CELTIC-NEXT
eureka Cluster

Project Information

6G-SKY

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LCA LOGISTIK CENTRE Austria Sud GmbH
RED Bernard Twins

Germany

Airbus Defence and Space GmbH
Deutsche Telekom AG
Ericsson Antenna Technology
Fraunhofer Institut für Integrierte Schaltungen IIS
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Project Website

www.celticnext.eu/project-6g-sky

6G for Connected Sky (6G-SKY)

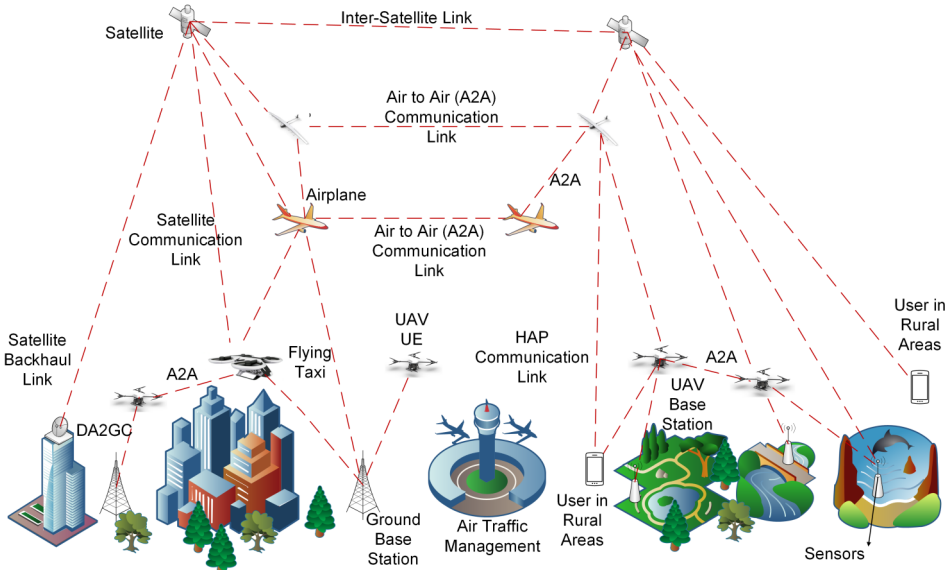
Satellites and high-altitude platforms (HAPs) are being deployed in large numbers to provide connectivity to ground and aerial users. Besides, flying vehicles are becoming ubiquitous unprecedentedly in the sky as users in the sky, which require robust and reliable communication connectivity for their safe and secure operation. 6G-SKY aims to provide integrated connectivity solutions and holistic network architecture by utilizing aerial and ground elements. It will unlock a potential of the recent advances and create new services for ground and aerial users.

Main focus

The 6G-SKY project aims at solutions to enable reliable and robust connectivity for aerial and ground users via flexible and adaptive network architecture adopting multiple technologies such as satellite and direct air-to-ground communications. In addition to the holistic system architecture, novel radio technologies will be proposed to support high capacity, reliable, and secure air-to-ground and air-to-air communication links as well as low delay and reliable command and control links. The devised novel radio technologies and resource allocation schemes will address challenges posed by wireless communication and networking, and regulations concerning safety, airspace management, and frequency usage. Furthermore, this project focuses on novel wireless network design and management schemes in the 3-dimensional (3D) space including different types of flying vehicles with their unique requirements. Another focus is to provide robust, low latency, and/or high-capacity communications to ground users in the rural areas without any infrastructure via non-terrestrial networks (NTNs).

Approach

The first approach of the 6G-SKY project is to design a holistic adaptive NTN architecture including HAPs and satellites to facilitate use cases such as urban air mobility, and different scenarios and regulations. The NTN architecture study also focuses on business modeling for 6G service provisioning, joint sensing, communication, and computation with safe and explainable machine learning models for adaptive and robust communications with safety and security solutions for flying UEs. Other approach is to utilize a mix of various radio technologies including Terahertz, mmWave communications, and



the usage of intelligent reflecting surfaces for 6G air-to-air (A2A) and direct air-to-ground (DA2G) links. Furthermore, the best link parameters and antenna systems for different challenges of the various communication channels will be defined and proved. Additionally, from a networking perspective, we investigate how to integrate network layers for 3D networks to allocate resources in a balanced way and minimize interference, and control their mobility among domains considering satellite, DA2G, A2A communications, and usage of different frequency bands. The system performance will be evaluated for terrestrial users in simulations of heterogeneous networks, covering a multitude of application types from eMBB, mMTC, and critical communication. Communication technologies capturing multi-technology, multi-link 3D network integration, swarm control methods, and required hardware components will be integrated into demonstrators for subsequent proof of concept tests.

Main results

The 6G-SKY project aims at the following visible results:

- Holistic and adaptive network architecture to support different use cases such as urban air mobility and IoT services in rural and urban areas by using flying network elements and cloud-based architectures,
- New antenna design for heterogeneous network infrastructure for ground stations and integrated 6G antennas for flying vehicles,
- Link level design considering different radio technologies with the usage of the new frequency range and new waveforms,
- Solutions for resource, interference and mobility management for flying users in a co-existing aerial-terrestrial network,
- Adaptive network topology shaping with cell-less joint communications,
- Technology demonstrations of selected communication cases,
- Contribution to 3GPP standardization preparation and/or open-source engagements as well as providing inputs for the strategic direction of 6G.

Impact

Connectivity from the sky as initially introduced by the 5G Non Terrestrial Networks (NTN) in the current Release 17 can fully complement terrestrial networks and meet a demand for the full area coverage provided in an economically viable way. Another business segment is the aviation industry with UAVs, flying taxis, and airplanes. Our holistic network architecture will enable future aviation services such as last-mile cargo delivery, personalized travel in the sky, and gate-to-gate high-speed Internet for airplanes. The 3D network architecture combining the advantages of terrestrial, HAPS, and satellite networks has the full potential to provide ubiquitous broadband connectivity with a managed latency to both terrestrial and aerial users. "Connected Sky" complementing the 6G terrestrial network will bring sustainability and required data service for everyone everywhere to unlock new services. A multi-layered architecture in 6G necessitates the joint interplay between the telecommunication, aviation, and space industries. The project innovations address key elements, to demonstrate 5G Advanced and 6G features that underpin the architecture, to de-risk technical challenges at an early stage, and ensure corresponding interoperability standards, commencing in the 3rd Generation Partnership Project (3GPP) in ~5 years for 6G. Our technology demonstrations are important to ensure the eventual certification of communication systems, especially in the aviation and space business. De-risking addresses principal showstoppers such as the use of spectrum between ground/air/space entities and technical issues such as communications performance of mobile ground/air/space entities to eventually provide 6G services. Hence, the 6G-SKY project opens up a potential new market segment in the NTN sector, new products can be derived that can secure industrial partners' business.

About CELTIC-NEXT

CELTIC-NEXT is the EUREKA Cluster for next-generation communications enabling the digital society. CELTIC-NEXT stimulates and orchestrates international collaborative projects in the Information and Communications Technology (ICT) domain.

The CELTIC-NEXT programme includes a wide scope of ICT topics based on new high-performance communications networks supporting data-rich applications and advanced services, both in the ICT sector and across all vertical sectors.

CELTIC-NEXT is an industry-driven initiative, involving all the major ICT industry players as well as many SMEs, service providers, and research institutions. The CELTIC-NEXT activities are open to all organisations that share the CELTIC-NEXT vision of an inclusive digital society and are willing to collaborate to their own benefit, aligned with their national priorities, to advance the development and uptake of advanced ICT solutions.

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