6G-TakeOff:
Holistic 3D Communication Networks for 6G

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Project idea: Combine ground-based and flying execution platforms in a holistic manner as infrastructure for network elements

Consortium Partners:

Project coordinator: Deutsche Telekom

Contact person: Markus Breitbach

Start | Duration: 2022/08/01 | 3 years

Volume:

- approx. 1000 person months / 12.9 mn € = 1.8 bn ¥
- 38% SME, 31.7% industry, 30.3% research institutes and universities

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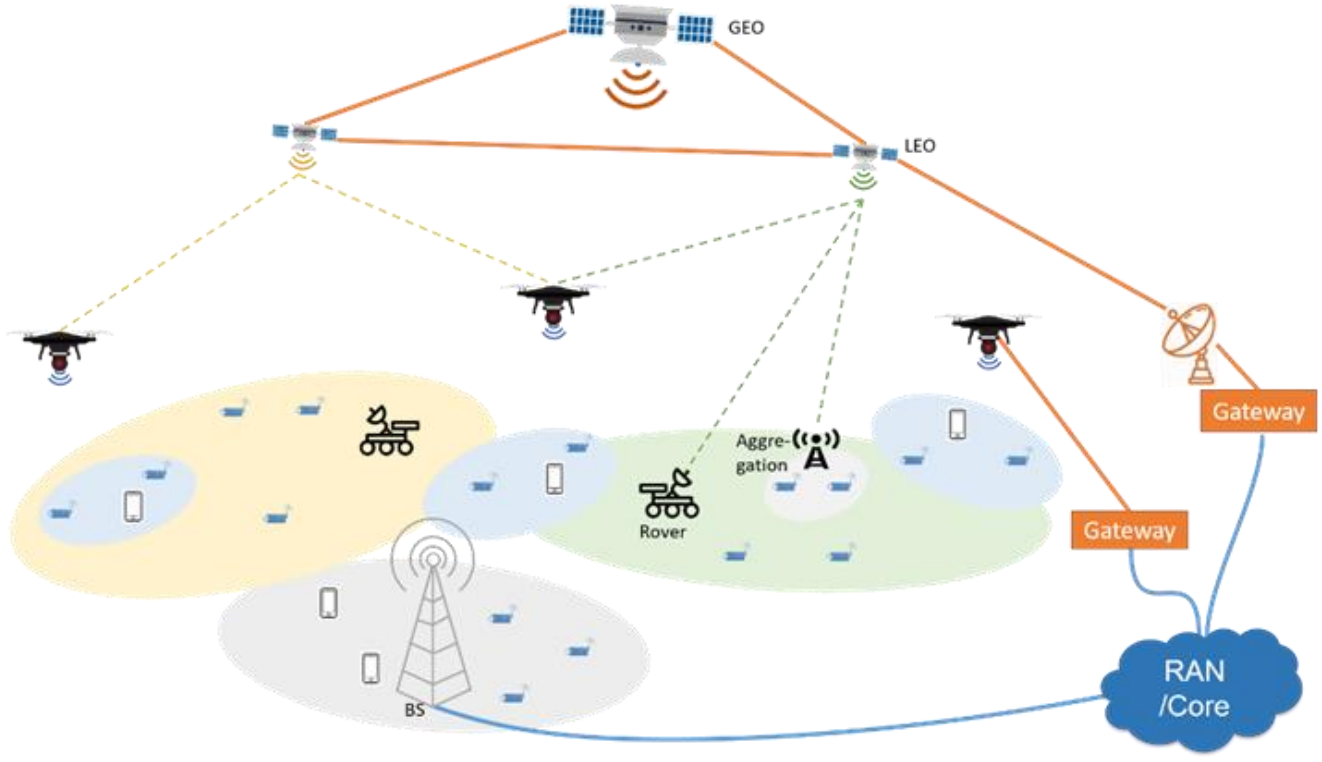
3D Networks

Unified processing platforms for network functions on different heights

- GEO satellites
- LEO satellites
- HAPS: Stratospheric airplanes, balloons
- LAPS: Drones
- Terrestrial sites



Different properties wrt.

- **Geography / economics:** Global business model needed for LEOs; local business model sufficient for HAPS
- **Performance:** Coverage, capacity, data rate / link budget, latency, processing capabilities
- **Flexibility, mobility**

6G-TakeOff Ambitions

Connectivity everywhere and anytime

- Essential prerequisite for a digitalized society
- Allows for flexible and demand-oriented provisioning of network capacity in space and time

Fully exploit the potential of network sites on different altitudes

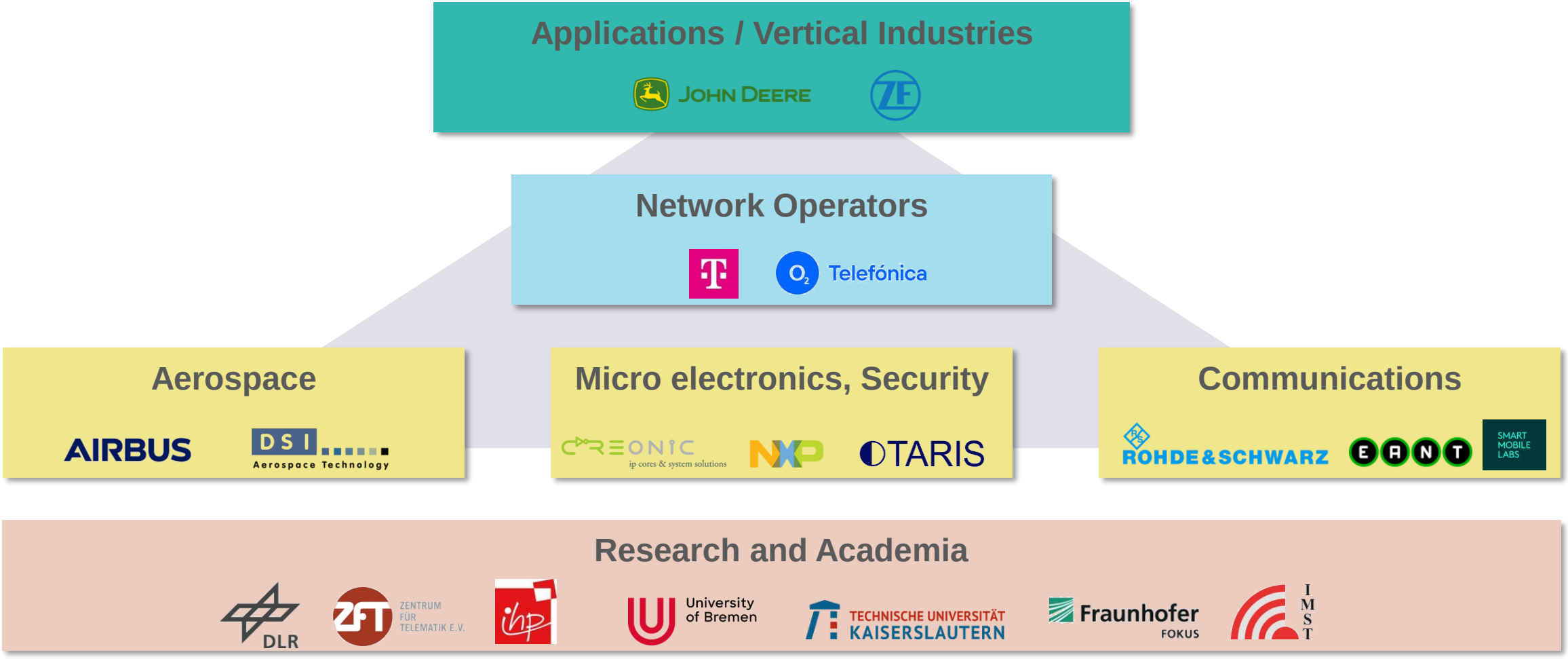
- Holistic design approach for unified networks from terrestrial and non-terrestrial network sites:

  Value (unified network) > *Value* (terrestrial network) + *Value* (non-terrestrial network)
- Create innovations going beyond 5G and promote them in relevant standardization bodies and industry associations

Bringing aerospace industry and telecommunications industry together

- Jointly create substantial contributions to the development of a future European communications infrastructure
- Contribute to long-term sovereignty of German and European societies

Consortium Structure



The Need for Reliable, Ubiquitous Connectivity

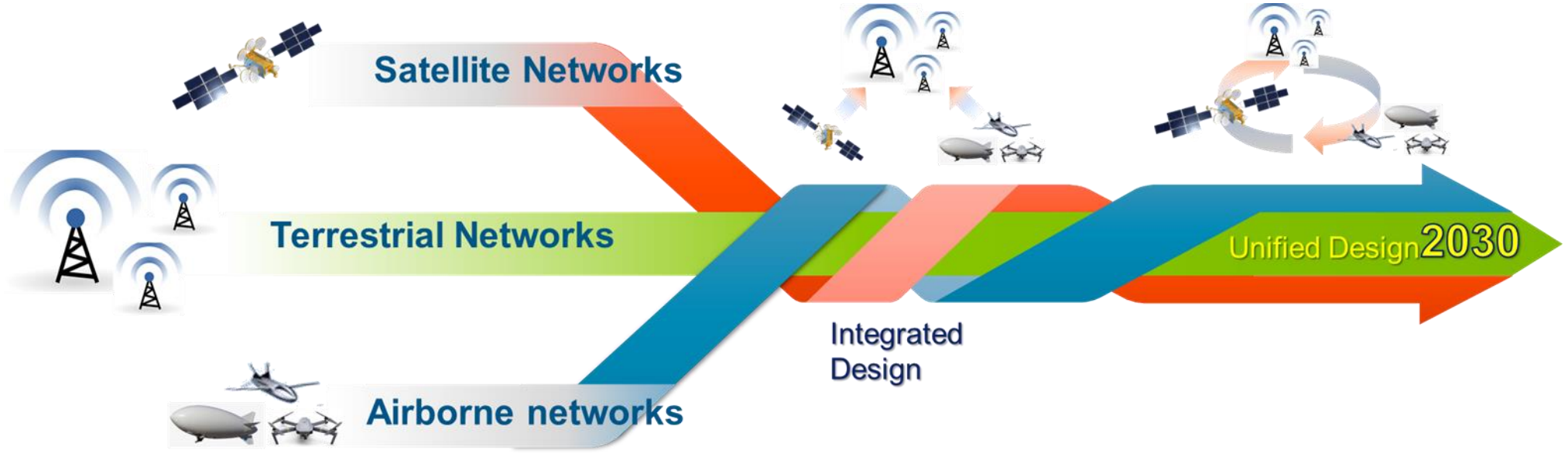
Insufficient coverage for mobile connectivity:

- Coverage of (terrestrial) white spots
- Automotive: Autonomous driving
- Maritime: Cruise ships, oil drilling platforms
- Aerospace: Passenger aircraft

Temporarily / locally insufficient capacity:

- Agriculture
- Construction areas
- Cultural and sports events
- Disaster recovery

Unified 3D Networks



4G & Before

Design optimized **independently** and exclusively for terrestrial networks

5G & B5G

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

6G & beyond

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

Technical Challenges and Envisaged Solutions

Paradigm Change: **Infrastructure network nodes will be moving relatively to each other**

- LEO satellites crossing Germany in less than 5 mins
- Frequent handovers of terminals
- Rapidly changing connectivity within network infrastructure (sat-2-sat and sat-2-ground)

Required properties:

- Nodes can join / leave network dynamically
- Security mechanisms / authentication of joining nodes
- Connectivity management for air interface and backhaul
- Dynamic reallocation of network functions
- Steerable high-gain antenna systems
- Reconfigurable hardware / micro electronics

Novel Network Architecture:

- Unified 3D: Ground, LAPS, HAPS, LEO, GEO
- Dynamically varying network structure

Key Technologies:

- Dynamic connectivity management and allocation of network functions
- Highly automatic operation, based on Information Flow Processing and AI/ML

Key Components

- Innovative antennas and reconfigurable HW platforms and communication modules of LEOs

Conclusion

- 6G-TakeOff aims to serve applications with demand for ubiquitous coverage and to provide capacity in cases of temporarily and locally varying traffic demand

- 6G-TakeOff's architecture will be
  - 3D: consisting of execution platforms on multiple altitudes (satellites, UAVs, terrestrial sites)
  - Unified: jointly optimized for both terrestrial and non-terrestrial network nodes

- 6G-TakeOff's key challenge is the relative movement of network nodes, requiring novel technologies for connectivity management and function reallocation as well as steerable high-gain antennas

Thank You!

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