AWCIA | American Weather and Climate Industry Association

American Weather
and
Climate Industry Association

June 20, 2019

Ms. Marlene Dortch, Secretary
Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Washington, DC 20554

Re: AWCIA response to Notice of Proposed Rule Making and Order in the matter of Allocation and Service Rules for the 1675-1680 MHz Band; WT Docket No. 19-116

Dear Ms. Dortch:

The American Weather and Climate Industry Association (AWCIA) is the trade association for the professionals who make weather their business. AWCIA represents a diverse weather industry, and our members have a significant impact on how weather information is collected, disseminated and enhanced to provide custom services to weather-sensitive sections of the economy and the general public. AWCIA members build weather sensors, implement government weather programs, broadcast weather information to the nation, disseminate raw government and privately-owned weather data, generate weather products and services, and provide specialized services to a variety of markets. We are the "value-added provider" or extension to government supplied weather data because we assimilate and tailor information for specific commercial and consumer uses.

Our members utilize the direct broadcasts from the Geostationary Operational Environmental Satellite (GOES) and will use the direct broadcasts from GOES-R series satellites in the 1675-1695 MHz radio spectrum. As we develop and issue value-added meteorological and hydrological products for use by our customers, the timely and reliable reception of data from NOAA's geostationary satellites is a very important component of the information needed to create products and services. Some of our members own satellite earth stations that currently receive GOES Variable (GVAR) broadcasts direct from NOAA's operational satellites. We believe that radio frequency interference that can be generated from strong terrestrial downlinks, which share the same spectrum as the relatively weak signals from GOES in space, would have a devastating impact on our members.

Warnings to protect lives and property must be issued as rapidly as possible and be available under all conditions and situations. Although we may depend upon more than one means to acquire data, we know that cellular networks and Internet capabilities are often taxed to their maximum during severe weather and natural disasters, whereas the GOES / GOES-R direct broadcasts are always there and have very little infrastructure that is subject to failure during stressing conditions.

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In 2016, the FCC solicited comments on RM-11681 Petition for Rulemaking in the 1675-1680 MHz band. Since then, many concerns have been raised by members of the weather community[1] and government officials[2] about a reduction in fast and reliable access to critical, life-saving weather satellite data.

At this time, AWCIA continues to express grave concern regarding the Notice of Proposed Rulemaking (NPRM) in the 1675-1680 MHz band and hereby provides comment to various portions of the NPRM.

Since 1980, 246 weather and climate disasters have occurred in the United States that have caused over $1 billion in damage. In total, the cost of these events exceeds $1.6 trillion.[3] The significant impact of weather has a tangible effect on GDP with 3-6% of its variability attributed to it.[4] Internationally, thousands of events occur adversely impacting the economy, disrupting business, and tragically causing loss of life and property. Although high-impact weather events will continue to occur, the prediction of such events has significantly advanced in the last decades. Weather forecasts, accessed over 300 billion times per year in the United States, improve due to a variety of factors such as increased computing capability, revolutionary advances in atmospheric observing technology, research on Earth's atmospheric processes, and the ability to better reach people with critical information during times of adverse weather.[5]

One of the most important technological advances in the last decade is the new generation geostationary weather satellites GOES-16 and GOES-17 launched by NOAA in 2016 and 2018, respectively. These satellites transmit time-sensitive, life-saving data to users in the United States, Americas, and globally. Unimpeded, real-time, and highly reliable access to this data is critical for members of the American Weather Enterprise to meet its mission of saving lives, keeping people out of harm's way, protecting property and mitigating economic disruption.

The American Weather Enterprise consists of organizations from three sectors: America's Weather Industry, academia, and government. Working together, the collective Enterprise leverages the expertise of each sector to generate weather forecasts and information that benefit citizens, business and society. The partnerships are critical in terms of keeping people safe, reducing injuries and fatalities and helping people and companies avoid financial loss.

AWCIA members forming the American Weather Industry, utilize foundational weather data generated by government organizations to build value-added products. These products and services, spurred by public, private, and academic collaboration, enable the Enterprise to have an accelerated and positive impact on citizens, businesses and society by protecting property and minimizing the economic impacts of weather.

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[1] "Re: Oral Exparte presentation in GN 19-116 "In the Matter of Allocatoin and Service Rules for the 1675-1680 MHz Band"; RM-11681 "Petition [by Ligado Networks] for Rulemaking to Allocate the 1675-1680 MHz Band for Terrestrial Mobile Use," May 2, 2019.
[2] David Grimes, "Re: FCC Notice of Proposed Rulemaking and Order in the Matter of Allocation and Service Rules for the 1675-1680 MHz Band (WT Docket No. 19-116), dated April 18, 2019," May 1, 2019.
[3] "Billion-Dollar Weather and Climate Disasters: Overview," NCEI, NOAA, https://www.ncdc.noaa.gov/billions/.
[4] "National Weather Service Enterprise Analysis Report", NOAA, June 8, 2017: 2. https://www.weather.gov/media/about/Final_NWS%20Enterprise%20Analysis%20Report_June%202017.pdf
[5] Richard B. Alley, Kerry A. Emanuel, Fuqing Zhang, "Advances in weather prediction", *Science* Vol. 363, Issue 6425 (2019): 342-344.

The weather data received from satellites and other sources is only useful to people if transformed into actionable information, provided in a timely manner. AWCIA members represent the vast majority of service providers of weather forecasts, warnings, news and information in the US and globally, and disseminates important and critical content each day. Collectively, our members provide relevant and timely weather information to nearly 2.0 billion people. In every case, whether it be a Fortune 500 company, a school district, or a member of the public, America's Weather Industry is a critical part of the value chain of data distribution from the National Oceanic and Atmospheric Administration (NOAA).

Innovation in consumer electronics and mobile enhancement will no doubt enable new exploration and achievement. This mobile network technological advancement will bring significant business opportunity to the entire Weather Enterprise and may unlock new ways to benefit society in the form of more accurate forecasts, higher resolution predictions, and broader distribution of critical weather information.

However, we stress this advancement cannot come at the cost of reduced access to highly reliable and timely weather satellite data, which is used by federal and non-federal users alike to provide life-saving warnings and information.

The portion of the radio spectrum (1675-1680 MHz) currently being discussed is utilized for or adjacent to the spectrum which enables transmission of essential information that is used by organizations within the American Weather Enterprise to make important decisions each day about weather's impact on life, property and the economy. These organizations include federal users, private companies, academic institutions, and other non-federal government groups.

Two essential data transmission methods are employed by the GOES-R series spacecraft. GOES Rebroadcast (GRB) downlink, accessed by many federal and non-federal users for the highest reliability and lowest latency data transmits at 1686.6 MHz. The GOES Data Collection System (DCS) uses 1679.9 MHz to support downlink, within the portion proposed for rule-making.[6]

GRB is the direct feed of real-time atmospheric data that federal and non-federal users obtain as a key input when diagnosing severe thunderstorms, blizzards, forest fires, hurricanes, and other weather hazards to issue forecasts and time-sensitive warnings. Many organizations recently installed new hardware and software designed to reliably receive, process, and incorporate GRB via a downlink. This method of data collection has been repeatedly stated by federal government officials within NOAA as the most reliable way to receive this mission-critical data, as specified in the GRB design and outlined in the GOES-R Product User's Guide.[7] Given these assurances in combination with operational needs, the Weather Enterprise has significantly invested in this technology to ensure the lowest latency and highest reliability of data.

[6] Department of Commerce, National Oceanic and Atmospheric Administration, *GOES Rebroadcast (GRB) Downlink Specifications for Users*, 2012.
[7] Department of Commerce, National Oceanic and Atmospheric Administration, *GOES-R Series Product Definition and Users' Guide (PUG).* Revision 2.0, 2018.

Latency, the time it takes for data from a scan of Earth to reach an end user, is of utmost importance to members of the Weather Industry who maintain weather forecasting operations. This environment requires the lowest possible latency in order to rapidly integrate new data into computer forecast systems and provide to meteorologists for analysis. By way of example, some of the highest resolution data from the GOES-R series of satellites is captured every minute. This data can indicate the start of a wildfire, the growth of a storm capable of producing a tornado, or a volcanic eruption that could quickly impact aviation due to an ash cloud. In each situation, each second matter so that accurate information can be provided to citizens and businesses to make decisions.

As members have evaluated the processing of GOES-R series satellite data, many options were reviewed. These options included cost, maintenance, reliability, data latency, and performance in times of natural disasters or national emergencies. The decision to install ground stations for GRB (and in years past, GOES VARiable - GVAR) has resulted in millions of dollars of investment, which was necessary to leverage this essential satellite data in a way that most reliably meets our operation's needs.

Without protection zones for non-federal users, hundreds of organizations, many who are AWCIA members, will face significant adjacent band interference from wireless operations within 1675-1680 MHz spectrum, which may render GRB downlink functionality useless or at least severely disrupted. This cannot occur. In times of severe weather, such as tornadoes, forest fires, and flooding, missing just one scan of satellite data can result in several minutes of reduced lead time for weather forecasters to issue life-saving warnings.

It has been suggested that a content delivery network (CDN) could be used in place of GRB for non-federal users to access the same data with the same level of timeliness. This assumption is incorrect, and should not be considered, because:

1. GRB was designed to an uptime specification of 99.998% over a 30-day time period, leaving room for only 5 minutes of downtime per month. Although many enterprise-grade internet service providers offer highly reliable access to the internet, the infrastructure may not consistently and reliability function to provide that service, especially in times of natural disasters. After Hurricane Michael struck the Gulf Coast in 2018, numerous fiber lines were cut and major carriers had to deploy mobile towers to support internet functionality during this "unprecedented" outage.[8] It is exactly at these times where satellite data is needed most and GRB enables little infrastructure, only relying on the cable connecting the satellite dish to the data center. Even if there was a private internet network or direct fiber used by the CDN, it could be rendered unusable in the event of a natural disaster such as Michael.[9]

2. Latency is not reduced with a CDN. As part of an effort to prove the effectiveness of such a solution, Ligado Networks partnered with George Mason University to ingest GOES-R data for research

[8] Jon Brodkin, "Verizon fiber suffered 'unprecedented' damage from Hurricane Michael", *Ars Technica,* October, 15 2018, https://arstechnica.com/information-technology/2018/10/verizon-fiber-suffered-unprecedented-damage-from-hurricane-michael/

[9] Gerard J. Waldron, et al, "Reply Comments of Ligado Networks LLC", August 11, 2016, Attachment A: 1

purposes.[10] The latency of data through the study period is posted online.[11] In a review of this data in comparison to members' GRB latency, it is clear that the latency falls well short of what is required by AWCIA members and that of which is currently available with GRB.

George Mason's system monitoring indicates satellite radiance data (data used to make images) received via the CDN has a latency of 20 to 80 seconds.[12] Conversely, a review of data received via GRB indicates a much lower latency, 2 to 15 seconds. Even if referencing the maximum latency specified by NOAA (55 seconds for Full Disk and CONUS data), the CDN has used is in adequate.[13] It is important to note the George Mason statistics are daily mean latency which smooths times of poor latency. In addition, the statistics omit outliers from the calculation, further massaging the latency data. We find it interesting this study was completed in partnership with two research universities and did not engage with any member of America's Weather Industry whose use case and requirements for GOES data is significantly different.

Even if the latency of data transmitted via CDN was similar to that via GRB, this does not account for times of highly congested terrestrial networks that caused latency to increase further. Our members require the most-timely data and it must be consistent and reliable. A GRB downlink guarantees consistent, low latency and high reliability. Milliseconds, seconds or minutes lost during high impact weather events is simply unacceptable and poses serious public danger.

The type of inconsistent latency inherent in terrestrial networks is experienced regularly by many in the Weather Enterprise. For example, most computer weather model data is disseminated via the public internet and sometimes dedicated fiber. While this works adequately most of the time, it does not always provide low latency. There are a handful of times each year where latency drastically increases or dissemination reliability breaks down. This causes significant challenges and cannot be introduced to mission-critical satellite data.

3. One of the ways that NOAA receives significant return on investment from the GOES-R series of satellites (four in total – two in operation now; two planned for launch) is through Weather Enterprise users who access the highest resolution data as quickly as possible and incorporate the data into value-added products and services. In total, the GOES-R program budget is $10.8 billion.[14] Given the troublesome latency statistics of the trial CDN, there should be significant concern that a large part of this investment risks being squandered should organizations lose access to data via GRB.

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[10] Gerard J. Walderon, Hannah Lepow, Covington & Burling LLP, "Re: Written ex parte presentation, WT Docket No. 19-16, June 13, 2019.

[11] "GTPAS", George Mason University, Ligado Networks, http://aoes-ligado.gmu.edu/tmp/system.shtml.

[12] Ibid.

[13] Department of Commerce, National Oceanic and Atmospheric Administration, *GOES-R Series Product Definition and Users' Guide (PUG).* Revision 2.0, 2018.

[14] "GOES-R Series Frequency Asked Questions (FAQs)", GOES-R, NOAA, NASA, https://www.goes-r.gov/resources/faqs.html.

4. GRB contains a significant amount of data and all of it would need to be disseminated through a CDN. Throughput of high volumes of data, feeding constantly, requires a large bandwidth and high cost while a GRB ground station is a fixed cost.

5. There is a recommendation that the successful bidder for this spectrum auction, build and support a CDN.[15] This raises critical questions. What type of support would be provided? What type of latency and reliability of the CDN would be guaranteed? It would have to be 24/7/365 with an uptime the same or better than the GRB SLA of 99.988%. Who will maintain the CDN over many years?

6. Sixth, the benefit of expanding the access of satellite by using a CDN is not correct. Amazon Web Services already employs its own method of access to GOES-R and S data which is used by a variety of entities from academia, industry, and government. A CDN as proposed in the NPRM is not revolutionary but already exists. In fact, many members considered utilizing Amazon's data when exploring GOES-R options, and ultimately decided it was only useful as backup given our time-sensitive operations.

It should be clear that a CDN, while acceptable for certain use cases such as academic research, forensic weather analysis, and education, it is not a viable solution for operations who rely on the most consistent, reliable and lowest latency data such as members of America's Weather Industry. The suggestion that NOAA entities exist in protected zones that will not be provided to our members in addition to public, non-federal users, mistakes how weather information is created and disseminated in the United States. The distribution of data to members of the entire Weather Enterprise is what makes our country's weather community unique. Many companies in America's Weather Industry are directly involved in the support of federal, state, and local emergency managers and the direct support of land, air and sea transportation operations. In each of these applications, the satellite data transmitted in or near the 1675-1680 MHz portion of spectrum play a vital role in the provision of tailored weather information services, which enable decisions that affect the safety of large numbers of the public and the country's economic vitality.

Not to be missed in this discussion is DCS. This very different but important function on the GOES-R spacecraft is used by entities across the western hemisphere to ensure reliable and cost-effective transmission of data not captured by the GOES-R spacecraft. For example, the Florida Department of Transportation (FDOT) sends data from bridge wind sensors through DCS instead of the public internet. This has reduced costs and provides consistent transmission during the times when the data is most needed, such as during and after tropical cyclones, which can cut public internet access.[16] While uplink of DCS will not be impacted by this proposal, downlink would be as it operates directly in the 1675-1680 MHz band. Once again, a CDN has been proposed to mitigate any interference. As enumerated above, a CDN is not a viable alternative.

Further, the proposed sharing of 1675-1680 MHz with non-federal wireless operators raises serious concerns about the viability of DCS downlink as a data transmission option due to power considerations. The downlink power is far weaker than what would be utilized by a wireless network and could be completely overwhelmed, leaving entities that rely on data transmitted via DCS without critical, life-saving information.

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[15] Gerard J. Waldron et al. "Reply Comments of Ligado Networks LLC," August 11, 2016: 24.
[16] Florida Department of Transportation, *Best Practices for Road Weather Management*, https://ops.fhwa.dot.gov/publications/fhwahop12046/rwm09_florida1.htm

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The items raised here that address many of the questions posed by the NPRM are being extensively studied by NOAA with a completion date in 2020. Given the important and complex issues being discussed, it is prudent and necessary to wait until such spectrum studies are finalized in order to understand the full consequences of sharing the 1675-1680 MHz band. Any decision by the FCC should wait until these studies have been thoroughly reviewed.

In this time window, non-federal users who currently operate a ground station should be asked to register with the FCC to create a record of the wide variety of organizations that make use of GRB. AWCIA members have made significant investments in ground station and related equipment which would be rendered unusable without protection zones. Why should these incumbent users not also qualify for protection zones as federal users would when many organizations perform actions similar to that of federal users for the protection of life and property? Since the Weather Industry is considered a core part of the value chain used to disseminate life-saving information to citizens and businesses, any adverse impact that occurs from sharing 1675-1680 MHz renders these significant investments useless.

In conclusion, our members favor continued U.S. leadership in mobile enhancement and its deployment through innovation and sensible management of spectrum for public benefit. This deployment though cannot and should not jeopardize the use of 1675-1680 MHz, which is of high importance to the protection of life and property, not only by federal users but by numerous non-federal ones.

AWCIA members continue to feel strongly that no sharing of 1675-1680 MHz should occur due to the lack of other viable data access options. This portion of spectrum and the infrastructure used to receive data should be considered critical and its interference minimized. Without a viable data dissemination alternative that matches GRB in reliability and latency that is thoroughly proven and documented to do so, accurate, life-saving weather forecasts and warnings will be compromised, resulting in a genuine risk to life and property, thereby causing a direct, negative, and grave impact on the American public.

Sincerely,

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