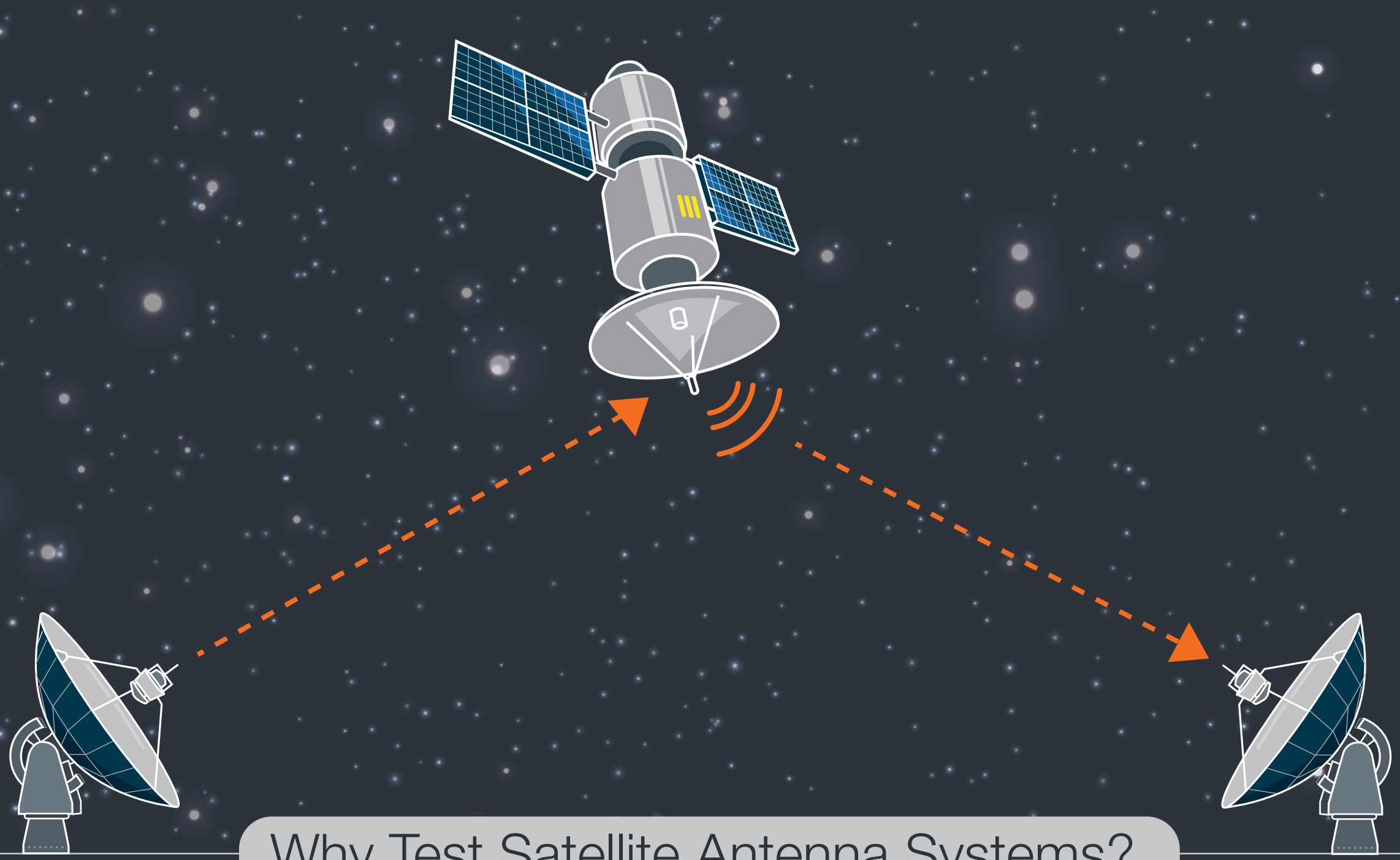
Satellite Antenna Testing

Antenna testing is one of many crucial tests required before launching a satellite into orbit. Not only is space one of the harshest operating environments for any technology, opportunities for repair are minimal once these sophisticated and expensive devices are out there. Measuring the accuracy and reliability of satellite antennas to transmit vital data and growing quantities of information before a satellite leaves Earth demands equally accurate and reliable test systems and environments.



Why Test Satellite Antenna Systems?

- Measure antenna performance
- Analysis of antenna coupling with the satellite structure
- Evaluate uplink and downlink load capacity
- Optimal design and placement of antennas and subsystems
- Evaluate end-to-end transmission [capacity/performance]

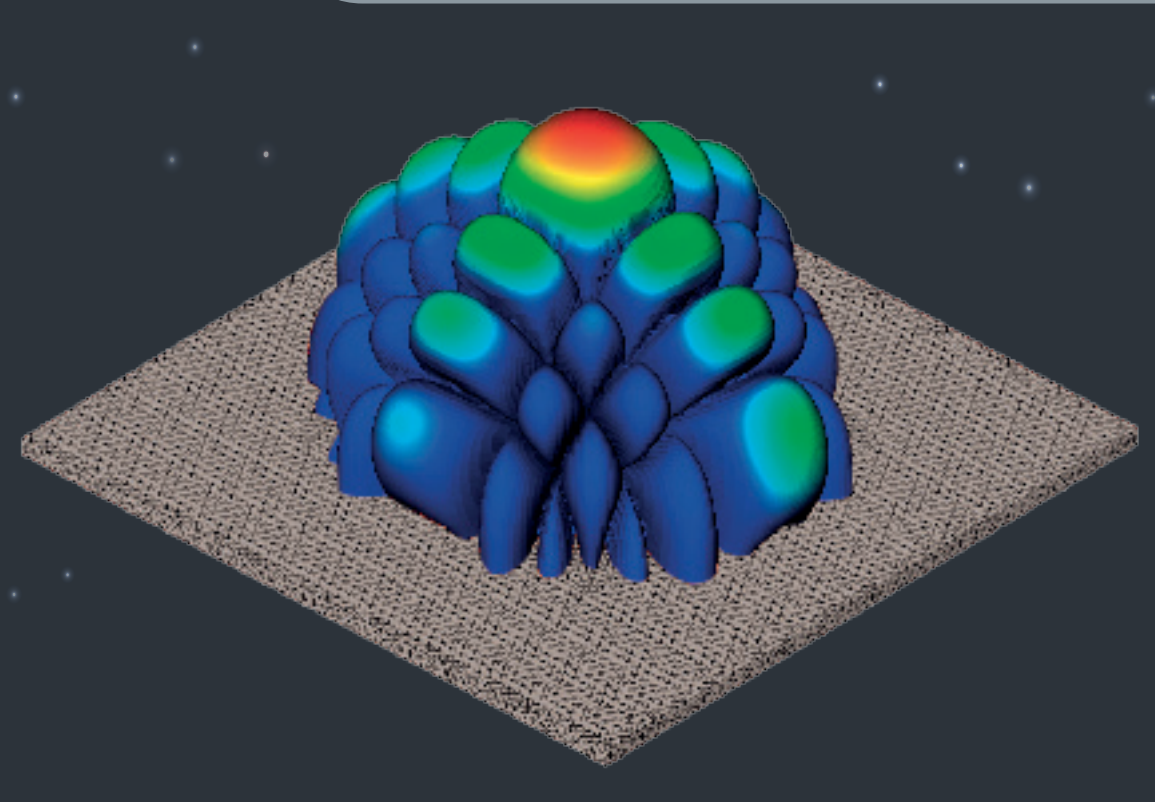
Subsystem Testing

Relatively small stand-alone antennas, antenna arrays or subsystem-integrated antennas can be tested using compact multi-probe near-field measurement systems or mini-compact ranges.

Full Satellite Testing

Testing a complete satellite in a spherical or planar near-field antenna measurement system, or in a compact range with an appropriately-sized quiet zone, validates the capacity of all antenna systems on the device to function optimally and in correlation.

Which tests?

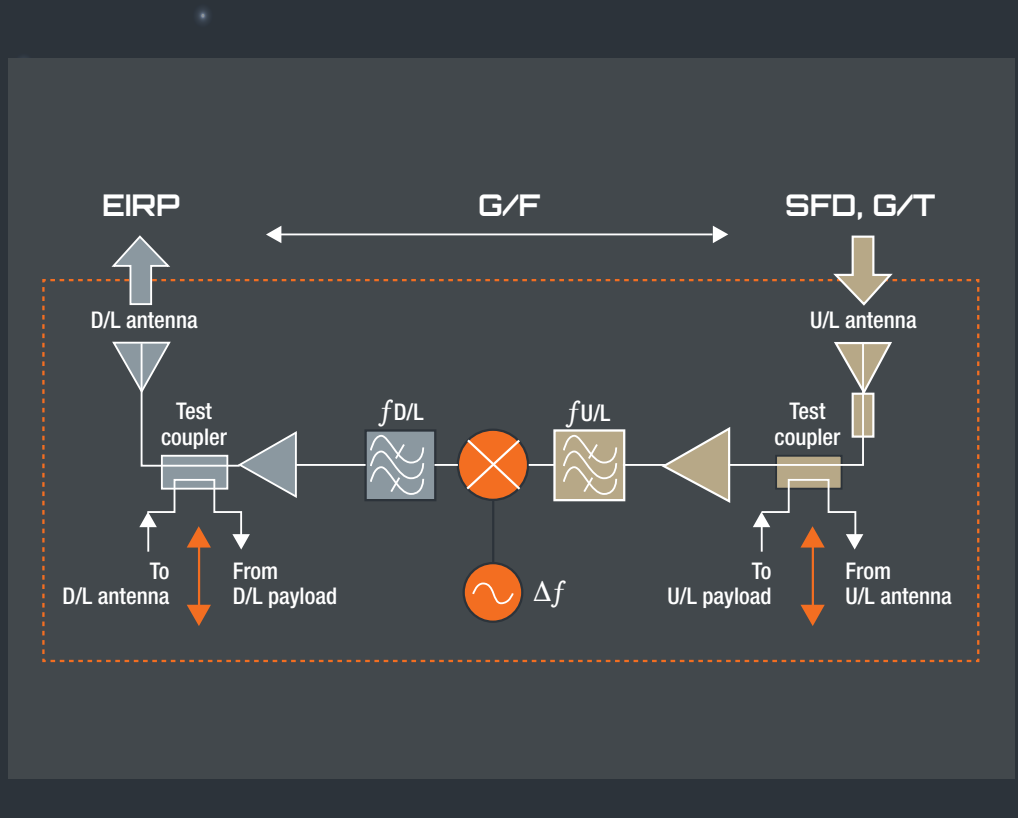


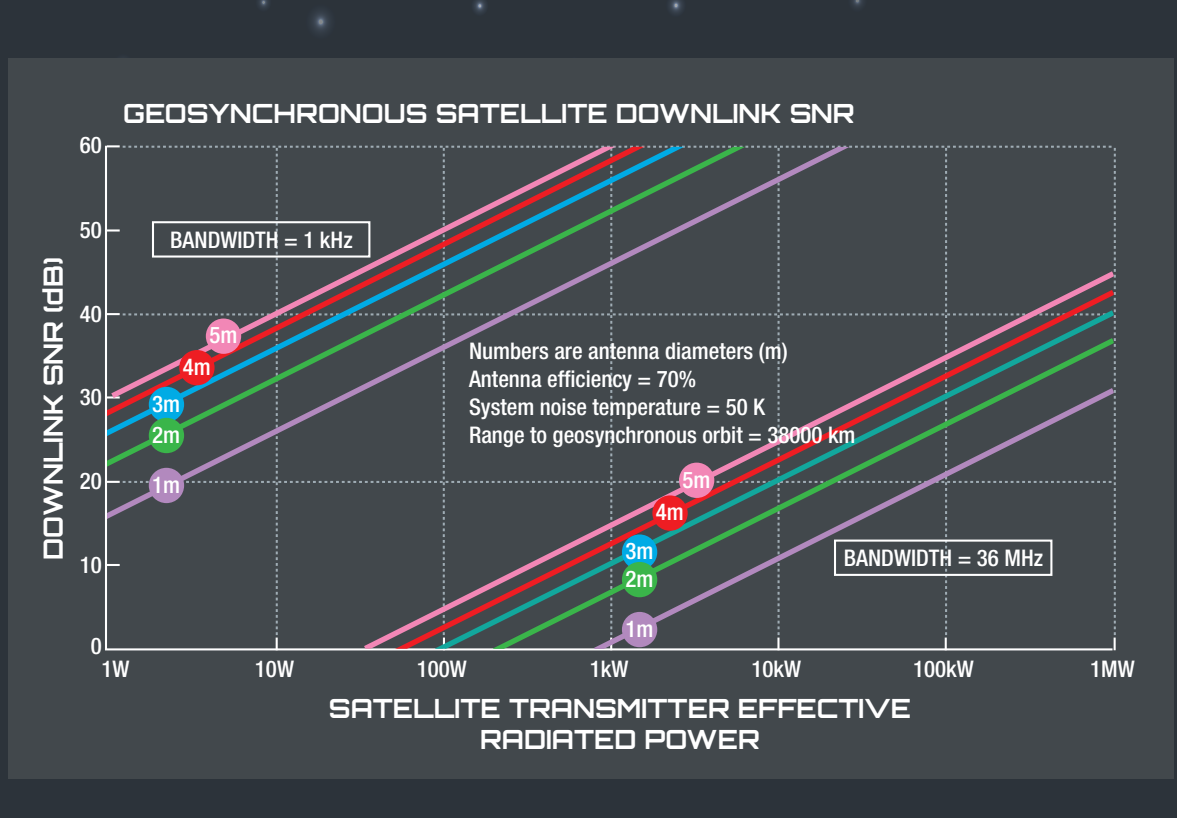
Measurements allow for the evaluation of antenna parameters:

- Radiation pattern
- Gain/Directivity (Φ, θ)
- Efficiency
- Polarization
- Beamwidth
- Beam pointing
- Phase center
- Cross polar discrimination

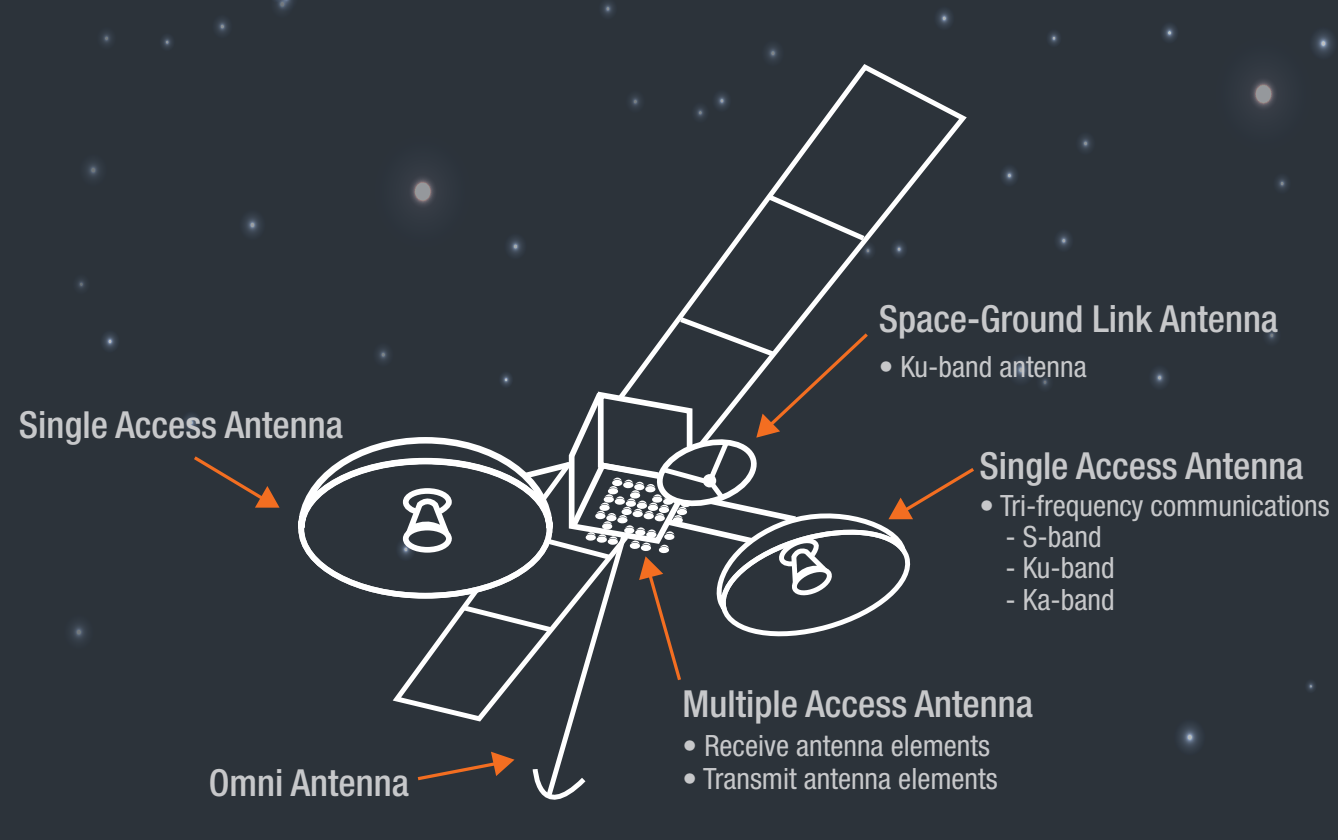
Measurements of subsystem antennas determine if performance meets expected characteristics:

- IPFD/SFD – uplink
- G/T – gain over temperature
- Group delay
- EIRP (power Φ, θ) – downlink
- G/F – gain over frequency
- In-band spurious emissions



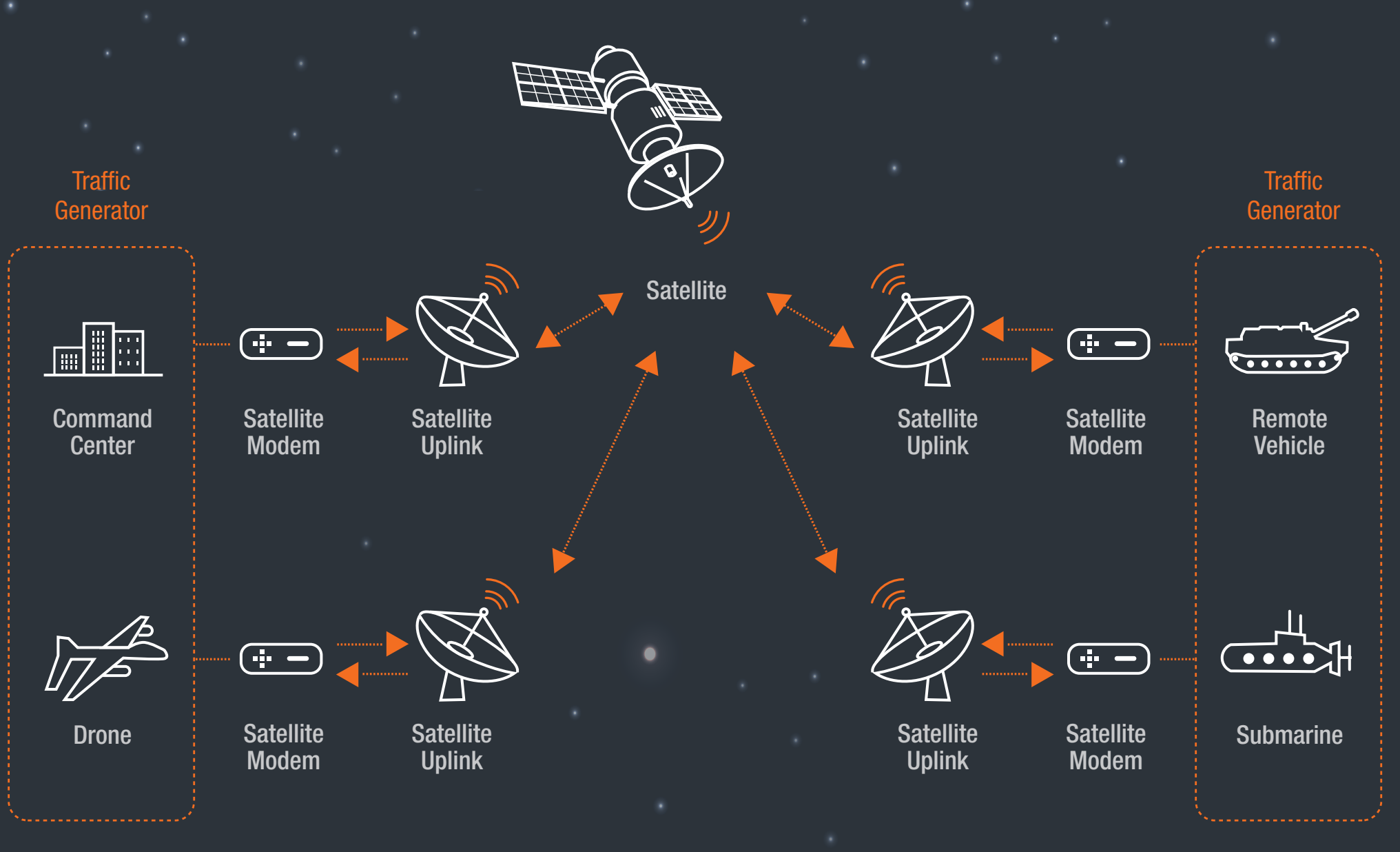


Mission critical factors.
Testing antenna systems on complete satellites enables understanding of coupling and/or interferences between antennas as well as between antennas and the satellite structure.



End-to-end testing on complete satellites validates system network and communication performance for all satellite objectives:

- Free space path loss
- G/F – gain over frequency
- IPFD/SFD – uplink
- G/T – gain over temperature
- EIRP (power Φ, θ) – downlink



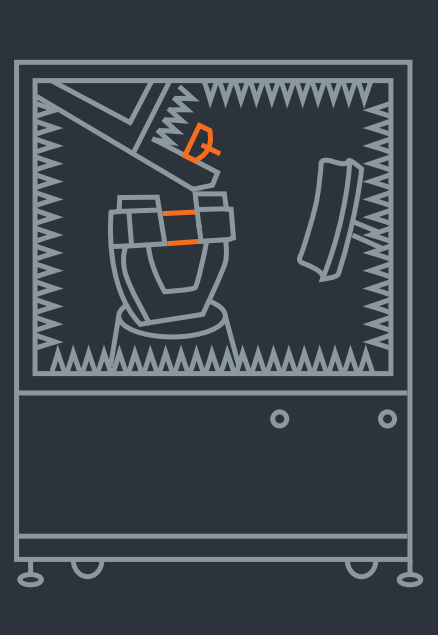
Selecting a test system

StarLab

- 650 MHz – 50 GHz
- Spherical NF
- Cylindrical NF
- DUT max size & weight: 45 cm - 50 kg

+ Component and small system-level testing, wide frequency bands, multi-probe electronic scanning

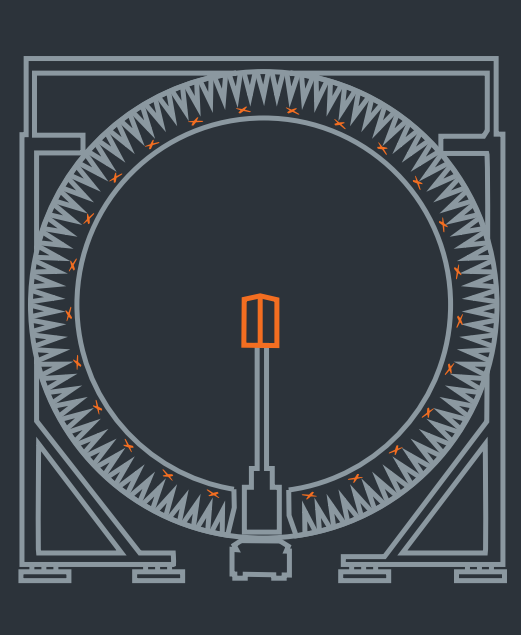
Mini-compact Range



- 4 GHz – 110 GHz
- Indirect FF
- DUT max size & weight: 50 cm x 50 cm - 60 kg

+ Component testing, wide frequency bands

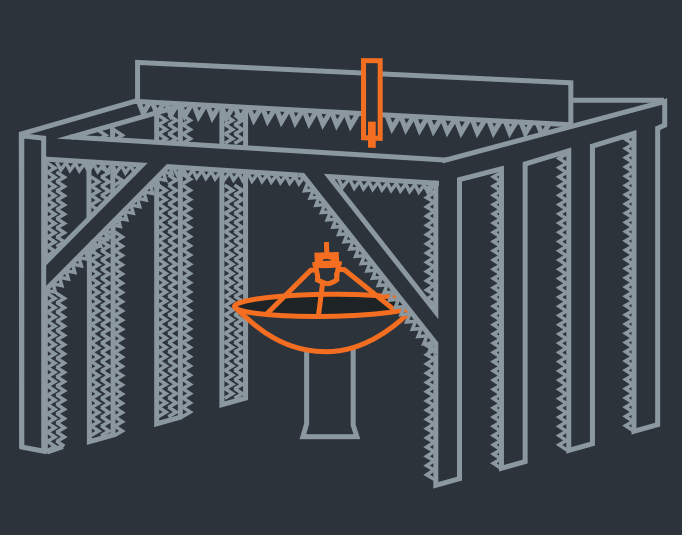
SG Evo



- 400 MHz - 50 GHz
- Spherical NF
- DUT max size & weight: customized build according to DUT

+ Gravity sensitive DUT, system-level testing, wide frequency bands, multi-probe electronic scanning

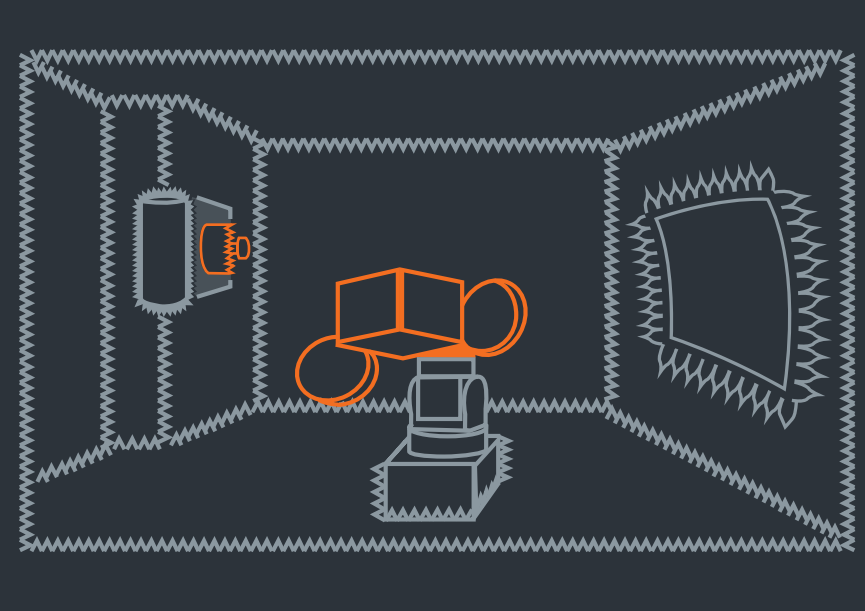
H-Scan



- 100 MHz – 110 GHz
- Planar NF
- DUT max size & weight: customized build according to DUT

+ Large DUT, system-level testing, wide frequency bands

CATR



- 700 MHz – 110 GHz
- Indirect FF
- DUT max size & weight: customized build according to quiet zone requirements of DUT

+ System-level & end-2-end testing, direct measurements in far-field, wide frequency band

Exploring further

POST-PROCESSING
In the antenna design and test process, the measured radiation pattern or shielding performance does not always correspond to what is expected. Identifying the source of discrepancies through post-processing allows for in-depth investigation into radiation characteristics of antennas under test.

Measured Antenna

FEATURES

+ NF/FF transformation
+ In depth understanding of antenna radiation
+ Measurement diagnostics and filtering
+ Echo suppression
+ EMC/ Spurious radiation detection
+ Data interpolation/extrapolation

ANTENNA DIAGNOSIS

- Obtain the measured field data of the antenna
- Compute the equivalent electric and magnetic currents on a 3D surface conformal to the test object
- The antenna is characterized as a black box (EQC model)

3D econstruction geometry — EQC Model

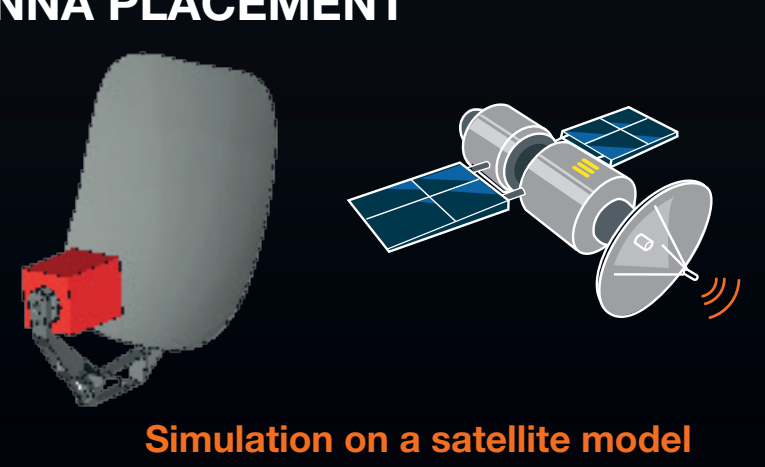
INSIGHT LINK WITH SIMULATION

- Import into CEM simulation software
- Evaluate the performance of installed antennas
- Analyze their interaction with the proposed platform

EQC + CEM software — Computed Huygen's Box

ANTENNA PLACEMENT

- Predict the performance of the antennas when placed on a satellite or satellite payload



Simulation on a satellite model

Depending on the electrical size of the complete satellite, antennas offset from its center can be tested using the conventional Spherical Wave Expansion (SWE) or the Translated-SWE (TSWE) techniques in a spherical measurement system.

TSWE can be used in the case of a large AUT offset in order to minimize the measurement samples and reduce testing time; With TSWE the reference system is moved to the AUT implementing a local measurement approach.

For all phases of product development, antenna design, and antenna placement, MVG offers antenna measurement systems, services and full test chamber solutions for satellite antenna technology testing.

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