



SMART 6GSAT MD Research Center

for Sustainable, Mobile, Autonomous and Resilient 6G Satellite Communications

SweWIN WS, 13 Oct 2025, Stockholm

Cicek Cavdar, Professor
Center Director
Director of Intelligent Network Systems Research Group
KTH Royal Institute of Technology



Cicek Cavdar

Professor at KTH, Sweden

- Leads *Intelligent Network Systems* group
- Director of *SMART 6GSAT* center
- Vice-head, *Communication Systems Division*

European & Industry Leadership

- Coordinator of *5GrEEen, SooGREEN, AI4Green, RAI-6Green*
- Technical lead in *ICARO-EU, 6G-SKY*

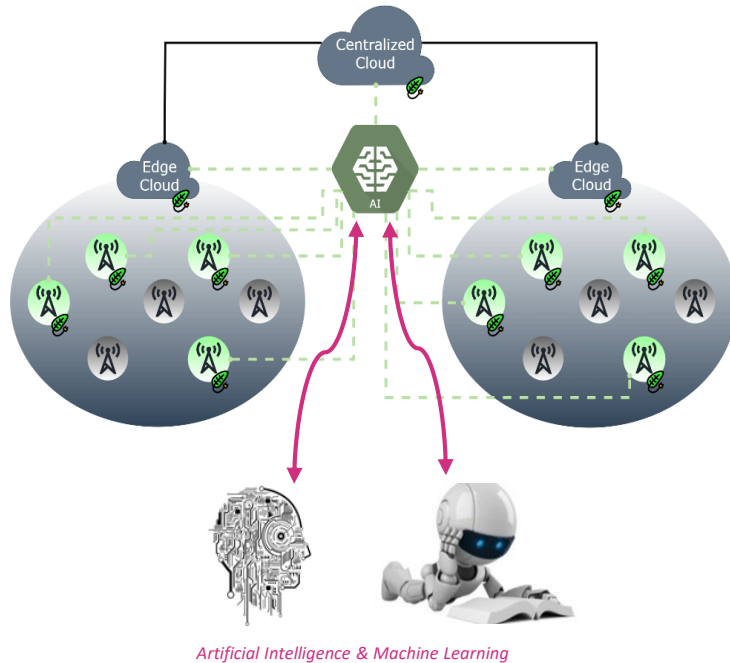
Research Focus

- Non-terrestrial & terrestrial network integration
- Cloud/edge computing
- Dependable communications
- AI-driven network resource allocation
- Green communications



RAI-6Green:

Robust and AI Native 6G for Green Networks



Start Date: January 2024; End Date: June 2027

Budget : 9284.76 K€; Effort: 93.96 PY

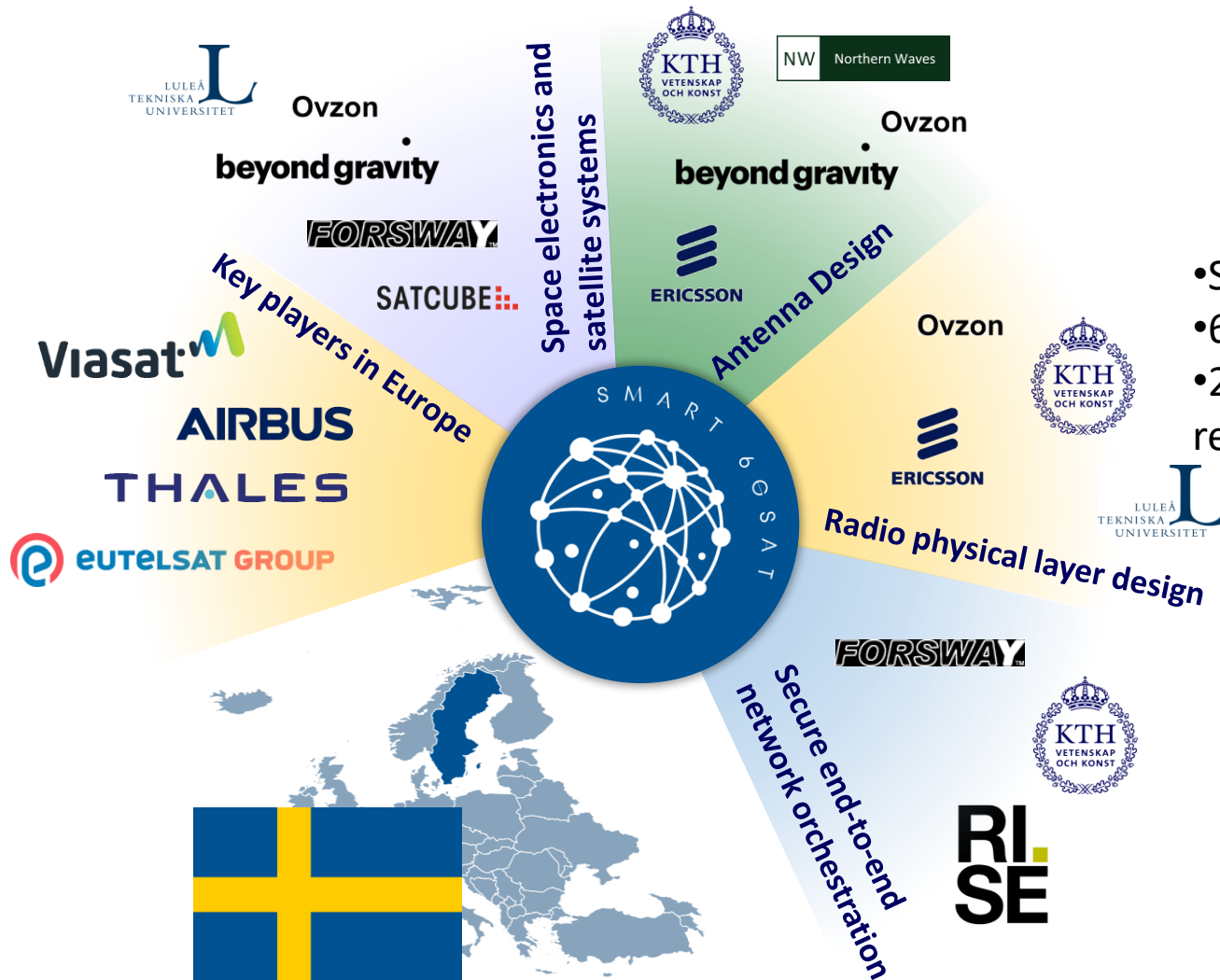
17 Partners from 5 Countries (Core partners: KTH, Tele2, Infovista, Maven W., Celfinet, Turkcell, Siemens, PI-Works, City Passenger, FireCell, Centrale Supelec, IMT)

- Green and flexible networks by design is possible:
 - Deeper and more sleep features,
 - Cloud and AI Native Network Architectures,
 - Open RAN with integrated sensing computing and communication features
 - Joint sensing communication and computing
- Robust and resilient networks
 - Fast reconfiguration and adaptation against failures
 - Flexibility in terms of changing and moving network topologies
 - Dynamic self-backhauling optimized together with the cloud and edge processing resources in O-RAN.
- AI enables parameter-free network management:
 - Learn from the environment and adapt the coverage and capacity instantly
- Self-sustainable networks integrated with Reconfigurable Intelligent Surfaces and Energy-harvesting
 - AI for energy resources management
 - Self sustainable reconfigurable intelligent surfaces
 - Green energy resources

SMART 6G-SAT: Sustainable, Mobile, Autonomous and Resilient 6G Satellite Communications



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- Sweden's first multidisciplinary satcom research center
- 60 million SEK from the Swedish Foundation SSF
- 22 partners from academia, industry, regulatory authorities, regions, and municipalities.

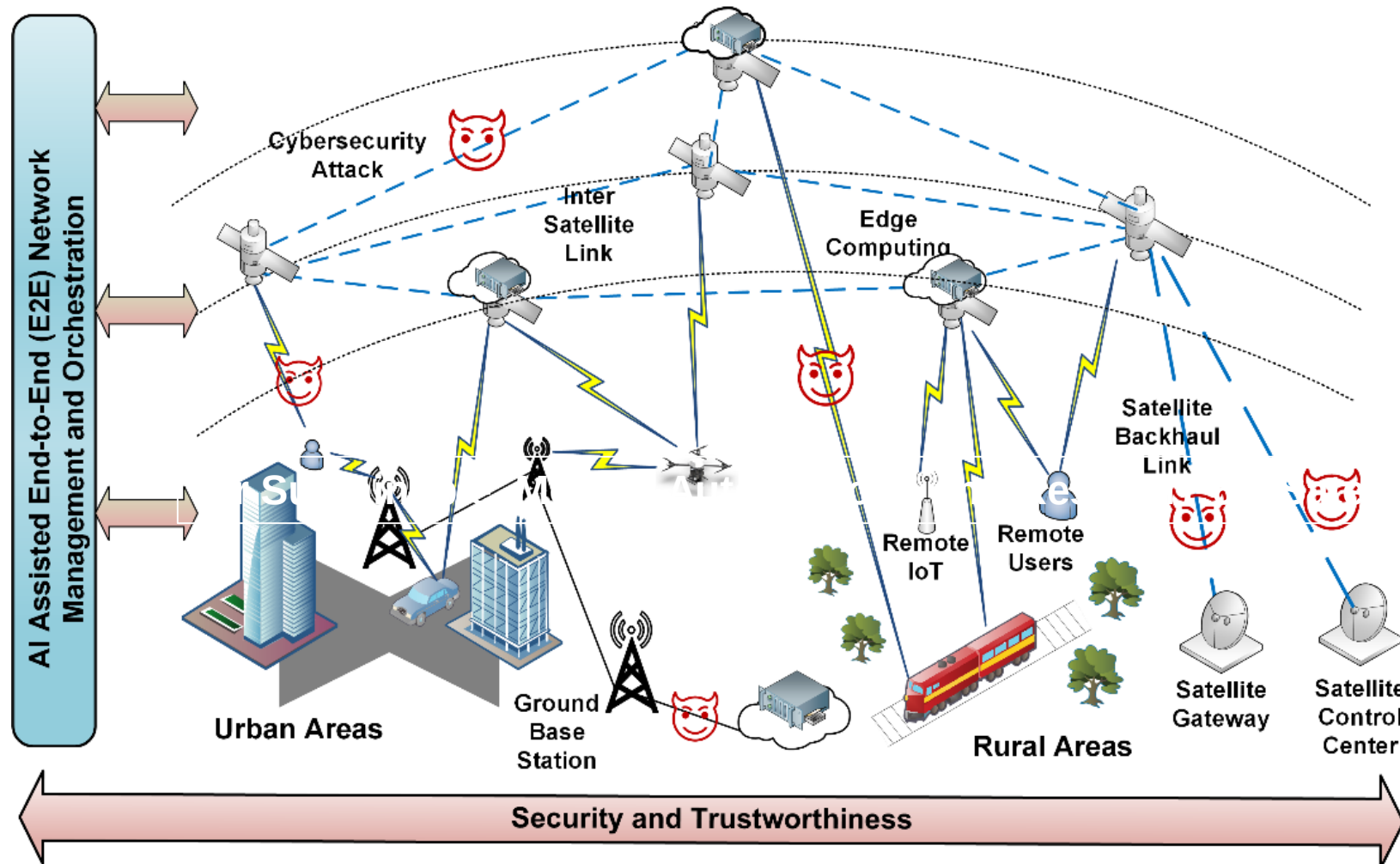


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for Sustainable, Mobile, Autonomous and Resilient 6G Satellite Communications



Goal:

Robust and Sustainable Seamless Connectivity via Integrated TN and NTN with Sensing, Localization and Computing

2025-2031, 60MSEK
21 partners from telco and space industry

Transition of the Space Industry



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Constellations

- GEO -> Multi-orbit, multi-layer mesh topologies GEO, MEO, LEO
- ISLs enabled (Optical+ radio)
- Processing enabled at the satellite

Coverage

Semi-static -> dynamic

Ownership

National/governmental investments
-> large industry, SME, Start-ups

Economics

Expensive launches -> reusable rockets

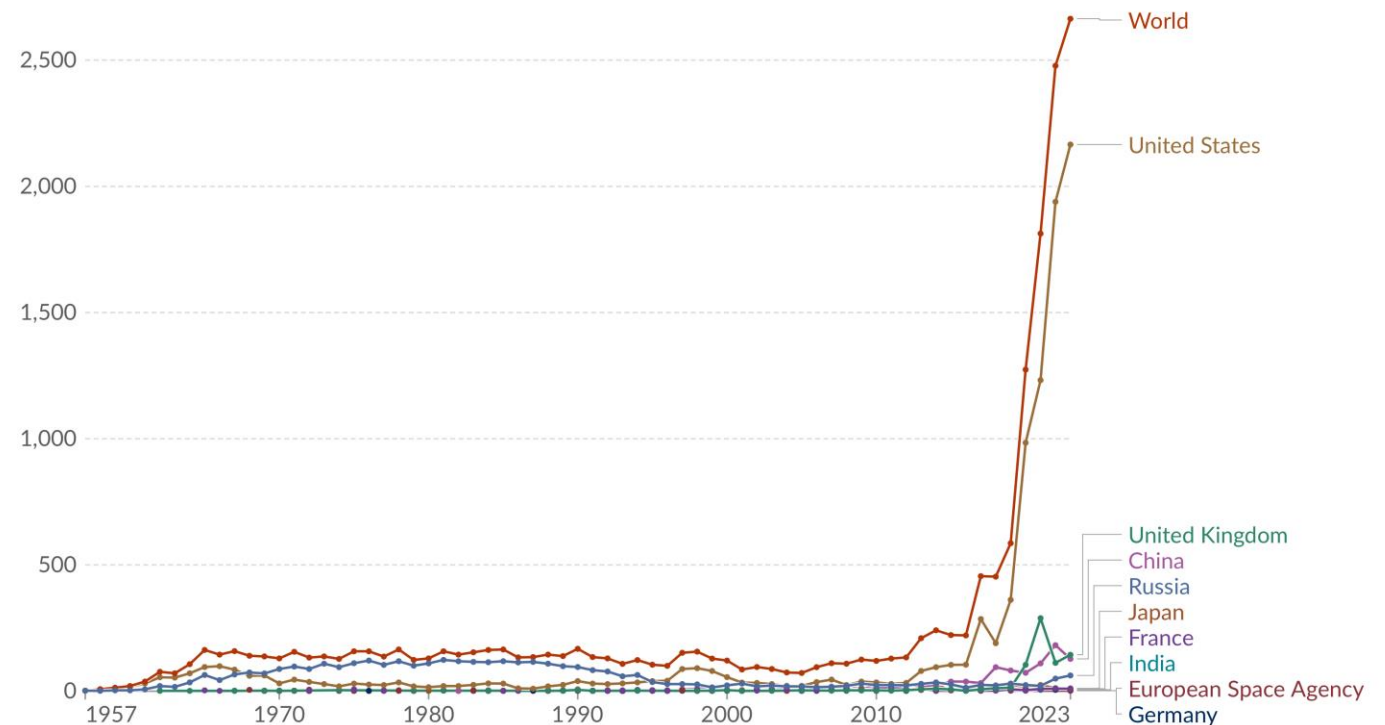
Devices

Parabolic VSAT receivers
-> flat panel beamforming antennas

Annual number of objects launched into space

This includes satellites, probes, landers, crewed spacecrafts, and space station flight elements launched into Earth orbit or beyond.

Our World
in Data



Data source: United Nations Office for Outer Space Affairs (2024)

OurWorldinData.org/space-exploration-satellites | CC BY

Note: Where they differ, launch attributions are based on the commissioning country, not the country conducting the operations.

Transition in Cellular Networks



4G->5G->6G: Sustainability and Resiliency

- Deployment cost and energy consumption in 5G has been a key issue to make it scale
- Truly global sustainable coverage and cont. availability is only possible with a satellite component
- Satellite coverage in sparsely populated areas is more economical than terrestrial
- NTN is to a large extent immune to natural (or man-made) disasters

Evolution of NTN/TN Integration



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Interconnected heterogeneous networks

Design optimized independently and exclusively for terrestrial networks

Seamless interconnections

Design optimized for terrestrial network component
Minimum impact to support integration of satellite for coverage and availability extension

Single unified network

Design optimized for both terrestrial and space components against a set of common goals

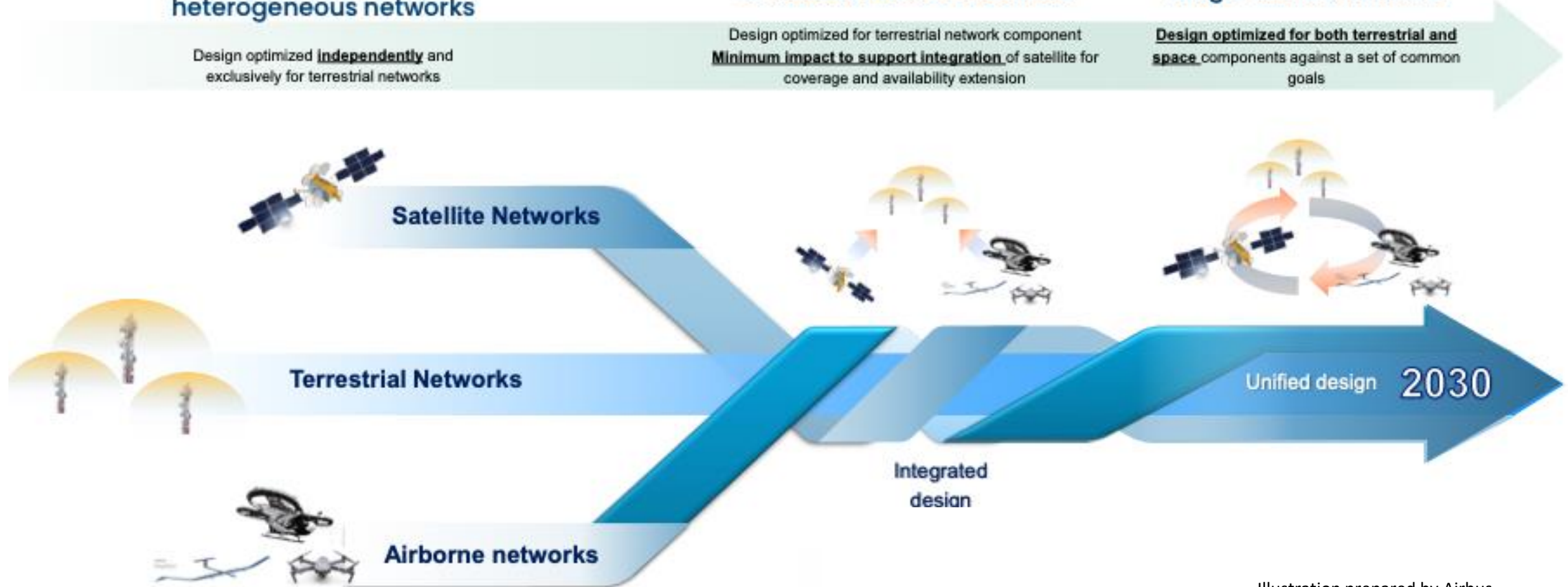
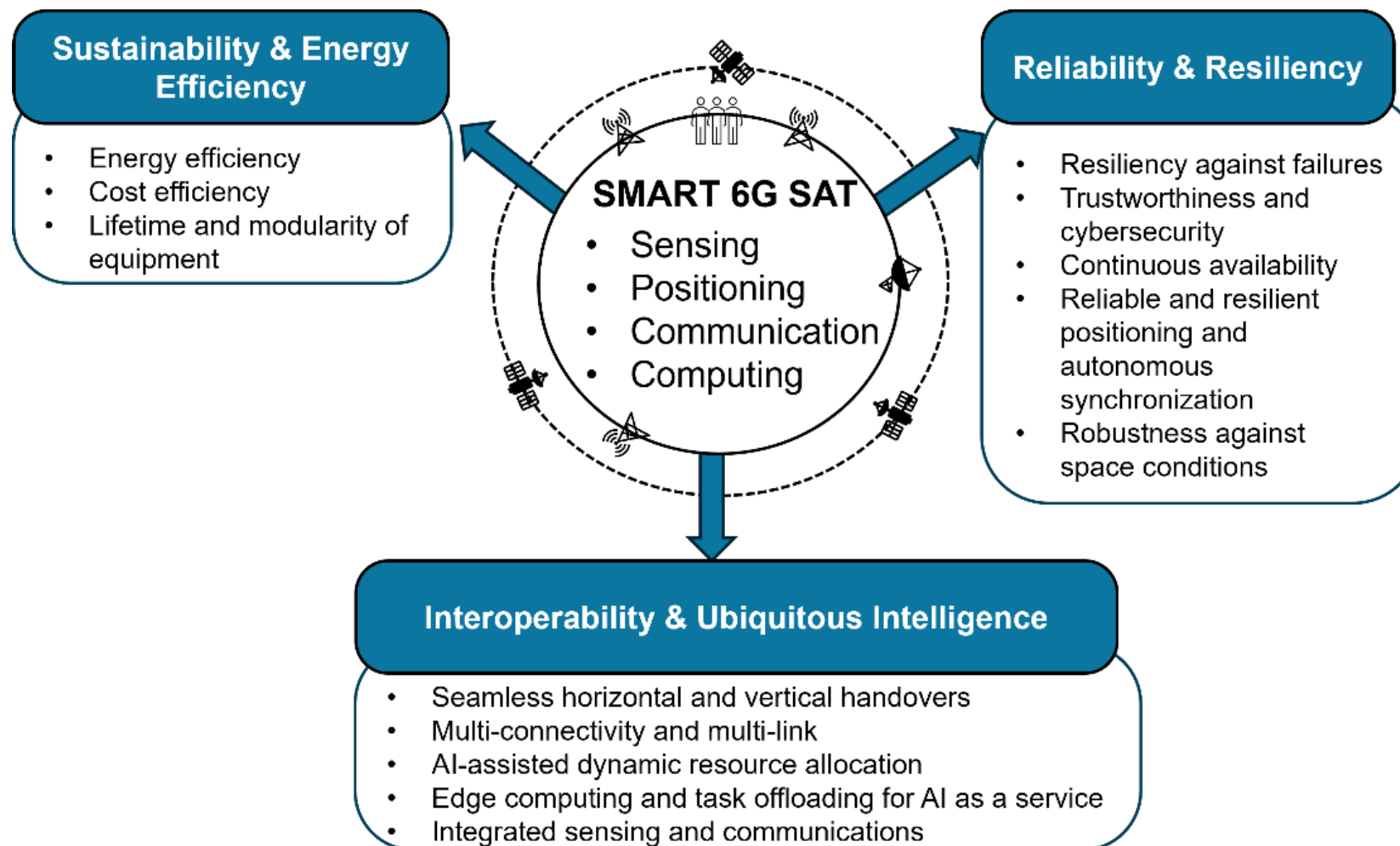


Illustration prepared by Airbus

Objectives



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Use Cases for 6G Integrated Satellites



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Ubiquitous Global Coverage

- Remote and rural area coverage
 - Farming industry (IoRT)
 - Rescue missions by public service
 - Maritime missions (in archipelago or oceans/seas)
 - Broadband connectivity in remote areas

Boost capacity and resiliency

- Safety critical communications
- Remote driving/piloting
- Disaster recovery

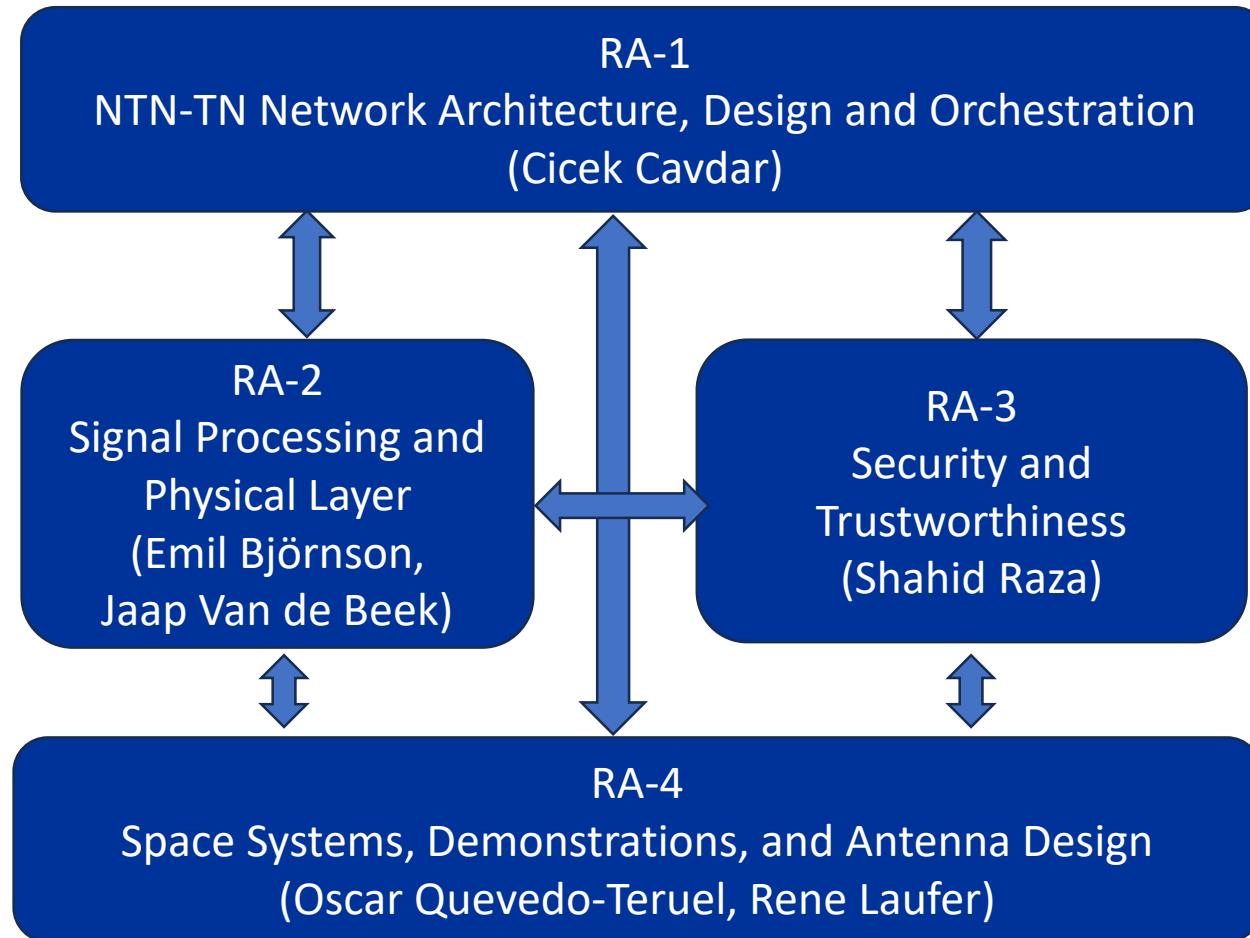
Services and Applications running on 6G Satellites

- Earth observation
 - Collection of weather data
- Content delivery
- Edge Computing
- Real-time earth observation
- High-precision satellite-based sensing
- Positioning, navigation, timing (PNT)

Research Areas



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The Team

PIs and Innovation Areas

with specific focus on Energy Efficiency and Reliability



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Cicek Cavdar

Satellite
Integrated 6G
network
architecture and
network
orchestration



Emil Björnson

Physical layer
design:
D-MIMO and
beamforming



**Oscar
Quevedo-Teruel**

Robust and
Energy-efficient
Antenna Design



**Jaap
van de Beek**

Positioning and
Sensing



Rene Laufer

Space Systems,
validation and
testing



Shahid Raza

Cyber security
and AI for
Satellite
integrated 6G
networks





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Partners

- **Research:**
 - KTH, LTU, RISE
- **Industry:**
 - Ericsson, Saab, Ovzon, Beyond Gravity, Forsway, Satcube, SSC, NorthernWave, Primekey, Airforestry, Effnet
- **Government, societal, and regulatory:**
 - PTS, IRF (Institute for Space Physics), EISCAT, Trafikverket, Forest Industry Association, Region Norrbotten, Region Västerbotten, Region Stockholm

International scientific advisory board

- **Research:**
 - Luxemburg University, 6G-SpaceLab, University of Oulu (6G Flagship), Northeastern University (the Institute for the Wireless Internet of Things (WIOT)), University of Bologna, CTTC
- **Industry:**
 - Eutelsat-OneWeb, Airbus, Viasat, Thales Alenia Space

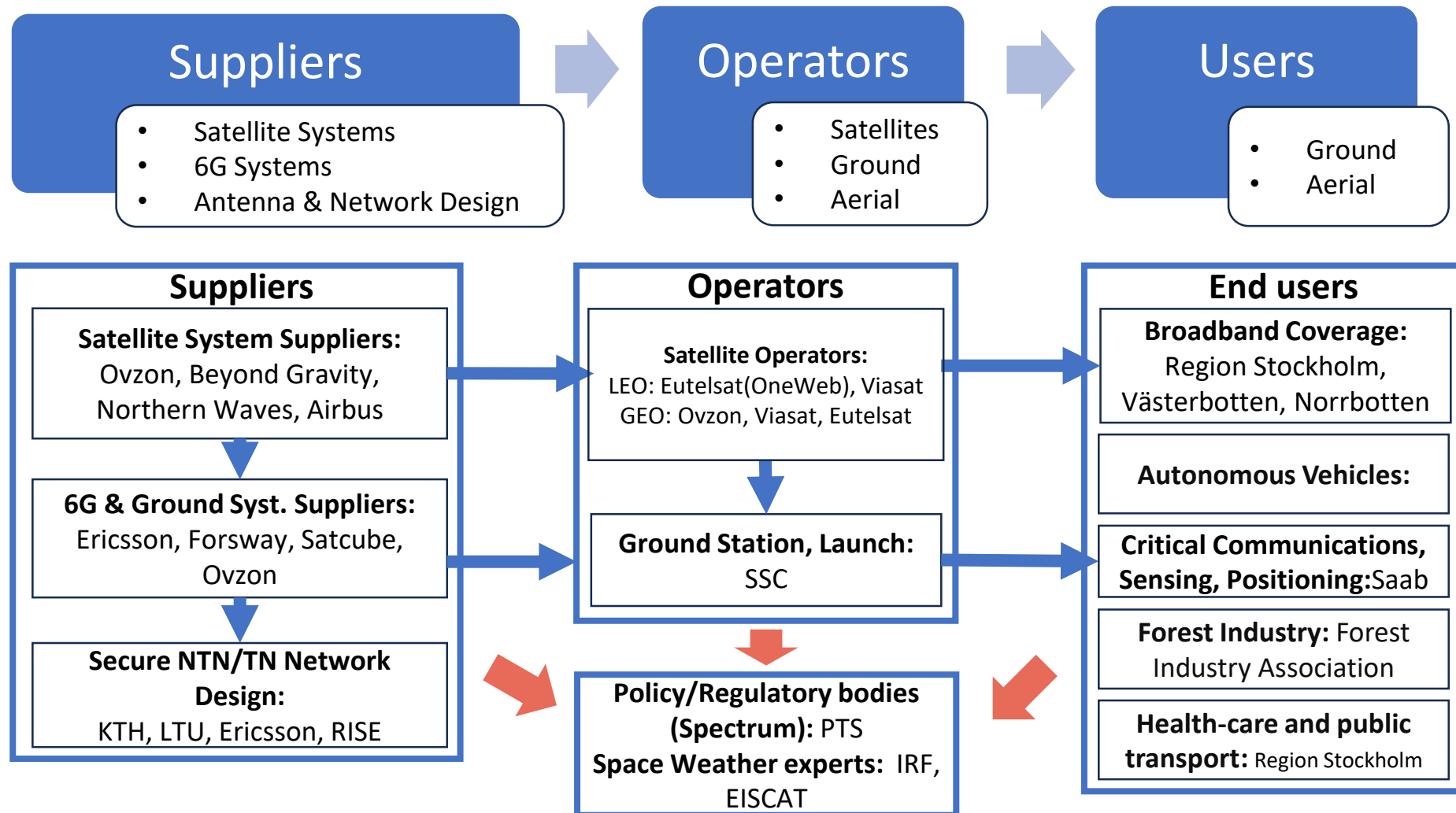
Governing Board

- **Chair: (Industry/Society)**
 - Ericsson
- **Center Director**
 - KTH
- **Other members:**
 - Ericsson, Saab, Ovzon, Beyond Gravity, Forsway, Satcube, SSC, NorthernWave

6G Satellite Communications Value Chain



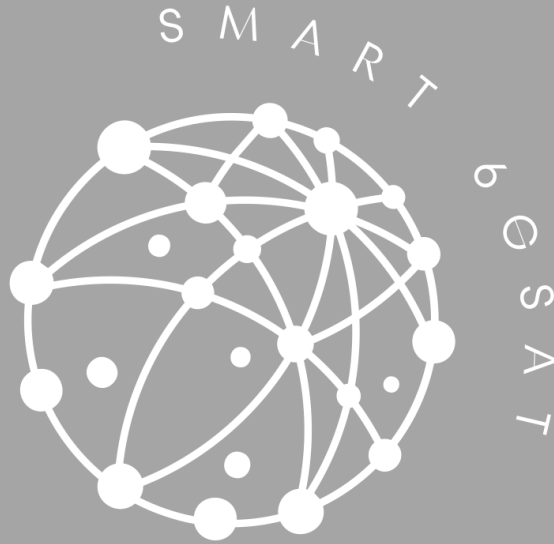
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How we work together

- KTH students visiting industry partners
- Joint PhD and Ms thesis with industry
- Joint funding applications to ESA, EU, VR, Vinnova
- Attend our WSs
- Become an associate member
- Join our email list to receive event invitations and news about 6G SATCOM
 - Seminars
 - Workshops
 - News channels



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