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October 17, 2019

FILED VIA ECFS

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

**Re: Notice of *Ex Parte* Presentation, WT Docket No. 19-116:
Allocation and Service Rules for the 1675–1680 MHz Band**

Dear Ms. Dortch:

On October 15, 2019, Dan DePodwin, Director, Forecast Data and Systems, AccuWeather, Inc. (“AccuWeather”), and Edward A. Yorkgitis, Jr., of Kelley Drye & Warren LLP, AccuWeather’s counsel, met with Charles Mathias, Sean Spivey, Lloyd Coward, Jessica Quinley (by telephone), and Kirk Arner (by telephone) of the Wireless Telecommunications Bureau (the “Bureau”) to discuss the issues under consideration in the above-referenced matter regarding the use of the 1675-1680 MHz band and the concerns of AccuWeather regarding their potential adverse impact on the American Weather Enterprise.

Specifically, AccuWeather elaborated on certain points within its June 21, 2019 comments in WT Docket No. 19-116 and responded to certain claims made by Ligado Networks (“Ligado”) in its subsequent reply comments and by other proponents seeking to make the 1675-1680 MHz band available for commercial wireless services.

The AccuWeather representatives discussed with the Bureau staff the importance of America’s Weather Industry in serving time-critical weather information to the public and businesses. With a market capitalization estimated at \$7 billion, America’s Weather Industry is a critical part of the value chain of data distribution from the National Oceanic and Atmospheric Administration (“NOAA”).¹ America’s Weather Enterprise is an ecosystem of cooperation between federal and non-federal agencies and entities which mutually support each other’s objectives.

¹ See National Weather Service Enterprise Analysis Report (June 8, 2017) (“NWS Report”), available at https://www.weather.gov/media/about/Final_NWS%20Enterprise%20Analysis%20Report_June%202017.pdf.

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Non-federal entities, such as AccuWeather, rely on robust, timely, and reliable GOES Rebroadcast (“GRB”) downlink capabilities to obtain data to create and provide products and services to clients and users that are time-sensitive and of utmost importance during high-impact weather situations. These non-federal users have every right to obtain GRB data via downlink as providing that downlink to non-government users is a key element of the intended design of the GOES-R framework. The collection and analysis of GRB data for issuance of critical forecasts and warnings is a joint federal and non-federal exercise. The AccuWeather representatives explained that Ligado’s claims that non-federal entities are “eavesdropping” or “free-riding” on NOAA’s data significantly misunderstand the collaborative manner in which weather information, forecasts and warnings are provided to the American public and, just as important, the role that NOAA intends for the GOES-R satellites to play in supporting America’s Weather industry.² This is clearly explained by NOAA’s National Weather Service (“NWS”) in a 2017 report: “The products and services offered by private weather companies are largely grounded in free access to timely, robust, and widely available NWS data. Without this common foundation, the private, weather, water, and climate enterprise would likely be constrained Providing this foundation . . . is thus a key way in which the NWS fulfills its mission to enhance the national economy.”³

The AccuWeather representatives also sought to clear up certain misimpressions created by some comments regarding the data latency via downlink of the GOES Rebroadcast (“GRB”) signals from NOAA’s Geostationary Operational Environmental Satellites (“GOES”) in comparison with obtaining the same weather data from an Internet-based content delivery network (“CDN”). AccuWeather refuted Ligado’s claim in its Reply Comments that not a single second of latency will be lost with a CDN.⁴ In support of AccuWeather’s refutation, it provided data latency numbers from AccuWeather’s own GRB ground station as well as a diagram (see attachment) illustrating how such data are processed. The AccuWeather proponents explained that, in fact, the numbers provided by AccuWeather for the GRB latency (of 15-25 seconds) account for the entire path from scanning by sensors on the GOES satellites through generation by AccuWeather through further

² Because GRB is a broadcast by the GOES satellite, no registration or system use agreement is needed. *See* NOAA Satellite Information System , National Environmental Satellites, Data, and Information Service (“NESDIS”), GOES Rebroadcast,” available at <https://noaasis.noaa.gov/GOES/GRB/grb.html> (“GRB Webpage”). But NESDIS has created a GRB User Group “which encourages collaboration among users, facilitates information flow among NOAA and users” and currently has over 160 members, including AccuWeather. *See* NESDIS, “GRB Users,” available at https://noaasis.noaa.gov/GOES/GRB/grb_users.html. NESDIS requests that users complete a survey on the DCS Administration and Data Distribution System (“DADDS”) website and join the GRB User Group. *See id.*; *see also* GRB Webpage.

³ NWS Report at 9

⁴ *See* Reply Comments of Ligado Networks, WT Docket No. 19-116 at 14 (filed July 22, 2019)(“Ligado Reply Comments”).

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processing of usable product files, known as Level 1b radiance netCDF files. In comparison, the Representatives explained how a CDN would experience significantly greater latency, as much as a 500% increase in latency, as detailed by the data found on a website hosted by George Mason University (“GMU”) which has partnered with Ligado.⁵ Such a comparison – which shows that the CDN mean data latency would be on the order of 80 seconds without taking into account outliers, a lag by as much as one minute relative to GRB– is not “apples-to-oranges,” as claimed by Ligado. In particular, the AccuWeather analysis shows that the creation of Level 1b radiance netCDF files after data are sensed by the GOES satellite is significantly faster when using GRB *versus* a CDN. The addition of one minute of latency is detrimental in many rapidly evolving weather situations including severe thunderstorms that produce tornadoes and wildfire monitoring. To elaborate, the current mean tornado warning lead time (the time between tornado warning issuance and tornado detection on the ground) is 9 to 14 minutes. Receiving critical satellite data one minute later in this situation would represent a reduction of lead time by 7 to 11%, a significant amount in such a life-threatening situation.

In addition, Ligado’s data regarding the CDN performance do not adequately consider reliability of the Internet Service Provider (“ISP”) or the ISP’s performance, which will vary from location to location and may not be as favorable as the ISP used by GMU. The ISP beyond the point of termination of the CDN represents a source of potential additional latencies.

Not only does utilizing a CDN introduce increased latency relative to GRB, it introduces more points of failure. With a GRB downlink, the earth station is the point of termination, with a user’s servers typically close at hand. In AccuWeather’s case, the connection from the earth station to its acquisition servers is a simple and short one, on the order of forty yards. With a CDN, a third-party ISP is introduced between the CDN and the user. This reduces reliability. GRB was designed with a specification allowing for only a five (5) minute outage every 30 days, or 99.988% reliability. Terrestrial networks and cloud delivery systems have documented Service Level Agreements (“SLA”) that do not meet this 5-minute criteria. During critical weather events such as flooding, tornados, and hurricanes, a data outage (separate from the latency issue discussed earlier) of as little as twenty or thirty minutes (as is allowed under certain ISP SLAs), significantly increases the threat to life and property. This significant reliability difference and its inherent increased risk to life and property is further detailed in an April 10, 2017 letter filed in RM-16881 by the

⁵ See, e.g., George Mason University and Ligado Networks, “GTPAS System Monitoring,” available at <http://aoes-ligado.gmu.edu/tmp/system.shtml> (ongoing daily data mean latency reporting for ABI L1 data, L2 data, and space weather L1 data); George Mason University and Ligado Networks, “About GRB-T Processing and Analysis System (“GTPAS”),” available at <http://aoes-ligado.gmu.edu/tmp/about.shtml> (characterizing GTPAS data latency as being “of the order of a few minutes”).

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American Meteorological Society, American Geophysical Union, and the University of Wisconsin-Madison.⁶

Ligado makes unsupported claims that the CDN it advocates could be enhanced to reduce latency from the results experienced by GMU. Before accepted as a factor for decision, this assertion must be vigorously and transparently tested to see if the reductions would be material, ideally in partnership with an operational center such as AccuWeather to meet the needs of a time-critical operation.⁷ George Mason, to AccuWeather's knowledge, did not have the need to obtain the GOES information in near real-time. To AccuWeather's knowledge, the proposed CDN has not yet been evaluated or even built, let alone the CDN in an enhanced version. Nonetheless, AccuWeather would invite Ligado to further explain on the record how such a system could be tested by an organization, such as AccuWeather, which has need for GOES-R data products in near real-time in partnership with Ligado. Were Ligado to do so, AccuWeather may be willing to enter into discussions to make such testing a reality.

Other points covered by the AccuWeather representatives in the meeting included concerns about the uncertainties of what the cost of a CDN would be (apart from being significant) and what organization(s) would be responsible for such cost over many years, *i.e.*, for the indefinite future. These points should not be left to future consideration after the Commission's issues an order premised on the existence of a CDN, but need to be squarely addressed by CDN proponents now. Similarly, the questions of support for a CDN and how the reliability and latency would be sustained and, critically important, restored in the event of a failure must be answered by proponents. Reliable and timely delivery of the data contained in the GRB is too important for saving lives and preserving property for solutions to these matters, if adequate ones exist, to be identified and decided upon after the 1675-1680 MHz band is made available.

Furthermore, the representatives observed that, if a CDN were created, it will not likely expand usage of satellite data as Ligado claims.⁸ The archived GOES-R data are already available via Amazon Web Services and has been for several years. Organizations wishing to access that data

⁶ See Letter from the American Meteorological Society, American Geophysical Union, and the University of Wisconsin-Madison, to Marlene H. Dortch, Secretary, Federal Communications Commission, RM-16881 (April 10, 2017).

⁷ Certain "enhancements" would provide marginal improvements at best and not significantly reduce latency. See, *e.g.*, Ligado Reply Comments at 12 (calling on NOAA to provide a connection to the CDN at the Wallops uplink to the GOES satellites). AccuWeather notes that even if the CDN obtained the data at this point, the time saved would just be, at most, a healthy fraction of a second or so since the round trip for radio waves traveling at 186,000 miles per second to the GOES satellite at a distance of 22,300 miles in geostationary orbit is just a quarter of a second.

⁸ See, *e.g.*, *id.* at 14-15.

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that do not require them in real-time already enjoy the means to do so, and so a CDN would not create added benefits in this regard, as Ligado claims.

Lastly, although not discussed in the meeting in detail, the transmission of data from the Data Collection System (“DCS”) (separate from GRB) that is supported by the GOES-R series spacecraft is also of critical importance to a variety of users. Reception of the DCS downlink at 1679.9 MHz is in-band the frequency range at issue in the rulemaking, and interference to it would cause users to not obtain certain information in a timely manner. The data contained within the DCS downlink often come from sensors deployed by non-federal governmental bodies and other entities, and the use of the DCS follows review and sponsorship by the federal government.⁹ This includes, for example, time-critical fire weather observations and wind observations in the event of a tropical cyclone in Florida.¹⁰

In summary, the AccuWeather representatives maintained that the Commission should not move forward with an auction of the 1675-1680 MHz band until the completion and full review of the NOAA studies on this subject. The Commission should also compel Ligado to further prove its CDN will work in an operational environment such as AccuWeather’s instead of the research institution they chose to work with. The needs of America’s Weather Industry and other users relying on GRB for near real-time weather data and products and research institutions, like GMU, are very different. The potential interference to the GRB (and DCS) created by sharing the 1675-

⁹ As explained on the NESDIS website, DCS consists of (i) *in situ* platforms that collect environmental information, (ii) the GOES satellites, (iii) an operational receiving and processing center located at the NOAA Command and Data Acquisition station in Wallops, Virginia, and (iv) communications links for dissemination of the collected data, among other elements. See NESDIS, “GOES Data Collection System,” available at https://noaasis.noaa.gov/GOES/GOES_DCS/goes_dcs.html. Non-federal users, many of whom provide the platforms that collect the data, must enter into a Systems Use Agreement (“SUA”) with NESDIS to access the DCS downlink. *Id.* As a primary example of the involvement of the non-federal sector, the Hydrometeorological Automated Data Systems (“HADS”) is a real-time data acquisition, processing, and distribution system running as part of the Meteorological Assimilation Data Ingest System (“MADIS” operated by NCEP Central Operations (“NCO”), part of NOAA and the NWS. HADS acquires raw hydrological and meteorological observation data messages from GOES Data Collection Platforms (“DCPs”), which are owned or operated by departments of natural resources from numerous state and local agencies throughout the country in addition to federal agency operators, collectively and generally known as cooperators. See NOAA, NCEP Central Operations, “What is HADS?,” <https://hads.ncep.noaa.gov/WhatIsHADS.shtml>. In return the NWS shares other hydrological and meteorological products and information with these non-federal and federal agencies and organizations, including through direct DCS downlinks. See *id.*

¹⁰ See Letter of Dr. Brian Kopp, Assistant Professor of Electrical Engineering, University of North Florida Comments, WT Docket No. 19-116, at 14 (filed June 22, 2019).

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1680 MHz band without a proven and viable alternative method of data retrieval for non-federal users is a serious risk to the timely delivery of accurate, life-saving weather forecasts and warnings. Such risk is an unacceptable danger to the American public and economy, and it undermines the combined efforts of multiple government and non-government sectors that constitute the American Weather Enterprise. Consequently, non-federal, as well as federal, earth stations accessing the GRB downlink to obtain [near] real-time should be protected until a CDN can demonstrably provide comparable latency, availability, and reliability, and issues regarding the costs and support for a CDN are adequately resolved.

Pursuant to Section 1.1206(b) of the Commission's rules, this letter is being filed electronically. A copy of the material handed out in the meeting is attached.

Please direct any questions to the undersigned.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'E. Yorkgitis, Jr.', with a stylized, cursive script.

Edward A. Yorkgitis, Jr.
Counsel for AccuWeather, Inc.

Attachment

cc: Charles Mathias
Sean Spivey
Roger Noel
Lloyd Coward
Jessica Quinley
Kirk Arner



AccuWeather

ACCUWEATHER:

THE IMPORTANCE OF AMERICA'S WEATHER INDUSTRY & WHY LATENCY OF WEATHER DATA DELIVERY MATTERS

October 15, 2019

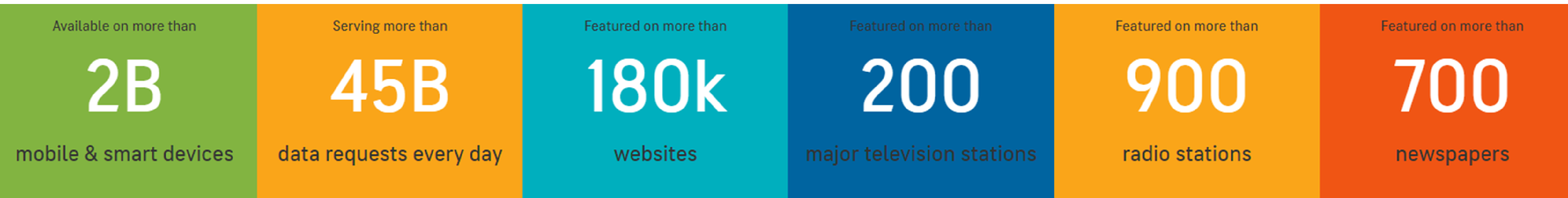
Meeting with the Wireless Telecommunications Bureau Staff
to discuss WT Docket No. 19-116

Presented by: Dan DePodwin; Director, Forecast Data and Systems



Agenda

- About AccuWeather
- Role of America's Weather Enterprise and Importance of America's Weather Industry
- GOES-R Rebroadcast (GRB) Dataflow
- Why Delivery of Weather Data with Low Latency Matters
- Other Important Items
- Summary



- **Mission: “To save lives, protect property, and help people prosper...”**
- Global headquarters in State College, PA and offices around the world.
- Distributes weather forecasts and related products and services to consumers and businesses globally at great scale.
- Trusted partner of the National Weather Service (“NWS”) and one of the first Weather-Ready Nation Ambassadors.
- Member of America’s Weather Enterprise which helps to keep people safe and minimizes the economic impacts of weather.



American Weather Enterprise

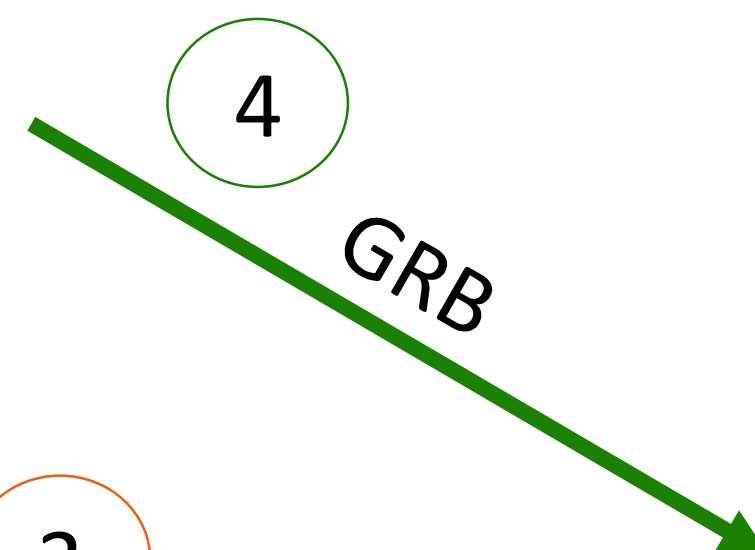
- A continuum of data and information that reaches people with critical information during times of adverse weather: **public, academic, America's Weather Industry.**
- **America's Weather Industry** - Market capitalization estimated at \$7B.
 - Serving Fortune 500 companies, school districts, general public among others.
 - A critical part of the value chain of data distribution from the National Oceanic and Atmospheric Administration (NOAA).
- The NWS recognizes that satellite and other data are crucial not just to federal entities but private companies such as AccuWeather, playing a critical role in protecting life and property.
 - The NWS Enterprise Analysis Report¹ (June 8, 2017) states: “**Without this common foundation, the private weather, water, and climate enterprise would likely be constrained...Providing the foundation...is thus a key way in which the NWS fulfills its mission to enhance the national economy.**”



GOES-R Rebroadcast (GRB) Dataflow

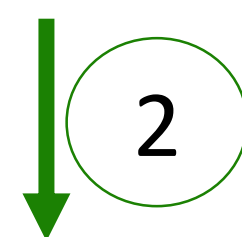
GRB consistently stated by NOAA as best data which is the *“full resolution, calibrated, near-real-time direct broadcast”*.²

GOES-R



Sensing
Atmosphere

1



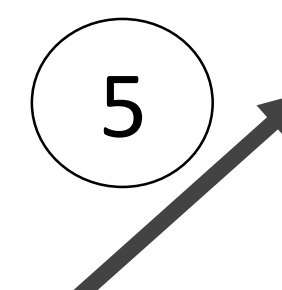
3



NOAA Command and Data
Acquisition Station
Wallops, VA



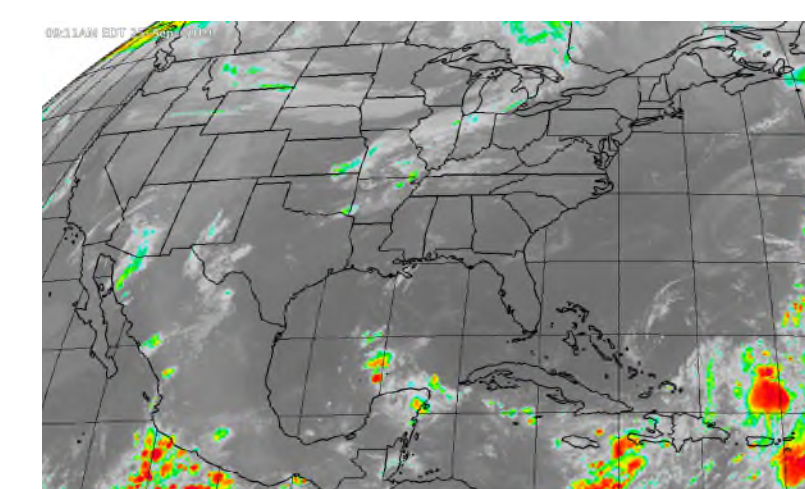
GRB Downlink
(like AccuWeather)



Acquisition
Server

6

Level 1b Radiance
Products (netCDF)



Latency Comparison
AccuWeather: 15 to 25 seconds
George Mason University: 20 to 80 seconds³



Importance of Low Latency in Time-Critical Operation

- AccuWeather has direct knowledge of its data latency (15 to 25 seconds) for processed netCDF files **via GRB**.
- Ligado's partner, George Mason University ("GMU"), reports on its website a latency of 20 to 80 seconds for the same product (Level 1b) **using a CDN**.
- One Minute Matters
 - A reduction of detection by 60 seconds is a 7-11% reduction in the average tornado warning lead time of 9-14 minutes.⁴
 - Understanding a fire has started/spread as quickly as possible provides important time for first-responders and for people nearby to evacuate.
- Testing of a CDN by a non-operational entity such as GMU, does not prove that a CDN meets the requirements of a time-critical operation.

Importance of Low Latency and High Reliability in Time-Critical Operation

- Weather forecasting operations, like AccuWeather, rely on the lowest possible latency and highest possible reliability of satellite data to make split-second decisions for high-impact weather events.
 - AccuWeather examined many solutions including cloud-based delivery and determined that it did not meet our needs in an operational environment.
- GRB reliability/latency relies on only the cable from the dish to facility while a CDN relies on multiple factors that have been shown to have lower reliability.
 - GOES-R allowed outage/month: 5 minutes; AWS EC2: 20 minutes; AWS Simple Storage: 40 minutes.⁵
 - Reliability of terrestrial connections via Internet Service Providers adds another potential point of failure beyond the termination of a CDN which is not present with GRB – **where the earth station is the point of termination.**



Other Important Items

- What is the **cost of a CDN** and who will bear that cost? Who will operate the CDN in the near-term and long-term?
- What will the **reliability and performance requirements for a CDN** be and how would the CDN operator be held to the requirement standard?
- Ligado claims that a CDN should be embraced as it would make NOAA data more broadly available. But Amazon has already made GOES-R/S data available for several years, albeit with nowhere near the latency of GRB.
- The Data Collection System (DCS) is in-band (1679.9 MHz) to the proposed commercial mobile services and would be interfered with by them, causing **data loss** to those who rely on DCS for reception of real-time weather data.



Summary

- AccuWeather strongly urges the Commission to create protection for GRB downlinks not only for federal users but for non-federal users due to their shared mission to protect lives and property.
- In-band or adjacent-band interference to the GRB would be a clear side effect of the sharing of 1675-1680 MHz spectrum. AccuWeather believes a CDN, as has been documented and tested thus far, is not a viable alternative to GRB.
- NOAA should be allowed to finish its compatibility studies before the Commission takes action on 1675-1680 MHz.
- Before a decision is made to implement a CDN in lieu of protecting non-federal earth stations receiving the GRB, a CDN should be robustly tested with operational partners in America's Weather Industry to ensure it consistently meets requirements.