

5G RedCap connectivity over satellites: 6G- SatMTC project

Marko Höyhtyä, Research Professor

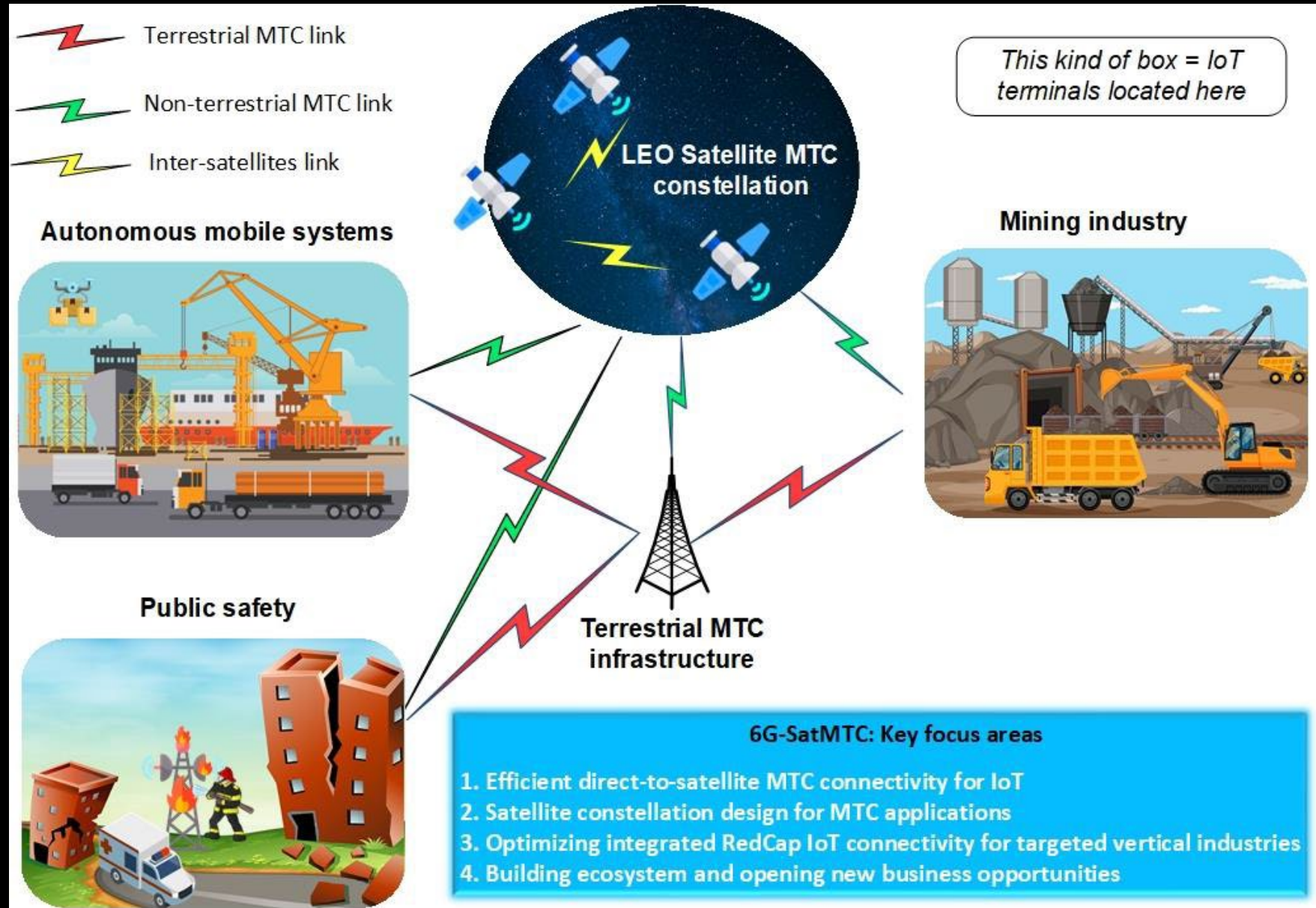


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6G-enabled Satellite-based Machine Type Connectivity for Demanding Applications in Remote Regions (6G-SatMTC)

Integrated satellite-terrestrial systems and LEO satellite based MTC connectivity – RedCap technologies over satellite links



Basic information

- 3.4.2023 – 31.10.2025
- VTT is coordinator, University of Oulu research partner
- Budget: 930 k€, partly funded by Business Finland 6G Bridge program

- In-kind input from companies:
 - Work for use cases and publication
 - 3GPP presentations/contributions
 - Testbed definitions and emulation/simulation work, SW and lab use



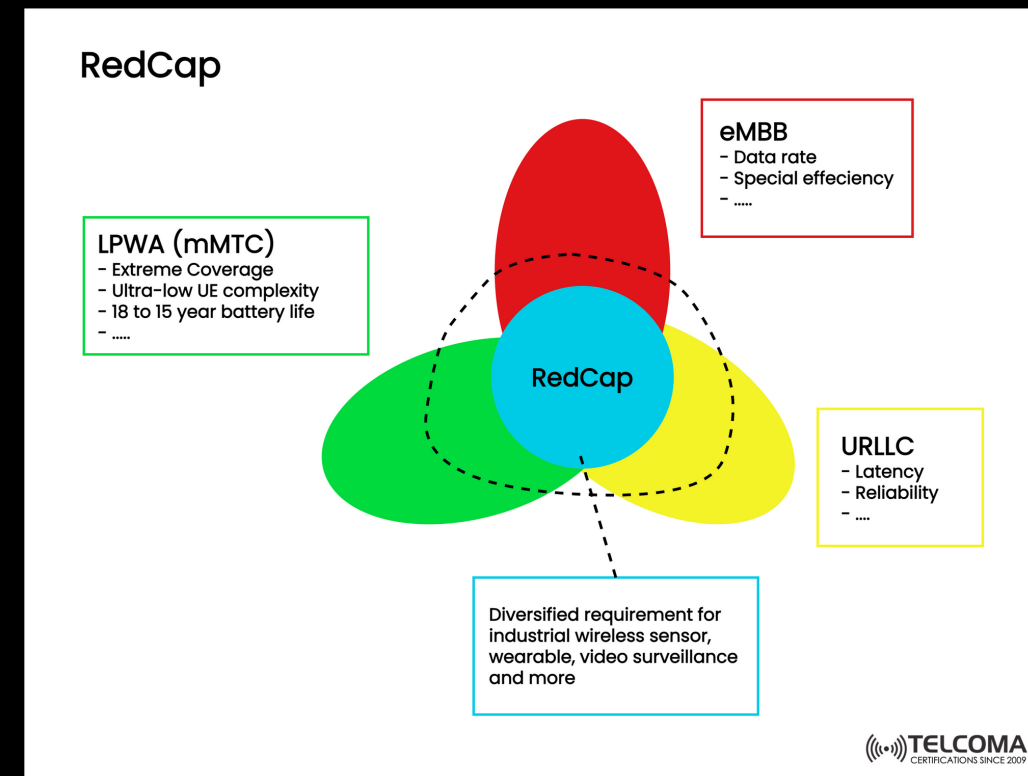
- **The main use case: operation during large forest fires**
 - Reliable situational awareness and connectivity for mobile units
 - Various sensors and devices
 - Mission-critical services for people
- **Links to other initiatives:**
 - ESA MLSS activity (collaboration with Inmarsat and Fraunhofer)
 - ESA 4SSTB (simulation and emulation testbeds to support future constellations R&D incl. IRIS²)



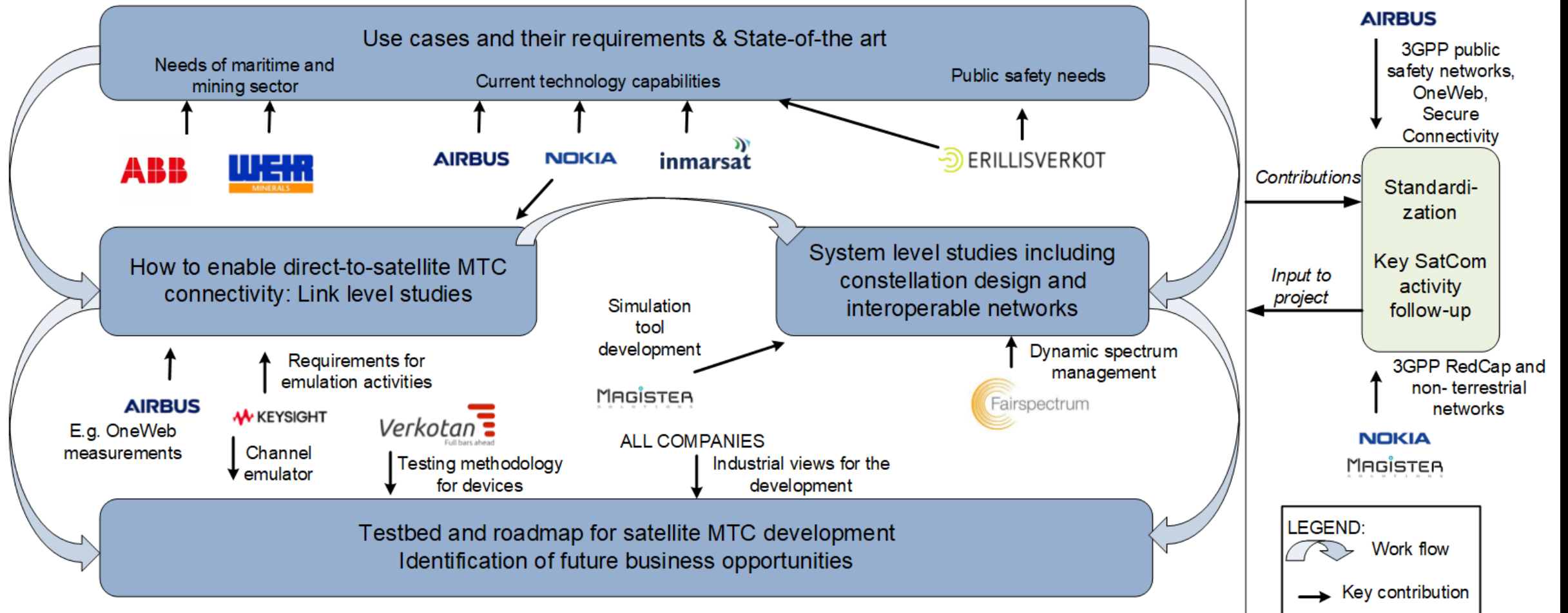
What is RedCap?

Reduced Capability (RedCap) technology is the evolution of the 5G New Radio (NR) to support lower cost, lower complexity, longer battery life and more energy-efficient operation, and enable a smaller form factor than regular NR devices, thus reducing performance to the levels optimal for MTC applications.

- Not yet tailored for satellite connections

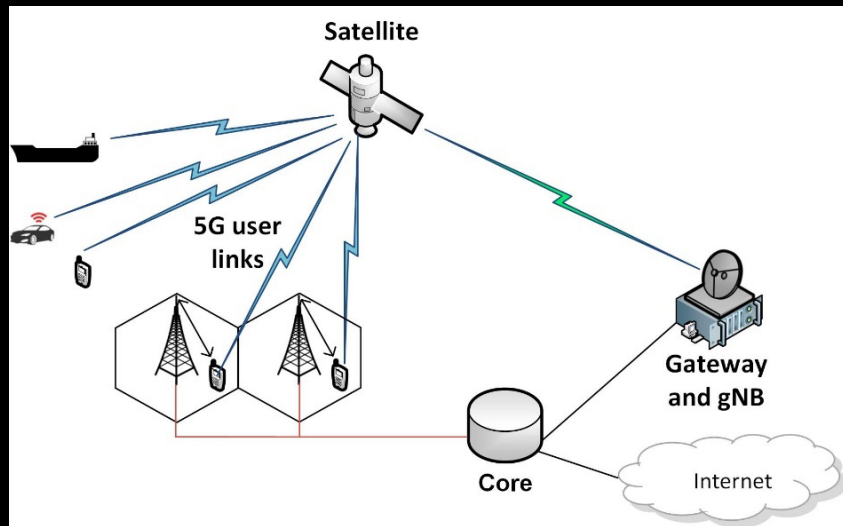


Core 6G-SatMTC activities

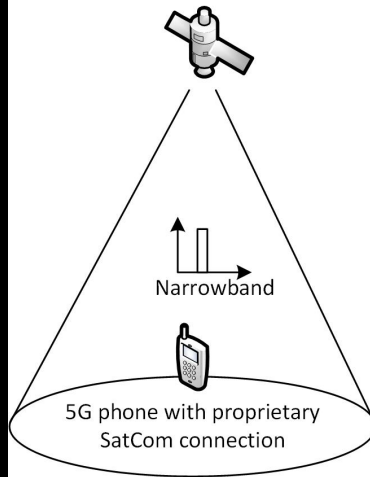


Architectural aspects: Direct access to satellite

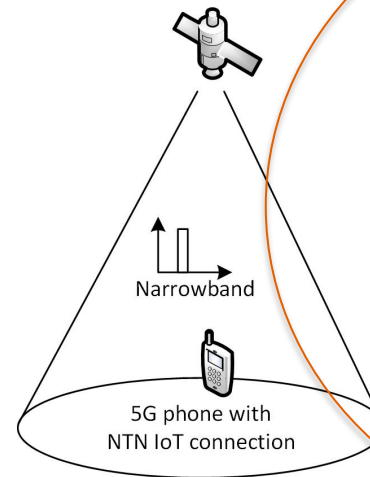
- Same interface towards BS and satellites
- Direct connections inside and outside terrestrial coverage



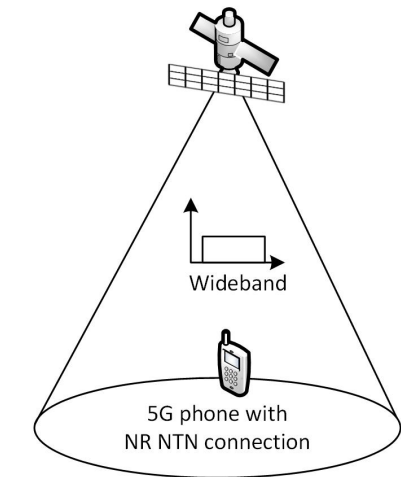
a) Legacy LEO/MEO satellite (e.g., Globalstar, BeiDou)



b) GSO/NGSO satellite with NB-IoT



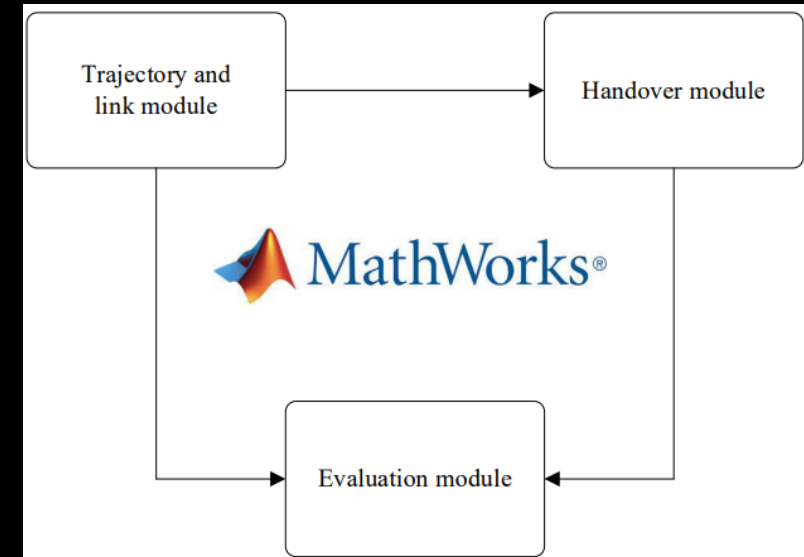
c) LEO satellite with an antenna array and 5G NR/RedCap



- We are studying suitability of RedCap technology over satellite links to support industrial use cases → what are required adaptations to protocols for direct satellite-to-device use?
 - Both IPR and publications targeted
- Another main theme is mobility management and seamless connectivity, including interoperability and coexistence between TN and NTN networks
 - Quasi earth-fixed beams and handover procedures
- We design and implement emulation and simulation testbeds to support development work
 - Measurements with OneWeb terminals to support the work and to analyze suitability for public safety use

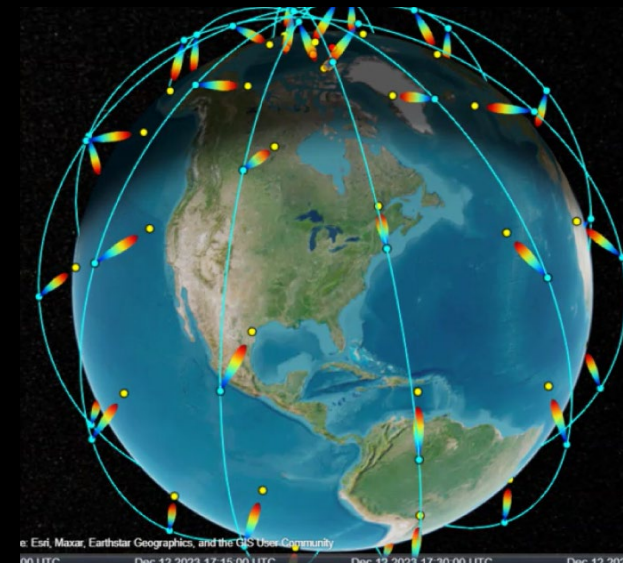
Matlab simulator

- Models satellite trajectories, used devices and their antennas and the link models
- Handover module for decision criterion and timing, enabling conditional HOs
- Evaluation module for coverage and link availability; handover frequency

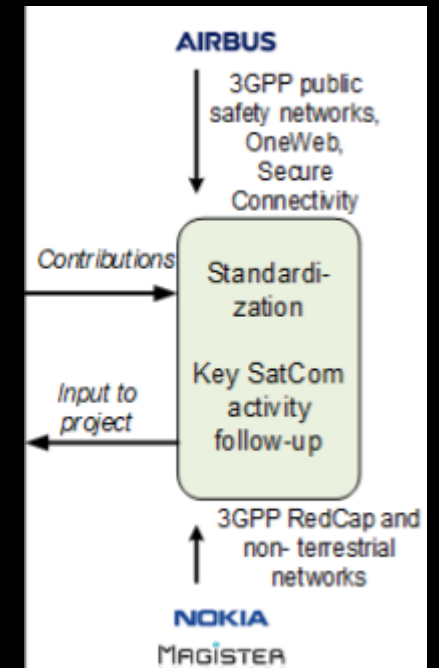


Quasi-Earth fixed beams with parametrizable multibeam antennas and the 3GPP NTN fading channel

- Goal is to reduce HO complexity of handheld devices to support direct-to-satellite RedCap concept



- During the course of work the involved companies (such as Nokia, Airbus) keep 3GPP status presentation for the project group to keep up-to-date information available for researchers
- We plan to create IPR and standardization inputs related to link level protocols (RedCap over satellite link) as well as mobility management procedures.
 - The contributions to 3GPP via the involved companies, most probable WG is RAN



Thank you!

