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National Weather Association
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1 March 2016

Federal Communications Commission
Ms. Marlene Dortch, Secretary
445 12th Street, S.W.
Washington, DC 20554

Re: Ex Parte submission in IB Docket No. 12-340; RM-11681 Petition for Rulemaking to Allocate the 1675–1680 MHz band for Terrestrial Mobile Use

Dear Ms. Dortch:

The American Meteorological Society (AMS) and the National Weather Association (NWA) hereby submit additional information regarding the Ligado Networks / New LightSquared LLC request to share the 1675–1680 MHz Band.

Founded in 1919, the American Meteorological Society is the nation's premier scientific and professional organization promoting and disseminating information about the atmospheric, oceanic, and hydrologic sciences. Its 13,000 members include scientists, researchers, educators, meteorologists, broadcast meteorologists, students, weather enthusiasts, and other professionals in the fields of weather, water, and climate.

The National Weather Association is a member-led, all-inclusive, professional association supporting and promoting excellence in operational meteorology and related activities since it's founding in 1975. The NWA mission is to connect operational meteorologists in pursuit of excellence in weather forecasting, communication and service.

Introduction

Information carried on or collected by meteorological satellites is critical to hydrometeorological services and products issued by the American weather enterprise including Federal agencies, companies that make up America's weather industry, and the academic meteorological community. The preparation of critical forecasts and warnings for severe weather, tropical cyclones, flooding and tornados requires specialized data to be delivered quickly and reliably to Federal and non-Federal meteorologists and hydrologists so they can meet their missions of protecting life and property. Many industry segments are weather sensitive and must receive accurate and timely products upon which economic and safety decisions are made. A 2008 study estimated the value of weather forecasts to households at $31.5 billion.[i] Benefits to business (e.g., aviation, ground and sea

transportation, agriculture, construction, retail, tourism, financial services, etc. would add to this value.) For example, nearly all sectors in America's weather enterprise directly utilize data from the Geostationary Environmental Operational Satellites (GOES) or unknowingly benefit from data provided by communication systems that utilize the 1675–1695 MHz spectrum band. A new generation of GOES, known as the GOES-R series, will be launched into space in October 2016, providing a wealth of new information and a significant increase in data volume that will become invaluable to operational meteorology and the end user industry segments which they serve. The request to share the 1675–1680 MHz spectrum is very concerning because there is a significant likelihood that signal interference could disrupt the data flow from the GOES and GOES-R satellites. According to manufacturers of satellite ground station equipment, they have very few options to mitigate against strong signals located at 1680 MHz, which is in the same frequency band as some GOES/GOES-R services or extremely close in the adjacent band to remaining services. Because so many diverse users exist for Data Collection System (DCS) data relay or GOES/GOES-R Direct Broadcast within the broad coverage area of these geostationary satellites, any interference from 1675-1680 MHz would have a wide-ranging impact on the provision of operational meteorological and hydrological forecast and warning services.

Radiosonde Operations - Considering that National Weather Service (NWS) radiosondes (weather balloons that measure various atmospheric parameters and transmits them by radio to a ground receiver) will continue to operate in the 1675-1679.6 MHz band until the last systems are transitioned out to new spectrum in 2021, this would likely expose both hydrometeorological ground receivers and radiosonde receivers at NWS facilities to radio frequency interference from proposed transmitter sources. The satellite data and the radiosonde data are fundamental and essential to the development of many critical products.

Weather Infrastructure

The nation's weather infrastructure is complex, and few people appreciate the details of the entire data path from space-based sensing to product generation and then end user application of those products. In many cases, the end beneficiary may not realize that reallocation of Federal spectrum in the 1675–1680 MHz band could impact the data products, services, forecasts, watches, or warnings upon which they depend. Because some of the products and services have yet to become available from the newest generation of satellites, we are not certain that a public comment process would receive adequate response from all potentially impacted users.

Example Services Requiring Direct Broadcast or DCS Near-Real Time Relay

Drivers for using the direct broadcast from GOES-R include: 1) low data latency (e.g. data must flow as fast as possible), 2) high data availability (e.g., data must always be available), or 3) data uniqueness - select categories of data[ii] from GOES-R are not available via any other means. We feel these strict requirements should be met, even if alternative means of data transmission to all users are considered. Today, direct broadcast is used to satisfy these requirements.

We cite three examples[iii].

Water Management, Flood Warning and Control

The GOES DCS has been indispensable in preventing damage and loss of life due to natural disasters by providing timely and mission critical data to the United States Army Corps of Engineers (USACE) operations and to emergency management personnel. Between fiscal year 2005 and fiscal year 2014 the Corps of Engineers estimates a 10-year average of over $47-billion in flood damages were prevented versus a 10-year average of $3 billion suffered. In the Lower Mississippi River (LMR) region alone, $238 billion in flood damage was prevented during historic flooding in fiscal year 2011. Any loss of life is a tragedy but placed in context with historic flood conditions on the LMR in 2011, casualties were minimized to 6 that year; 108 total nationwide. GOES data collection platforms and DCS receive-sites using 1675–1695 MHz band allocation represent the Corps' primary data telemetry capability from hydrometeorological data relayed via the GOES DCS.

The DCS provides data for, but not limited to, the nation's military and civil works projects, operating over 600 Corps-owned dams: navigation dams on over 12,000 miles of commercial inland waterways, 329.2 million acre-feed of lake water supply storage, generating 24% of the U.S. hydropower capacity and dam and levee safety; maintaining 926 coastal, Great Lakes, and inland harbors; monitoring water quality and preserving wetlands; supporting environmental engineering, public and internal information dissemination, planning, modeling, and inundation mapping.[iv]

Total Lightning Detection Over Land and Water, Day and Night

GOES-R advancements include the Geostationary Lightning Mapper (GLM) sensor, which will map both in-cloud and cloud-to-ground lightning activity continuously day and night with a product refresh rate of less than 20 seconds over the Americas and adjacent oceanic regions in the Western Hemisphere. Although meteorology depends upon current generation lightning detection methods, the GLM should aid in the prediction of severe weather and the issuance of more timely warnings. For example, research has shown that a rapid increase or "jump" in the number of lightning strikes inside a thunderstorm serves as a precursor signature for the occurrence of tornados and other severe weather phenomena (e.g., hail, wind)[v]. Currently, the operational tornado warning methodology relies heavily on ground weather radar signatures and visual cues from storm spotters, resulting in a national average tornado warning lead-time of 13 minutes with a false alarm rate of nearly 80%. A rapid increase or "jump" signature in total lightning rates, which is dominated by in-cloud lightning that GLM can detect, suggests that the tornado warning lead time could be increased to 21 minutes on average with a reduced false alarm rate.[vi]

The entire data production chain for lightning event detection at the satellite to end user access via the direct broadcast downlink in the 1675–1695 MHz band is designed to be less than 20 seconds. Federal centers, firms in America's weather

industry and stakeholders across a variety of other industries are planning to receive these data using direct broadcast as their primary means of data acquisition. The flash detection efficiency of the GLM is expected to be as high as 90%, accomplished by the data downlink rate and the fact that the downlink technology is sized to accommodate all data necessary for the measurement of such lightning flash events.

Aviation Products and Protection of Commercial Satellites

Products derived from satellite meteorology are essential for aviation operations. Commercial and general aviation pilots utilize Aviation In-Flight Advisories (known as SIGMET and AIRMET products[vii]) that allow aircrews to anticipate and avoid severe turbulence, excessive icing, hurricanes, severe weather and volcanic ash clouds. These warnings, for regions over the fifty United States and nearby ocean areas, are developed by aviation meteorologists that rely on satellite data and imagery received in 1675–1695 MHz. FAA flight route decisions are made based upon avoiding the location of these SIGMET areas.

Increased natural radiation levels (e.g., space weather), as measured by GOES satellites, are used to warn airlines to reroute over-the-pole flights to protect passengers and crew from exposure to excessive radiation levels. Communication satellite operators also benefit from excessive natural radiation level warnings and they take damage mitigation action within seconds of receiving the critical warnings.

Spacecraft imagery is also utilized to identify volcanic ash clouds. Because volcanic ash hardens (similar to cement) in jet turbine engines causing those engines to stall or lose power in flight, it is essential that pilots be immediately warned of the location and movement of volcanic ash clouds along their flight path. The Anchorage, AK Volcanic Ash Advisory Center (VAAC) protects approximately 10,000 people per day, and up to 50,000 aircraft per year, as they fly across one of the most active volcanic regions on the planet[viii]. Geostationary satellite imagery is essential in this effort (received in 1675–1695 MHz) because full resolution Earth disk scans from the GOES-R Advanced Baseline Imager (ABI) below 6 kilometers in elevation for regions outside the CONUS will not be rebroadcast via commercial satellite to forecast offices. The fastest, most reliable method of obtaining these data is by receiving it directly from space in 1675-1695 MHz band.

Geostationary satellite imagery is also essential in providing satellite-derived winds, which are particularly useful for the prediction of hurricane trajectories. Wind data derived from the GOES satellite imagery is typically one of the most important datasets used for numerical weather prediction models[ix].

Conclusion

As indicated in an earlier letter to the FCC[x], the AMS and NWA have significant concerns regarding the sharing of the 1675–1695 MHz radio spectrum (or portions thereof such as 1675–1680 MHz) between current meteorological and hydrological

users and terrestrial broadband wireless users because such sharing could create losses of critical capabilities which are used in real time to create weather and hydrological warnings and forecasts that save lives, protect property and limit economic loss.

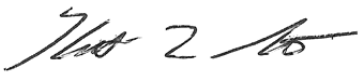
Our members in the meteorological equipment receiver manufacturer's community are concerned about the introduction of strong terrestrial downlink signals up to 1680 MHz and possible reductions in reliability due to interference and want to emphasize the criticality of the data and receiving it with very low latency. Sharing this spectrum band without addressing the concerns of the meteorological and hydrological communities could result in critical losses of life-saving information.

We believe that many of the weather enterprise stakeholders do not fully appreciate the details of the Federal spectrum's direct broadcast or direct relay role in the national weather infrastructure, especially as it relates to the forthcoming GOES-R series of satellites. As a result, we do not believe soliciting public comment at this time on the impacts of sharing the 1675-1680 MHz band would capture a comprehensive picture of all potentially affected meteorological and hydrological end users.

Based upon our understanding of the delivery methods for low latency, high availability satellite data, and issues raised above, the AMS and NWA oppose sharing the 1675-1680 MHz spectrum until comprehensive Federal and private infrastructure studies determine that another equally reliable, timely and cost-effective methodology could deliver these critical data to all stakeholders.

Thank you for the opportunity to express these views.

Sincerely,



Dr. Keith Seitter
AMS Executive Director

Janice Bunting
NWA Executive Director

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[i] Jeffery K. Lazo, et. al, "300 Billion Served: Sources, Perceptions, Uses and Values of Weather Forecasts," *Bulletin of the American Meteorological Society,* June 2009, pp. 785-798.

[ii] (e.g., fastest, high resolution scans outside of the US, Alaska and Hawaii regions, essentially Outside the Continental United States).

[iii] There are multiple examples, but in the interest of brevity, we will mention only three.

[iv] GOES DCS Reliance and Preservation Whitepaper, Advisory Committee on Water Information, Subcommittee on Hydrology, Satellite Telemetry Interagency Work Group (STIWG). http:// http://acwi.gov/hydrology/stiwg/

[v] Goodman, S.J., et. al., "The GOES-R Geostationary Lightning Mapper (GLM)," J. Atm. Research, 2013 and other citation references.

[vi] Schultz, C.J., et. al., "Lightning and Severe Weather: a comparison between total and cloud-to-ground lightning trends," Weather Forecast., Vol. 26, 2011

[vii] SIGMET = SIGnificant METeorological Event; AIRMET = AIRmen's METeorological Information

[viii] The Washington (DC) Volcanic Ash Advisory Center, another US-based center covers the continental United States, and southward through Central America, the Caribbean to 10 degrees South in South America, and the United States controlled oceanic Flight Information Regions. See http://www.ssd.noaa.gov/VAAC/GFX/wvaac.jpg

[ix] http://gmao.gsfc.nasa.gov/products/forecasts/systems/fp/obs_impact/#

[x] AMS NWA letter dated July 17, 2015 filed in RM-11681