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SAFEGUARDING RADIO ASTRONOMY AND SPACE NAVIGATION: CSIRO'S OBSERVATIONAL DATA SHARING SYSTEM FOR MITIGATING SATELLITE INTERFERENCE

Abstract

Within the ITU-R Radio Regulations (RR) Table of Frequency Allocations, there are specific Radio Astronomy Service (RAS) allocations covering parts of the spectrum that are of particular importance to astronomy, such as molecular line emissions. However, these allocations cover only a small part of the spectrum, whereas cosmic radio emissions of equal importance occur over the whole radio spectrum due to the laws of physics. Hence, to meet its science goals, radio astronomy facilities must operate in bands not specifically allocated to radio astronomy.

RAS receivers are many orders of magnitude more sensitive than receivers used in communications applications. Therefore, any signal emitted within the line of sight of a RAS facility, irrespective of distance, will be visible in the observed band of a RAS receiver. The receivers are in fact so sensitive, that even EMI from spacecraft electronics is readily detected.

In order to avoid emissions from transmitters in bands that are not specifically allocated to RAS, telescope facilities are constructed as far away from population centres as possible. This maximises terrain shielding and clutter loss for terrestrial transmitters and limits the amount of interference measured by radio astronomy observations. Satellites above the radio horizon of a radio telescope by contrast are always in the line of sight and therefore pose a particularly insidious problem to RAS.

Of critical importance to the space industry is geodetic Very Long Baseline Interferometry (VLBI), which provides the reference frame essential for precise spacecraft navigation, orbit determination, and mission planning. This vital space infrastructure is increasingly threatened by satellite emissions, jeopardizing the accuracy of services that all space missions depend upon.

In Australia there are many radio astronomy facilities. Observatories at a number of these facilities make passive observations in the frequency bands 50 – 350 MHz, 700 – 4032 MHz, 4.5 to 6.7 GHz, 8 to 12 GHz, 16 to 27 GHz, 30 to 50 GHz, and 75 to 116 GHz using receivers that are highly sensitive to interference.

In this paper we discuss the newly developed CSIRO Observational Data Sharing (ODS) system and describe the methodologies the system enables to improve protection of RAS from the most significant impacts of satellite constellations operating inside their allocated bands and illustrate how this system can help pave the way to new spectrum sharing methods between active services and RAS that will benefit the entire space community.