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**FRAUNHOFER INSTITUTE FOR
INTEGRATED CIRCUITS IIS**

SATELLITE COMMUNICATIONS AT FORTE

FACILITY FOR OVER-THE-AIR RESEARCH AND TESTING



TEST PORTFOLIO

Static tests

- Antenna pattern (Ku-/Ka-Band)
- Power levels and out-of-band emission masks
- ETS/ITU/FCC limits
- Link budget verification
- Cross-polar performance
- Bit error rate (BER) of forward/return link

Motion emulation modes

- Playback of synthetic/recorded motion profiles
- Playback of synthetic/recorded GPS signals
(for GPS-assisted PAT systems)
- Analysis of PAT dynamic performance and off-axis emissions

Simulation of satellite segment

- Single satellite transparent payload with payload impairments (nonlinearity and phase noise)
- LMS channel (independent for forward/return link)
- Optional: single satellite with interfering satellite (1° to 3° offset)
- Optional: single satellite with on-board filtering/on-board processing

Optional measurements (depending on hub station simulation)

- Throughput, acquisition time, etc., for satellite network
- Performance of Positioning, Acquisition, Tracking (PAT) system
- End-to-end system evaluation

SERVICE

Authorized test entity of Global VSAT Forum

Testing according to GVF-101, GVF-104, and GVF-105

Eutelsat type approvals

- Prototype testing according to ESOG 120

Other services

- Prototype terminal evaluation and development
- Test of algorithms for tracking systems including pointing accuracy and adjacent satellite interference
- Test of commercial satellite communication systems
- Test of overall system performance, including modems and different network topologies
- Accessible database of standard and non-standard motion profiles for SatCom on the Move testing

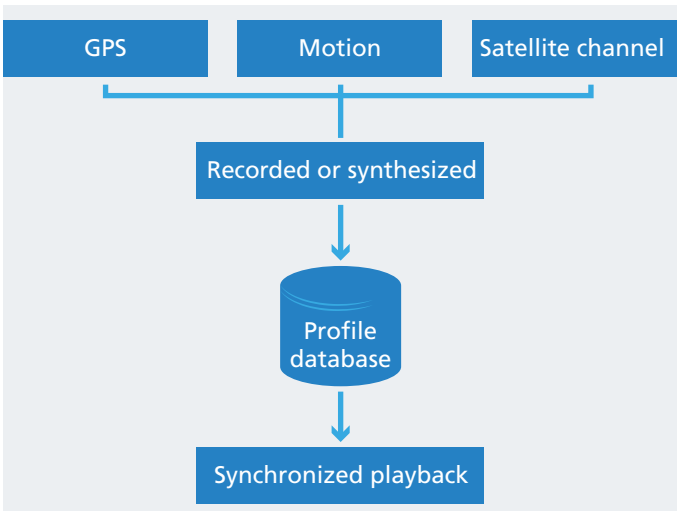
Advantages of FORTE

- Higher accuracy of depointing measurements compared to satellite-to-terminal tests (link budget)
- Precise depointing measurement in azimuth and elevation
- Cost-efficient and available at all times
- Far-field radiation pattern measurements
- Weather independent
- Test of antenna systems in combination with operational GEO satellites (45° E to 45° W) possible



SOTM – ENVIRONMENT EMULATION

- Several environments with respect to motion, GPS, and satellite channel can be emulated by replaying recorded profiles
- Other environments are possible by synthesizing artificial profiles from statistical models
- Set of standard environments is available
- Tests are possible with both tower (satellite emulator) and operational satellites (45° W to 45° E)





TEST FACILITY – COMPONENTS

Motion emulator

Payload

Size 90 cm diam.

Weight 30 kg

(with reduced rate/acc.: 140 cm diam./75 kg)

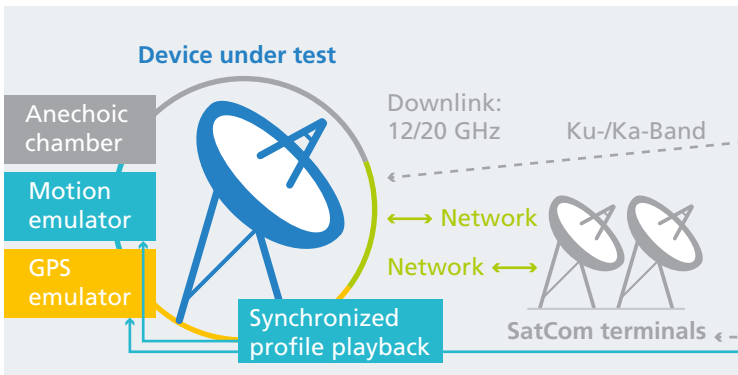
Position

Roll, pitch, yaw up to $\pm 45^\circ$ / continuously

Static accuracy $< 0.0083^\circ$

Rate/acceleration

Roll, pitch, yaw 300 $^\circ/s$ / 1000 $^\circ/s^2$





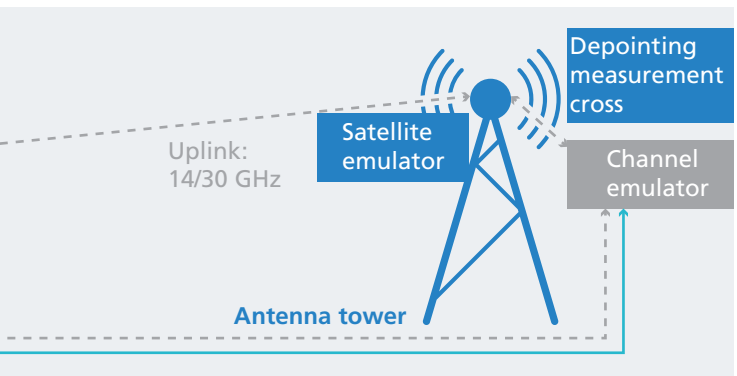
TEST FACILITY – COMPONENTS

Antenna tower

- Satellite emulator is available on a 30 m high platform (elevation: 16°), and at 45 m (elevation: 24°)
- Additional transmit antennas in azimuth (1° to 3°) to emulate interference from other satellites

Detector cross

- Five power detectors at off-axis positions in azimuth and elevation (Ku-/Ka-Band)
- Synchronized measurement at all detectors
- Synchronized to the environment emulation
- Matched positioning of the detector for different antenna patterns possible (detector separation between 1° and 6°)





TEST MODES – EXAMPLES

Measurements for type approvals of SOTM systems

- Eutelsat ESOG 120
- GVF type approval (GVF-101, GVF-104, and GVF-105)

Any tests consisting of

- Antenna pattern measurement
- Co- and cross-polar measurements (circular/linear)
- Positioning, Acquisition, and Tracking (PAT) performance test
- Residual off-axis emissions evaluation
- Forward/return link performance test
- End-to-end link performance test
- Adjacent satellite interference measurement

including

- Fading of the LMS channel
- Satellite signal impairments
- Mechanical movement of the terminal platform
- Interference from satellites in adjacent positions

for

- Ku-Band (12/14 GHz) and Ka-Band (20/30 GHz)
- Linear or circular polarization

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