

## Development of Western Australia's Optical Space Communications Capabilities

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Free-space communications at optical frequencies offer a quantum leap in data transfer capacities and will eliminate the data flow bottleneck currently impeding spacecraft communications. The orders-of-magnitude higher carrier frequencies, higher directionality of transmitted beams, and lack of spectrum regulation mean that optical communications will supplant traditional radio frequencies to become the backbone of space communications. Supporting this requires networks of optical ground stations capable of suppressing the effects of atmospheric turbulence.

The University of Western Australia is at the forefront of free-space optical communications research in Australia. The Western Australian Optical Ground Station (WAOGS-1)[1], the first dedicated optical communications ground station in the southern hemisphere, was installed in 2021 and is on track for its first space downlink testing as soon as Q4 2022. Leveraging expertise in novel atmospheric stabilization technologies, our aim is to establish facilities capable of ultra-high data rate coherent communications to low earth orbit, high photon efficiency communications to cis-lunar space, and satellite mediated secure quantum communications. These facilities will form a micro network within the larger Australasian Optical Ground Station Network (AOGSN) [2]. We provide an overview of the architecture of WAOGS-1 and our mobile optical terminal, and report on progress to date including results from proxy demonstrations between the mobile optical terminal and a drone.

[1] Walsh, S. et al. (2022). The Western Australian Optical Ground Station. IET Conf. Proc. 71–78(7)

[2] Bennet, F. et al. (2020). An Australia/New Zealand optical communications ground station network for next generation satellite communications. Free-Space Laser Communications XXXII [1127202] (Proceedings of SPIE - The International Society for Optical Engineering; Vol. 11272). SPIE. <https://doi.org/10.1117/12.2545305>