TELEKOM a.s.

Defence Systems Division

TeleOrbit

LEO Satellite Constellation

Technical Data Sheet & Service Overview

14	550–650 km	~94%	<25 ms
Satellites	Orbital Altitude	Global Coverage	Latency

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1 System Overview

TeleOrbit is a proprietary Low Earth Orbit (LEO) satellite constellation operated by Telekom a.s. Defence Systems Division. The system is designed as a resilient, always-on communications backbone for government, defence, and critical infrastructure customers, providing continuous connectivity when commercial terrestrial and satellite networks are unavailable, degraded, or compromised by cyber or physical attack.

The constellation is hardened against electromagnetic threats and engineered for autonomous operation, making it suitable for deployment as a last-resort communications layer in national contingency and crisis management scenarios.

Constellation at a Glance

Constellation size	14 multifunctional satellites (expandable to 24)
Orbital altitude	550–650 km LEO (Sun-synchronous and near-polar planes)
Orbital planes	3 planes, approximately 120° separation
Global coverage	~94% of Earth's surface (continuous at mid/high latitudes)
Revisit interval	< 15 min average at any point within coverage zone
Design lifetime	7 years per satellite (on-orbit refuelling interface available)
Ground Control	Primary: Prague, Czech Republic | Backup: undisclosed, hardened

NOTE	Coverage figures are based on orbital simulation at solar minimum with a 10° minimum elevation mask. Actual coverage may vary slightly depending on terminal location and local terrain masking.

2 Communications Payload

2.1 Radio Frequency Links

Each TeleOrbit satellite carries a Ka-band phased-array communications payload supporting simultaneous spot-beam and wide-beam operation. Inter-satellite links (ISL) in Ka-band enable store-and-forward and real-time routing across the constellation without ground relay, reducing dependence on ground station availability.

Frequency band	Ka-band (downlink: 17.7–21.2 GHz; uplink: 27.5–31.0 GHz)
Inter-satellite link (ISL)	Ka-band, optical ISL option (laser, 10 Gbps, select satellites)
Spot beam count	Up to 16 simultaneous spot beams per satellite
Aggregate throughput	Up to 40 Gbps per satellite (forward + return)
Latency (end-to-end)	< 25 ms (single hop, ground-to-ground via one satellite)
Gateway connectivity	X-band and L-band legacy interface (software-defined modem)
Modulation / coding	DVB-S2X (forward link); MF-TDMA with ACM (return link)
Terminal compatibility	Telekom TK-GND-40 (portable), TK-GND-200 (fixed), third-party VSAT

2.2 Link Budget Summary

The following table summarizes key link budget parameters for the standard government terminal configuration (TK-GND-40, 40 cm dish, 3 W uplink). Values are at worst-case geometry (10° elevation, edge of spot beam).

Parameter	Forward (Sat → Terminal)	Return (Terminal → Sat)
EIRP	56 dBW (spot beam, peak)	39 dBW (3 W + 40 cm)
Free-space path loss	209.4 dB @ 550 km, 20 GHz	212.2 dB @ 550 km, 28 GHz
G/T (receiver)	–5.2 dB/K (terminal)	+8.1 dB/K (satellite)
Received C/N_0	86.4 dB·Hz	84.9 dB·Hz
Rain fade margin	4.5 dB (Ka-band, mid-latitudes)	4.5 dB

3 Security Architecture

3.1 End-to-End Encryption

TeleOrbit implements multi-layer end-to-end encryption. Traffic is encrypted at the application layer before entering the terminal and decrypted only at the intended destination. The satellite and ground network infrastructure never handle plaintext. Government and defence customers receive dedicated key management infrastructure operated separately from commercial traffic.

Primary encryption algorithm	AES-256-GCM (symmetric, data-at-rest and in-transit)
Key exchange	ECDH over P-384 / X25519 (classical)
Post-quantum key exchange	CRYSTALS-Kyber (NIST PQC standard, FIPS 203)
Post-quantum signature	CRYSTALS-Dilithium (NIST FIPS 204)
Hybrid mode	Classical + PQC key exchange combined (defence tier, default)
Certificate authority	Telekom a.s. sovereign PKI (air-gapped root CA)
Key management system	TeleKMS — HSM-backed, FIPS 140-3 Level 3 certified
Traffic separation	Government traffic on dedicated VLAN + frequency segment
Zeroization	Remote and local zeroization of terminal and ground station keys

3.2 Quantum-Resistant Protocols

The TeleOrbit defence tier is the first European LEO constellation to offer standardized post-quantum cryptography (PQC) as a default configuration. The hybrid key exchange model ensures that sessions remain secure against both classical and quantum adversaries. All PQC algorithms are NIST-standardized (FIPS 203/204/205) and implemented in hardware-accelerated modules on both the ground terminals and the on-board satellite processing unit.

NOTE	Quantum-resistant protocols are available as standard for government/defence-tier service agreements. Commercial tier uses classical AES-256 + ECDH only.

3.3 Cyber Threat Hardening

Command link authentication: All satellite command uplinks require dual-factor authentication: pre-shared command key (256-bit) plus time-based one-time password (TOTP). Replay protection via sequence number and 5-minute time window.

Uplink anti-spoofing: Ground stations continuously monitor uplink signal characteristics. Anomalous commands from unexpected ground locations trigger automatic command inhibit.

Onboard anomaly detection: Each satellite runs an onboard integrity monitor that validates command sequences and telemetry consistency. Detected anomalies trigger safe-mode transition and alert to ground control.

Secure firmware update: Firmware updates are cryptographically signed (Dilithium) and verified onboard before installation. Rollback protection prevents downgrade to vulnerable versions.

4 Spacecraft & Platform

4.1 Platform Specifications

Spacecraft bus	Telekom SB-200 (proprietary small satellite bus)
Dry mass	~220 kg per satellite
Power (BOL / EOL)	3.2 kW / 2.6 kW (triple-junction GaAs solar panels)
Battery capacity	300 Wh Li-Ion (90 min eclipse survival)
Attitude control	3-axis stabilized, reaction wheels + magnetorquers
Pointing accuracy	< 0.05° (3σ) — required for Ka-band spot beam alignment
Propulsion	Xenon Hall-effect thruster (orbit raising, station-keeping, deorbit)
Delta-V budget	> 150 m/s (total mission)
Deorbit compliance	Controlled reentry within 5 years post-EOL (IADC guidelines)
Launch vehicle compatibility	Ariane 6, Falcon 9, Vega-C (rideshare capable)

4.2 EMP and Space Weather Hardening

All TeleOrbit satellites are designed to operate through severe space weather events and survive high-altitude electromagnetic pulse (HEMP) exposure at levels consistent with MIL-STD-461G RS105. Key hardening measures include:

- Radiation-hardened (RadHard) FPGA and processor ICs (total ionizing dose > 100 krad Si)
- Single-event upset (SEU) mitigation via triple modular redundancy (TMR) on critical logic
- Shielded enclosures on all command and data handling subsystems (> 3 mm Al equivalent)
- ESD protection on all external electrical interfaces
- Redundant attitude control and onboard computers (cross-strapped, cold standby)
- Automatic safe-mode entry during geomagnetic storm conditions (Kp > 7)

NOTE	Hardening levels are calibrated to the worst-case space weather environment defined by the ECSS-E-ST-10-04C standard (Solar Particle Event 10^-5 probability per year).

4.3 Autonomous Operations

Each satellite is designed to operate autonomously for a minimum of 30 days without ground contact. The onboard Autonomous Mission Management System (AMMS) handles routine orbit maintenance, payload scheduling, fault detection and recovery, and inter-satellite link management. This capability is critical for scenarios involving disruption or denial of ground control infrastructure.

Autonomous operations duration	Minimum 30 days without ground contact
AMMS processing	Dual redundant space-grade processor (LEON4 SPARC V8)
Fault detection & recovery	Onboard FDIR — component, subsystem, and system level
Safe mode capability	Full Earth-pointing safe mode, < 5 min transition
ISL autonomy	Autonomous topology management and rerouting via onboard mesh routing
Payload scheduling	Pre-uploaded mission queue, 7-day lookahead

5 Ground Segment & Service Operations

5.1 Ground Infrastructure

Primary ground station	Prague, Czech Republic (hardened facility, EMP-shielded)
Backup ground station	Classified location, hardened, independent power and comms
Telemetry, Tracking & Control	S-band TT&C; independent from payload Ka-band links
Network operations center (NOC)	Prague — 24/7 staffed, security-cleared personnel
Gateway stations	3 regional Ka-band gateways (EU, MENA, Central Asia)
Monitoring coverage	24/7 constellation health monitoring, 15-min telemetry cadence
Mean time to detect (MTTD)	< 3 min for major satellite anomalies
Mean time to respond (MTTR)	< 15 min for operator command response

5.2 Service Tiers

TeleOrbit is offered in three service tiers to match customer security and availability requirements:

Tier	Target Customer	Encryption	Dedicated Capacity	SLA Availability
Commercial	Enterprise, NGO	AES-256 + ECDH	No (shared)	99.5%
Government	Civil agencies, ministries	AES-256 + ECDH + PQC	Reserved burst	99.9%
Defence	Armed forces, intelligence	AES-256 + PQC hybrid	Dedicated segment	99.95%

NOTE	Defence-tier customers receive a dedicated frequency segment, independent key management infrastructure, and a direct secure line to the NOC duty officer. Crisis management capacity reservation is available under bilateral government agreements.

6 Standards & Compliance

TeleOrbit is designed and operated in compliance with the following international standards, regulations, and agreements:

ITU Radio Regulations	Ka-band frequency coordination filed with ITU-R; coordination completed for primary service area
ETSI EN 302 186	Satellite Earth Stations and Systems — technical requirements
ECSS-E-ST-10-04C	Space environment standard (radiation, plasma, micrometeoroid)
MIL-STD-461G (RS105)	EMP hardening reference standard for spacecraft electronics
FIPS 140-3 Level 3	Cryptographic module standard (ground TeleKMS HSMs)
NIST FIPS 203 / 204	Post-quantum cryptography — Kyber / Dilithium algorithms
IADC Space Debris Guidelines	Controlled deorbit within 5 years of EOL
Czech Act No. 231/2021 Coll.	National space activities regulation and licensing
EU Space Programme Reg. 2021/696	Compliance with EU space security framework

Contact & Further Information

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Classified annexes (link budget details, encryption key architecture, ground station locations) are available under NDA and applicable security clearance.