Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Revision of Part 15 of the Commission's	)	ET Docket No. 98-153
Rules Regarding Ultra-Wideband	)	
Transmission Systems	)	

REPLY COMMENTS OF
NORTHROP GRUMMAN CORPORATION AND THE RAYTHEON COMPANY

Northrop Grumman Corporation ("Northrop Grumman") and the Raytheon Company ("Raytheon") (collectively, "the Parties"), by counsel, hereby submit these reply comments in response to the Commission's *Further Notice of Proposed Rulemaking* in the above-captioned docket.[1] These reply comments are limited to the Commission's request for comments on proposed additional new rules to address issues raised in the Siemens' petition for reconsideration regarding the operation of frequency-hopping vehicular radars in the 22-29 GHz band as Ultra-Wide Band ("UWB") devices.

The Parties urge the Commission not to permit the operation of pulsed frequency-hopping vehicular short range radar systems near or in the 23.6-24.0 GHz band without adopting strict limits to reduce the potential for increased interference that likely will result under standards being proposed by manufacturers. Additionally, the Parties strongly urge the Commission to clarify existing unlicensed vehicular radar system regulations to limit the sale of Ultra-Wide Band ("UWB") vehicular radar devices to automotive applications using original

---

[1] Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, *Memorandum Opinion and Order and Further Notice of Proposed Rule Making*, ET Docket No. 98-153, 18 FCC Rcd 3859 (2003).

equipment manufacturer ("OEM") installed units or qualified dealer retrofits to older vehicles where manufacturers can show that the Commission's performance standards can be met.

I. BACKGROUND

The Parties have a substantial interest in this proceeding, as they are now developing the National Polar-orbiting Operational Environmental Satellite System ("NPOESS") under a contract awarded in 2002 by the NPOESS Integrated Program Office ("IPO").[2] NPOESS is the nation's next-generation low-earth, polar-orbiting environmental satellite system. Sensors on the NPOESS satellites will use the Earth Exploration Satellite Service ("EESS") bands.

Northrop Grumman is the prime contractor, leading the overall system design effort and space segment, including the development of highly sensitive sensors that sense natural phenomena in the Ka-band. Raytheon is responsible for the ground segment, including command and control, mission data processing, and providing system engineering support. The national investment to build (including options), deploy and operate the NPOESS system from the present through 2018 is projected to exceed $4.5 billion dollars.

Converging NOAA's current Polar-orbiting Operational Environmental Satellite program and DoD's Defense Meteorological Satellite program into a single satellite system, NPOESS will meet critical civilian, homeland and national security requirements for space-based, remotely-sensed environmental data. Through extremely sensitive measurement of propagation in the 23.6-24.0 GHz band, among others, highly detailed modeling of atmospheric, terrestrial and ocean phenomena will allow more precise meteorology as well as the tracking of pollution,

[2] The Departments of Commerce and Defense as well as NASA created the NPOESS Integrated Program Office ("IPO") to develop, acquire, manage, and operate the next generation of polar-orbiting operational environmental satellites.

environmental change and the impacts of natural or man-made disasters in a manner that will promote public safety, effective defense and economic security.

NPOESS satellite sensors will provide higher resolutions and better accuracies than current capabilities, as part of an overall system that will deliver orders of magnitude more data to its users on a much more timely basis. The result will be more accurate short term forecasts as well as better and more extensive long-term forecasts.

An interference-free environment in the 23.6-24.0 GHz band is critical to the NPOESS system because certain phenomena related to atmospheric and surface conditions only can be observed in and around these frequencies, where water vapor has unique absorption properties. Two specific NPOESS sensor instruments make high sensitivity measurements in this band:

- **Conical Scanning Microwave Imager/Sounder ("CMIS")**. The CMIS collects global microwave radiometry and sounding data to produce microwave imagery and other meteorological and oceanographic data. Data types include atmospheric temperature and moisture profiles, clouds, sea surface winds, and all-weather land/water surfaces. The CMIS detector is critical for short term weather forecasts and critical in responding to short term natural disasters or other catastrophic and/or unseen events. The CMIS contributes to 23 different Environmental Data Records ("EDRs")[3] and is the primary instrument for 9 of these EDRs. Current plans are to deploy the CMIS sensor on all NPOESS satellites.

- **Advanced Technology Microwave Sounder ("ATMS")**.[4] The ATMS instrument is a passive microwave sounder instrument that provides observations which, when combined with observations from an infrared sounder, provides global atmospheric temperature and water vapor profiles. This new instrument will have 22 microwave sounding channels that measure microwave energy emitted and scattered by the atmosphere.

---

[3] The basic output from NPOESS will be a collection of EDRs. EDRs contain the environmental parameters or imagery required by users for weather prediction and environmental monitoring.

[4] An ATMS instrument will also fly on the NPOESS Preparatory Project (NPP) satellite, which is scheduled to launch several years prior to NPOESS as a bridge to these new capabilities.

There is no other frequency band in the spectrum with the same characteristics as the 23.6-24.0 GHz band. Total water vapor content from the ground to the satellite is best measured in this band. This is critical to not only measuring atmospheric moisture, but also to separate measurements of surface moisture from atmospheric moisture. Earth surface measurements such as ocean wind speed, surface temperatures, and many surface moisture EDRs rely heavily on total vertical moisture profile derived in this channel. The band also is unique within the microwave spectrum because it covers a small spectral zone where water vapor in the lower levels of the atmosphere is a moderately strong absorber of radiation. Clouds and water vapor have similar spectral patterns of absorption in most of the microwave spectrum, except for the 23.6-24.0 GHz band. This distinction makes this band critical for separating the cloud effects from the water vapor effects. In short, the generation of most CMIS and ATMS EDRs depend on this channel because of these characteristics.

The 23.6-24.0 GHz band is absolutely essential to meeting NPOESS mission requirements. Any man-made emissions (in-band or out-of-band) that are of significant amplitude with respect to the noise levels of the passive receivers will degrade measurement skill for CMIS and ATMS top-priority missions. If such emissions happen broadly or frequently, they would jeopardize the ability of NPOESS to meet its performance requirements.

While the Parties recognize the potential benefits from vehicular radars, they remain quite concerned about the potential for degradation if emission limits into 23.6-24.0 GHz are exceeded or if deployment is different from what had been modeled when the UWB rules were adopted. Protection against harmful interference to remote passive sensors deployed by NPOESS is important not only in view of the billions of dollars of taxpayer and government money to be spent on the NPOESS system, but also because the capabilities of the NPOESS

system to offer significant safety of life benefits, support for homeland security and defense objectives. For example, the knowledge obtained from NPOESS data will reduce the potential loss of human life and property resulting from severe weather events or atmospheric conditions coincident with natural or man-made catastrophes. Support for general aviation, agriculture, and maritime activities aimed at improved early warnings will mitigate the devastating effects of floods through disaster planning and response. From a national security perspective, NPOESS shifts the tactical and strategic focus from coping with weather to anticipating and exploiting atmospheric and space environmental conditions. Proposals to amend the Commission's rules to permit pulsed frequency-hopping vehicular radars to be included under the definition of a UWB device must be closely scrutinized to ensure that limits are adopted that prevent potentially disruptive changes to these NPOESS objectives.

II. THE PARTIES SUPPORT THE NATIONAL ACADEMY OF SCIENCES' COMMITTEE ON RADIO FREQUENCIES ("CORF") RECOMMENDED MEASUREMENT INTERVAL AND TECHNIQUES

In its comments, CORF expresses concern that devices allowed under the Siemens proposal could generate greater levels of interference because the emission level measured under an extended measurement period may not be a true average emission but could be more similar to a time averaged emission.[5] In other words, an extended measurement period could allow frequency-hopping devices to momentarily emit at a much higher level at a particular frequency, which would generate increased interference to space borne passive sensors unless the averaging time is shorter then the integration time of the passive measurement. The Parties agree and join CORF's comments in that respect.

[5] *See* CORF Comments at 5.

The Parties believe that passive radiometer integration time is a key factor in determining interference. To ensure that UWB interference to space borne passive sensors does not exceed the threshold for frequency hopping, the Parties urge the Commission to ensure that the EFPD limits applicable to frequency-hopping devices are met with an integration time that is significantly less than the passive sensor integration time. Otherwise, the limits applicable to the unlicensed devices cannot provide us assurances that there will not be harmful interference to earth exploration sensing devices. As CORF notes, EESS sensors being developed for the Ka-band have integration times as low as 1.2 milliseconds and these times are likely to decrease as sensor technology improves.[6] Accordingly, the Parties support CORF's recommendation that as a condition of permitting frequency-hopping devices in the 22-29 GHz band, that an averaging time of 0.1 milliseconds be used to determine compliance with interference requirements into 23.6-24.0 GHz, using a fast response (0.1 milliseconds or faster) power detector measurement with the signal entering a power detector head properly filtered to define the passband of interest.[7]

III. PRELIMINARY ANALYSIS INDICATES THE POSSIBILITY OF INCREASED RISK OF INTERFERENCE TO SPACE BORNE PASSIVE SENSING SYSTEMS

When adopting rules in 2002 to permit the unlicensed operation of certain vehicular radar systems in the 22-29 GHz band, the Commission determined that attenuation of emissions below 24.0 GHz is required above the horizontal plane in order to protect space borne passive sensors operating in the 23.6-24.0 GHz band. The specific attenuation requirements are set forth in Section 15.515(c) of the Commission's Rules, 47 C.F.R. § 15.515(c). The rules require the level

6 *Id.* at 6.

7 *Id.* at 6.

of attenuation to tighten in three steps beginning with equipment authorized, manufactured, or imported on or after January 1, 2005. The requirements become more stringent on January 1, 2010, and even more exacting on January 1, 2014.

The Parties are continuing their analysis of the potential impact of vehicular radar systems in the Ka-band on CMIS and ATMS sensing operations.[8] However, preliminary findings using the Rec. ITU-R SA 1029-2 limit of -166 dBW/200 MHz as the interference noise density threshold show that cumulative interference from vehicular radar devices to the CMIS and ATMS passive sensing instruments in areas of high vehicle density (*i.e.*, areas of high population density) will approach this interference threshold, even when using the more conservative limits required for equipment authorized, manufactured or imported after *January 1, 2010*. Given that there is very little margin against harmful interference using the 2010 levels, the Parties are concerned that there is considerable potential for interference to space borne passive sensors if radar is deployed in significant numbers of vehicles applying only the pre-2010 standards. Consequently, it is all the more important that very strict standards apply to any additional types of vehicular radar systems the Commission might consider allowing in the band, such as frequency-hopping systems.

Future improvements to on-board sensor instruments are expected to result in greater sensitivity to the phenomena being monitored and, as a result, to interference. The NPOESS space segment will initially consist of two satellites in different polar orbital planes. In its final configuration, the space segment will be comprised of three satellites, each in different polar orbital planes. Up to six satellites will be deployed over the life of the system, through 2018.

---

[8] The Commission itself said that it would continue to monitor developments in the band. *See* Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, *First Report and Order,* 17 FCC Rcd 7435, 7503 (¶ 196) (2002).

Later satellites will carry next-generation sensors that will be expected to operate with greater sensitivities, requiring unlicensed devices to be subject to strict emissions limits and measurement methods.[9] Accordingly, even if new types of vehicular radars, such as the pulsed frequency-hopping devices proposed by Siemens, operate consistent with existing limits, they would impose limitations on the improved sensitivity that can be incorporated in next generation instruments. Therefore, the Parties urge the Commission not to permit the operation of pulsed frequency-hopping vehicular radar systems in the 22-29 GHz band unless the rules are amended to mitigate the potential for increased interference that would likely result.

IV. THE COMMISSION SHOULD LIMIT THE DEPLOYMENT OF UWB VEHICULAR RADAR DEVICES

While the Parties expect that vehicle manufacturers will meet the 2010 standards set forth in Section 15.515(c), the potential that these UWB proximity sensing devices might be used in applications other than terrestrial transportation vehicles causes concern that uncontrolled interference might result. Because these devices are unlicensed, there is no effective way for the Commission to undo damage once it is done. Accordingly, the Parties urge the Commission to clarify its rules that vehicular radar systems be subject to the following restrictions. Specifically, the Parties urge the Commission to adopt regulations to limit the sale of UWB vehicular radar devices to automotive applications using OEM installed units and to qualified dealer retrofits to older vehicles where vehicle manufacturers can show that the required performance standards can be met. Under no circumstances should these devices be available for retail sale.

9 *Id.* at 6.

V. CONCLUSION

For the reasons set forth above, the Parties urge the Commission not to permit pulsed frequency-hopping vehicular radar systems in the 23.6-24.0 GHz band without adopting strict limits to reduce the potential for increased interference. The standards being proposed by manufacturers in this proceeding for such devices would not satisfactorily protect passive sensors that must operate in this band. The Commission should also clarify existing unlicensed vehicular radar systems regulations to limit the sale of UWB vehicular radar devices.

Respectfully submitted,

NORTHROP GRUMMAN CORPORATION

THE RAYTHEON COMPANY

/s/

Edward A. Yorkgitis, Jr.
Randall W. Sifers

KELLEY DRYE & WARREN LLP
1200 19th Street, NW
Suite 500
Washington, DC 20554
(202) 955-9600

Dated: August 20, 2003

Their Attorneys

Peter Hadinger
Director, Advanced Systems Strategy
NORTHROP GRUMMAN SPACE TECHNOLOGY
1000 Wilson Blvd, #2300
Arlington, VA 22209
(703) 741-7717

David G. Lubar
Manager, NPOESS Regulatory Affairs
RAYTHEON COMPANY
16800 E. CentreTech Parkway
Building S-77, Mail Stop 2108
Aurora, CO 80011
(720) 858-5227