

October 11, 2016

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

Re: Oral *Ex Parte* presentation in RM-11681 “Petition [by Ligado Networks] for Rulemaking to Allocate the 1675-1680 MHz Band for Terrestrial Mobile Use”; IB Docket No. 12-340 “LightSquared Request to Modify Its ATC Authorization.”; IB Docket No. 11-109, Regarding the Ligado Modification Applications.

Dear Ms. Dortch:

On October 6, 2016, the following representatives of the hydrological, meteorological and aviation communities met with Jessica Almond, Legal Advisor, Media, Public Safety and Enforcement to Chairman Tom Wheeler:

- Dr. David Titley, Director, Center for Solutions to Weather and Climate Risk, Penn State University (Rear Admiral, USN (ret.), and former DUS-Operations, National Oceanic and Atmospheric Administration)
- Dr. Paul Higgins, Director, Policy Program, American Meteorological Society
- Mr. Steve Fitzgerald, President, National Hydrologic Warning Council and Chief Engineer, Harris County (Texas) Flood Control District, Houston
- Mr. Andrew Roy, Director of Engineering, Aviation Spectrum Resources, Inc.
- Ms. Renée A. Leduc Clarke, Founder and Principal, Narayan Strategy, a weather and climate policy consulting firm

The primary purpose of this meeting was to present information on how real-time water and weather information received directly from the GOES satellite in 1675-1695 MHz is used by the hydrometeorological and aviation communities and to discuss concerns regarding proposals to share 1675-1680 MHz with strong terrestrial transmitters proposed by Ligado Networks.

The American Meteorological Society¹, the National Hydrologic Warning Council², the Harris County (TX) Flood Control District³, and Aviation Spectrum Resources, Inc. (as a member of the Joint Aviation Parties)⁴ have filed multiple letters in the RM-11681 and the 12-340 proceedings, and references to these letters were mentioned by the participants in this briefing. For example, participants referenced how science data and imagery from GOES (and the upcoming GOES-R series) satellites are used by Federal and non-Federal meteorologists and hydrologists to protect life and property across the U.S. and its territories and support the economy.

It was noted that the National Weather Service has already begun to move radiosondes (e.g., weather balloons) out of the subject spectrum, and the design of

¹ June 20, 2016 AMS letter in RM-11681

https://ecfsapi.fcc.gov/file/1062092110704/AMS_Letter_FCC_RM11681_20June2016.pdf; February 19, 2016 Joint letter from AMS and the National Weather Association in RM-11681 and No. 12-340 (LightSquared Request to Modify its ATC Authorization) <https://ecfsapi.fcc.gov/file/60001525407.pdf>,

<https://ecfsapi.fcc.gov/file/60001525404>); July 17, 2015 AMS letter in RM-11681 <https://ecfsapi.fcc.gov/file/60001122040.pdf>

² June 21, 2016 NHWC letter in RM-11681

https://ecfsapi.fcc.gov/file/10621121915837/NHWC%20FCC%20GOES%201675-1680MHz%20Spectrum%20Protection%20Comments_6-21-16%20finalx.pdf

; March 18, 2016 NHWC letter in RM-11681

<https://ecfsapi.fcc.gov/file/10621121915837/NHWC%20FCC%20GOES%201675-1680MHz%20Spectrum%20Protection%20Letter%203-18-16.pdf>

³ June 21, 2016 HCFC letter in RM-11681

https://ecfsapi.fcc.gov/file/10621121915837/NHWC%20FCC%20GOES%201675-1680MHz%20Spectrum%20Protection%20Comments_6-21-16%20finalx.pdf

⁴ August 12, 2016 Reply Comments in RM-11681 of Airlines for America, Aviation Spectrum Resources, Inc., Cargo Airlines Association, Delta Airlines, Federal Express, Helicopter Association International, National Air Transportation Association, and National Business Aviation Association (“Joint Aviation Reply Commenters”)

<https://ecfsapi.fcc.gov/file/1081211620678/Joint%20Aviation%20Reply%20Comments%208%2011%202016.pdf>

August 17, 2016 Ex Parte Presentation of Airlines for America, Aviation Spectrum Resources, Inc., Aerospace Industries Association, and Helicopter Association International in IB Docket Nos. 11-109 and 12-340

<https://ecfsapi.fcc.gov/file/108171106228817/Aviation%20Spectrum%20Resources%20et%20al%20Ex%20Parte%208-17-16%20Final.pdf>

NOAA's new GOES-R satellite was changed to move out of AWS-3 spectrum in 1695-1710 MHz pushing it below 1680 MHz. This proposed action would be a third major impact in recent years on the hydrological and meteorological forecasting communities.

Real-time Data Transmitted in 1675-1680 MHz Critical to Public & Private Users

Meteorologists and hydrologists rely on real-time information transmitted through 1675-1680 MHz from NOAA's geostationary environmental satellites to produce forecasts that protect life and property. It was noted that these data are not necessarily used directly by members of the general public (other than water level and flow information to support recreational boating use) but are required by specialists who generate watches, warnings and specialized forecasts relied upon by the public and numerous industries.

Considering that Hurricane Matthew was approaching Florida and other southeast U.S. states as this meeting was underway, one example was described regarding critical time-sensitive use of the GOES Data Collection System (DCS) by the State of Florida. The Florida Department of Transportation⁵ (FDOT) directly transmits wind speed data from bridges along the Florida coast via GOES into state-owned and operated receivers so that timely bridge closure decisions may be made in severe environmental conditions such as hurricane force winds. Bridges from islands and across causeways remain open as long as officials feel that conditions are safe for evacuation. When power and terrestrial connectivity have been impacted by the storm, as they were starting on October 6, 2016, FDOT was still able to receive relayed information from GOES that was crucial to their ongoing operations.

It is crucial to hazard forecasting that the real-time information via the GOES direct broadcast system (and on the future GOES-R) always arrive at times when seconds matter, and receipt must be assured, in response to major environmental hazards like hurricanes, floods and wildfires. The satellite broadcast, which is dependent on access to 1675-1680 MHz without interference, is a free-standing system that does not rely on commercial power⁶ and connectivity that do fail in the most hazardous situations when the information is needed the most.

⁵ Florida Department of Transportation comments, July 20, 2016 in RM-11681. <https://ecfsapi.fcc.gov/file/1072020498400/ligado%20reply%20comments%20160619.docx>

⁶ Earth stations can be operated on generators or backup power as the only terrestrial interface point for a GOES or GOES-R based relay, whereas a terrestrial system has multiple points that could fail under hazardous conditions, including the "last-mile" connectivity.

Information Via Direct Broadcast Protects the Safety of The Public and Supports the U.S. Economy Via Federal and non-Federal Efforts

The direct broadcast system is used by those federal, state, tribal and local governments as well as private sector users who know they must get information without delay about hazards that impact both the safety of the public and the U.S. economy.

- Major changes are underway in how weather forecasting is done: Previously numerical weather prediction was only performed by government entities such as the National Weather Service (NWS) or the European Centre for Medium-Range Weather Forecasts (ECMWF). Now several private sector companies like IBM and Panasonic Avionics are developing and running private weather prediction models. They require a timely global data set of information including critical information from satellites to initialize and run these private sector weather models.
- Similarly, Silicon Valley start-up companies, such as Spire Global, Inc., are launching multiple small satellites to provide Global Positioning System Radio Occultation data as inputs to public and private sector weather models. and simultaneously developing their own global weather prediction model capability
- Also, a generational change with NOAA weather satellite capabilities is underway, with the pending November launch of the advanced GOES-R satellite.

If only a limited subset of Federal ground receiving sites, such as NOAA's, were protected, as proposed by Ligado, there are still many dozens of other private and public sector users of this information who require direct reception in the 1675-1680 MHz or 1675-1695 MHz band. Those users could be impacted by spectrum sharing and related interference with the proposed nationwide network of terrestrial Ligado transmitters. A few examples were cited:

- The U.S. Army Corps of Engineers receives GOES data at each of their 26 district offices in support of maritime navigation on inland waterways and the operation of locks and dams.
- Private sector meteorology companies provide products supporting aviation operations used by commercial aviation, helicopters, cargo transport and general aviation. At least three major suppliers⁷ receive data directly from GOES today and plan to receive data from GOES-R once it becomes operational.
- State and local emergency managers, decision makers and private sector companies directly receive hydrological data from their own receiving systems. These are systems that would not be protected from interference under the spectrum-sharing scenario proposed. Three examples cited were:
 - South Florida Water Management District (SFWMD) – which receives DCS data directly to manage water usage and flooding in their part of the state

⁷ See letters from The Weather Company, an IBM Business and Schneider Electric in RM-11681

via the Central and Southern Florida Project. That system of canals and natural waterways connects to community drainage districts and hundreds of smaller neighborhood systems to effectively manage floodwaters during heavy precipitation events. (Their water managers have been very busy managing effects from Hurricane Matthew, monitoring conditions and making adjustments to the system around the clock. Direct reception of data without delay from the future GOES-R in 1675-1680 MHz makes that possible.)

- The State of Nebraska has their own gages, in addition to those of the United States Geological Survey (USGS) to use for flood forecasting, flood control and operational decisions for water reservoirs supporting the water supply. They directly receive DCS data in support of their mission. In Nebraska, the Nebraska Department of Natural Resources⁸ (NDNR) has jurisdiction over all matters pertaining to surface water.
- A private sector, local entity, the Salt River Project⁹ (SRP) in Phoenix, Arizona is one of the nation's largest public power utilities, providing electricity and water to more than two million people in Central Arizona. They manage several high hazard dams and generate hydroelectric power. For this they receive both GOES GVAR and DCS in support of their operations.

Concern was expressed that there is a need to further expand and improve hydrological networks of sensors that rely on GOES-DCS. If current downlinks are protected (though that may not be the case within the current Ligado proposal), there also needs to be provisions to allow for adding future protection zones as hydrological networks are expanded.

People whose homes and businesses may be impacted by flood water not only want to know if their area will be impacted or not, but also when the water levels will recede. This requires the river and coastal gage data be available after the event first occurs and on an ongoing basis while the hazardous conditions continue – during times when the terrestrial communications infrastructure can be most impacted.

The current proposal from Ligado only protects Federal users from interference (and the protection zones as currently proposed may not successfully do that) – but no other direct users. This is not acceptable given the important roles played by

⁸ The Nebraska Department of Natural Resources filed a letter in RM-11681 dated July 18, 2016 <https://ecfsapi.fcc.gov/file/10718033289979/2016-07-18NeDNRCommentOnFCCRM-11681.pdf>

⁹ The Salt River Project commented in RM-11681, in a letter dated June 21, 2016 <https://ecfsapi.fcc.gov/file/106212156919978/SRP%20SWR%20to%20FCC%20June%202016%20proceeding%20number%20RM%2011681.pdf>

state, local and tribal governments, the private sector, and academia to respond to and predict weather and water hazards in partnership with the federal government.

Use of GOES data in the Aviation Sector

Mr. Roy described how all aviation users require real-time GOES data to maintain the safety and efficiency of air travel, with the primary concern of the aviation community being safety. Therefore, accurate and timely weather data is critical to the modern aviation industry, including large passenger aircraft, helicopters, and even small private owned aircraft. The meteorological data broadcast from the GOES system is used by both Federal and non-Federal users to generate the data required by pilots and airlines to plan and adapt to changing weather conditions.

The advanced capabilities of GOES-R will further enhance meteorological support to aviation. For example, improved detection and reporting of aviation hazards such as solar flares causing radiation hazards to polar flight routes, or volcanic ash accumulations that can affect aircraft engines, require these capabilities. Other aviation applications such as airport operations and helicopter operations in the Gulf of Mexico that support energy exploration and production will suffer without timely weather data, which could be impacted by the proposed spectrum sharing.

Significant Issues Still Outstanding in Ligado Proposals

The attendees noted several concerns that had not been addressed by Ligado in its proposals to provide an alternative distribution of NOAA data. This included several technical concerns about the Ligado funded study on the protection zones defined for the NOAA ground stations, and that no protection was intended for commercial providers' reception of GOES signals.

In reviewing the Content Delivery Network (CDN) proposed by Ligado, it was also noted that it still lacked substantive details related to performance requirements meeting the existing GOES system, guaranteeing the last mile connectivity to users under all environmental conditions, and what data standardization processes would be needed by end users in order to be able to read and use the data. Of particular note was the unanswered questions about the running costs end users would be expected to take on once Ligado ended its funding of the systems after ten years. If these are not fully understood by the user community and deemed acceptable, it was unknown if such a system would be viable in the long-term.

Summary

Satellite data and imagery provide time-critical information about extreme events. This information improves forecasts and warnings for tornados, hurricanes, thunderstorms, floods, and solar storms. Furthermore, satellite transmission ensures that weather and water information is available quickly, reliably, and in remote locations where emergency managers, service providers, and key

practitioners are often located. Consistent, reliable, and timely access to weather information is also critical to the research community and the private sector, which use the information for scientific advancement and a wide range of commercial applications.

Multiple sectors of the economy, including land, sea and air transportation and energy generation and production, require reliable real-time information to make immediate decisions to mitigate the risk of economic losses from major weather hazards and, most importantly, to ensure safety.

- For example, state and local emergency managers in Florida, Georgia, South Carolina and other surrounding states have been relying on real-time information broadcast from satellite to determine where evacuation orders were issued due to storm surge and other hazards caused by Hurricane Matthew.
- Every day, aviation operators flying passengers and carrying cargo require timely warning of weather events including thunderstorms, snow and ice storms, and low visibility and ceilings, which impact the safety of flight. Today, forecasters and operators receive weather data reliably and quickly via a direct satellite broadcast. From that information, forecasts are developed and warnings are issued which are essential to the operation of the nation's airspace.
- Maritime ship operators traverse the nation's inland waterways, the Great Lakes and the nation's coastal ports, carrying billions of dollars of cargo and commodities. The safety of navigation depends upon data relayed via GOES and GOES-R satellites.

Private and non-Federal users both depend upon the timely and reliable receipt of such data in non-Federal receiving stations, as well as the Federal products derived from Federal ground stations.

The internet-enabled CDN proposed by Ligado is not acceptable as currently proposed since it does not guarantee that all current users of this information (both Federal and non-Federal) will have uninterrupted access to this real-time information regardless of access to power and internet. The Ligado proposal is not fully defined, independently validated or cost estimated through its life cycle beyond ten years.

Solutions proposed for meeting or restoring this direct broadcast capability through surface-based approaches (e.g., cloud computing services) have, thus far, been inadequate because they do not appear to be capable of providing data and information as quickly, reliably, and for the full range of potential users as the current spectrum-based approach.

As a result, sharing the 1675-1680 MHz radio spectrum poses significant risks to the nation's forecast, communication, and warning capabilities for extreme events. The potential degradation in this capability would create risks to public health and safety, private sector initiatives, and scientific advancement. Before any further efforts are made toward a notice of proposed rulemaking in this matter, additional research that is both independent and comprehensive is required.

Submitted by the briefing participants from the hydrometeorological and aviation communities.