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Engineering & Technology

Efficient and secure intensive distributed computing for 6G and Non-Terrestrial Networks (NTN)

Description

The evolution toward 6G networks is driving a transformative shift in mobile communications, enabling ultra-high-speed, intelligent, and globally connected systems. Additionally, non-terrestrial networks (NTN) extend connectivity beyond ground infrastructure by integrating satellites, high-altitude platforms, and airborne base stations with terrestrial systems to deliver seamless global coverage, especially in remote regions. AI-native networks embed artificial intelligence directly into network architecture to enable autonomous, self-configuring, self-healing, and self-optimizing systems. Edge intelligence and Mobile Edge Computing (MEC) move computation, storage, and AI processing closer to users at the network edge to reduce latency and congestion, enabling real-time services through distributed AI processing, edge caching, task offloading, and cooperative edge-cloud architectures. This infrastructure addresses emerging challenges for compute-intensive distributed computing solutions, which must operate under conditions of intermittent connectivity, mobility, variable latency, interoperability, and limited energy availability.

Infrastructures

UVIGO's cutting-edge, 7-million-euro 5G & 6G network provides an ideal platform for advanced 6G research. Its three independent network cores enable the emulation of complex roaming and interconnection scenarios. Twenty base stations are deployed across five locations, each equipped with edge computing servers, allowing support for real-time ultra-low-latency and AI-native applications. Flexible spectrum operation across the n40, n77, and n258 bands facilitates experimentation. Indoors, 40 nodes at the School of Telecommunication Engineering form one of the largest millimeter-wave deployments in Europe, making it ideal for studying high-density 6G scenarios. With software-defined radio equipment at all locations, researchers can fully customize signal processing, while the optical mesh backhaul and P4 programmable switches enable the emulation of extreme network conditions, including fiber cuts, dynamic topologies, and ultra-reliable low-latency communications. This infrastructure supports hands-on experimentation across all 6G research areas, from THz communications and edge intelligence to non-terrestrial networks and green networking.

Keywords

6G Networks | AI-Native Networking | Edge Intelligence | Green and Energy-Efficient Networking | Multi-access Edge Computing (MEC) | Non-Terrestrial Networks (NTN) | Self-Optimizing Networks

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