QR Code
DO NOT REMOVE

SMARTSAT COOPERATIVE RESEARCH CENTRE

The University of Western Australia | University of South Australia | THALES AUSTRALIA | Australian Government Department of Defence, Defence Science and Technology Group | GOONHILLY EARTH STATION

Demonstrations for Optical Ground Stations

Skevos Karpathakis[1]; **Supervisors**: Sascha Schediwy[1], David Gozzard[1], Brett Nener[1], Gottfried Lechner[2]

Introduction

Free-space optical (FSO) communications technologies promise to provide a significant boost to the downlink capability of satellites and spacecraft.

Optical communications offer significantly larger bandwidth relative to radio frequency communications. The significantly smaller beam divergence leads to higher power transmission efficiency and lower probability of intercept.

UWA is developing stabilisation technologies to measure and suppress the atmospheric turbulence currently limiting reliable FSO communications.

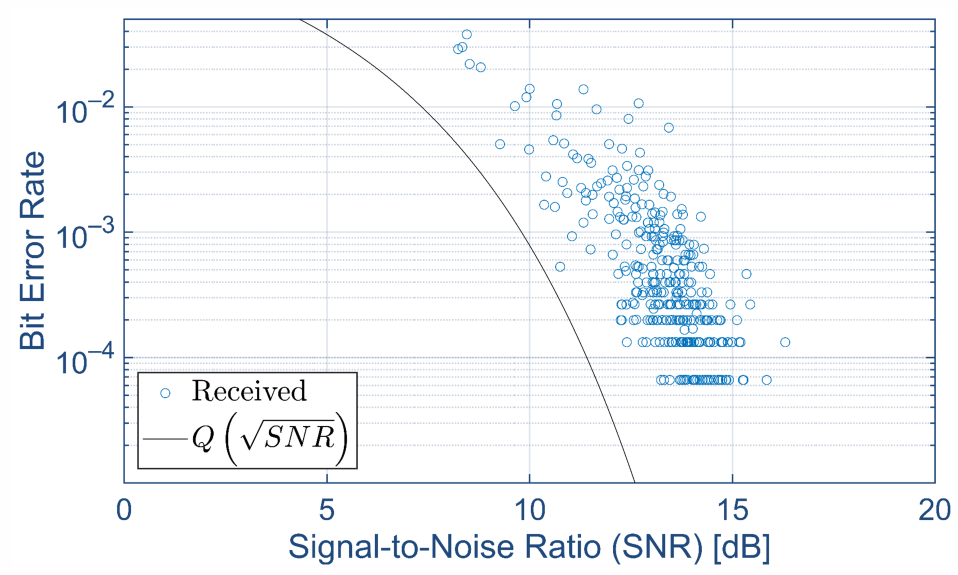
Aims

My research project aims to demonstrate optical fibre-like data rates on terrestrial FSO links as proxies for a variety of space-ground optical communications links, comprising:

- High photon efficiency downlink from cislunar space [1];
- Earth observation downlink from low Earth orbit [2];
- Telecommunications feeder from geostationary orbit [3].

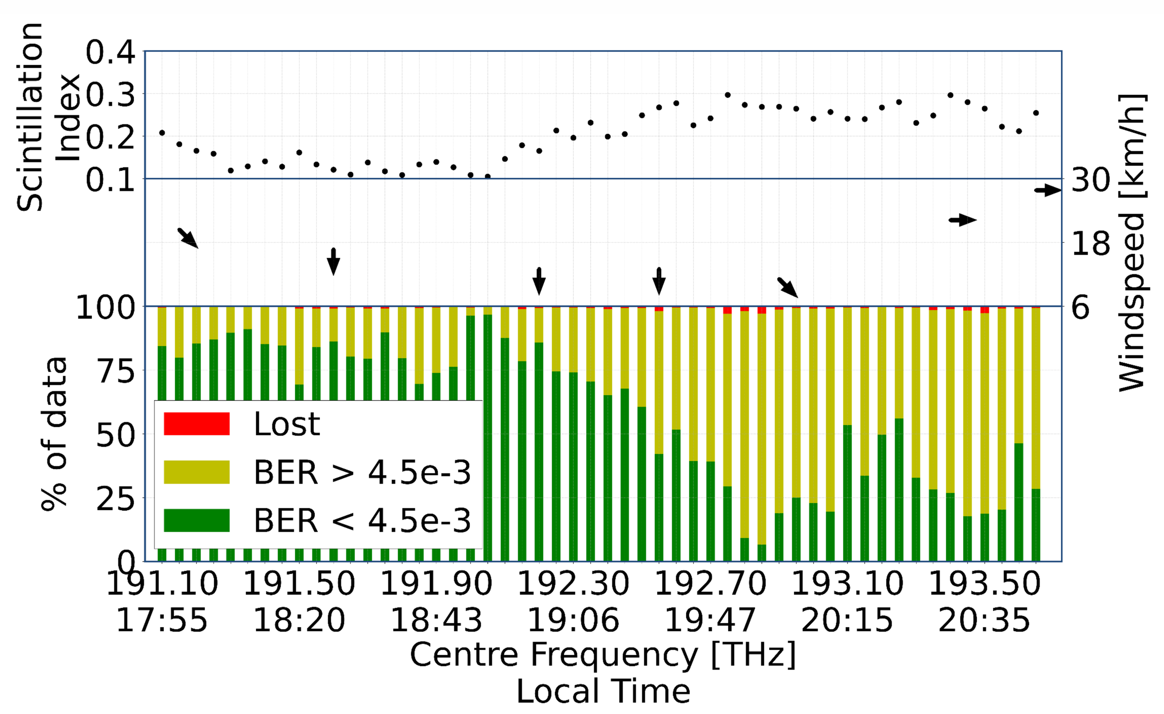
High photon efficiency [1]

An optical pulse-position modulation signal was transmitted at very low power to a hovering drone to simulate the CCSDS 141.0-B-1 physical layer.

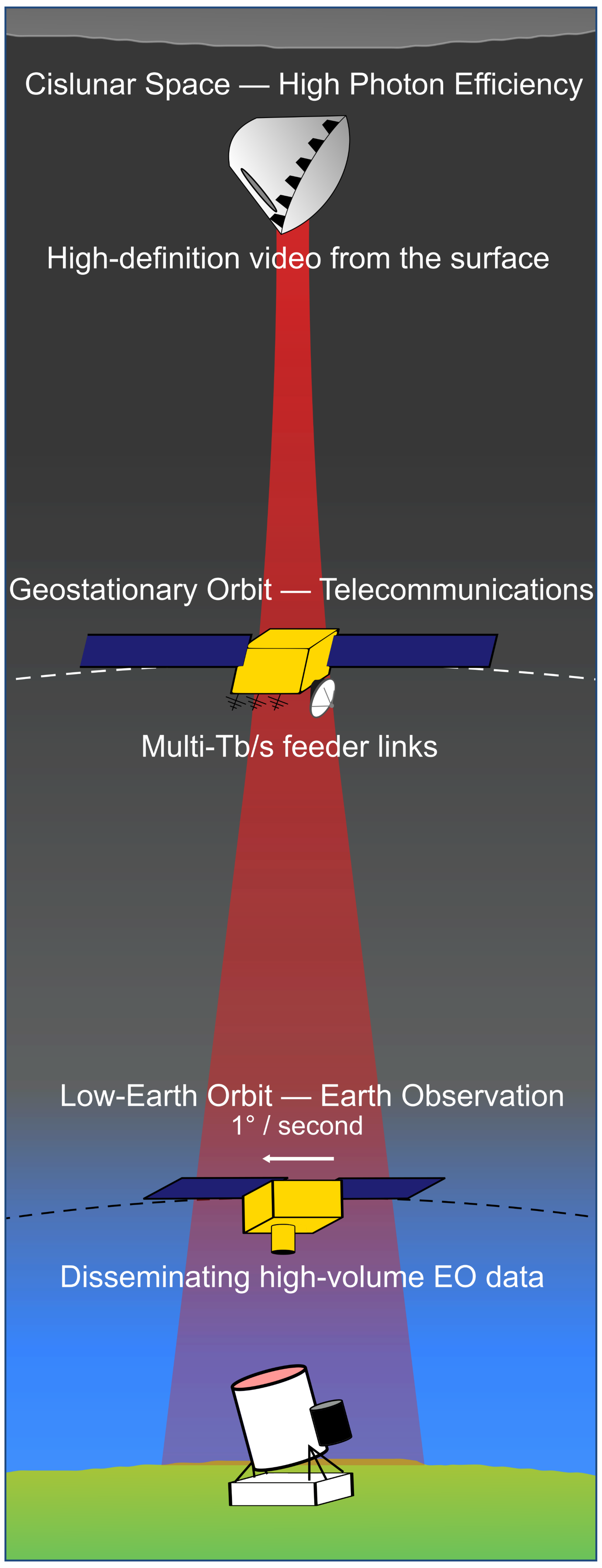


Telecommunications [3]

Coherent optical communications signals were transmitted to, and received from, a corner cube retroreflector, 5.15 km away, over a river.



High-throughput coherent communications were demonstrated on 52 channels. Recorded scintillation indices were equivalent to indices predicted by models for space-to-Earth distances.

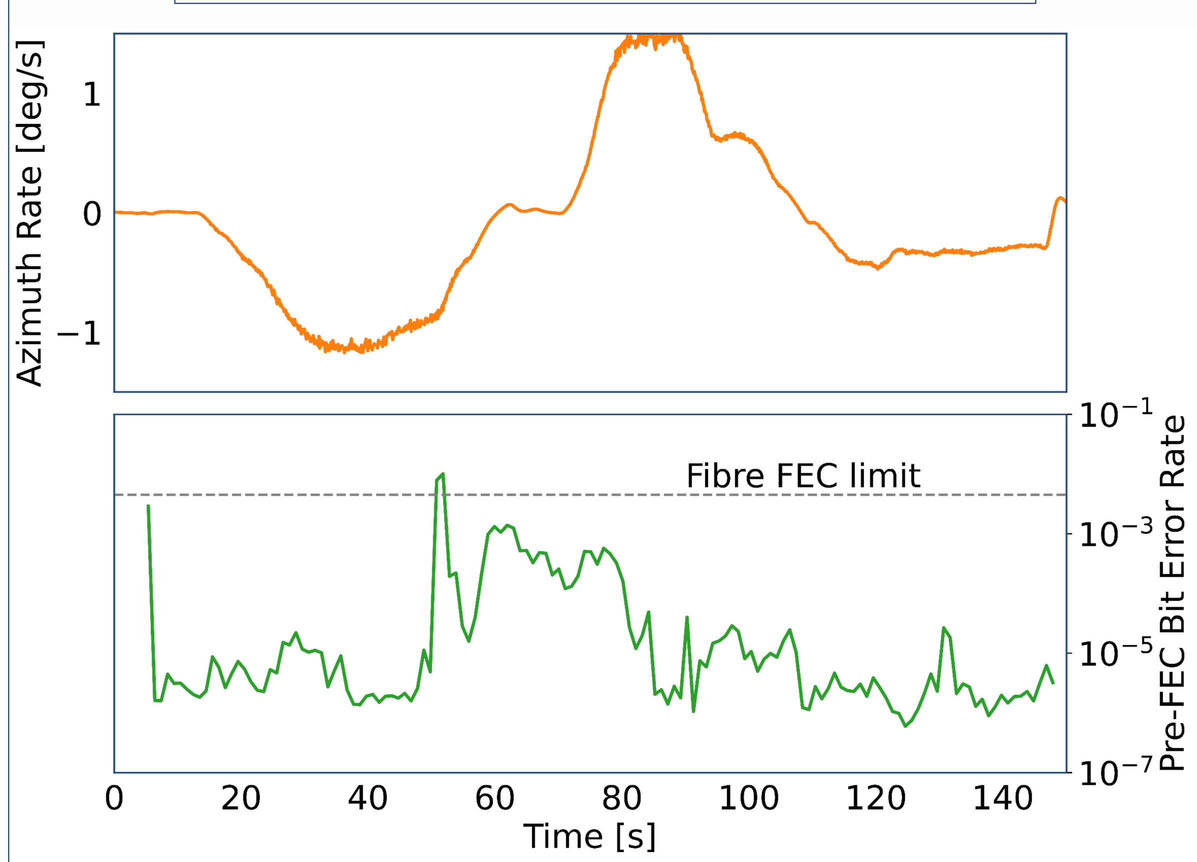


Earth Observation [2]

An orbiting drone was used as a proxy for an Earth observation satellite in low-Earth orbit.

A 100 gigabit-per-second coherent optical communications signal was transmitted to, and received from, the drone, carrying a corner-cube retroreflector.

Corner cube retroreflector on drone target



The drone was tracked at azimuth rates exceeding 1.5 degrees-per-second, while the optical link was maintained, with bit error rates (BER) almost completely below the conventional fibre network forward-error correction limit.

References

[1] S. Karpathakis, et al. Drones **7**, p 99 (2023).

[2] S. Walsh, et al. Nature Scientific Reports, **12**, p 18345 (2022).

[3] S. Karpathakis, et al. Applied Optics, **62**(23), p G85 (2023).

Affiliations

[1]International Centre for Radio Astronomy Research, The University of Western Australia

[2]University of South Australia

Australian Government Department of Industry, Science, Energy and Resources | AusIndustry Cooperative Research Centres Program