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TRL4 feasibility of public 5G / LEO SATCOM hybridisation demonstrated

Complementary bearer behaviour

- Public/private 5G combined with OneWeb LEO SATCOM through the Adaptable Communication System (ACS)
- 5G: higher throughput and lower latency, but degraded in forested areas
- SATCOM: affected by tunnels, bridges and other obstructions

Representative laboratory PoC

- 5G RSRP and performance trends reproduced with high fidelity
- Calibrated SATCOM Model B substantially improved throughput and interruption representativeness
- Limitation: severe SATCOM RTT degradation remains insufficiently reproduced

Configurable hybridisation

- AUTO-02 recommended for stability-focused ETCS; AUTO-03 for responsive critical voice
- GEO-01 as preferred geographic starting point: proactive, predictable and traceable switching
- Edge Computing: staged, service-driven deployment, strongest benefit for multi-train video

Remaining gaps

Performance and service continuity

- Complete handover and application-session traceability still to be achieved
- Representative voice and video traffic not yet tested

Combined AUTO / geographic arbitration

- Arbitration rules, hysteresis, dwell times and switching inhibition to be defined and validated
- SATCOM RTT calibration to be reworked

Railway integration

- GSM-R / FRMCS integration not performed

GovSatCom integration not performed

- ACS to be connected to operational FRMCS infrastructure (3GPP TS 33.180 security, MCX continuity, regulatory compliance)

Cybersecurity and Edge

- Impact of ACS compromise and loss of bearer diversity quantified; detection, mitigation and security assurance remain open
- Edge Computing assessment to be extended to at-scale deployment constraints

Perspectives

SHORT TERM
Publication and dissemination

Disseminate the results

- Europe's Rail JU, ETSI, UIC, ERA and EUSPA
- Priority topics: GOVSATCOM integration for railway application, handover mechanisms, cybersecurity requirements

MEDIUM TERM
TRL5 / TRL6 and FRMCS integration

Raise maturity

- Advance trackside and onboard solutions from TRL4 to TRL5/6, including operational satellite-antenna integration
- Integrate the ACS with operational FRMCS infrastructure
- Evaluate IRIS² as primary or backup bearer (QoS, security, coverage adaptations)

LONG TERM
Standardisation and intelligence

Structure the ecosystem

- Standardise railway SatCom-terrestrial handover procedures through ETSI, 3GPP and UIC
- Investigate edge computing at scale and AI/ML-based predictive ACS handover using GNSS and radio-map data
- Maintain the laboratory as an open, shared railway satellite-communications testbed



THANK YOU

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