Title: Integrated Space/Aerial/Terrestrial Networks for Ubiquitous 3D Super-Connectivity

Abstract:

One reasonable starting point in the unfolding Network 2030 discussion is to reflect on the possible shortcomings of the 5G networks to-be-deployed. 5G promises to provide connectivity for a broad range of use-cases in a variety of vertical industries; after all, this rich set of scenarios is indeed what distinguishes 5G from the previous four generations. Many of the envisioned 5G use-cases require challenging target values for one or more of the key QoS elements, such as high rate, high reliability, low latency, and high energy efficiency; we refer to the presence of such demanding links as the super-connectivity.

However, the very fundamental principles of digital and wireless communications reveal that the provision of ubiquitous super-connectivity in the global scale – i.e., beyond indoors, dense downtown or campus-type areas – is infeasible with the legacy terrestrial network architecture as this would require prohibitively expensive gross over-provisioning. The problem will only exacerbate with even more demanding Network 2030 use-cases such as autonomous aerial vehicles requiring connectivity, thus the 3D super-connectivity.

In this presentation, we will explore a 5-layer vertical architecture (VHetNet) composed of fully integrated terrestrial and non-terrestrial layers for networks of 2030s:

- Terrestrial HetNets with macro-, micro-, and pico-BSs
- Flying-BSs (aerial-/UAV-/drone-BSs); altitude: up to several 100 m
- High Altitude Platforms (HAPs) (floating-BSs); altitude: 20 km
- Very Low Earth Orbit (VLEO) satellites; altitude: 200-1,000 km
- Geostationary Orbit (GEO) satellites; altitude: 35,786 km

In the absence of a clear technology roadmap for the 2030s, the presentation has, to a certain extent, an exploratory view point to stimulate further thinking and creativity on opportunities and challenges.