PROTECTING RADIO ASTRONOMY THROUGH REAL-TIME COORDINATION

SpaceX's mission is synonymous with expanding humanity's understanding of the universe. As a result of years of coordinated work with the radio astronomy community, in particular the National Science Foundation (NSF) and the National Radio Astronomy Observatory (NRAO), SpaceX and NRAO have developed new techniques to ensure Starlink's advanced satellite constellation can provide critical connectivity options near radio telescopes while simultaneously protecting their important scientific research of the cosmos.

Telescope Boresight Avoidance

Engineers from SpaceX and NRAO have determined, through years of collaborative experiments, that the direct transmissions from satellites towards the eye of radio telescopes may pose a significant risk of interference to astronomical research. To mitigate this risk, the teams from SpaceX and NRAO have developed techniques that enable Starlink satellites to avoid transmissions into the line-of-sight of radio telescopes by leveraging Starlink's advanced phased array antenna technology, which can dynamically steer satellite beams away from telescopes in milliseconds. These techniques are made possible by a real-time data sharing framework between radio astronomy observatories and Starlink that provides the Starlink network with a telescope's planned observation schedule, including the telescope's pointing direction (aka "boresight") and its observed frequency band. With this information, the Starlink network can ensure that satellites passing near the boresight of a telescope dynamically redirect their beams away from the telescope. This boresight avoidance method protects the telescope's observations while ensuring Starlink service remains uninterrupted for customers near the telescope, and it is now live and operational for the Starlink network and NRAO's Very Large Array in New Mexico.

Building on a coordination agreement in 2019 and a subsequent co-sponsored project to provide Starlink service to under-connected families of the Alamo Navajo Indian Tribe, SpaceX and NRAO analyzed the potential impact of satellite constellations on radio astronomy research at the nearby Very Large Array telescope in New Mexico and at the Green Bank Observatory in the National Radio Quiet Zone in West Virginia. This joint work led to the development of the telescope boresight avoidance method to protect these telescopes. SpaceX and NRAO have since published the results of their work at the Green Bank Observatory in the AAS Astrophysical Journal Letters.

SpaceX intends to continue its work with the radio astronomy community to expand the implementation of the telescope boresight avoidance method to other observatories in the USA and beyond. NRAO and SpaceX are currently working to implement this in the National Radio Quiet Zone to ensure local residents have access to reliable high-speed, low latency satellite internet. SpaceX maintains an open invitation to other radio astronomy organizations from around the world to implement the approach to protect their important scientific research.