#22 - Breaking Barriers

With the rapid growth in the amount of global data transfer, secure and fast point-to-point communications are in higher demand than ever. Laser-based communication can provide the required data rates and security but is generally limited to the confines of pre-placed fibre optic lines between fixed points. The use of free-space optical communication technology for wireless data transmission provides the potential for fibre-optic performance from anywhere on the globe. This technology allows for a number of new communication system approaches, especially when integrated with a high-altitude pseudo satellite (HAPS). A HAPS platform operating in the stratosphere serves as the ideal carrier for a free-space optical system, providing long effective range and long duration operations.

Mission Objective

In order to explore the potential for a HAPS-borne laser communication system, a mission need statement was developed: To identify valid business cases for free space laser communication with the use of a high altitude pseudo satellite and design the necessary components to bring the system to market. In order to accommodate this need, the HAPS platform Eurus has been developed. Capable of operating within the stratosphere for more than six months while carrying two independent laser communication terminals to support simultaneous data relay. In support of the Airbus Zephyr initiative, the mission was designed to integrate into the existing Airbus communications infrastructure.

System Design

The Eurus HAPS system consists of a twin-tail aircraft propelled by a set of two electric propellers. The system is powered by a set of solar cells covering the upper surface of the aircraft providing power generation in the daylight, with energy storage provided by a bank of lithium-ion batteries. The platform supports a pair of bespoke laser communication terminals, each capable of acquiring a connection and completing air-to-ground links to points up to 80km away and air-to-air links of 400km range. Furthermore, they can support air-to-space links to satellites orbiting in low earth orbit, providing usable connection time in excess of 30 minutes per orbit to a satellite orbiting at 600km orbital altitude. These terminals can support relay capability, allowing multiple Eurus platforms to work in a network to extend communications range with data transfer rates of up to 10Gb/s. The platform operates for up to 6 months and can operate in excess of 45 degrees north latitude. It cruises with zero emissions at cruise speeds of 16m/s and 28m/s between altitudes of 15km and 24km respectively. In order to support this mission profile, the Eurus will follow a novel flight path. By climbing to an altitude of 24km during the daylight hours excess energy can be stored as gravitational potential energy, minimizing the required battery banks. Once night falls, the craft conducts a powered descent back to 15km, expending the stored potential energy efficiently, and finally cruising at this altitude till sunrise.