Satellite based free-space (quantum) optical communication

Optical communication can be conceived as the backbone of human interaction on planet Earth. Without continuously transmitting terabits of data through transatlantic submarine cables, the internet, instant messaging, remote working, bank transaction and all connected technology, is unthinkable and only possible through the invention of low-loss single mode fibre based optical communication.

This technology has become a commodity on ground, with optical communication data backbones and user access (WIFI, 5G) though radio technology. As a next step, we see global data distribution shifting from confinement in underseas optical fibres to satellite mega-constellation based internet-like services (Starlink, OneWeb, LaserLight, …) and point-to-point direct optical data dump.

In free-space optical communication the loss of spatial mode confinement poses additional challenges at delivering light from transmitter to receiver, as the wavefront is diverging and easily disturbed by atmosphere. In a first step of technology adoption, optical-inter-satellite links are being established, passing light through vacuum without major wavefront impairments (e.g. European Data Relay System - EDRS). In a second step optical communication is established through the atmosphere, passing data to and from satellites, (pre-)compensating wavefront aberrations with adaptive optics.

This talk will give an introduction to free-space optical communication, describe ESA's involvement in major optical communication missions and give an outlook to the first deep-space optical communication demonstration at Mars distances.