VIAVI Solutions

# VIAVI NTN Digital Twin Solutions

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# NTN Challenges


**Station in Orbit**
(Relay, gNB, O-RU/O-DU)
Propagation Delays,
Doppler, Link Budgets,
Timing

**VIAVI RIC and NTN controller certification**

**Security** – Large Geographical coverage areas, country boundaries, etc.

**VIAVI TeraVM Security Testing and Certification**

**Integration with Non-3GPP NTN Networks** – Unified Core

**VIAVI NITRO Assurance and Optimization Solutions.**

**Mobility**
Fast - moving beams and cells, frequent beam/cell switch, ground station switch

**VIAVI NTN AI-RSG Digital Twin**

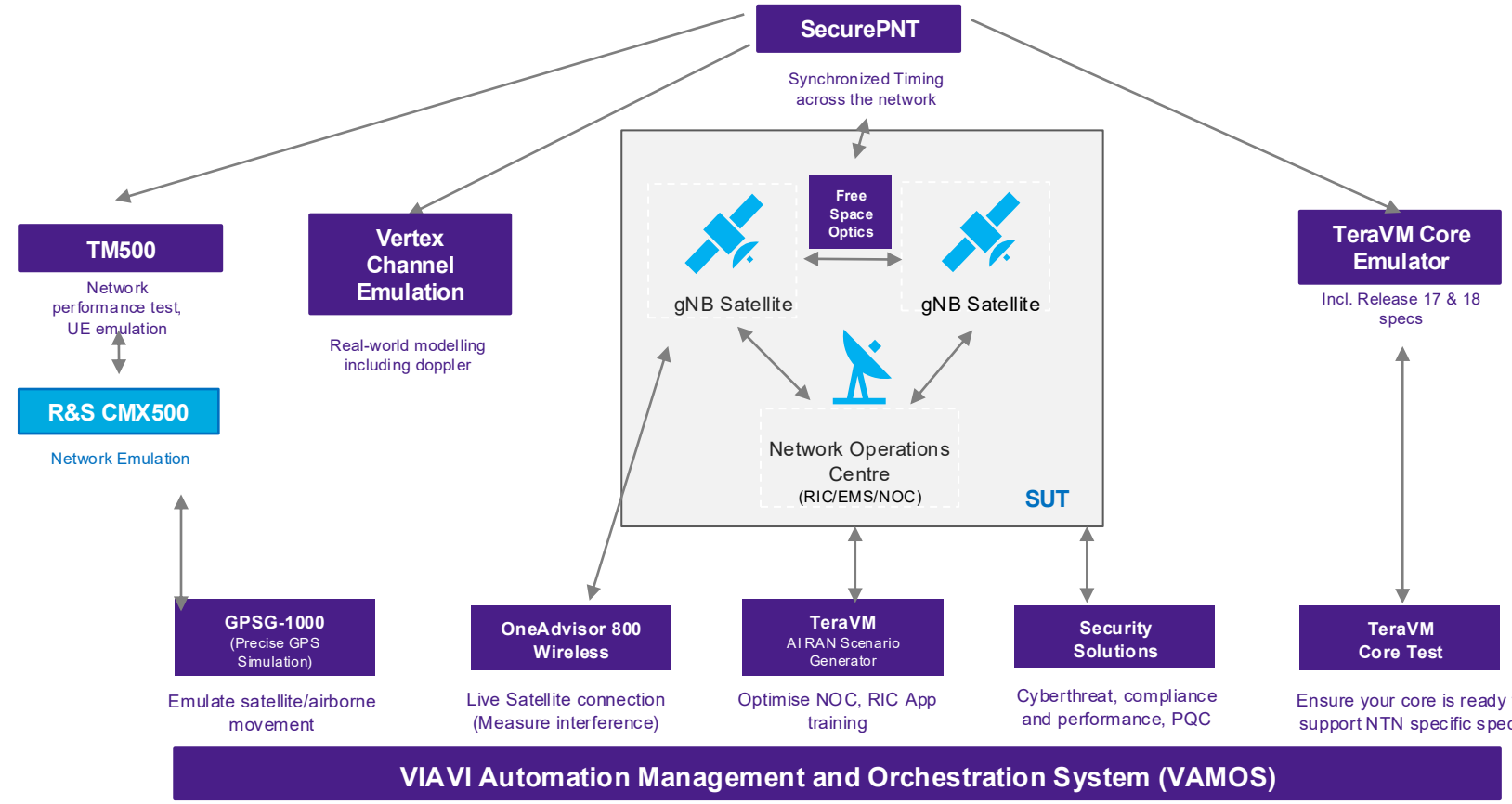
**Mobility**
RACH storms due to handovers

**VIAVI NITRO AIOps**

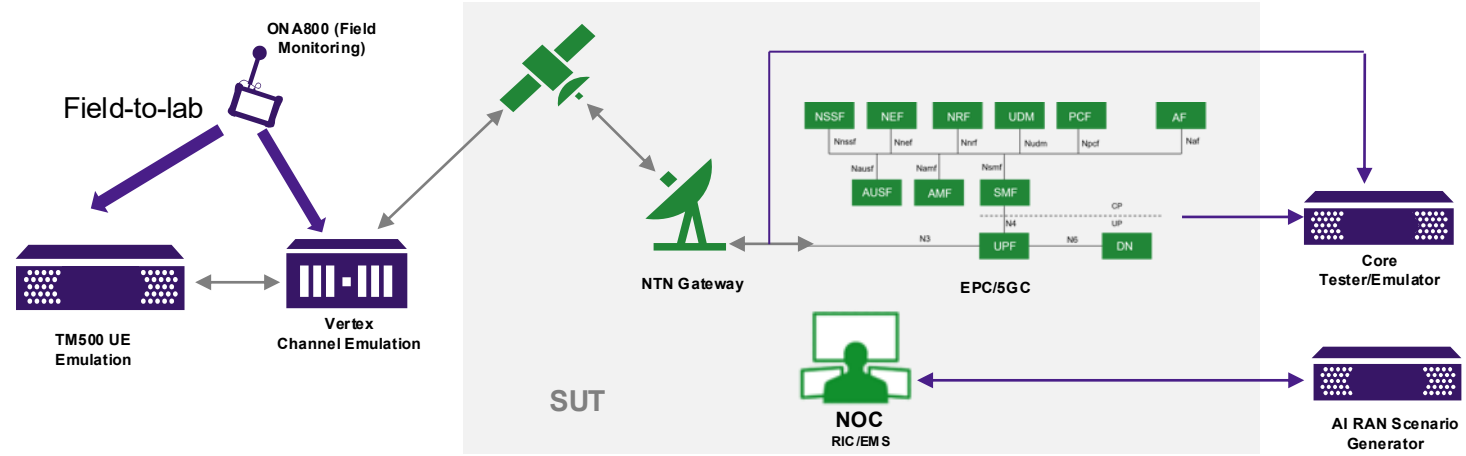
**Intersatellite, TN-NTN Mobility**

**VIAVI NTN UE Emulation**

# Comprehensive Solutions to Test, Train, and Optimize NTN



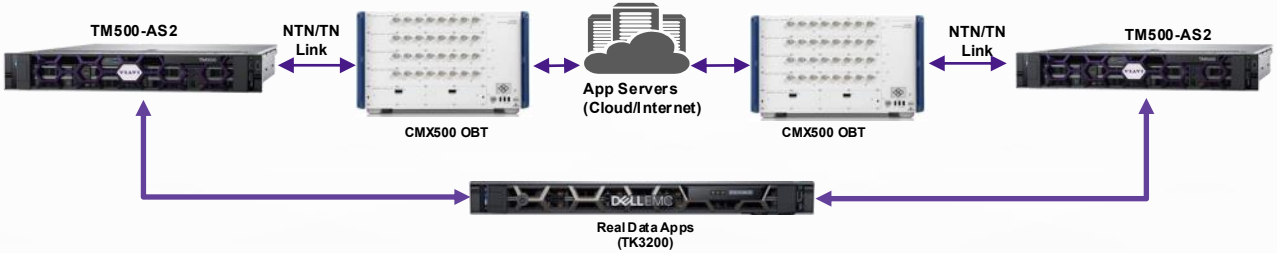
# NTN Digital Twin for Wraparound Test




VAMOS

| | TM500 UE Emulator | Core Emulator | Core Tester | AI RAN Scenario Generator | Vertex Channel Emulator | ONA800 |
|---|---|---|---|---|---|---|
| NTN Type | ✓ Legacy (Unmodified)<br>✓ 3GPP Rel-17 NTN | ✓ Legacy (Unmodified)<br>✓ 3GPP Rel-17 NTN | ✓ Legacy (Unmodified)<br>✓ 3GPP Rel-17 NTN | ✓ Legacy (Unmodified)<br>✓ 3GPP Rel-17 NTN | Agnostic | ✓ Legacy (Unmodified)<br>✓ 3GPP Rel-17 NTN |
| RAT | ✓ LTE (Unmodified)<br>✓ NR<br>✓ NB-IOT | ✓ 5GC<br>✓ EPC | ✓ 5GC<br>✓ EPC | ✓ 5GC / ORAN | Depends on Channel model implemented | ✓ LTE (Unmodified)<br>✓ NR |
| Test Type | ✓ Functional<br>✓ Load | ✓ Functional<br>✓ Load | ✓ Functional<br>✓ Load | ✓ Functional<br>✓ Load | Functional | Functional |

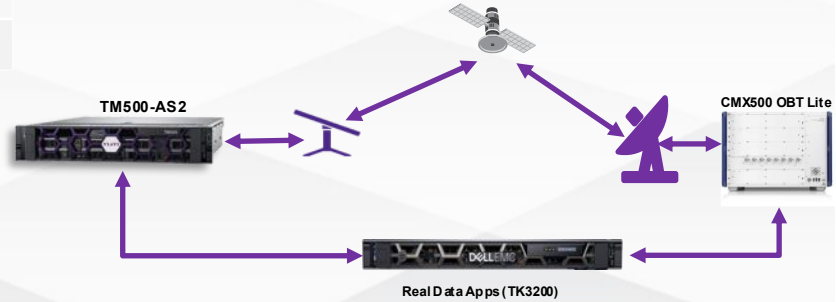
# End-to-End NTN Test Bed with R&S



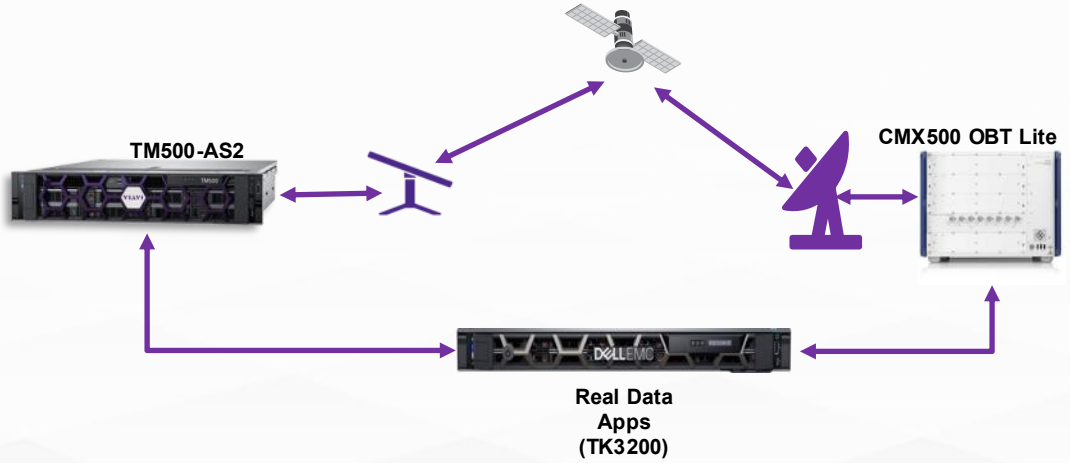

| | TM500 | CMX500 & CMW500 |
|---|---|---|
| NTN Type | ✓ Legacy (Unmodified)<br>✓ 3GPP Rel-17 NTN | ✓ Legacy (Unmodified)<br>✓ 3GPP Rel-17 NTN |
| RAT | ✓ NR<br>✓ NB-IOT | ✓ NR (CMX500)<br>✓ NB-IOT (CMW500) |
| Test Type | ✓ Functional | ✓ Functional |

**Flexibility on how testbed can be setup:**
- ✓ 1 TM500 with 1 CMX/CMW
- ✓ 1 TM500 with 2 CMX/CMW
- ✓ Custom data app can be piped directly into TM500

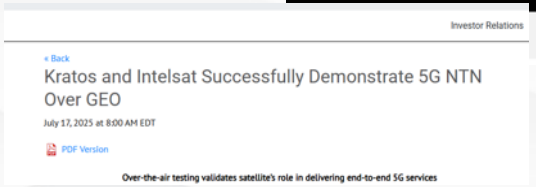
**OTA Scenario:**
- ✓ VSAT and Gateway provided by customer



# Satellite Operator PoC Test Bed

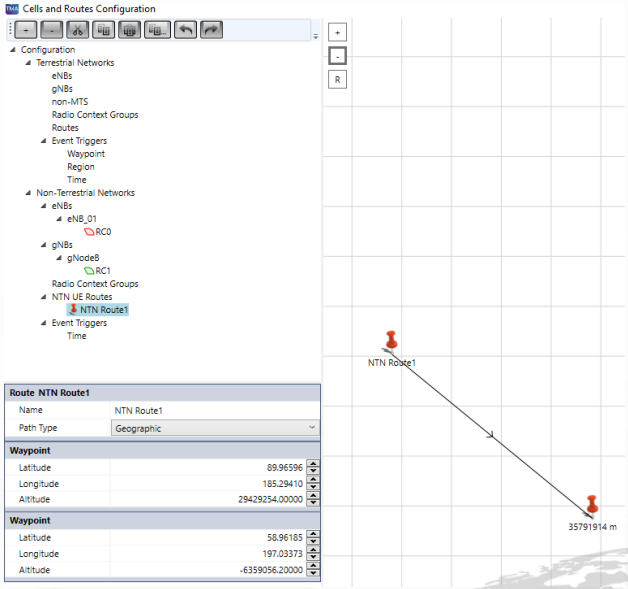


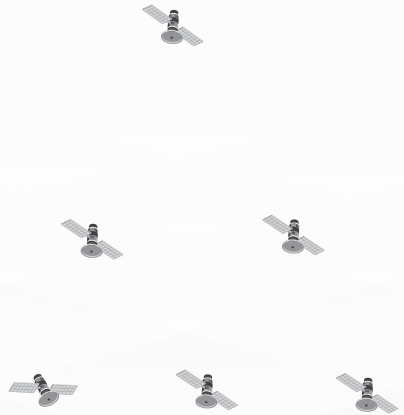



- 1 carrier on TM500 + 1 Carrier on CMX500,
- VSAT required for signal conditioning on TM500. Gateway will do signal conditioning for CMX500.
- RDA with full e2e data analysis.

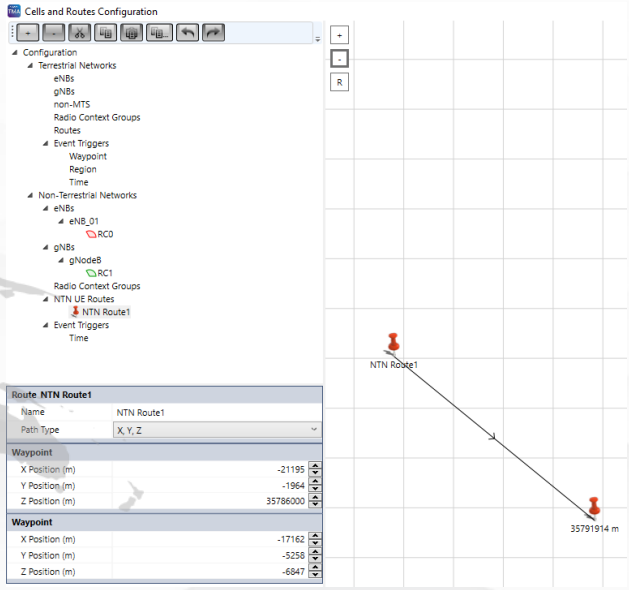
# Flexible UE Location facilitating multiple Orbits



**Earth Centered Earth Fixed (XYZ):**

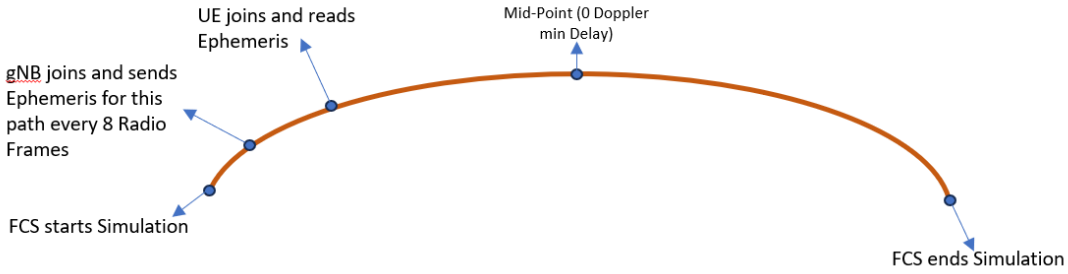
Like Ephemeris from 3GPP SIB19/31

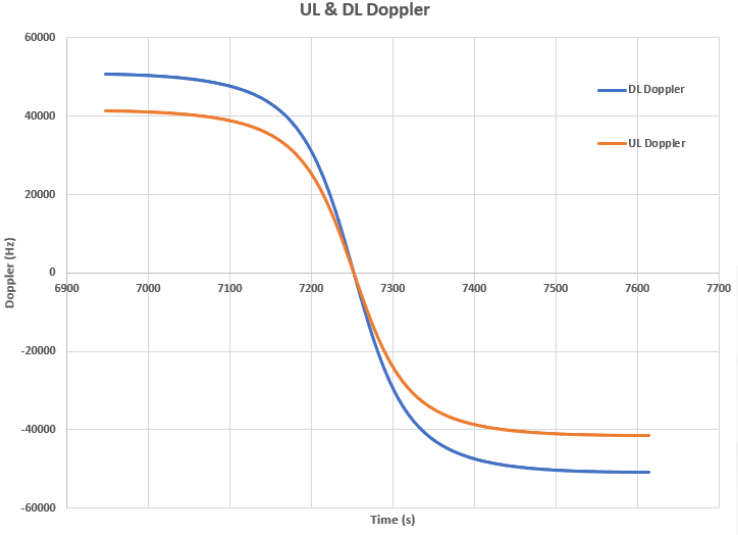


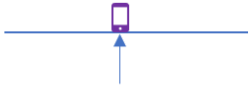

**Longitude, Latitude Altitude (LLA):**

Standard GNSS notation for location.

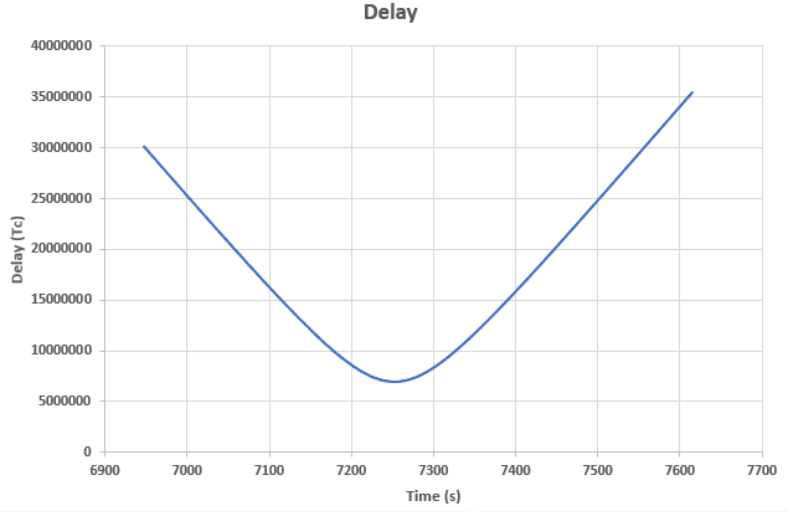
# Rel-17 NTN – Doppler and Delay Pre-compensation



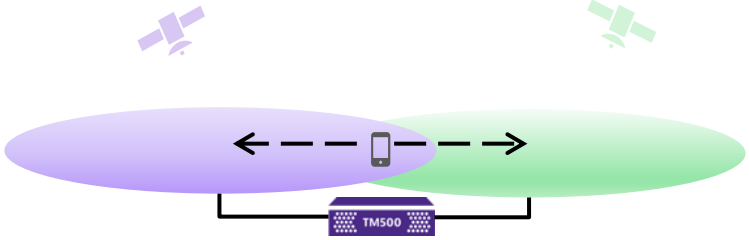



UE Location, ground level and centre point for FCS path simulation

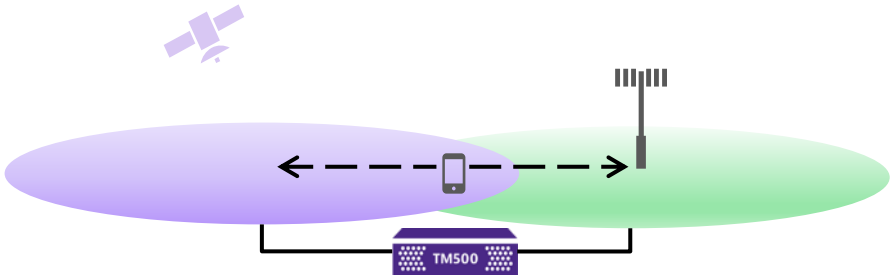


# Comprehensive NTN Mobility Testing

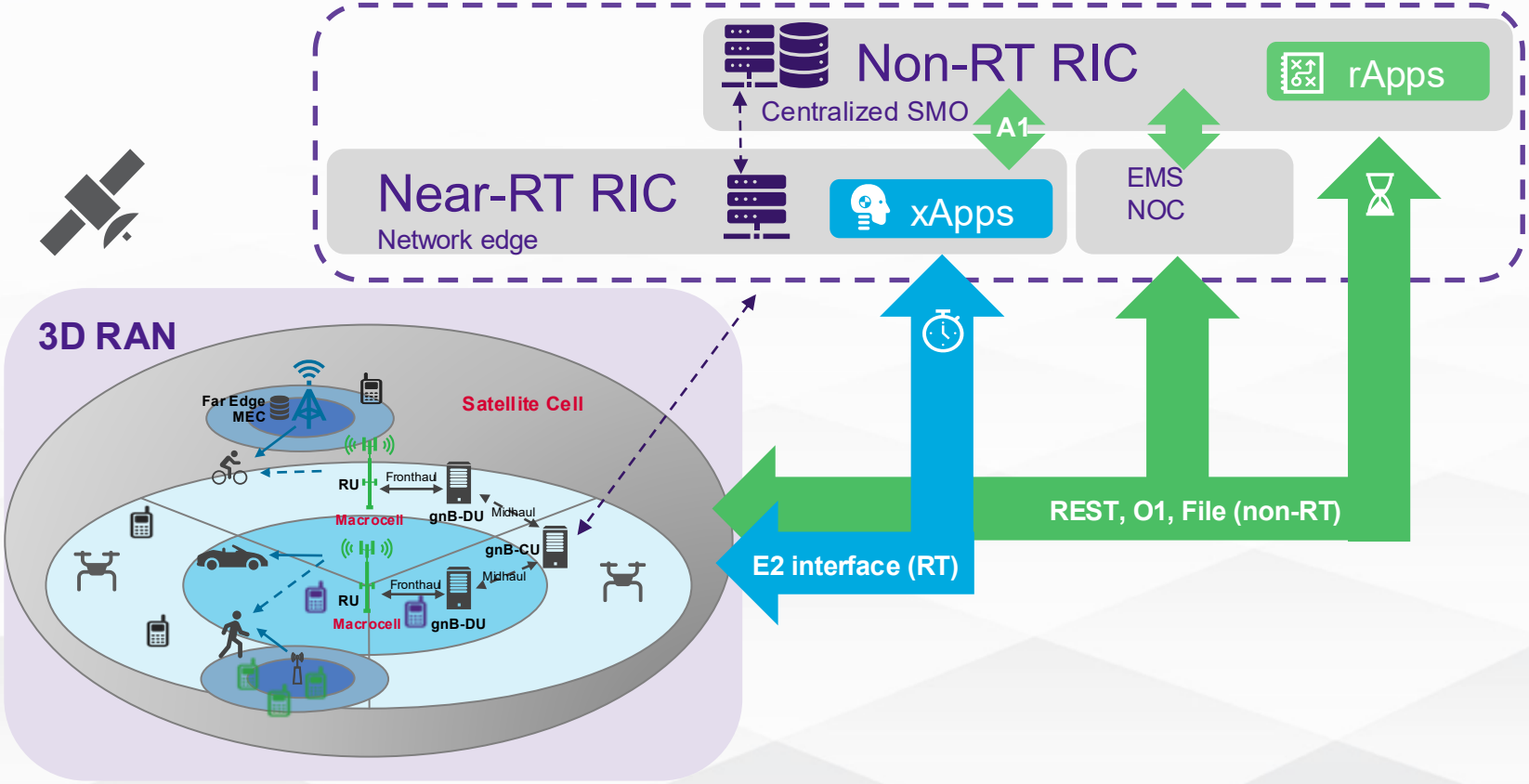
- Support for UE mobility between cells on satellites.
  - Based Ephemeris (SIB-19) and global UE location configuration
  - Cell Re-selection: using t-service
  - Conditional Handover Rel-17 additions: Cond A4 Event + Cond T1/D1
  - **Mobile UEs + GSO cells** OR **Static UEs + NGSO Cells** OR **Mobile UEs + NGSO cells**



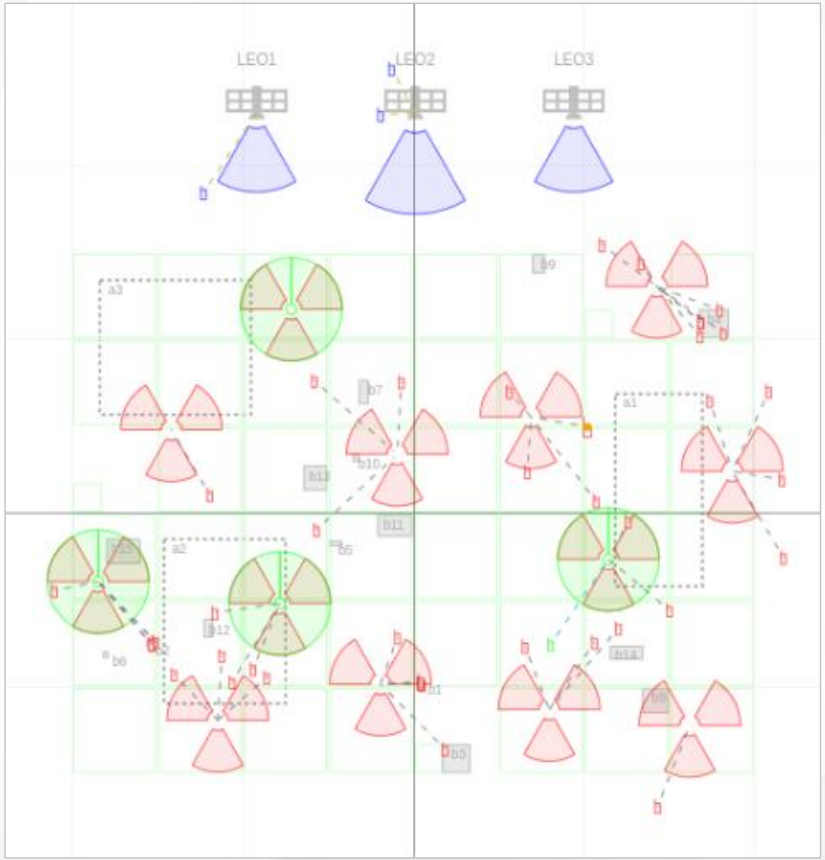

- Support for UE mobility between satellite cell and terrestrial.
  - Based Ephemeris (SIB-19) and global UE location configuration
  - Cell Re-selection: using t-service
  - TN to LEO NTN – Static UE & TN Cell with moving NTN cell
  - TN to GEO NTN – Moving UE with Static TN and NTN cells



# AI RAN Scenario Generator (AI-RSG) for NTN



# AI-RSG Satellite Support




## Satellite Cells

- LEO and GEO Constellations
- Cell Frequency Settings – overlapping, non-overlapping, radius, coverage time
- Cell Size – standard and beamforming
- Handover based on power and policy (A1 to A6)
- Bent-Pipe Support with 4G Handsets
- Long-Delay Channel Model
- Per Cell KPIs – Frequency, Power, Utilization and throughput

## Satellite Models

- 5G SA
- Pre R17 NR, R17 NR NB-IOT and CAT-M Handsets
- Regen – Ariel DU and gNB
- Cloud Interference
- Beam Hopping

# Wireless Field Testing

## OneAdvisor 800: Wireless, Transport, and Fiber Test Solution

OneAdvisor 800 brings unprecedented simplicity, speed, and accuracy for cell site deployment and maintenance, through multi-test capability and test process automation that streamlines the work into a short sequence of push-button tests.

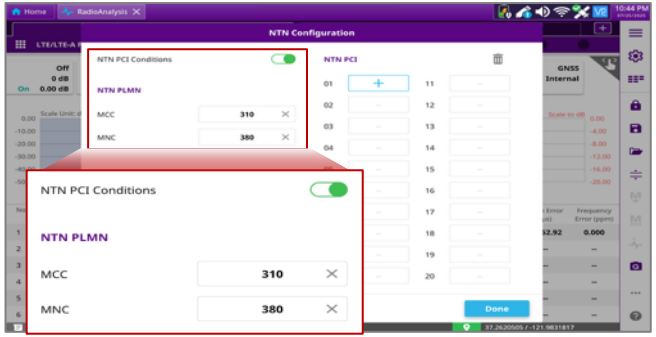
OneAdvisor 800 test functions include:

- Fiber cable verification: fiber inspection, optical power measurements, and fiber verification (OTDR)
- Coaxial cable verification: return loss, VSWR, cable loss, distance to fault, and insertion gain/loss
- Real-time spectrum and Interference analysis including TDD auto-gated spectrum, spectrogram, recording and post-analysis.
- PIM Detection: RFoCPRI™ Interference analysis: PIM Detection
- Interference Finding: automatic interference finding with InterferenceAdvisor
- RF signal analysis: GSM, LTE, DSS, 5G and concurrent LTE & 5G (NSA) signals analysis
- Transport analysis: Ethernet test of 1GE, 10GE, 25GE, 25GE and 100GE

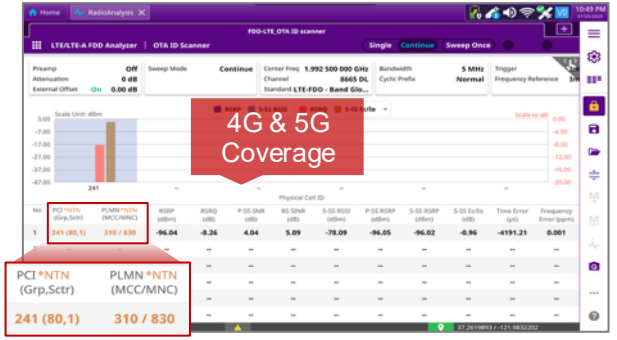
# OneAdvisor 800 LTE-NTN Signal Analysis

- ONA800W - LTE ID Scanner

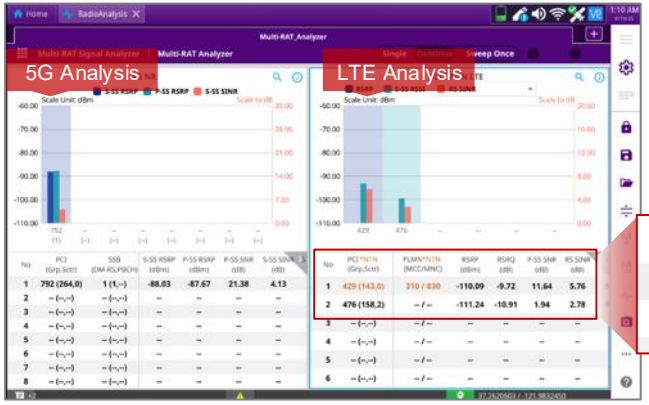
- NTN Public Land Mobile Network (PLMN)
- NTN Physical Cell Identifier (PCI)




LTE-NTN Configuration (PLMN & PCI)

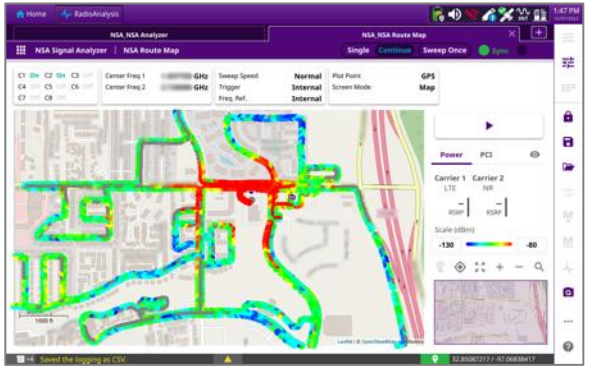



LTE-NTN ID Scanner (PLMN & PCI)




Multi-RAT Analysis | Concurrent 5G + LTE & LTE-NTN (PLMN & PCI) Analysis

| No | PCI *NTN (Grp,Sctr) | PLMN*NTN (MCC/MNC) | RSRP (dBm) | RSRQ (dB) | P-SS SNR (dB) | RS SINR (dB) |
|---|---|---|---|---|---|---|
| 1 | 429 (143,0) | 310 / 830 | -110.09 | -9.72 | 11.64 | 5.76 |
| 2 | 476 (158,2) | -- / -- | -111.24 | -10.91 | 1.94 | 2.78 |



Multi-RAT Analysis | Coverage Assessment

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