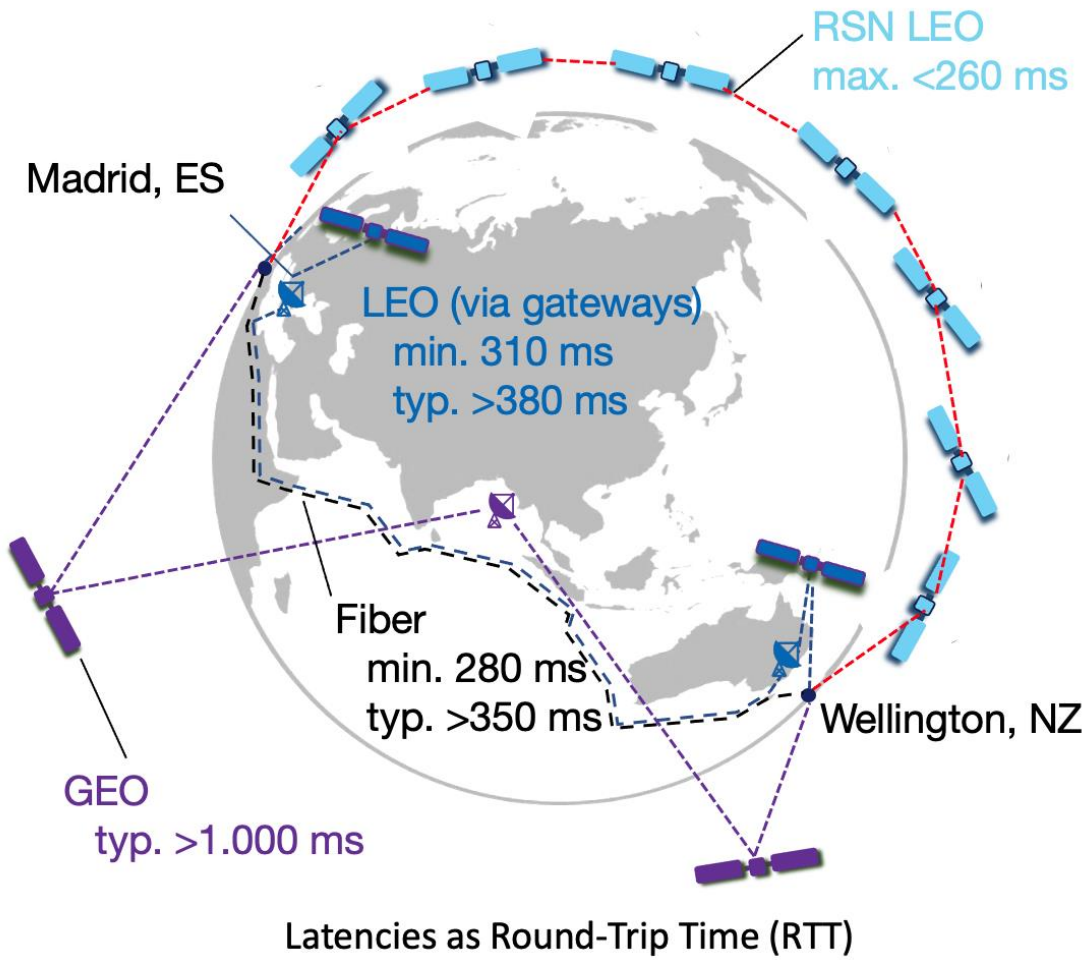
A near - but not that near Satellite Network – Fast and Secure

The property: ultra low latency

- **35x times closer** than GEO
- **50% faster** in vacuum than in fiber optic cable
- **Efficient shortest path** with optical intersatellite links
- Typical RTT <150 ms
- RTT < 25 ms up to 1000 km distance

The value: highest security

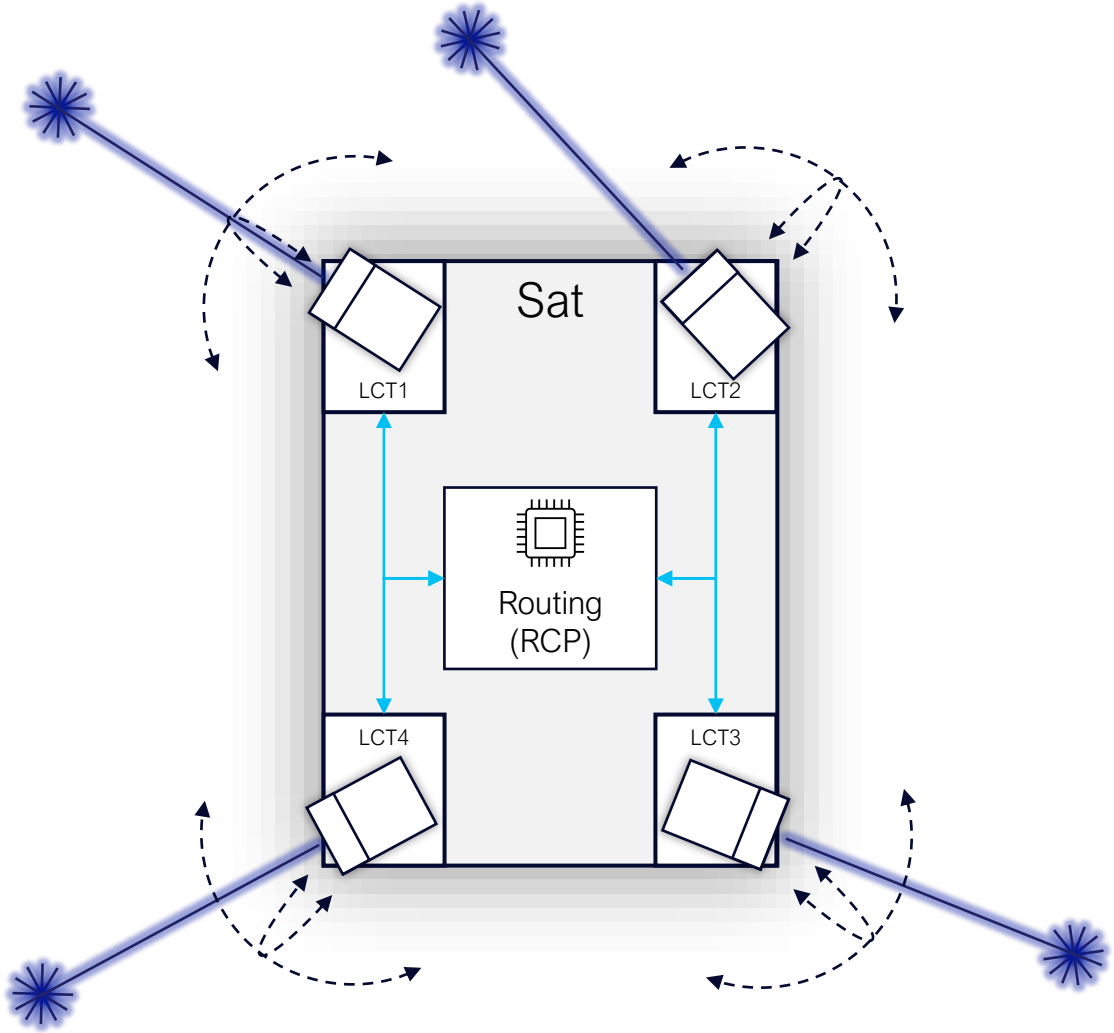
- **Focused radio transmissions** thanks to narrow spot-beams
- **Resilient against cyberthreats** thanks to optical intersatellite links
- **Security and data sovereignty** in a single end-to-end network
- **Separation** from the Internet and other public and private networks



Optical Intersatellite Links

Baseline Configuration

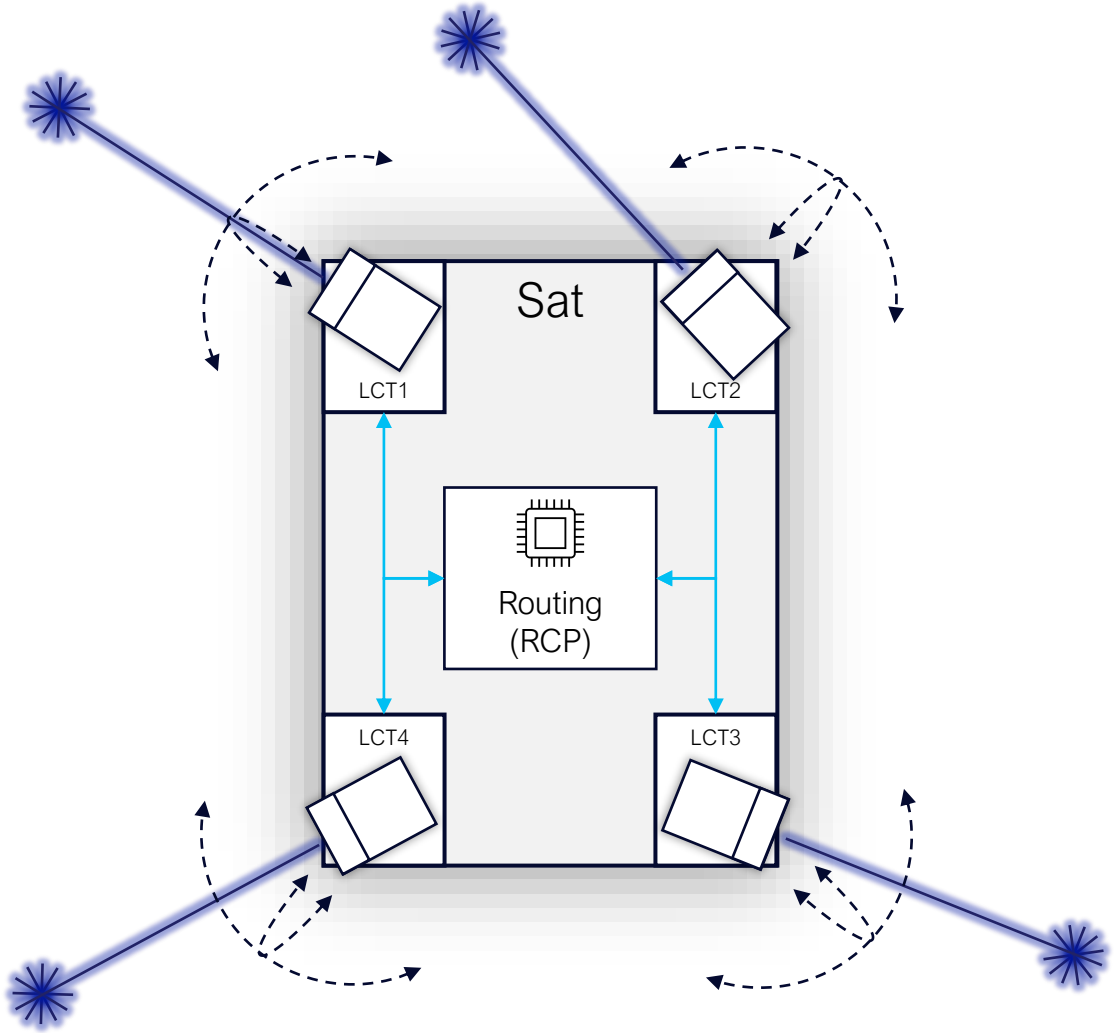
- Each satellite equipped with four independent Laser Comm Terminals (LCT)
- Up to 1176 steady point-to-point links
- Automated tracking of the relative movement of connected satellites
- Full-duplex optical links with 10 Gbps and more connected to the on-board Router (RCP)
- Upcoming generations aim for 100 Gbps
- Laser links bridge distances from ~450 up to ~7000 km



Optical Intersatellite Links

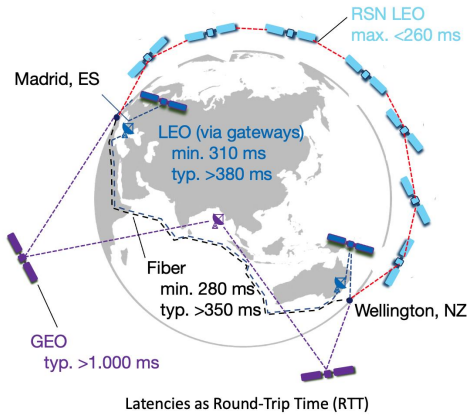
Benefits

- Narrow beam –
  physically secure end-to-end user links
- Substitutes a ground station based bent-pipe approach
- Lowest impact on propagation delay compared to bent-pipe and/or fiber backbone (in space: n = 1)
- High link redundancy



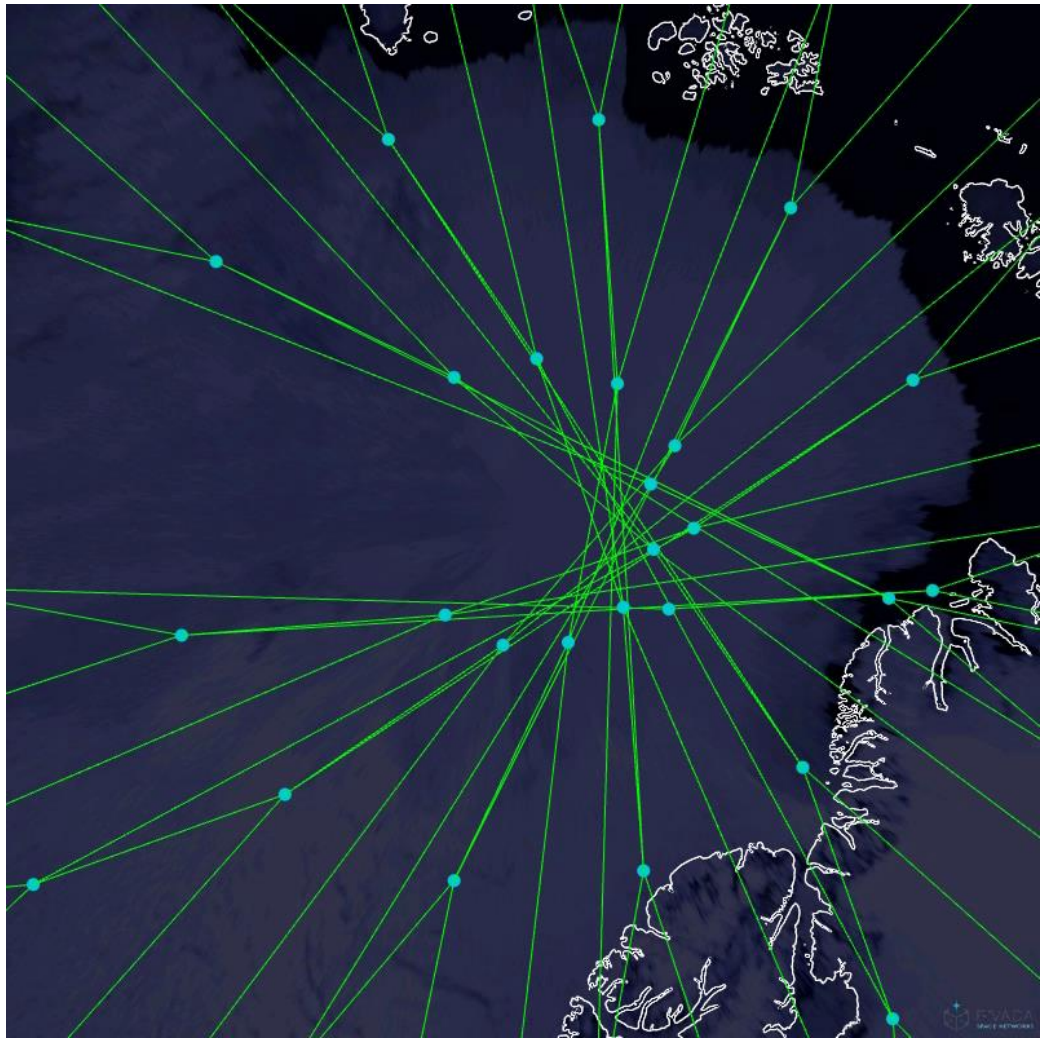
Optical Intersatellite Links - Dynamics

Shortest Path Connection Visualization – Santiago de Chile to Seattle



Optical Intersatellite Links - Dynamics

“Polar Satellite Ballet”
and node swap



Thank you

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