

NTN DAYS | CNAM | KEYNOTE



From Vision to Validation:

Univerty's 5G NTN Journey

Architecture. Emulation. End-to-end testing.



Space is **the new frontier** for telecommunications

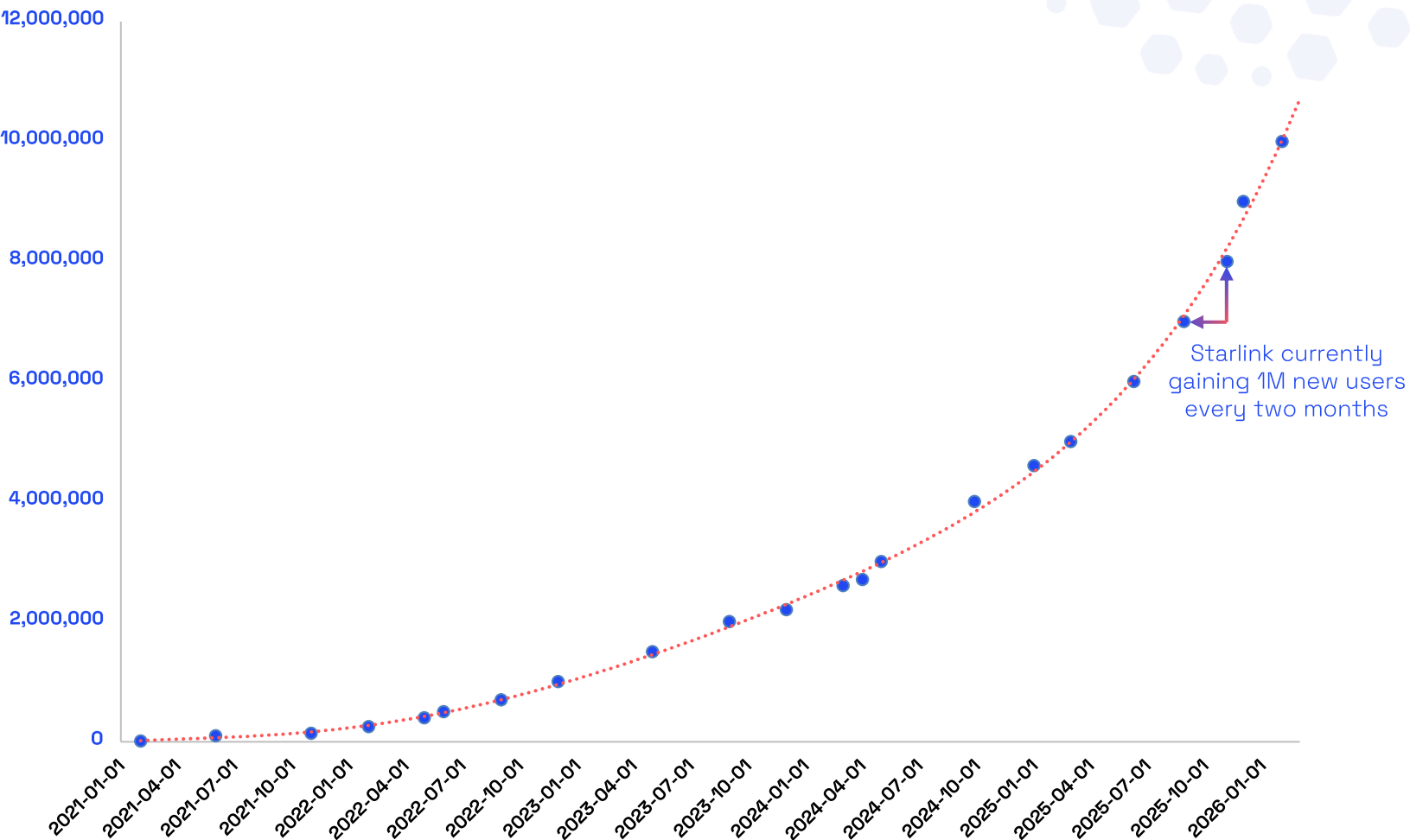
For the first time in history, with the advent of **very innovative low earth orbit constellations, internet services from space** are at a price point and a quality of service that **compete with terrestrial telecommunications networks**. This is **disrupting** the trillion-dollar telecom industry.

A massive new market opportunity is emerging for terrestrial telecom operators to serve anyone who cannot be cost effectively addressed through fiber and cellular networks.



New telecom players capturing customers and spectrum

Number of Starlink users



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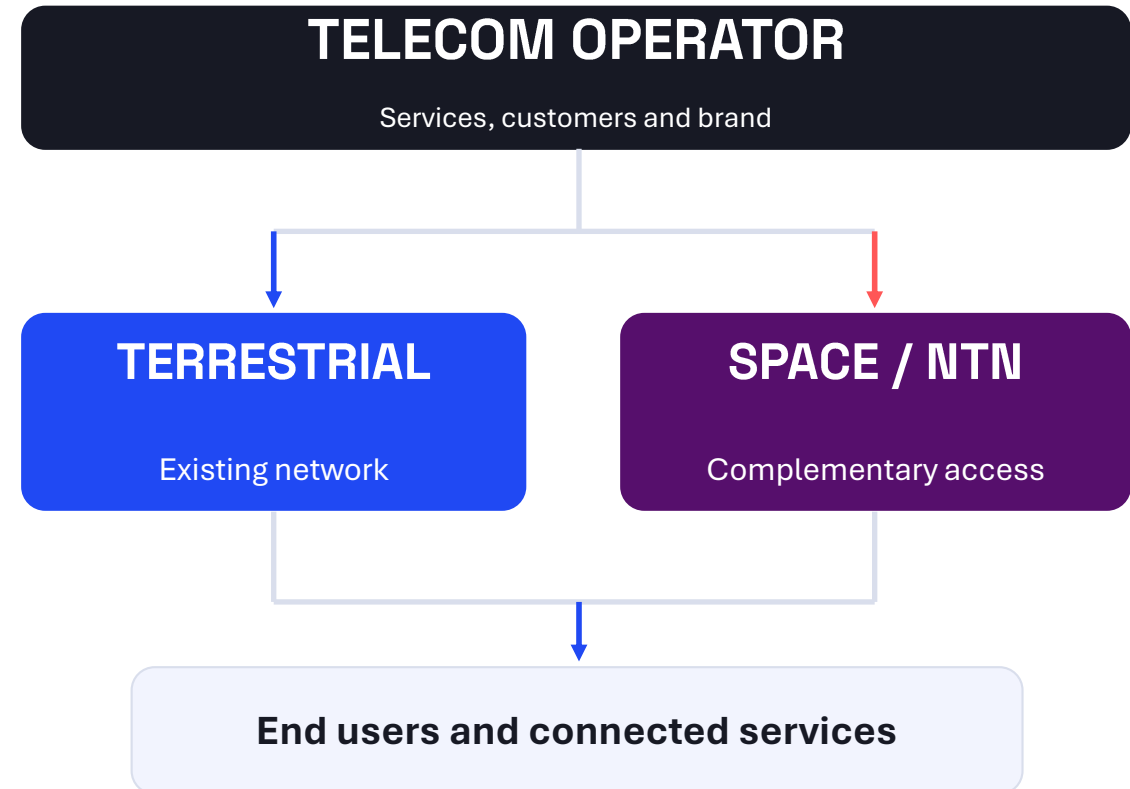
Space as an extension of the operator network



THE VISION / OPERATOR-LED CONNECTIVITY

**A new access layer.
The operator keeps
the customer
relationship.**

Neutral, shared satellite infrastructure
complementing terrestrial coverage.

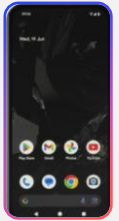


TECHNICAL FOCUS

Broadband 5G NTN using mmWave spectrum and TDD.

The Space Wholesale Infrastructure for Telecom Operators

Competitive* high speed / low latency internet services for all connectivity use cases delivered by one single capacitive infrastructure



5G S-band

Internet services delivered
Direct-to-Cells

- 1-10Mbps ↓↑ over smartphones
- < 30ms latency
- 3GPP-compliant



5G mmWave-band

Internet services delivered
over electronically steerable antennas.

- 150Mbps↓ / 50Mbps↑ over a user terminal
- < 30ms latency
- Compact cost-effective user terminal

RF spectrum strategy (User link)



5G S-band (“2 GHz”)

Internet services delivered
Direct-to-Cells

1920-2010 MHz
FDD* uplink ↑

Telecom operators’
spectrum (n1)
1920-1980
MHz

MSS**
spectrum
(n256)
1980-2010
MHz

2110-2200 MHz
FDD * downlink ↓

Telecom operators’
spectrum (n1)
2110-2170
MHz

MSS**
spectrum
(n256)
2170-2200
MHz

*FDD: Frequency Division Duplexing

**MSS: Mobile Satellite Service



5G mmWave-band (“26 GHz”)

Internet services delivered
over electronically steerable antennas.

24.25 – 27.5 GHz
TDD*** uplink / downlink ↓↑

Telecom operators’
spectrum (n258)

***TDD: Time Division Duplexing

Three programs. Different validation questions.

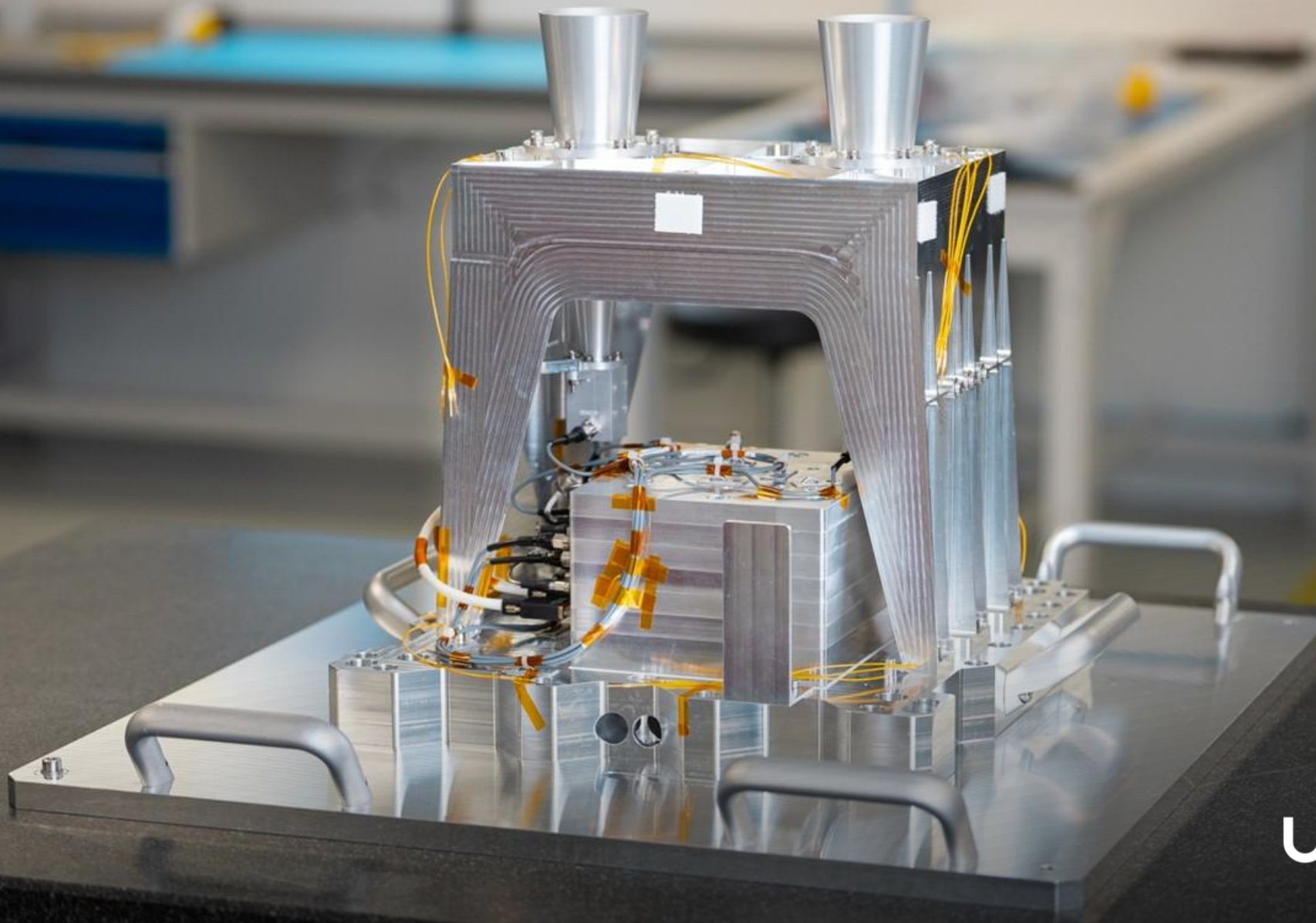


THE JOURNEY / PROOF, INTEGRATION, INDUSTRIALISATION



Digital Twin

Exercise constellation networking and routing without flying hardware.



uniSpark
by univity

TDD at orbital velocity is a system problem



THE BUILDING BLOCK / MMWAVE + REGENERATIVE 5G + TDD

26 GHz

One carrier, time-shared between downlink and uplink — on a continuously moving link.

SCHEMATIC TDD ALTERNATION



Illustrative only - not a waveform or timing specification.

01 Changing distance

Changing range → track propagation delay.

02 Orbital motion

Relative velocity → track Doppler shift.

03 Alternating transmission

DL/UL switching → align time and frequency.

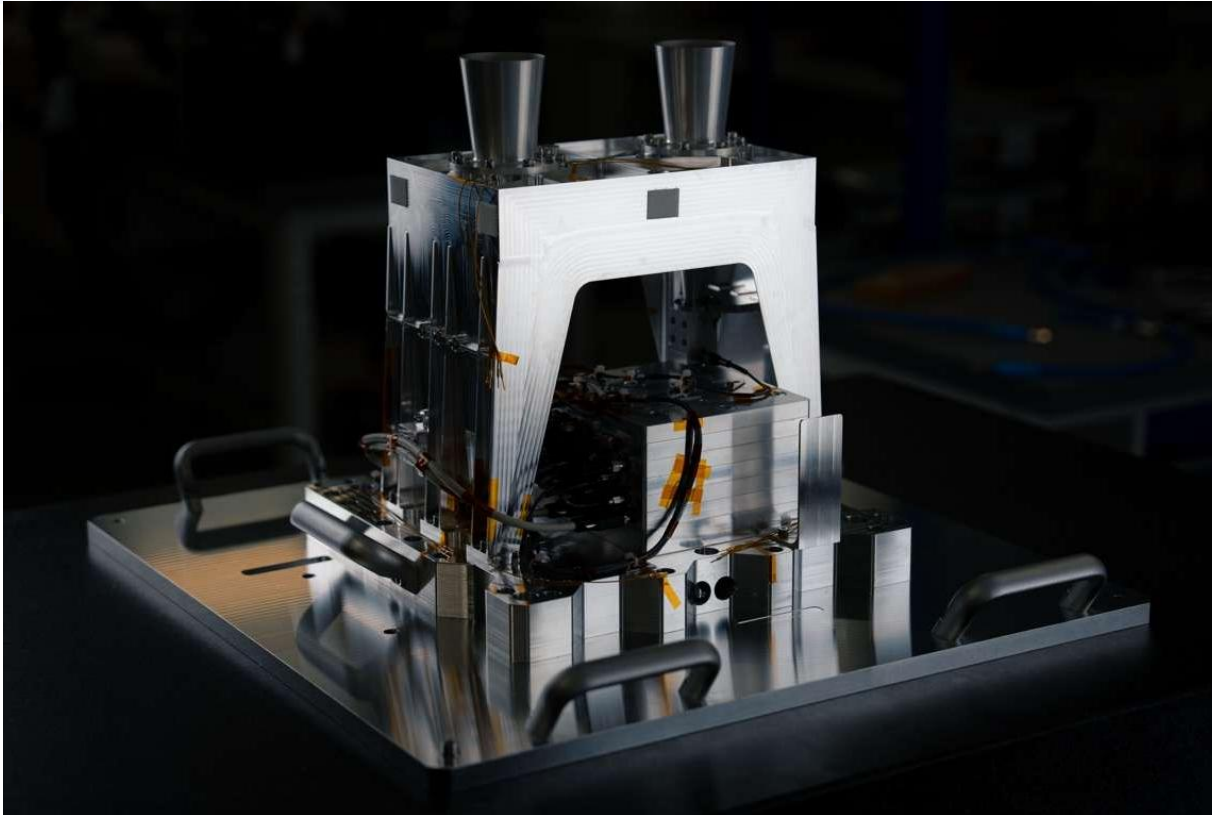
THE CHALLENGE

Adapt terrestrial TDD to a link whose range, Doppler and timing change continuously.

uniSpark proves regenerative 5G NTN over 26 GHz TDD in orbit



IN-ORBIT RESULT / ANNOUNCED 9 SEPTEMBER 2026



uniSpark payload assembled at D-Orbit. Photo: Hugo Brems / UNIVITY, 2025.

01 Onboard regenerative 5G

A 5G base station runs onboard, processing traffic in orbit instead of acting as a bent-pipe relay.

02 26 GHz mmWave in TDD

Uplink and downlink share one spectrum resource, requiring precise time/frequency sync plus delay and Doppler compensation.

03 Standard 5G core registration

The ground terminal synchronized and registered as a 5G device on a standard core using a terrestrial-like TDD protocol.

The milestone is a complete connection



UNISPARK / STEP-BY-STEP VALIDATION AT CNES



uniSpark ground test campaign, CNES rooftop, Toulouse. Photos: CNES, 2025.



01 Synchronize

Time and frequency



02 Register

5G terminal and core



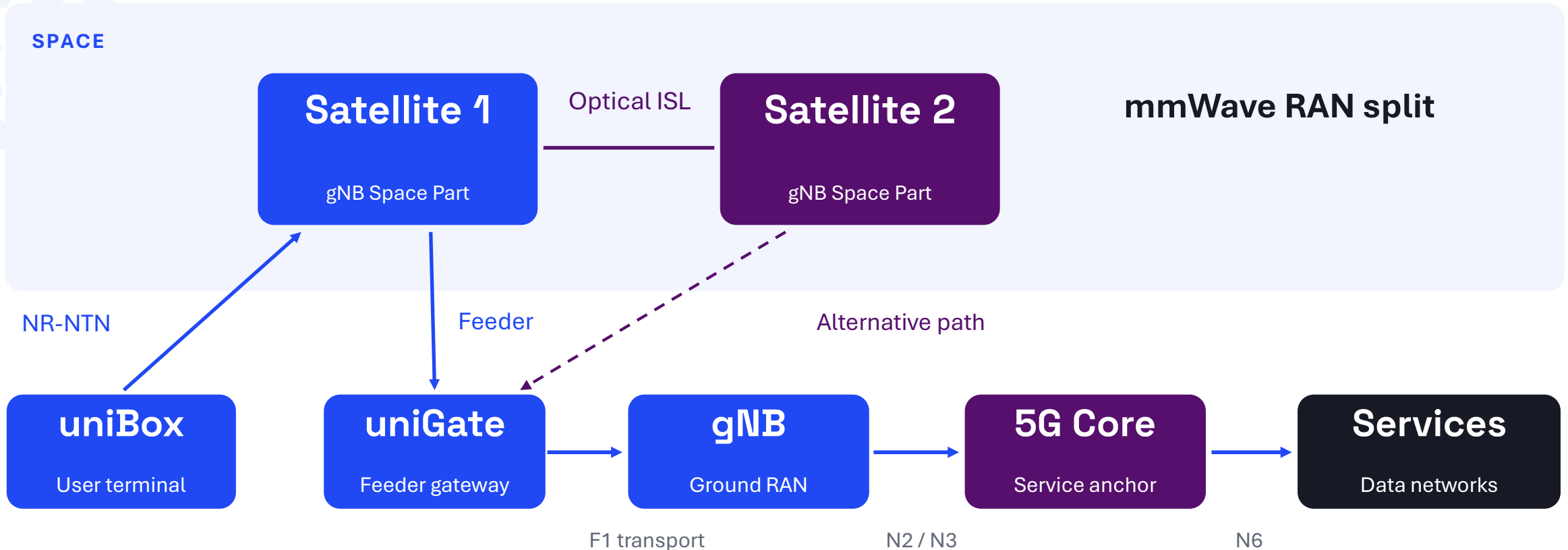
03 Exchange data

Bidirectional link

uniShape: from link proof to a representative system



DEMONSTRATOR DESIGN / TWO SATELLITES + ASSOCIATED GROUND SEGMENT



INTEGRATION

RAN, transport, core and mission operations must work as one chain.

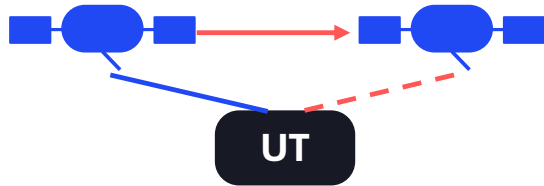
Continuity is tested when the network changes



UNISHAPE / END-TO-END VALIDATION OBJECTIVES

VALIDATION OBJECTIVE

Satellite handover



Can a session survive a satellite handover?

VALIDATION OBJECTIVE

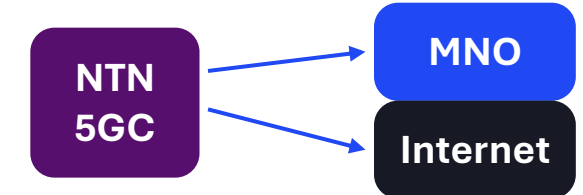
Feeder / ISL rerouting



Can traffic recover after a path change?

VALIDATION OBJECTIVE

Operator interoperability



Can service reach Internet and partner networks?

EVIDENCE

Session state, packet delivery and recovery behavior - not signal strength alone.

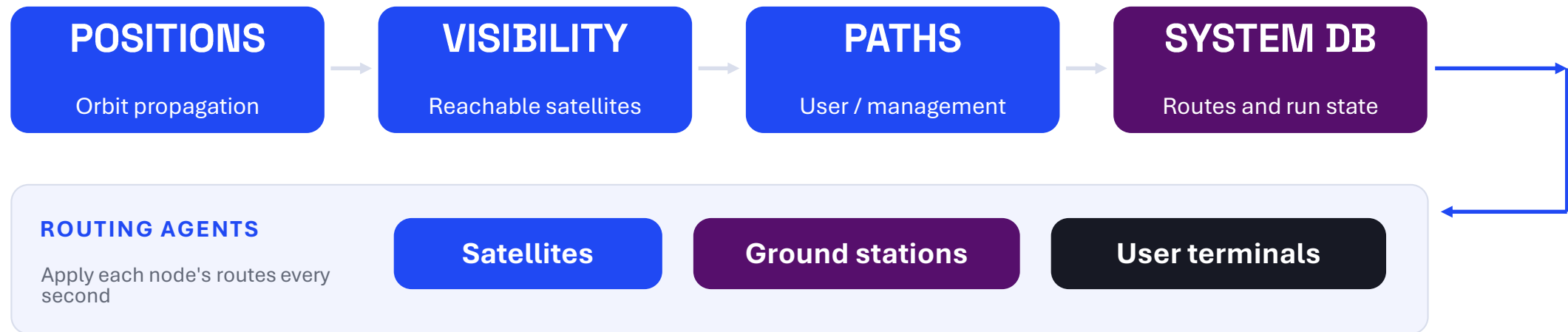
The Digital Twin turns orbital geometry into routes



NETWORK EMULATION / A LIVE CONTAINERISED CONSTELLATION

One container = one network node

Satellites, ground stations and user terminals carry traffic over geometry-driven routes.



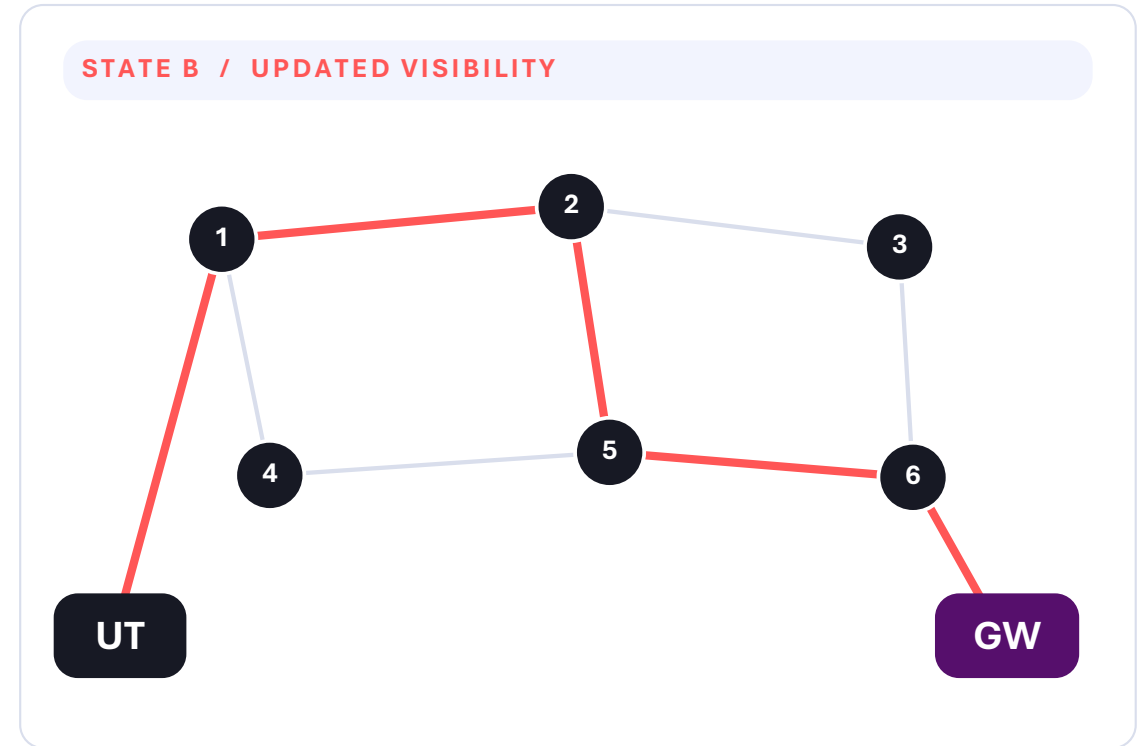
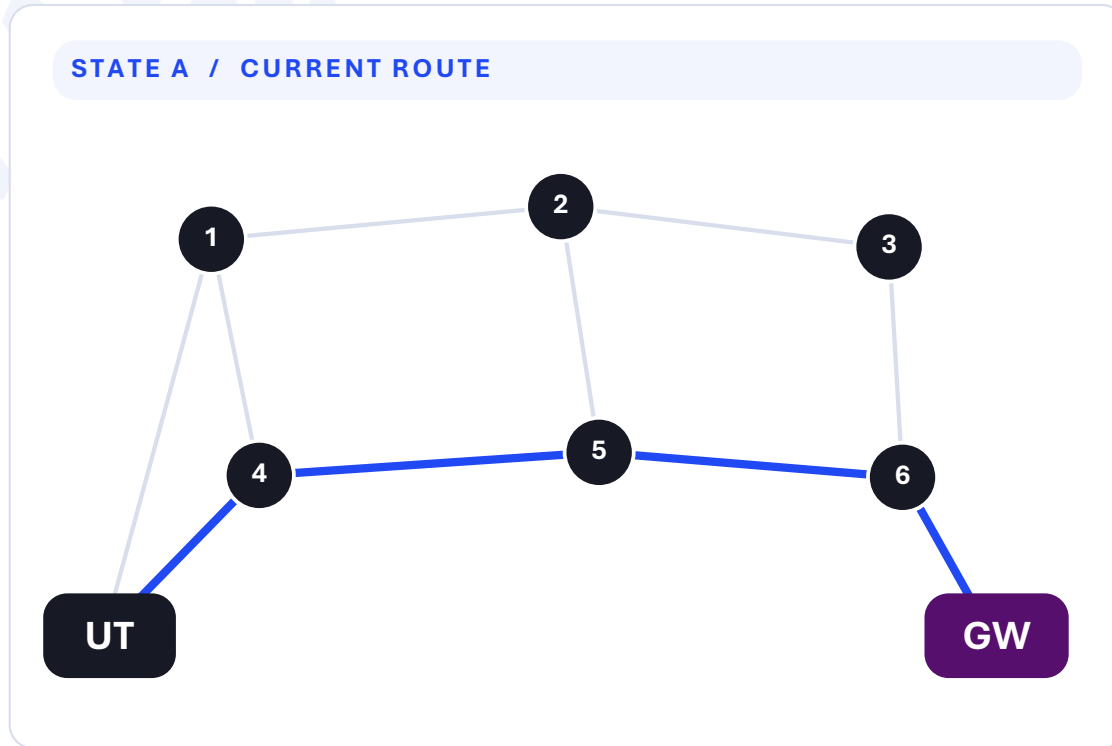
VISIBILITY

3D scenario view plus network reachability, interfaces and resource monitoring.

A changing topology becomes a changing packet path



DIGITAL TWIN / ROUTING FOLLOWS VISIBILITY AND GEOMETRY



Illustrative topology and paths - not measured positions or a captured test run.

EXECUTION LOOP

Compute the next state. Distribute routes. Apply forwarding rules. Observe.

Repeatable deployment supports repeatable experiments



DIGITAL TWIN / DEFINE, DEPLOY, OBSERVE

01

Define

Orbital definitions
Ground assets and users
Scenario and run state

MySQL / SDB

02

Deploy

OpenStack VMs
One VM per orbital plane
One container per node

Terraform / cloud-init / Ansible

03

Observe

3D constellation and links
Reachability and interfaces
Resource use / run control

Web UI / LibreNMS / SNMP

REPEATABILITY

Versioned definitions and deployment automation make configurations explicit.

From dynamic routes to end-to-end 5G service tests



INTEGRATION PATH / FULL-STACK LABORATORY SCENARIOS UNDER STUDY

NETWORKING ENVIRONMENT

Digital Twin

Orbital geometry
Visibility and routes
Live packet forwarding
Network monitoring

--->
Integration
path

5G TESTBED OBJECTIVE

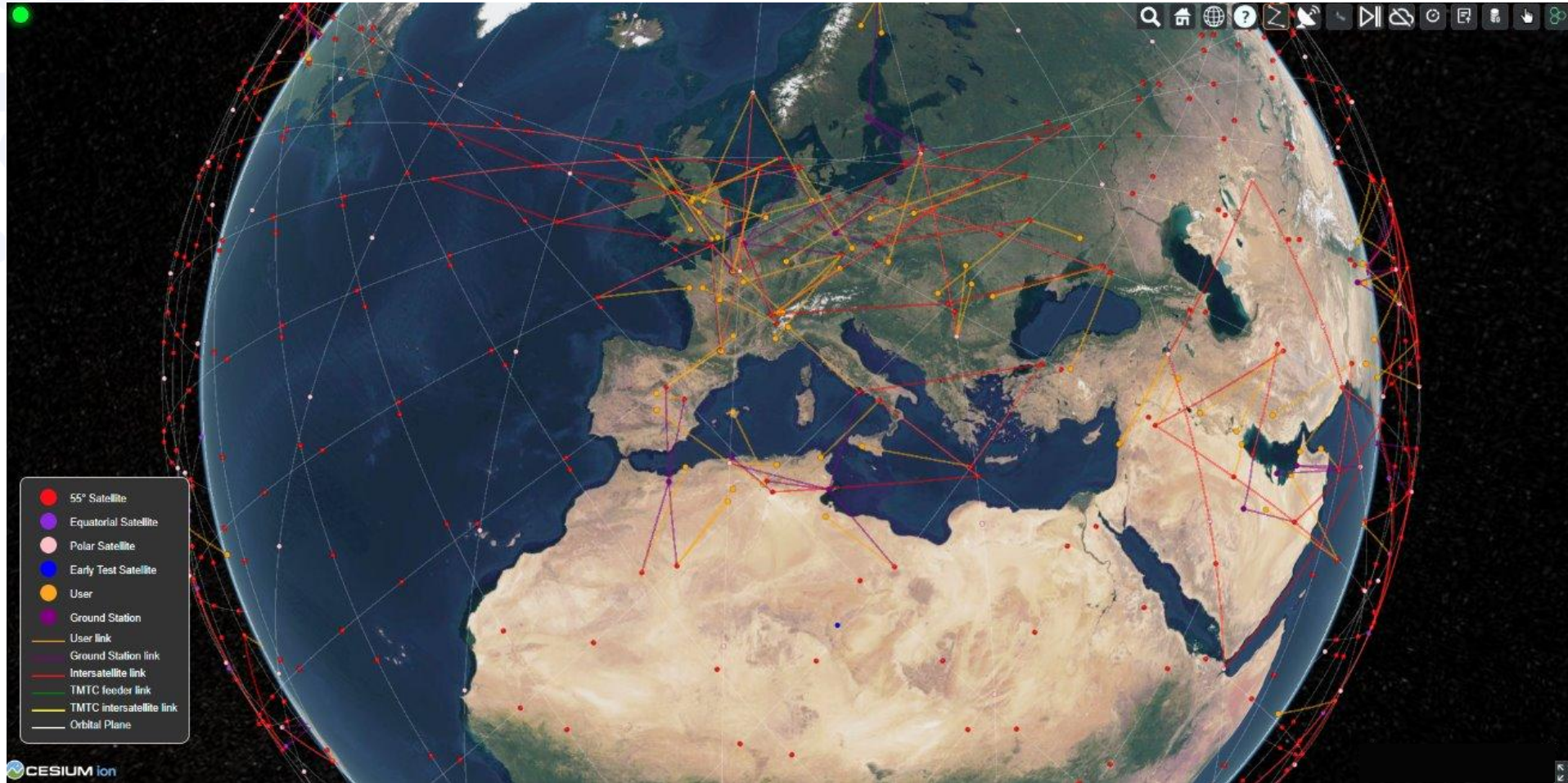
UE + gNB + 5G Core



Registration | Sessions | QoS | HR / LBO

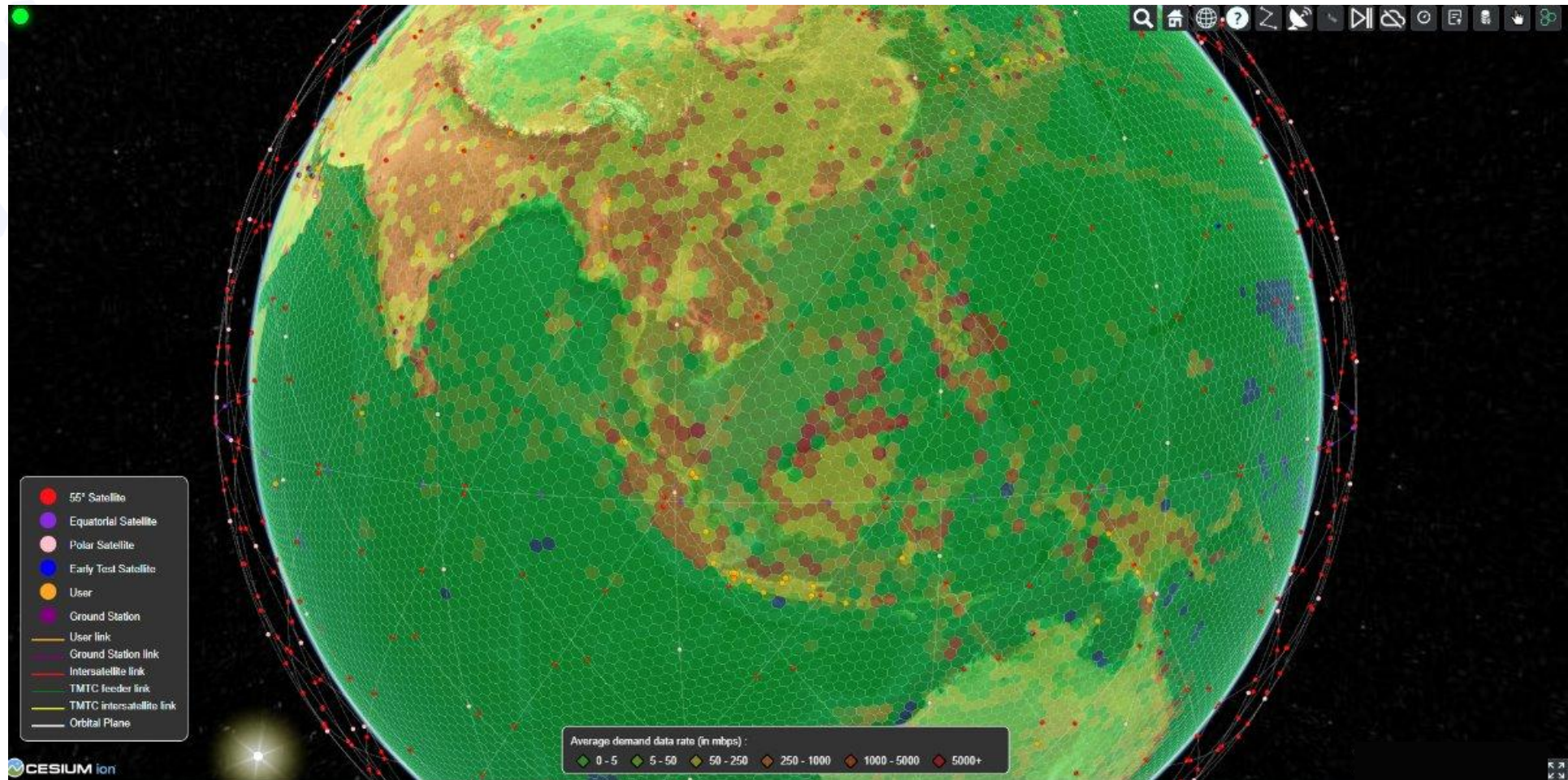
VALIDATION BOUNDARY A routing twin is not, by itself, proof of RF behavior or complete 5G interoperability.

Digital Twin GUI



GUI

Cesium ION is used to display and interact with all these elements



GUI

Display demand using a H3 cell tessellation. Capacity analysis using a demand model

Measure the service - not only the link



END-TO-END TESTING / VALIDATION CRITERIA

01 Access

Registration success
Network-entry time

02 Sessions

PDU-session success
Session setup time

03 Traffic

Throughput and latency
Loss and jitter

04 Continuity

Interruption and survival
Recovery of throughput

Defined scenario



Repeatable run



Logs and traces



Test verdict

Different environments answer different questions



VALIDATION STRATEGY / COMPLEMENTARY EVIDENCE

IN ORBIT

uniSpark

Can the critical radio combination work?

Bidirectional regenerative mmWave 5G TDD reported.

IN SOFTWARE

Digital Twin

How do routes follow moving geometry?

Containerized nodes and per-second route updates.

IN A REPRESENTATIVE SYSTEM

uniShape

Can the whole system deliver the service?

Two-satellite architecture; end-to-end validation target.

THE PRINCIPLE

Do not ask one environment to prove everything. Connect the evidence.



THE NEXT HORIZON / FUTURE COMMERCIAL CONSTELLATION

**The goal is not a larger demonstration.
It is an operator-integrated service.**

Service integration

Space access within
operator services.

System integration

Connect space, ground
and operations.

Industrialization

Deploy proven blocks
at commercial scale.

PROGRESSION

A proven building block → a representative system → a commercial constellation.

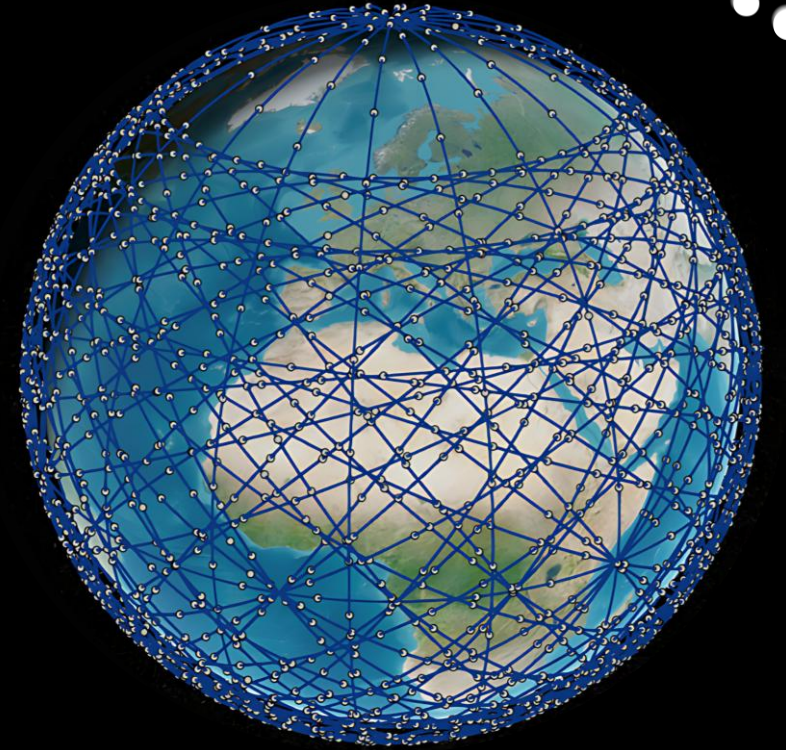
A large-scale competitive constellation

Very Low Earth Orbit (VLEO) deployed-constellation

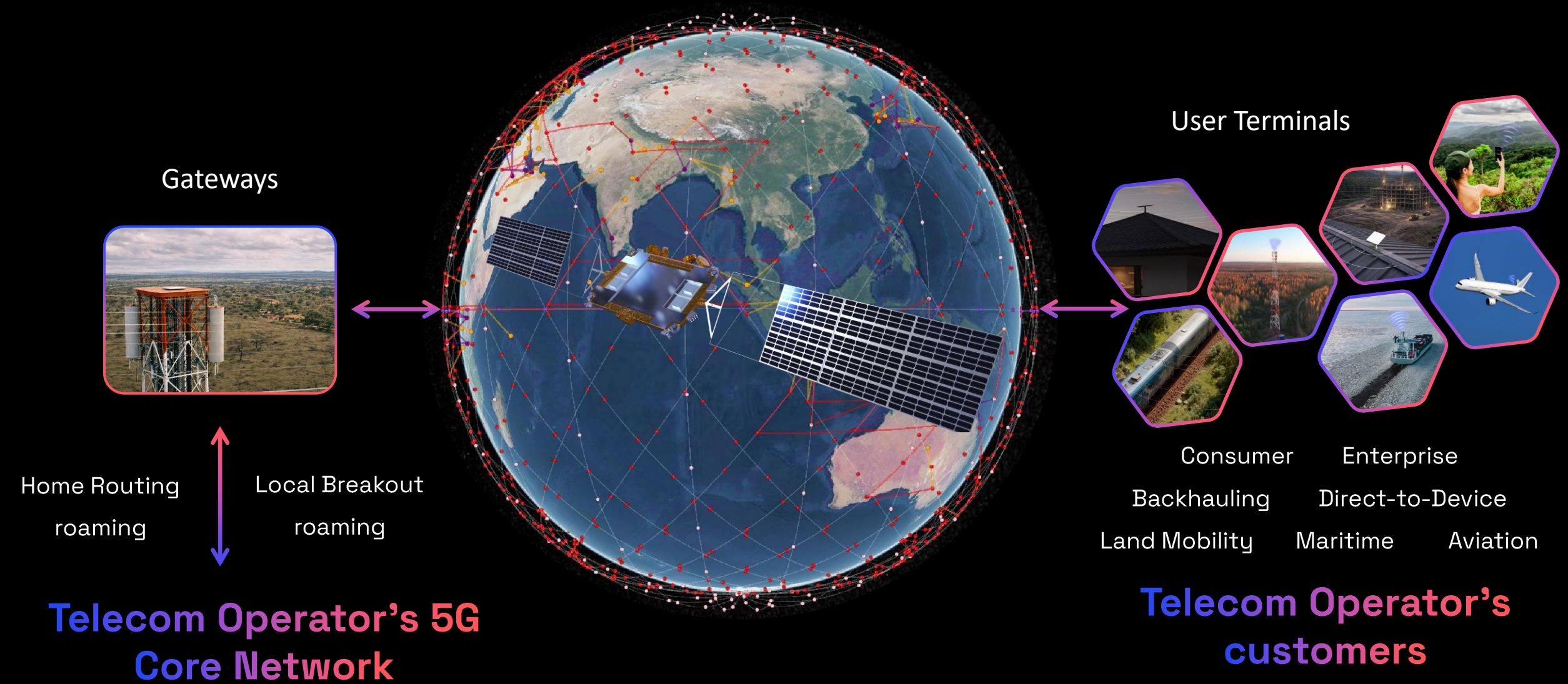
- Smaller size user terminals
- Very low latency
- Rapid reentry and disintegration of the satellites at the end of their lifetime

A unique network operated in space

- Global coverage by 1625 up to 3365 seven-year lifetime satellites deployed at 375 km
- 1200 very compact gateways (ground stations) integrated in telecom operators' networks



System overview



Vision becomes infrastructure through evidence.

Prove in orbit. Exercise in software. Integrate end to end.