Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
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Utilizing Rapidly Deployable Aerial Communications Architecture in Response to an Emergency	)))	PS Docket No. 11-15

COMMENTS OF THE
NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

The National Academy of Sciences, through the National Research Council's Committee on Radio Frequencies (hereinafter, CORF), hereby submits its Comments in response to the Commission's May 24, 2012, Notice of Inquiry (FCC 12-53) (NOI) in the above-captioned docket regarding Deployable Aerial Communications Architecture (DACA). In these Comments, CORF expresses support for exploring the use of DACA technologies to facilitate emergency response in the immediate aftermath of a catastrophic event. CORF notes, however, that in evaluating frequency planning and minimizing the potential for harmful interference, consideration must be given to passive scientific use of the spectrum. Indeed, some passive scientific uses of the spectrum might help to mitigate the effects of some natural disasters.

I. Introduction: The Role of Earth Remote Sensing and Radio Astronomy, and the Unique Vulnerability of Passive Services to Interference.

CORF has a substantial interest in this proceeding, because it represents the interests of the passive scientific users of the radio spectrum, including users of the Earth Exploration Satellite Service (EESS) and the Radio Astronomy Service (RAS) bands. Users of these bands perform extremely important yet vulnerable research.

The Commission has long recognized that satellite remote sensing, including sensing by users of the EESS bands, is a critical and uniquely valuable resource for monitoring aspects of the global atmosphere, land, and oceans. For certain applications, satellite-based microwave remote sensing represents the only practical method of obtaining atmospheric and surface data for the entire planet. EESS data have contributed substantially to the study of meteorology, atmospheric chemistry, climatology, and oceanography. Currently, instruments operating in the EESS bands provide regular and reliable quantitative atmospheric, oceanic, and land measurements to support a broad variety of scientific, commercial, and government (civil and military) data users. Major governmental users of EESS data include the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation, the National Aeronautics and Space Administration (NASA), the Department of Defense (especially the U.S. Navy), the Department of Agriculture, the U.S. Geological Survey, the Agency for International Development, the Federal Emergency Management Agency (FEMA), and the U.S. Forest Service.

As the Commission has also long recognized, radio astronomy is a vitally important tool used by scientists to study our universe. It was through the use of radio astronomy that scientists discovered the first planets outside the solar system, circling a distant pulsar. Radio astronomy has also enabled the discovery of organic matter and prebiotic molecules outside our solar system, leading to new insights into the potential existence of life elsewhere in our galaxy. Measurements of radio spectral line emission have identified and characterized the birth sites of stars in the galaxy, the processes by which stars slowly die, and the complex distribution and evolution of galaxies in the universe. Radio astronomy measurements have discovered the cosmic microwave background (CMB), the radiation left over from the original big bang after it cooled to only 2.7 degrees Kelvin above absolute zero. Later observations discovered the weak fluctuations in the CMB of only one-thousandth of a percent, generated in the early universe, which later formed the stars and galaxies we know today. Radio observations uncovered the first evidence for the existence of a black hole in our galactic center, a phenomenon that may be crucial to the creation of galaxies. Observations of supernovas have allowed astronomers to witness the distribution of heavy elements essential to the formation of planets like Earth, and of life itself.

However, the critical science undertaken by EESS and RAS observers cannot be performed without access to interference-free spectrum. Notably, the emissions that radio astronomers receive are extremely weak—a radio telescope receives less than 1 percent of one-billionth of one-billionth of a watt (10^{-20} W) from a typical cosmic object. Because radio astronomy receivers are designed to pick up such remarkably weak signals, radio observatories are particularly vulnerable to interference from in-band emissions, spurious and out-of-band emissions from licensed and unlicensed users of neighboring bands, and emissions that produce harmonic signals in the RAS bands. Even weak, distant man-made signals can preclude passive scientific use.

II. In Evaluating Frequency Planning to Minimize the Potential for Harmful Interference, Consideration Must Be Given to Passive Use of the Spectrum.

CORF commends the Commission for initiating this Inquiry to facilitate emergency response by rapidly restoring communications capabilities in the immediate aftermath of a catastrophic event. For generations communications technologies have been critical to improving public safety, and it is clearly in the public interest for the Commission to seek innovative ways to use communications technologies for that purpose.

The NOI properly recognizes, however, that "frequency preplanning will be vital to successful deployment of DACA systems in order to avoid harmful interference and to enable terrestrial communications to be restored on an efficient and timely basis," and accordingly, the NOI seeks comment on the frequency bands that are "most suitable for DACA use" (NOI at para. 23). CORF thus wishes to bring to the Commission's attention the need to be mindful of passive users of the spectrum in such an Inquiry.

CORF notes that remote sensing and users of the EESS band devote much of their resources to monitoring the climate and weather, providing data used by local, state, and federal public safety agencies to predict, prevent, measure, and mitigate the damage from weather-related natural disasters. In particular, FEMA and NOAA are major users of EESS data for such purposes. The EESS applications provide observations from satellites and aircraft day and night, regardless of cloud cover, over wide areas. EESS receivers are highly sensitive and detect signals in the range from 10^{-15} to 10^{-17} W, making interference an important concern for such systems. Interference can result either in lack of coverage in some areas (because of the need to discard contaminated data) and/or in erroneous analyses and predictions, adversely impacting safety and emergency responses. Thus, in evaluating frequencies for the use of DACA technologies, it is essential to ensure avoidance of interference with satellite and airborne remote sensing systems that provide important information for disaster response and mitigation.

For example, satellite-based passive microwave sensors within the protected frequency bands of 1.42 (such as that of the planned NASA Soil Moisture Active Passive (SMAP) mission, and the ESA Soil Moisture Ocean Salinity (SMOS) mission[1]), 10.7, and 37 GHz (such as that aboard the Special Sensor Microwave/Imager; and the Tropical Rainfall Mapping Mission) provide soil and surface-water information during floods.[2]

Frequency planning to minimize harmful interference must also consider time and altitude technical parameters, as well as the actual frequencies to be used by DACA technologies. With respect to time, the NOI refers to use of DACA technologies "in the immediate aftermath" and in "the first 72 hours after" a catastrophic event (NOI at paras. 1 and 2). Use of these technologies during short time periods after a disaster is clearly in the public interest. However, the Commission should consider time limits as required to prevent unnecessary interference to other users of the spectrum. Although it is not likely that radio astronomers could use their bands in a manner that would

1 The observations of areas in the United States from the ESA SMOS mission are available in near real-time to scientists in the United States. NOAA incorporates SMOS data for operational use in forecasts of flash floods.

2 CORF notes that passive sensors in the non-allocated bands of 4.6-7.2 GHz, such as the airborne stepped frequency microwave radiometers used by NOAA, provide information regarding ocean surface winds during hurricanes, and that sensors at 450 MHz and 1.15 GHz may be used to detect signs of life beneath debris and rubble. In addition, active microwave sensors at 1.2 GHz, such as that aboard the planned NASA SMAP mission, provide soil moisture and terrestrial surface water information; sensors at 5.4 GHz, such as that aboard RADARSAT-2, for high-resolution imaging radar; and sensors at 10 GHz provide data used to detect ground movement associated with landslides, volcanic activity, and earthquakes. Scatterometers operating at 5.4 and 13.3 GHz provide critical wind information to operational weather forecasters, including NOAA and the National Hurricane Center.

directly protect public safety in an emergency, they, like all citizens, recognize the need to contribute to public safety, including the possibility of accepting interference from DACA technologies when necessary in an emergency. However, there may be a real danger of "mission creep" in the deployment of DACA technologies that could result in the technologies being used in a particular location long after "the first 72 hours." In such cases, it may not be in the public interest to continue use of DACA technologies that cause interference to other uses such as radio astronomy. Of particular concern would be on going use of airborne technologies causing interference to other users within the line of sight of a DACA transmitter. After a certain period of time following an emergency, as traditional telecommunications services are restored, the balance in the public interest equation would accordingly shift from favoring the use of DACA technologies to protecting other spectrum users. Thus, the Commission should consider criteria for properly evaluating just how long the "immediate aftermath" of a disaster would be, during which DACA technologies would be authorized to transmit.

Similarly, given the nature of line-of-sight transmissions, the higher the altitude of DACA equipment, the greater the distance from the location of the natural disaster over which RAS facilities could suffer harmful interference. Thus, the Commission must seriously consider issues related to altitude as well.

Last, in considering rules to prevent interference from DACA technologies, the Commission must consider system testing as well as operation of the technologies after a natural disaster. Operators performing system testing should provide advance notification of such testing to users of the spectrum (including passive users) in adjacent bands and/or nearby locations. Testing should be limited to the minimum necessary to ensure an operational system.

III. Conclusion.

CORF commends the Commission for initiating this Inquiry to facilitate the use of communications technologies for emergency public safety response in the immediate aftermath of a catastrophic event. In evaluating frequency planning and minimizing the potential for harmful interference, however, consideration must be given to passive scientific use of the spectrum. Indeed, passive scientific uses of the spectrum may provide important information for disaster response and mitigation.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

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