NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION (NTIA)

ACTIVITIES ON ENSURING SPECTRUM ACCESS FOR RADIO ASTRONOMY (FY 2018 and FY 2019)

Senate Report 115-275, which accompanied the Consolidated Appropriations Act, 2019, Pub. L. No. 116-6, directs the National Telecommunications and Information Administration (NTIA) to report to Congress on "ensuring spectrum access for radio astronomy as commercial use of radio spectrum increases." This report covers all NTIA coordination activities from October 1, 2017 through August 14, 2019.

I. Domestic and International Coordination Efforts

In FY 2018, NTIA facilitated coordination with radio astronomy and other scientific uses of spectrum in both the domestic and international arenas, as key U.S.-funded radio telescopes and scientific assets are geographically located both within the United States (e.g., the Jansky Very Large Array in New Mexico) and outside of our national borders (e.g., the Atacama Large Millimeter/submillimeter Array in Chile). FY 2018 was a groundbreaking year for U.S. leadership in science with the announcement of the first image of the shadow of a black hole by the Event Horizon Telescope. The Event Horizon Telescope was comprised of many individual radio telescopes spread across the globe, funded in large part by the National Science Foundation (NSF). This exquisite image was a technical feat, representing the cutting edge of radiocommunication technology, with synchronized telescopes observing the center of the galaxy Messier 87 (M87) at millimeter wavelengths. To maintain support for keeping key portions of the radio spectrum available for use by the scientific community, NTIA engaged in the following activities:

- NTIA conducted monthly meetings of the Interdepartment Radio Advisory Committee (IRAC). Topics such as the Federal Communications Commission's (FCC's) Spectrum Horizons (above 95 GHz) and Spectrum Frontiers (above 24 GHz for mobile radio services), 6 GHz unlicensed use, and the FCC's Innovation Zone NPRM (ET 18-21), among others, have all been discussed and the IRAC has afforded NSF an opportunity to comment and represent radio astronomy interests and concerns. Both the IRAC and its sub-committees include key stakeholders representing radio astronomy and broader scientific interests, including NSF, the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA), with radio astronomy primarily funded by NSF. NTIA's Policy and Plans Steering

Committee similarly includes representatives from the key agencies funding fundamental science research, including NSF, NASA, NOAA, and the Department of Energy.

- NTIA supported international leadership roles at the International Telecommunication Union, Radiocommunication Sector's (ITU-R's) Study Group 7 for the representation of scientific spectrum interests. NASA personnel provide chairmanship for Study Group 7; NOAA employees lead the U.S. counterpart to ITU-R Working Party 7C (dealing with Earth sensing subject matter); and NSF personnel chair the U.S. counterpart of ITU-R Working Party 7D (focusing on radio astronomy issues) and provide delegation leadership to international meetings of the corresponding Working Party. These leadership roles were encouraged and provided mentorship by the NTIA International Spectrum Policy Division in the Office of Spectrum Management.

- NTIA supported a successful U.S. proposal in fall 2018 to amend a Working Group name to include "Scientific Services" in its title at the Inter-American Telecommunication Commission (CITEL)'s Permanent Consultative Committee II: Radiocommunications (PCC.II) regional group meeting. The amended working group now affords the science services a single venue for review of issues. CITEL is one of the specialized advisory bodies of the Organization of American States. This successful addition is important as the United States has many of its most critical investments in radio astronomy elsewhere in the Americas such as the Atacama Large Millimeter/submillimeter Array (ALMA) located in Chile and the Cosmic Microwave Background experiments (CLASS, SIMONS Array), which are also located in Chile, as well as the Large Millimeter Telescope (Mexico).

- NTIA coordinated responses to the FCC on commercial spectrum usage, and requested the inclusion of standard language, which highlights the scientific uses of the spectrum, especially radio astronomy. Licensees were made aware of the sensitive instrumentation of radio telescopes and the geographic locations of these instruments and were asked to coordinate with the NSF spectrum management office to obtain more details.

- NTIA's Manual of Regulations and Procedures for Federal Radio Frequency Management includes procedures and regulations for the protection of radio astronomy which has been enforced, such as the requirement for Coordination Agreements with Radio Astronomy Stations (*see* 47 C.F.R. § 2.106, footnote US131).

- The NTIA Frequency Assignment Branch automatically sidelines any frequency assignment request (governmental or non-governmental) that is ground-based and would operate in the National Radio Quiet Zone (NRQZ). These assignments are not issued until the NRQZ office has studied the request for compatibility with the sensitive radio astronomy telescopes within the zone, giving NSF crucial information for voting to accept those assignment requests that have been found compatible (maintaining compliance with NTIA Manual 8.3.9).

- NTIA requested and obtained a list of current and future spectrum requirements for U.S. astronomy as part of the requirements directed by the October 25, 2018 Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future. NSF has reported on the two key spectrum needs for radio astronomy and scientific uses of the spectrum: protection of existing uses of the spectrum and a framework facilitating future innovation. The needs highlighted by NSF include additional geographic protections for radio astronomy facilities in the few remote geographic locations where the most sensitive radio telescopes operate (see the telescope list in footnote US131), especially from airborne transmitters.

II. Ongoing Coordination Efforts

In additional to the domestic and international coordination efforts discussed above, there are several critical ongoing coordination efforts being discussed:

- **Adding geographical protections from airborne transmitters to the NRQZ, where the Green Bank, West Virginia, Observatory resides.** Established by the FCC and the IRAC in 1958[1] to minimize harmful interference to sensitive radio astronomy telescopes and to facilities operated by other government agencies, the NRQZ has served its purpose for over 60 years. However, the rules set forth in 1958 are no longer adequate to protect the Green Bank Telescope, which resides in the NRQZ, from airborne transmissions, such as airplanes, satellites, and unmanned aerial vehicles. The U.S. scientific community will need updated rules for the NRQZ that consider the modern progress of technology. Where possible, airborne transmissions should be minimized or coordinated. Coordination is being conducted on an ad hoc basis.

- **Newly created quiet zone protections around key radio astronomy observatories**. These observatories include the Jansky Very Large Array in New Mexico and the Very Long Baseline Array telescopes located across the United States. As spectrum demands and the capabilities of the telescopes increase, quiet zone protections are crucial to the operation of these facilities. This will allow critical science observations and temporal sharing. This is only feasible with newly created special zones around the most critical U.S. radio astronomy observatories, such as the VLBI stations, which are used for science research and very important Earth orientation information.

- **National Radio Dynamic Zones (NRDZs).** NTIA engaged in conversations with the NSF about a new concept to create National Radio Dynamic Zones (NRDZs). The NRDZ concept is a novel mechanism for piloting, testing, and rolling out the most innovative approaches to dynamic spectrum sharing in specialized geographic regions. In

[1] *See* FCC Docket No. 11745 and IRAC Document 3867/2. The NRQZ encloses a land area of approximately 13,000 square miles.

some regions, the NRDZs will allow more flexibility for experimental testing and in other areas it will pilot modern coordination techniques to increase spectrum sharing and protect radio astronomy telescopes. The NRDZs will increase situational awareness of the spectrum environment and provide the test bed for the necessary hardware and software tools for modern spectrum management to be built and tested. NTIA provided technical and policy guidance in initial brainstorming meetings about the innovative NRDZ concept.

Continued investment in research and development will be necessary to ensure that as the electromagnetic environment becomes increasingly congested and complicated, scientists have the resources to innovate and find new solutions (e.g., inventing more interference-resistant receivers) to pilot dynamic sharing and other advanced sharing techniques. NTIA is committed to continued partnering with the scientific community for the protection and progress of science.

III. Future Spectrum Needs

Requiring both protection and innovation to thrive, the U.S. scientific community has the following spectrum needs:

- Protection of existing passive and active allocations, especially for radio astronomy and the Earth-exploration satellite service;
- Expanded geographic protection of the NRQZ from airborne emitters and of the new NRDZ areas for piloting coordination and dynamic sharing;
- A responsive and flexible regulatory environment for research and development;
- Research and engineering investment in technical capabilities for Radio Frequency Interference (RFI) excision and avoidance, new methods of RFI protection (e.g., transmitters with shaped beams) and dynamic spectrum sharing; and
- Funding to support research and development, RFI research, coordination, and dynamic sharing.