GOES DCS Technical Working Group (TWG) 125th Meeting
Tuesday - Wednesday April 27 - 28th, 2021
(Virtual Via Webex and Teleconference)

TWG Day 1 – April 27, 2021

Introduction and Logistics: (Richard Antoine - NESDIS/OSPO/SPSD/ Direct Services Branch)

Richard Antoine welcomed the attendees and opened the meeting at 10:30 EDT.

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

TWG Agenda Review: (Richard Antoine - NESDIS/OSPO/SPSD/ Direct Services Branch)

Richard Antoine reviewed the agenda and went over logistics. The agenda was accepted as is.

DCS Update: (Richard Antoine - NESDIS/OSPO/SPSD/ Direct Services Branch)

Richard briefed that the extension to the final year of Microcom contract is now in effect until July 12, 2021. He noted that he is pushing for an extension. He also said that NESDIS is hoping to get an acquisition started for DADDS Next during the next year. A request for information (RFI) was released in late February 2021 and the responses have been returned. Another major effort is to complete the backup pilot antenna installation at the Combined Backup Facility (CBU) in Fairmont, WV. NESDIS hopes to complete this next year. This project will replace the omni-directional antenna with a parabolic antenna. The schedule is to work on civil works and logistics through the end of this year with the actual replacement in March of 2022.

NESDIS will continue the legacy engineering contract. This will ensure the following will continue:
- System engineering support
- System hardware and software sustainment
- System operations support
- Integration and installation
- Acceptance testing and evaluation
- Integrated logistics support
- Training and documentation.

This support also covers the following radio frequency (RF) and administrative infrastructure:
- DCS Demodulators (DAMS-NT)
- DCS Pilot/ Test Transmitters (P/TT)
- Dual DCS Pilot Control Modules (DPCM)
- DCS Platform Radio Set (DCPRS) Certification Upgrades
- DCS Administrative and Data Distribution System (DADDS)

Richard then briefed issues that will need to be resolved in the future. One issue is how will our RF infrastructure be supported? There is a need to see how NESDIS can align this with the new "OMS" operations and maintenance contract. Part of the OMS contract will be the migration of some programs into the NESDIS cloud infrastructure. Discussions on this will be ongoing. Another large effort will be to document the need for two-way communications and the need for a funded work assignment to finish the

demonstration of a successful operational capacity. Richard then noted that we will continue to work with the small-sat project in their validation efforts. Also included is the need to keep monitoring and working to mitigate frequency interference in our DCS spectrum. And, finally, continue to work with the GeoXO Program to ensure a viable DCS service on the next generation of satellites.

Richard also briefed that a large project that is ongoing in the DCS Program is DADDS Next Project. This acquisition will replace the current DADDS, but not the other subsystems of the DCS system. The goal of the replacement is to meet NESDIS enterprise security requirements and provide a flexible and easy to maintain architecture. The DADDS next will continue to be the interface to the HRIT, NWSTG and LRGS systems as well as the DCS web pages.

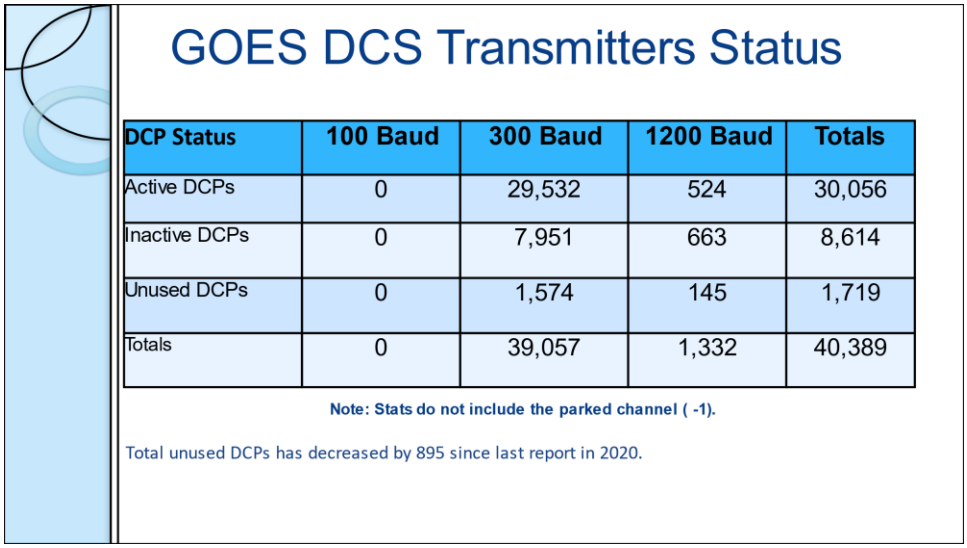
In closing, Richard summarized the challenges ahead for the DCS Program:

- Keeping up with change…
  - Legacy GOES DCS contract
  - GOES DCS maintenance & sustainment contract
  - DADDS Next acquisition
  - GeoXO in the future
- Keeping in step……
  - Align with NESDIS OMS contract and the NESDIS Cloud
- Questions for now….
  - Commitment to Two Way!!!
  - Keeping the system up to date, e.g., SUAs & PDTs

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Customer Service Update: (Letecia Reeves - NESDIS/OSPO/SPSD/ Direct Services Branch)

Letecia went over the statistics on the GOES DCS transmitter status. The statistics are contained in the table below. The inclusive dates for the inactive DCPs are 2011-2021.



GOES DCS Transmitters Status

DCP Status	100 Baud	300 Baud	1200 Baud	Totals
Active DCPs	0	29,532	524	30,056
Inactive DCPs	0	7,951	663	8,614
Unused DCPs	0	1,574	145	1,719
Totals	0	39,057	1,332	40,389

Note: Stats do not include the parked channel (-1).

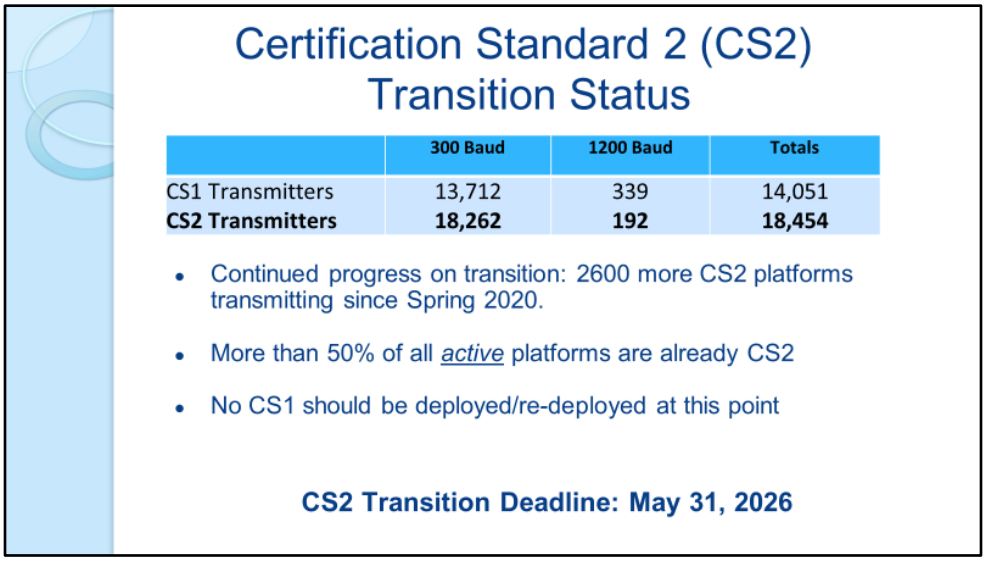
Total unused DCPs has decreased by 895 since last report in 2020.

Letecia briefed that there are revised policies on DCP assignments and that some of them are new. The proposed policies are listed below.

- Assignments should only be requested for definite deployments within 6 months (units should already be purchased)
    - Contact Letecia to discuss time slot availability at any time
- IDs that remain unused for 1 year will be reclaimed, effective June 1, 2021
    - Reapply for DCP IDs as needed
- IDs that are inactive for 3 years will be reclaimed after June 1, 2021
- IDs that have been inactive for more than 5 years will be reclaimed immediately
- Before using an ID that has been unused or inactive for more than 1 year, consult the DADDS to ensure that it is still on an active channel.

She also noted that if DCP has been unused it will be moved to the holding channel (-1) and the time slot will be reclaimed. DCP IDs that have been active for over 5 years will be reclaimed immediately. She noted that users can reapply at any time by reaching out to her. Letecia briefed that you can log into DADDS to see if your DCP is on an active channel. If you find it in the "parked" channel, you will have to contact her to re-apply.

Letecia next briefed the transition from CS1 to CS2. The results are contained in the table and notes in the graphic below. She noted that there has been good progress as more than 50% are already CS2. She reminded users that the CS2 transition deadline is May 31, 2026.



Letecia briefed the ongoing "PDT week" progress. She noted that the first one in 2020 was successful with 10 organizations participating. For decades we have briefed the need to keep the information up to date. Everyone benefits when the record is accurate. Letecia noted that we are working to develop a visualization tool to show where all the DCPs are located. This helps when there is an emergency. If the manufacturer needs to contact everyone with a certain model, they cannot do it if the information is missing or incomplete. This cannot be accomplished if the PDT entries are not accurate.

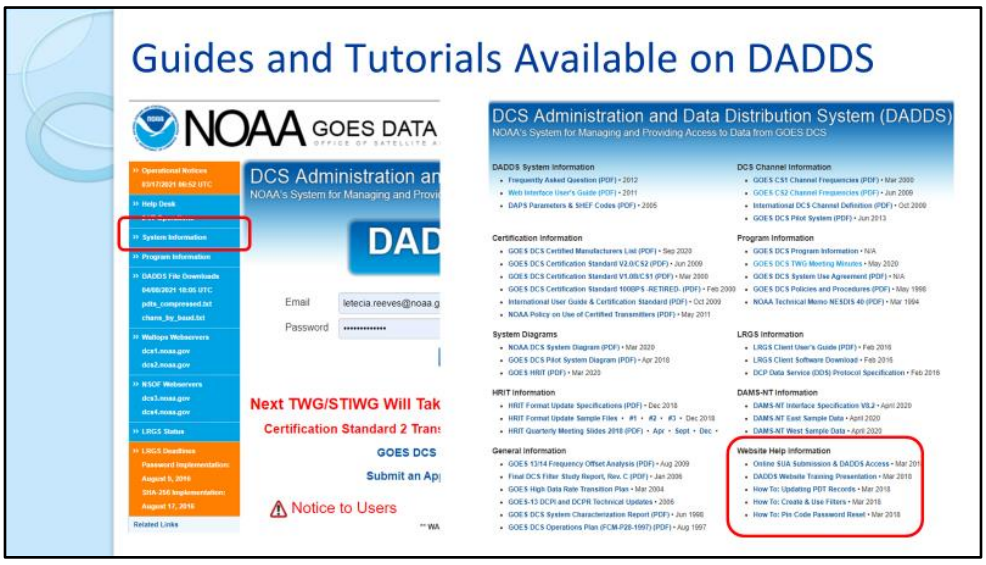
There are two PDT weeks scheduled for 2021. One scheduled for the week of June 1st and the second the week of December 1st. These will be full weeks. Outside of the PDT weeks, please contact Letecia for assistance. She noted that the PDT team consists of herself, Valerie Randall and Habtam Ayalew.

Another note is that there will be a training opportunity in 2021 in conjunction with Fall 2021 STIWG. Users can email Letecia with training needs.

It was also briefed that there is a DCS field test available OUTSIDE of the DADDS login. Users can use the four DCS web pages for this. The web pages are https://dcsx.noaa.gov/ with x being 1-4.

Letecia noted that if you do need to log into DADDS and have forgotten your password, the default answer to both security questions is your last name+4-digit PIN (Parker4411) with NO spaces. If you cannot remember your PIN, contact Valerie Randall (Valerie.Randall@noaa.gov) or the 24/7 Wallops Help Desk @ 757-824-7450.

Letecia then briefed that there are numerous guides and tutorials available on DADDS 1-4 (https://dcsx.noaa.gov/ with x being 1-4). She showed the graphic below noting that the guides are under the "Systems Information" item in the blue menu and then in the "Website Help Information" section on the lower right corner of the page.



The final item in the brief was a slide on the DCS Test Channels. She noted that there are test channels for both 300 baud and 1200 baud. She noted that Channel 151 should not be used for test transmissions. The list of test channels is

- GOES East 300 bps - CS1 & CS2 = Channel 195 (401.99200 MHz)
- GOES West 300 bps - CS1 & CS2 = Channel 196 (401.99350 MHz)
- GOES East and West 1200 bps - CS1 = Channel 99A/197 (401.99500 MHz)
- GOES East and West 1200 bps - CS2 = Channel 198 (401.99650 MHz)

Please note: CHANNEL 151 should NO longer be used

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Wallops Update: (Matt Sullivan - NESDIS/OSPO/Wallops Command and Data Acquisition Station)

Matt Sullivan provides an overview of the NESDIS GOES DCS system. He began by briefing the Geostationary Operational Environmental Satellite (GOES) constellation. The list of the satellites in the current constellation is:

- GOES-16: Prime East S/C @ 75.2° W Longitude
  - Replaced G13 18 Dec 2017

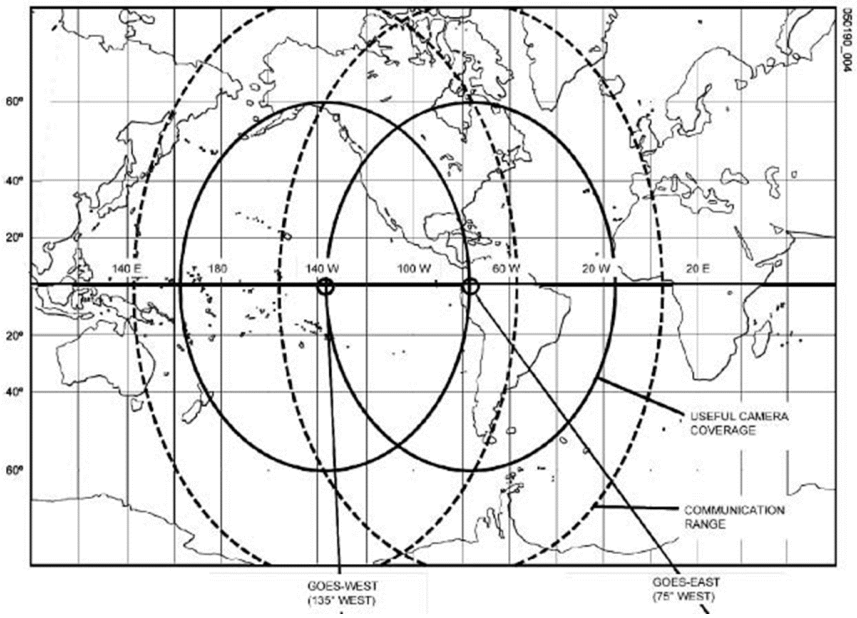
- GOES-17: Prime West S/C @ 137.2° W Longitude
    - Replaced G15 15 Nov 2018

- GOES-14: Storage @ 105° W Longitude

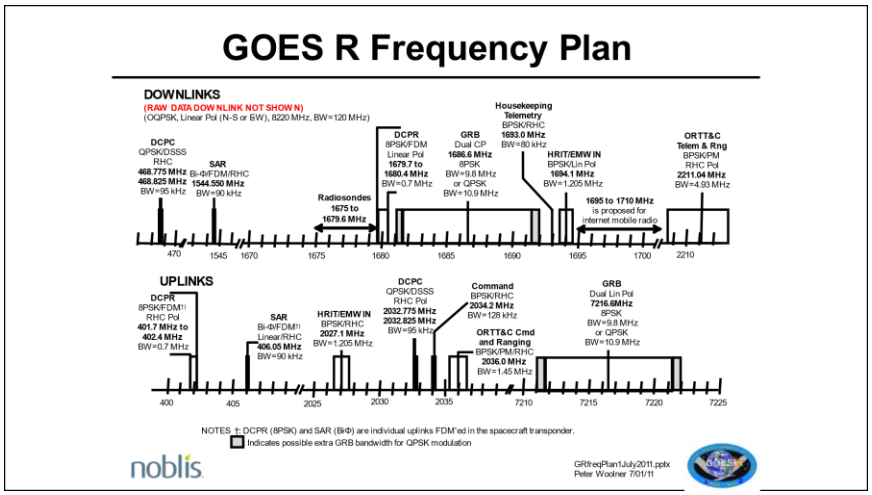
- GOES-13: Transferred to USSF to support the GOES IO mission
    - Became operational 9 Sep 2020, renamed EWS-G1 (Electro-optical Infrared Weather System Geostationary)

- GOES-15: Storage @ 128° W Longitude

He noted that the two Prime East and West satellites are GOES 16 and 17. These are GOES-R Series satellites. In addition to the GOES-R primary East and West satellites, there are still two GOES-M series satellites in the constellation. These are GOES 14 and 15. They are both in storage orbits. There is also a legacy I-M Series GOES satellite that was previously named GOES-13. It is now named EWS-G1 and is functioning as a weather satellite for the U.S. Space Force that has been moved over the Indian Ocean to support operations. The "footprint" of the GOES satellites in the western hemisphere are shown in a graphic below.



Matt then briefed the GOES-R frequency plan. The plan in graphic format is shown below. He noted the DCS DCPR uplink at 401.7 MHz to 402.1~~-~~4 MHz on the bottom section on the left side and the DCPR downlink frequency of 1679.7 to 1680.1 MHz on the left center of the top section.



Matt noted that NESDIS has a primary receive site at the NOAA Command and Data Acquisition Station in Wallops VA (WCDAS). There are three primary hurricane-rated receive antennas (110 mph winds). These antennas can receive in the L-band and the uplink in S-band and X-band. There are also three GOES antennas at the CBU in Fairmont WV. By next summer, the two older GOES antennas at Wallops Island will be upgraded to support the GOES-R series satellites. There was an antenna at the NASA Goddard facility in Greenbelt, MD that has been relocated to Australia to support GOES-13 operations. There are also GOES antennas at the NOAA Satellite Operations Facility (NSOF) in Suitland, MD to support NESDIS operations. Matt also noted that the second set of DCS subsystems are located at the NSOF. There is a plan to move these systems to the CBU in the next calendar year. A summary of the primary, backup and NSOF antennas are listed below:

- Primary GOES Site at WCDAS - Located at Wallops Island, VA
  - Three hurricane rate antennas (HR4, HR5, and HR6) capable of supporting the GOES R series spacecraft
  - Two legacy HR antennas at WCDAS (HR1 and HR2) are currently undergoing upgrades/enhancements to facilitate GOES R support.
    - Upgrades currently scheduled for completion Spring/Summer 2022
  - Primary DCS pilot antennas

- GOES Consolidated Backup Facility (CBU) - Located in I-79 Technology Park at Fairmont, WV
  - Provides full mission backup capability for GOES 14-17, **with the exception of a DCS receive ground system.**
  - Three hurricane rated antennas at CBU (HR7, HR8, and HR9)
  - Backup DCS pilot at 401.7 MHz
    - Installation of 3.8m Backup Pilot antennas is scheduled for November of 2021.

- NOAA Satellite Operation Facility (NSOF) - Located in Suitland, MD
  - Four 9.1m parabolic antennas (N1, N2, N3 and N4) in support of the GOES R series spacecraft. Currently holds the backup DCS receive system, including DAMS-NT, DADDS, and LRGS's.
    - Tentative plans are to move all DCS backup ground equipment to the CBU in 2022.

Matt also explained that the primary pilot antennas located at WCDAS provide a reference signal for the DRGS's to work smoothly with minimal interference. There are three antennas with one each for GOES

East and West and a third for redundancy. There is also capability at the CBU which will be upgraded in 2022.

He also briefed the NOAA dissemination systems for DCS. These are the various re-broadcast or terrestrial dissemination methods for the DCS messages.

The National Weather Service Telecommunication Gateway (NWSTG) is a dedicated data stream sent from DADDS to the NWS. DADDS adds a WMO header to the messages that are sent to the gateway. There are two dissemination sites that are the DADDS at WCDAS and at the NSOF. There is one active and one on standby at any time. These can be switched. The actual customers for this data have been mostly unknown in the past. The HRIT program has been working with their NWS counterparts to track where this information ends up.

Local Readout Ground Stations (LRGS) are server based terrestrial information technology systems. There are four NOAA supported systems. Two of them are at WCDAS and two at the NSOF. They receive messages from the DRGS systems (DAMS-NT) co-located with them. They can receive the messages from other LRGS systems as well. Thus, they are backed up by each other. The system that is connected today is the USGS Emergency Data Distribution Network (EDDN). These systems can be accessed by downloading the OPENDCS software package.

HRIT –This is a separate broadcast service on the GOES satellites. It can be uplinked from WCDAS and the CBU giving it a strong backup capability. The broadcast also includes imagery and the legacy EMWIN stream. The data stream for DCS is fed by the DADDS systems. It can be received within the GOES footprint using a receive station using small antennas of 1-2 meters diameter.

DCS Administration and Data Distribution System (DADDS) –DADDS provides message dissemination along with administration functions. It is managed by the DCS program office at the NSOF and by the support group at WCDAS. PDT updates are affected using the DADDS system. As a user, you can retrieve your message data. There are 4 servers, DCS1-4. DCS 1 and 2 are hosted by the WCDAS and 3 and 4 are hosted at the NSOF. Users need a login to access the message data and manage their PDTs.

It was noted that the System Information pages on the servers have a wealth of information on the DCS system. It includes a repository of all the DCS information. It includes access to previous TWG meetings, how to implement LRGS and many other functions.

Matt also showed the system or DCS wiring diagram. It is divided into the three sites, WCDAS, NSOF and the CBU. This is kept updated as there are system changes. It is included on the DADDS system information page.

Matt also showed the DCS points-of-contact page. He noted that there is 24x7x365 technical support at WCDAS. Travis Thornton is the DCS Operations Shift Supervisor, and Matt is the Radio Frequency Systems Specialist. The points of contact for WCDAS are listed below.

- Wallops Help Desk: 757-824-7450, wdcs@noaa.gov
    - 24/7 Technical Support for DCS, LRGS, DADDS, HRIT

- Travis Thornton: 757-824-7316, joseph.t.thornton@noaa.gov
    - WCDAS Operations Shift Supervisor
    - DCS Operations Team Lead

- Matthew Sullivan: 757-824-7360, matt.g.sullivan@noaa.gov

- DCS RF Systems Specialist
- WCDAS Frequency Spectrum Manager

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Two Way Comms: (Brett Betsill - Microcom Design Inc.)

Due to the highly technical nature of the two-way communication subject, the following summary was provided by Brett Betsill of Microcom Design who gave the presentation during the meeting.

"Microcom Design provided an update and the status of the Two-Way proof of concept work. Since the Over-the-Air Bit Error Rate (BER) testing has been on hold since the beginning of the COVID-19 pandemic, the focus of the presentation was the investigation into the impact of satellite movement on the Two-Way signal and the development of an algorithm to track the motion.

The presentation began by providing a summary of the Two-Way work since the last TWG in May of 2020 with a specific focus on detailing the need to track the satellite motion to ensure proper Two-Way timing alignment. The final summary slide showed the predicted time motion of the GOES-16 satellite from 04/16/2020. This graph was generated over a year ago from an analysis performed by Aerospace Corporation and was taken from the Two-Way Status presentation from last year's TWG. Following the summary slides, Microcom covered the three approaches it investigated to come up with an automated tracking algorithm.

The first approach Microcom reported on was titled the "Energy Drop Misalignment Investigation". The theory behind this approach is that a valid signal is present only if the hops remain aligned in time. Conversely, if the hops are misaligned, there will be a brief period-of-time when no signal will be present at the 455 kHz IF point due to the disparate frequencies of the received signal and the de-hopping synthesizer. As such, the misalignment should produce a detectable drop in signal energy after the de-hoping stage. Microcom demonstrated that this "Energy Drop" does occur and that it is detectable, but they determined that it does not have sufficient resolution to support a tracking algorithm. However, this approach may prove useful down the road to perform a course alignment for field deployed units.

The second approach reported on was the "Symbol Transition" investigation. Using symbol or bit transitions is a common method for tracking symbol rate variations. Since the symbol rate from the Two-Way modulator is precisely synced in time and does not vary, it is conceivable the symbol transitions can be used at the receiver to provide satellite motion tracking.

However, one concern covered in the presentation is that the Root Raised Cosine (RRC) filter utilized in the Two-Way Modulator design causes the symbol crossings to vary by approximately 400 microseconds. As such, a different digital filter that preserves the symbols crossings at a distinct point would be required. Microcom investigated several possible candidates and settled on a modified or Truncated version of the standard RRC filter.

In subsequent slides, Microcom compared the time domain and frequency domain performance of the Truncated RRC filter to the standard RRC digital filter at both the Two-Way Modulator and in the received signal of the Demodulator and demonstrated the two filters' similarities. While Microcom was not able to come up with a sufficiently accurate symbol transition tracking algorithm, it was believed that this was due to the current digital signal processing implementation demonstrated and not an issue with the Truncated RRC filter.

Accordingly, Microcom recommended preserving the use of the Truncated RRC as it is not expected to impact the performance of the Two-Way communications and will allow for the potential to use it for tracking purposes with an alternate future DSP implementation.

The remainder of the presentation highlighted the third and final approach Microcom investigated, and that also resulted in the required tracking algorithm. This approach was designated the Phase Transient Tracking Algorithm. The first slide demonstrated that a significant and readily observable phase transient occurs in the phase lock tracking loop with time misalignments on the order of microsecond or two, and the transient will still be present at levels below one microsecond. Further testing confirmed that the phase transient was proportional to the time misalignment and provided the direction of misalignment if the direction of the hop and phase of the symbol is taken into account.

Microcom then presented the results of the testing of initial implementation of the tracking algorithm for an unmodulated but hopped carrier signal. Results for both the bench and the over-the-air testing were presented, and these results indicated the algorithm showed significant promise.

The remaining slides then demonstrated how Microcom extended the algorithm to a true modulated Two-Way signal and showed the results for three levels of signal-to-noise ratios (SNR), culminating with an SNR level of approximately 5 dB, which is equivalent to a BPSK BER rate of 10^{-4}. Even at the lowest SNR tested, the Phase Transient Tracking Algorithm performed quite well and maintained a tracking accuracy of better than 0.5 microseconds more than 99% of the time.

Microcom concluded that while all three investigated approaches have merit and may ultimately prove useful, the Phase Transient Tracking Algorithm met the objectives of better than one microsecond tracking alignment, and even performed remarkably well at very low SNRs. Further, this tracking algorithm will support the final Over-the-Air BER testing once COVID-19 restrictions are relaxed to allow the testing to proceed."

LySanias Broyles asked if there is any way to have this work considered mission essential to allow the testing to continue during the current covid restrictions? Richard noted that from his perspective he can try to make the case for this to happen. A follow-on question was if Microcom has all they need, how soon can he provide a complete system. Brett Betsill answered that they need to break it away from the sustainment contract and have a funded task for this effort. He thinks they complete a demonstration by a year and a half depending on interruptions. This should be rolled into the DADDS Next for the command interface. That would be a good place to address it.

Beau Backus asked a question: What happens if the DCP is moving like on a buoy or a vehicle. Brett answered that yes, the system can track it. An algorithm should take out any earth as well as the satellite movement. This will take some more testing. The speed of the movement may make a difference and it remains to be seen if this will work on a small-sat satellite.

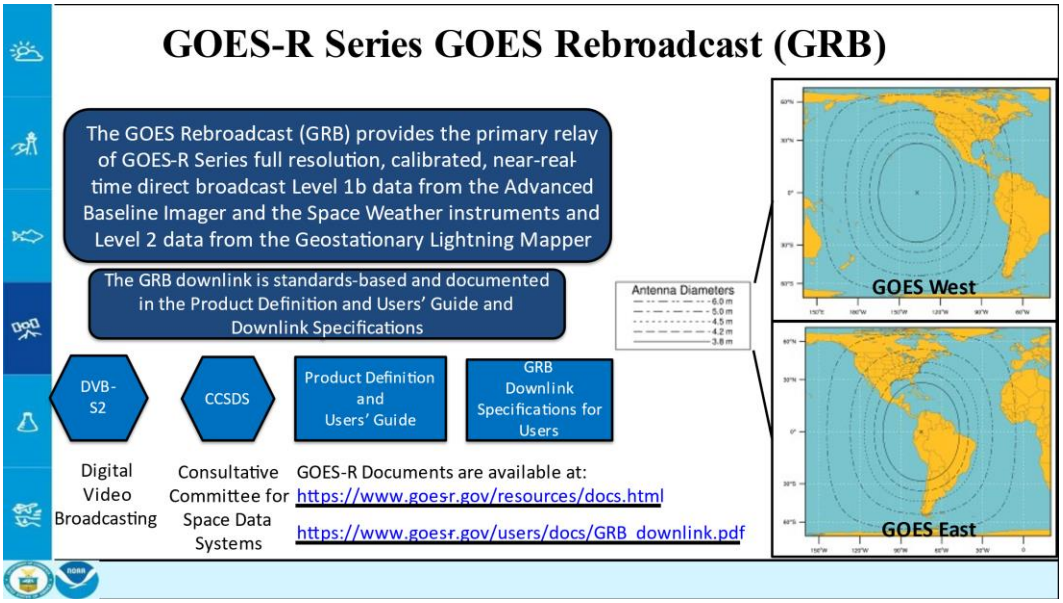
A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

HRIT Update: (Seth Clevenstine - NESDIS/OSPO/SPSD/ Direct Services Branch)

Seth began his presentation by giving an overview of the NESDIS rebroadcast systems. He noted that the GOES Rebroadcast or GRB has the highest bandwidth and is the primary relay of

GOES-R series data from the satellite to users. Also noted was that the standard imaging mode is now Mode 6 which gives a full disk every 10 minutes plus mesoscale images. Seth noted that more information on GOES-R can be found at: GOES-R Documents are available at: https://www.goes-r.gov/resources/docs.html and https://www.goes-r.gov/users/docs/GRB_downlink.pdf.

This information is contained in an image below as well as the GRB downlink specifications on the second image.

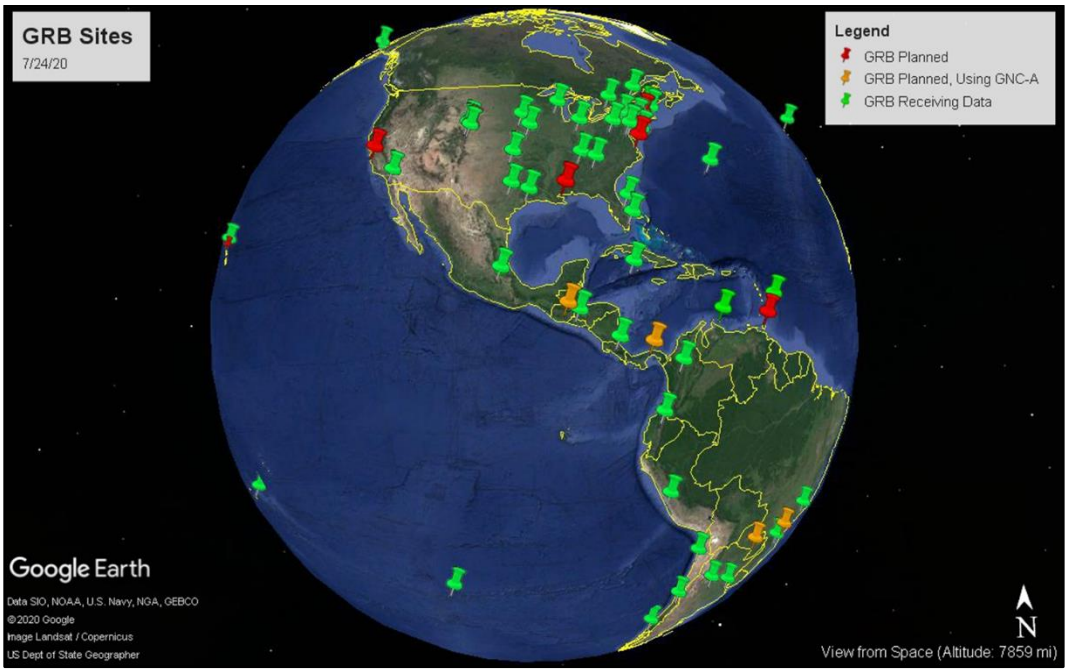


GRB Specifications

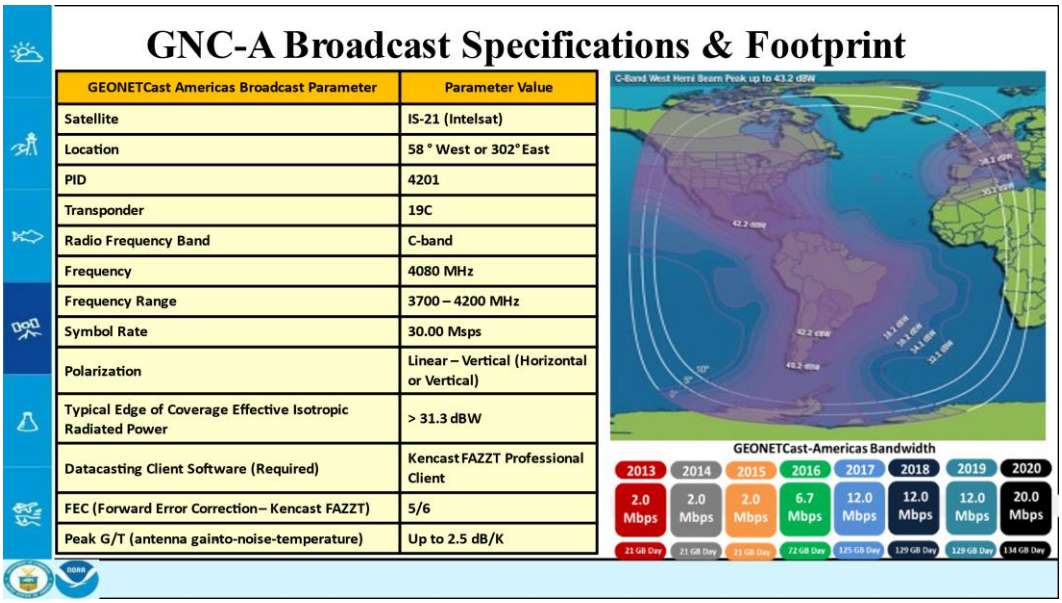
	GOES Rebroadcast (GRB)
Full Disk Image	5 mins (Mode 4) and 10 mins (Mode 6)
Other Modes	3000 km X 5000 km (CONUS: 5 minute) 1000 km X 1000 km (Mesoscale: 30 seconds)
Polarization	Dual Circular Polarized
Receiver Center Frequency	1686.6 MHz (L-Band)
Data Rate	31 Mbps
Antenna Coverage	Earth Coverage to 5^0
Data Sources	ABI (16 bands), GLM, SEISS, EXIS, SUVI, MAG
Space Weather	~2 Mbps
Lightning Data	0.5 Mbps

Seth also briefed the Community Satellite Processing Package for Geostationary Data or CSPP Geo. This package allows users to process the GRB data streams and generates the second level

products. It can be found at http://cimss.ssec.wisc.edu/csppgeo/. He noted that there are now 67 known GRB sites. Many of these stations use the CSPP Geo software package for processing the data. A graphic showing the locations on a "globe" follows.

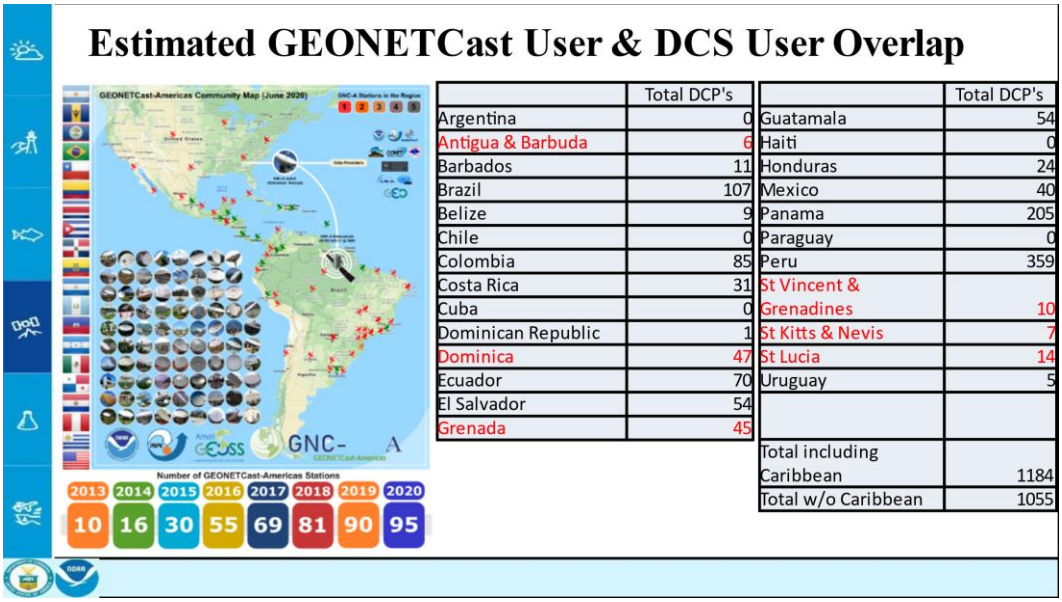


Seth then briefed the GEONETCast Americas (GNC-A) dissemination broadcast. He noted that GEONETCast is a system of systems with GNC-A being one of the regional broadcast systems that covers the Americas region. The specifications and broadcast footprint are shown in the graphic below. One point of note is that this is a C-band broadcast which has different characteristics from the GRB and HRIT L-band broadcasts. This is the middle size broadcast with a bandwidth of 20 megabits per second.



Seth briefed the products available on GNC-A noting that there are nine GOES-R bands with eight of them arriving every 15 minutes plus band 13 which arrives every 10 minutes when the satellite is in mode 6. There are also 20 GOES-R level 2 products along with a multitude of products from other U.S. agencies and international providers such as EUMETSAT, CIMSS, CIRA, NWS, and INPE/Brazil, among others. There are also many JPSS imagery products available, some for which DCS users have interest in such as VIIRS active fires, ocean color, and blended precipitable water. Seth noted that more product information can be found at: https://geonetcast.wordpress.com/gnc-a-product-catalog/.

He noted that there are now nearly 100 GNC-A receive stations mostly in Central America, South America and the Caribbean. He also briefed that there is a lot of overlap between the GNC-A and DCS communities. The graphic below shows a list of countries with GNC-A stations (proposed in red) and the number of DCPs located in each country.



	Total DCP's
Argentina	0
Antigua & Barbuda	6
Barbados	11
Brazil	107
Belize	9
Chile	0
Colombia	85
Costa Rica	31
Cuba	0
Dominican Republic	1
Dominica	47
Ecuador	70
El Salvador	54
Grenada	45

	Total DCP's
Guatamala	54
Haiti	0
Honduras	24
Mexico	40
Panama	205
Paraguay	0
Peru	359
St Vincent & Grenadines	10
St Kitts & Nevis	7
St Lucia	14
Uruguay	5
Total including Caribbean	1184
Total w/o Caribbean	1055

Another service of interest to the DCS community is the HRIT/EMWIN broadcast from the GOES satellites. Seth reminded the audience that HRIT/EMWIN is a combination of the legacy National Weather Service Emergency Management Weather Information Network (EMWIN) and the legacy Low Rate Information Transmission (LRIT) service from the previous series of GOES. It is a combined broadcast stream where the U.S. National Weather Service EMWIN data has the highest priority, as it contains watches and warnings, and the DCS messages have the second priority. However, the DCS observations have a guaranteed bandwidth equal or greater than their real bandwidth use, thus there is no impediment to their insertion in the stream. The bandwidth management scheme is depicted in the following graphic:

- HRIT "subscribes" to various products within the Product Distribution and Access (PDA) system. One being DCS data.
- When each of the subscriptions gets pulled for HRIT dissemination based on their availability or when they're scheduled, they move over to HRIT's Broadcast Management system where the subscriptions get labeled under a group listing and pushed to the dissemination queue for FEP uplink.
- HRIT separates subscriptions into three different groups and prioritizes each product on how its configured into the system.
  - DCS data is the second highest priority behind EMWIN data

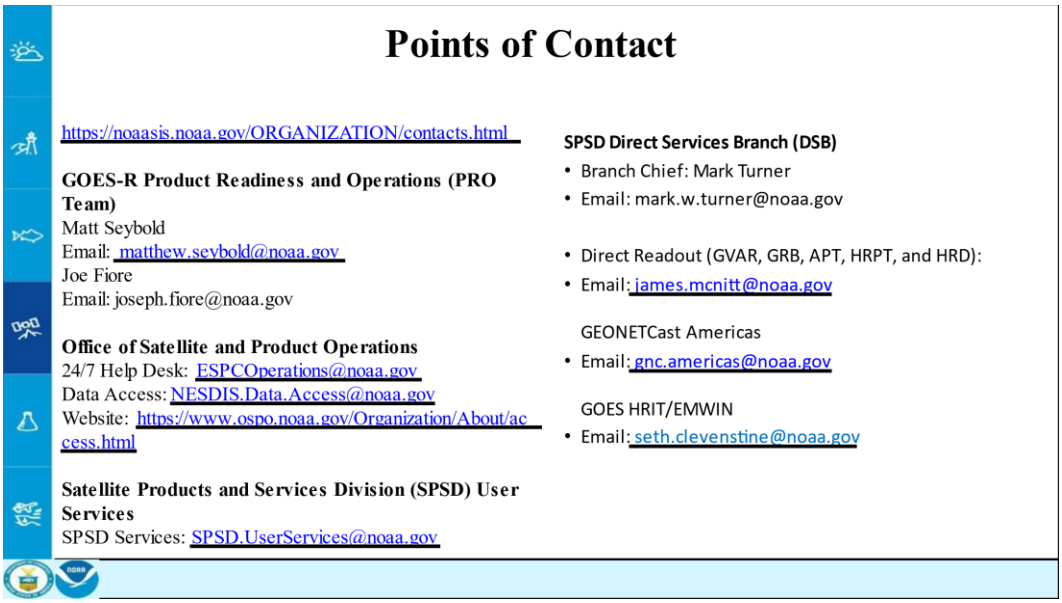
PDA Product Group Name	Guaranteed Bandwidth	Maximum Bandwidth	Group Order Rank
EMWIN	8%	15%	1
DCS	**5%**	**10%**	**2**
Imagery	87%	100%	3

Seth also briefed the way the HRIT broadcast is broken up into virtual channels. The DCS Administration Channel is virtual channel 30 and the DCS Data is channel 32.

He also briefed the latency of the HRIT broadcast which is important to the DCS community. The average latency of the HRIT system itself is sub-10 seconds at 9.6 seconds and normally less than thirty seconds overall. Over a message count of 147,300, there were 18 messages that had a latency greater than 20 seconds and 4 messages that had a latency over 1 minute. Seth also noted that the average expected availability of the HRIT broadcast is greater than 95% or .95 whereas the actual availability was .995 or greater than 99%.

Seth finished his presentation with a slide containing points of contact for the GOES-R Product Readiness and Operations or PRO Team, the NESDIS Office of Satellite and Product Operations (OSPO) web site, the NESDIS 24x7 Help Desk, the NESDIS OSPO User Services Office, and the Direct Readout (GRB and HRD), GEONETCast Americas and HRIT/EMWIN Program Managers. The slide is copied on the next page below.

Dan Schwitalla asked what is on the DCS admin channel. The answer is that it has not been used. Originally it was planned to be used in a manner similar to the legacy LRIT broadcast where outage messages were placed on the broadcast. Another question was whether GOES DCS is on GEONETCast Americas. It is available for GNC-A but has never been inserted. The DCS Program would need to get user input to gauge need. There is no plan, but the possibility is there.



A copy of the slide presentations can be found at: https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Small Sat Update: (Beau Backus – NESDIS/JHUAPL)

Beau briefed that the basic concept of the Satellite DCS Use Concept Validation project is to determine whether small satellites in low earth orbit can successfully interface with the data collection system (DCS) receivers and thus provide a low-rate data (100, 300, or greater bps) service to satellite users; primarily to assist in launch, early orbit, and anomaly (LEO&A) operations or low data required observations. It is expected that the satellite use of DCS may assist in minimizing the risk of interference but will not eliminate it. Additional regulatory controls and protections will continue to be needed as well.

DCS Transmitters (meteorological satellites) use the 401-402 MHz band to uplink data to the DCPR on GOES (and other DCPR equipped) satellites. Satellites are also allocated to use this band (space-to-Earth) for space operations purposes. These satellites often transmit with omni antennas and so they inadvertently also radiate in the direction of the DCS receiver on GOES. The thought is that the small-sats can be part of the DCS system. These satellites could have the capability to transmit data to the DCS system. The satellite could transmit almost anywhere in its orbit thus we would have to coordinate with EUMETSAT and JMA.

It was conclusively shown via TES-10 that the small-sats can transmit from the satellite to GOES, then from GOES into DCS thus data was retrievable to the mission team. This was accomplished on 20 August 2020. This is a shared platform system with several payloads on the same satellite. TES 11 will launch in September. It will be a 3 x 2 size satellite which is a rectangle.

In the near future, TES-11 will launch with an EarthSat payload. There will be cooperative testing with EUMETSAT with JMA observing. The primary goal is to demonstrate an

operational case for the small-sats' use of DCS.

Beyond TES-11 With funding, the possibilities include two-way communications, use of higher data rates and the addition of an alternative modulation scheme. NASA is exploring this architecture to support lunar monitoring and for monitoring the surface of Mars.

The small-sats may use the international channels (iDCS) channels. There are 11 channels. We would need to relocate some iDCS users that do not require the unique iDCS channels. It was also noted that satellites are best suited for random access.

In conclusion, Beau noted that the 401-402 MHz band for meteorological and earth exploration satellite application continues to be under pressure for use by small-sat companies. Small-sat operators access into the DCS system may alleviate some risk and further strengthen the value of protecting the system. Issues can be resolved through engineering or policy. Through the success of TES-10, the team believes satellite use of the DCS is a viable option. The basic satellite DCS use concept is now validated and testing for a more operational capability planned for late September 2021. Follow-on testing with EUMETSAT may confirm viability, then NOAA and CGMS must determine if, and under what rules, this capability may be made available to small-sats.

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Random Reporting User's Guide Document Refresh: (B. Kopp - Microcom Design Inc)

Brian Kopp briefed that the original "Random Reporting User's Guide" was published 40 years ago in 1980. It is a non-searchable PDF. NOAA wanted to review random reporting and then to update the document.

There was a set of tasks outlined:

- Review of the original user guide and current certification standards requirements (CS2)
- Analysis of the current performance of the random reporting channels
- Survey of users and vendors to understand how random reporting is done now and what operational variations were being used
- Propose document revisions and user recommendations for the update
- Implement the approved changes in a revised document

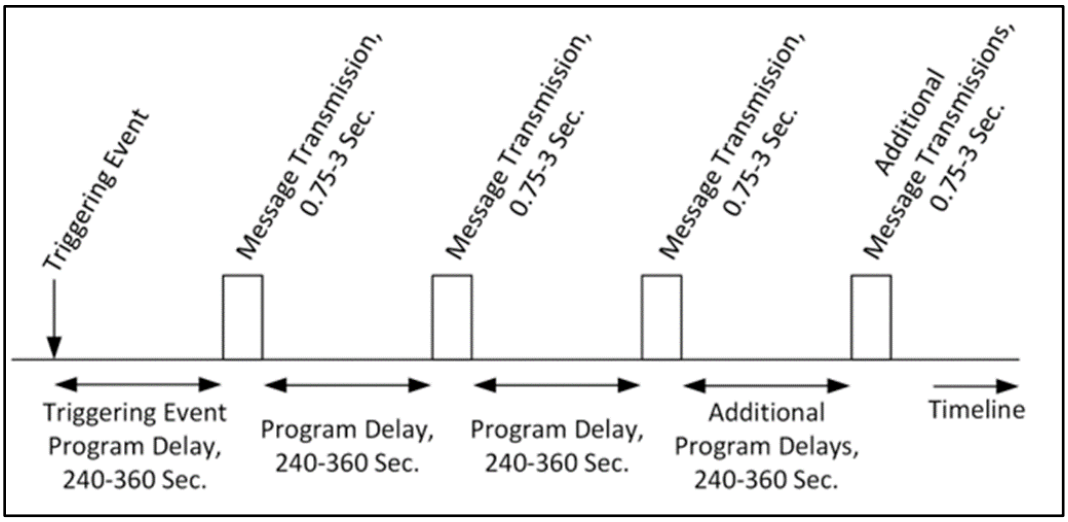
He also briefed the status of the project:

- The first draft of revised user's guide is complete
- NOAA has performed an initial review and made some suggested changes
- NOAA soliciting feedback from this presentation before Microcom updates draft
- Once a second draft is complete, NOAA will release it to the STIWG for comments.

Brian noted that the original document was more of an implementation guide for how to use random reporting. He reported that the guide recommended and has generally been implemented

with re-transmission of messages a limited number of times as this increases the probability of successful receipt. There needs to be some method to guarantee "independence" between transmissions.

He also noted that there is only one specification that limits random reporting transmission times and that is 3 seconds at 300 bps and 1.5 seconds for 1200 bps. It is efficient to use this at 300 baud. There are no 1200 baud users now. Random reporting is permitted on twenty-one 300 baud channels. Also noted that by default, the messages will be less than eighty-one bytes. Brian presented a diagram of a common random reporting configuration:



He noted the intervals guarantee the independence of transmissions. The second and following messages could contain updated information. The two parameters that gauge success are the probability of success by avoiding collisions with other messages and throughput which involves what percent of the capacity the message used. These parameters are compared to the channel loading, which is the sum of all messages sent, delivered or not.

Brian presented some performance graphs on Probability of Success, Measured Throughput, and the use of Multiple Messages along with a description of a simulation. He noted that the actual performance "on the ground" outperformed the simulated performance. The intervals used now work well and they found that lowering the interval does not impact performance.

Brian then presented the results of user and vendor surveys. He noted that four vendors responded. They all used multiple message transmissions with three of them saying that this was programmable. DCS users like random reporting. They expect a good probability of success (85% to 100%). Seventy percent of users would stop using random transmissions if the self-timed rate is lowered to 15 minutes, although a few users requested a five-minute interval. A list of four main user recommendations is:

- Recommendation 1: Comply with the CS2 requirement to keep messages shorter than 3 seconds for 300 baud transmissions.
- Recommendation 2: After a triggering event, wait a random length interval before initiating the first random message. Use a 5 + 1 (fixed + random) minute interval. A Poisson Interval with a message rate > 1 per hour is also acceptable.

- Recommendation 3: Send no more than 3 copies of the initial message and separate them with the same interval used in recommendation 2.
- Recommendation 4: Use only 300 baud for random reporting. 1200 baud is permitted but less efficient from a channel utilization standpoint. While random messages sent at 1200 baud can be sent in half the time (1.5 seconds for 1200 baud) they require three times the bandwidth. As a result, it is a net loss of channel resources to use 1200 baud for random reporting.

Two potential additional recommendations are:

- The initial delay interval between the triggering event and the first transmission could be shortened.
    - Having this interval ensures that separate platforms monitoring the same event will not transmit simultaneously so it is necessary.
    - However, it is possible to cut it in half to 2 ½ minutes ± 30 seconds.
    - Question for users… Would this be of any benefit?
- For many users, the value of the random reporting system is tied to the interval used for self-timed messages. If we shorten the interval for self-timed messages to 15 minutes, the random reporting delay intervals should likewise be shortened, perhaps to 2-3 minutes.
    - Question for users… If self-timed message intervals drop below 15 minutes will random reporting still be required?

Brian finished with a list of next steps for the project:

- NOAA would like to receive any feedback from Users and/or Manufacturers on the information provided here, especially the recommendations.
- Following receipt of this feedback, Microcom will consult with NOAA on any impact to User Guide.
- Microcom will then amend the first draft and provide NOAA with a second draft.
- NOAA will distribute it to the STIWG for final comment.
- Assuming the feedback from the STIWG is positive, NOAA will officially publish the revised Random Reporting User's Guide.

LySanias Broyles wondered whether the users are talking about 15-minute self-timed transmissions across the board or for critical locations. Brett Betsill noted that if we go down to a 15-minute interval, we could go ahead and see what the intervals should be.

Beau Backus noted that we should probably have an idea of loading for each channel so we could calculate the probability of success for each channel. This could guide how many repeat messages are sent.

Brian Kopp stated that the final report will contain all the calculations and analysis as an appendix.

Brett noted that since there is only one specification, users' random interval could be added to the PDT. With a two-way capability, you could change the intervals based on events such as an impending hurricane.

Letecia Reeves posed that if the standard timed interval is 15 minutes, would there still be requirements for random reporting. LySanias noted that if there was a standard 15-minute interval, there should be a reduction in the need for random channel use but there would still be a need. If we went down to a 5-minute interval, then maybe there would be little need.

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Action Items Review: (Richard Antoine - NESDIS/OSPO/SPSD/ Direct Services Branch)

- 123-1 Inform Seth that there is no DCS User Objection to canceling Virtual Channel 31 and to continue using VC 32 for the New HRIT DCS File Format
    - Status: Complete and closed
- 123-2 (122-1): NOAA to investigate a request from the Bahamas Met Service to maintain 5-10 years of GOES DCS data on website. See Pages 01-02
    - Status: Complete and closed. It was determined that this request would not be fulfilled.
- 123-3 (122-2): Investigate how to make configuration files available in the USACE DCP Monitor system.
    - Status: This action is In Progress and will be addressed at the Spring 2021 meeting. Action LySanias Broyles.
    - Update: will deal with this during the STIWG on Thursday. ?????
- 123-4 (122-3): As WCDAS puts WMO headers on 89% of messages and sends them to the NWSTG, consider putting WMO headers on all the messages; or assess whether we should be doing this at all by seeing if there are user requirements for this. This needs clarification or a statement of need then NOAA will scope the task. See Pages 01-02.
    - Status: Still in Progress. The Program needs to validate that all messages are being sent to the NWSTG with a WMO header. (Letecia Reeves)
- 123-5 (122-6): Provide the location, exact latitude - longitude for all Federal and non-Federal stations (including foreign) for DRGS, LRIT, HRIT/EMWIN to the NOAA SPRES Contractor Shared Spectrum Company so that they have a correct and comprehensive list of receiving stations. Send to Dr. Todd Martin at tmartin@sharedspectrum.com and please copy beau.backus@noaa.gov. Please provide within the next 30-60 days along with a point of contact with email and phone for your organization. See Page 13. See Pages 01-02
    - Status: Complete and closed as it has become overcome by other events.
- 123-6 (122-8): DCS Program to prepare some vehicle for getting user input on the DCPI two-way communication project. See Pages 01-02
    - Status: This action is In Progress. The Program will include this in a questionnaire within the next month or so. (Letecia Reeves)
- 123-7 (122-9): DCS Program manager to prepare a briefing for OSPO and NESDIS Management on estimates on the costs to bring the DCPI two-way communication project to completion for GOES-R Series and the next generation of satellites. NOAA and Microcom are in progress of executing a project plan. See Pages 01-02.

    - Status: This action is In Progress and a roadmap to completion need to be discussed with Microcom. (Richard Antoine)
- 123-8 (122-10): NOAA to investigate back-up (remote) pilot options including reuse of Goddard equipment or a new system for the CBU. Short term project complete; long term solution in progress. See Pages 01-02.
    - Status: This action is in progress under the CBU Pilot Antenna Project and should be resolved by March of 2022.
- 123-9 (122-12): Work with the HRIT/EMWIN Program Manager to plan for up to 10% DCS usage on HRIT/EMWIN. See Pages 01-02.
    - Status: This is complete and closed. Currently DCS is allowed up to 8% of the bandwidth, with 4% of it guaranteed. DCS never clips past 3.4% of the bandwidth each hour.

It was noted that there were no new action items from today's portion of the meeting. The list of open action items from previous meetings can be found in Appendix I.

Day 1 was adjourned at 15:15 EDT.

GOES DCS Technical Working Group (TWG) 125th Meeting

TWG Day 2 – April 28, 2021

Introduction and Logistics: (Richard Antoine - NESDIS/OSPO/SPSD/ Direct Services Branch)

Richard Antoine opened the second day of the meeting at 10:30 EDT.

Spectrum Sharing Challenges / FCC Rule Making Status/RF Interference/HE360 (David Lubar – The Aerospace Corporation)

Dave Lubar made a presentation to the group on four topics:

- 1675 – 1680 MHz and SPRES Report
- DCPR Uplink RF Interference 402 MHz band
- Analysis of likely source from a Small Satellite Constellation uplink
- International Frequency Usage of 401-403 MHz

Topic 1: 1675-1680 MHz regulatory status within US (FCC) and SPRES Report:

Dave noted that the Spectrum Pipeline Reallocation Engineering Study (SPRES) report is now complete. It has either now been provided or is about to be provided to the spectrum regulator. He also noted that there has been no change to the status of the 1675 – 1680 MHz regulatory status within the U.S. Federal Communications Commission (FCC).

Topic 2: DCPR Uplink RF Interference 402 MHz band:

It has been observed that RF Interference is occurring in the 402 MHz uplink band. The interference is happening at the space based DCPR receivers on both satellites. Some of this interference may be contributing to data loss. This interference is coming from outside of the United States. They are working on identifying these sources of interference. There are several sources. There is a known private commercial satellite system contributing signal interference. This is a satellite uplink to a moving satellite. It is using a signal centered around 402 MHz.

Dave briefed the detection process being used at this time. He noted that his is a very lengthy and manual process involving:

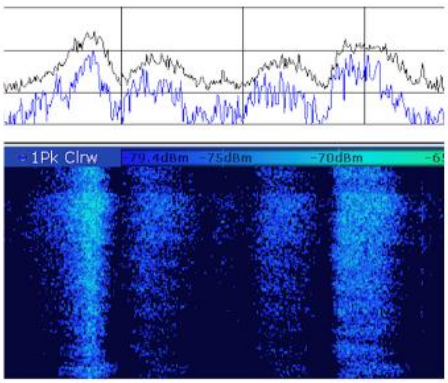
- A spectrum analyzer is configured to make measurements from one GOES satellite, with settings that are optimum to capture a portion of the DCPR uplink spectrum
- An analyzer takes a snapshot in time and frequency, and depending on settings selected, may or may not capture the entire interference event
- Data is taken over a 24-hour period, generating thousands of spectrum analyzer plots similar that shown on slide 5

Topic 3: Analysis of likely source from a Small Satellite Constellation uplink

Dave showed examples of the satellite uplink interference using the following graphics:

Interfering Satellite Uplink Example, cont.

- In spring 2020, measurements detected a 16 kHz wide signal
- It occurred over several frequencies that covered slightly different DCS channels
- The shaded areas of the spectrogram show the unwanted signal power seen by GOES



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Interfering Satellite Uplink Example, cont.

- In some cases, the interference covers the desired DCP uplink, causing loss of that support
- This Ch 208 DCP was covered by the interference and not received

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Dave briefed that Aerospace has a model that can match the raw data when first visible and when it disappears on GOES and when the offending satellites fly by. The company responsible for the interference shown above has a constellation of three small satellites. The ground stations are in Canada. The operator plans to have up to ten satellites next year.

Other interference sources seem to be coming from Central America (Guatemala) and South America (near Quito, Ecuador).

Topic 4: International Frequency Usage of 401-403 MHz

Dave noted that the use of the radio spectrum is based on an International

Telecommunications Union (ITU) roadmap. The member countries sign on to be compliant with the roadmap. Meteorological satellites are primary in the 402 MHz range. In the U.S., the federal system has priority. There is a footnote that non-federal entities can only uplink to GOES. Essentially, these are DCP platforms. Unfortunately, the footnote only applies to the U.S. In other words, other uses are permitted in other countries. Thus, as the use of small satellite increases, we may see even more interference.

Brett Betsill said that he has been following steady interference. One may be a DCP that is transmitting in error. A caution to users is that if you are not getting data from a DCP, please service it as it may be interfering with others. Also, they may be transmitting signals that are not identifiable.

Matt Sullivan noted that at WCDAS, they have been concentrating on the satellite noted by Dave Lubar. The satellite interference covers several channels where errant DCP interference covers single channels. Some assignments have been moved to mitigate data loss.

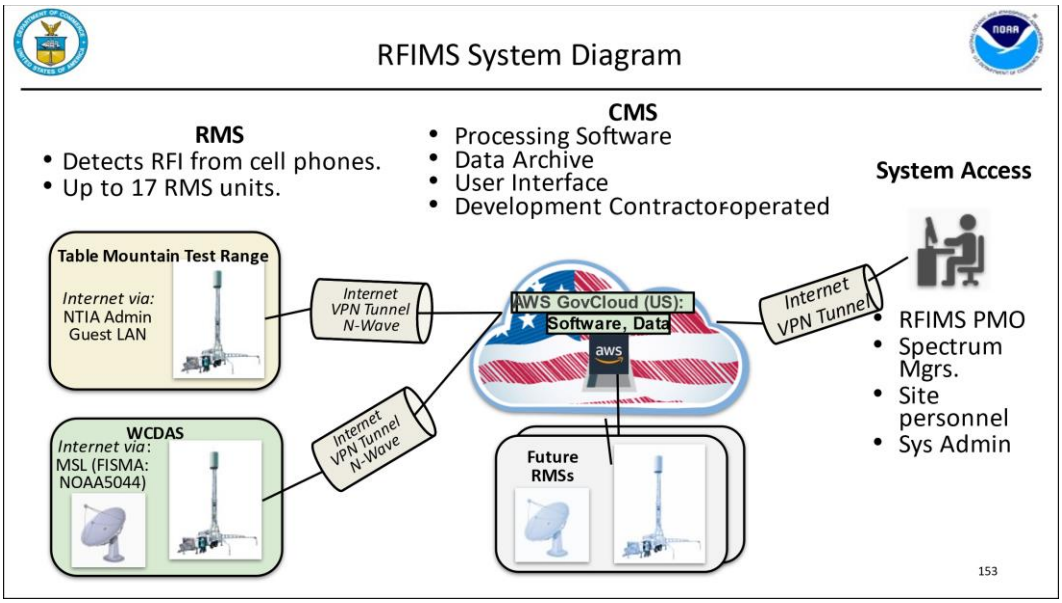
Dave Lubar emphasized that the invitation is going out for DCS users to help the team identify sources of interference or to help contact the organizations involved in the interference. He asked users to let the team know if you believe you have a DCP that is not transmitting its message.

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Radio Frequency Interference Monitoring System (RFIMS) (Ed White for Steven Grippando)

Ed White began his presentation by briefing that the RFIMS is a "cloud-centric NOAA solution for spectrum sharing in L-Band supporting both NESDIS and NWS earth stations." The system is able to detect, classify and identify interference in the L-band. It covers 1670 – 1675 MHz frequencies." He noted that "The main component of the system is the cloud-based Central Monitoring System (CMS), while the Remote Monitoring System (RMS) was designed for deployment at earth stations with minimal equipment footprint."

Also noted was that NOAA has deployed a system in the NESDIS cloud and that there are two systems: one at the Table Mountain Test Range (TMTR) and the other at WCDAS. The WCDAS system is not fully connected at this time. He briefed the RFIMS system diagram that is shown in the graphic below.



He noted that up to 17 RMS units can be deployed. They would all be connected to the Central Monitoring System. In the future, the CMS will be used by Spectrum Managers and other personnel.

He briefed that the project has installed a 3.7 meter Microcom GOES DCS Direct Readout Ground Station (DRGS) at the Table Mountain site. It is a similar system to NOAA operational systems at WCDAS and the NSOF. They have a DAMS-NT 16 channel cage with DigiTrak Demodulators, DAMS-NT server management software, and DAMS-NT client software. The project is "preparing to conduct a DCS study to determine the system's interference susceptibility." This may help NOAA "understand how the RFIMS can protect DCS reception during spectrum sharing." He also noted the following points:

- Long-term Evolution (LTE) or 5G user equipment signal may interfere with DCS downlink.
- Ligado transmissions may also create interference to DCS.
- RFIMS can monitor 1670 – 1695 MHz, which includes DCS downlink of 1679.7 to 1680.1 MHz.

Ed also noted that the project is conducting a capability assessment. This is detailed in the list below:

- RFIMS PMO is conducting a capability assessment to validate the RFIMS's ability to support spectrum sharing in a NOAA satellite environment.
    - Objective is to provide an independent, objective, and quantitative assessment of the RFIMS's capability to support sharing of the 1695 – 1710 MHz band with AWS-3 wireless carriers.
    - Conducting testing at the operationally representative Table Mountain site (TMTR) earth station environment.
- Validating RFIMS detection, classification, identification, and notification in the presence of emulated LTE and 5G user equipment interference levels that impact NOAA earth stations.

    - Using Aerospace, MITRE, and NTIA ITS Spectrum and Propagation Measurements Division test systems to emulate LTE and 5G interference.
    - Conducting testing while operating POES, GRB, DCS, HRIT/ EMWIN ground stations to correlate RFIMS capability with interference thresholds that impact these NOAA systems.
    - Assessment results will inform decision-making at the Milestone 3.5 Full-Rate Production Decision Review scheduled Summer 2021.
    - Assessment results will inform DCS and HRIT/ EMWIN user groups.
- Capability assessment is currently in the planning and dry-run phase of the testing campaign.

Matt Sullivan noted that RFIMS was designed for use looking at AWS-3. He asked whether WCDAS could see spectrum plots in the 1670-1690 range. Ed answered that you can see 1670-1680 or 1710-1755 but cannot do identification. They were able to see that Ligado was transmitting in the 1670-1675 range.

As a follow-up to factory testing, they did an operational environment at Table Mountain. They are working with their test partners to operate the systems while inserting interference in the Table Mountain environment to see how the receive systems are affected. They realize they need to customize RFIMS to the individual environments where they are installed. They can accept tests that users would like to do based on the systems installed.

Ed then briefed the next steps for the program to include:

- RFIMS PMO will complete capability assessment test planning with test stakeholders.
- Engage DCS Working Group to discuss measures and metrics the test team may consider for establishing interference protection criteria.
    - Typical latency performance and levels that create outages.
    - Pilot level, channel noise, phase noise
    - Other metrics operators have successfully used to manage DCS performance.
- Work with NTIA/ ITS to plan and complete DCS study (in early phase of discussions).
    - DCS test approach and plan, test procedures, and test results report.
        - Use test results to update capability assessment test procedures for correlating RFIMS testing while operating DCS in an emulated interference environment.
- Conduct testing.
- Coordinate follow-up meetings with DCS Working Group to discuss test results and next steps in better understanding how the RFIMS can help protect DCS reception.

He emphasized that once they are done with testing, they will present their findings in the TWG meetings.

Matt Sullivan stated that WCDAS will offer help with performance metrics for the DCS system.

Dave Lubar noted that there is complexity to switching to 5G signals that we want to measure in the future. Ed stated that they believe they can modify the algorithms and servers to do this. They also may have to improve the digitizers. They have not yet gotten permission to upgrade to

monitor 5G. They will test with 5G signals to show what their system would be able to do.

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

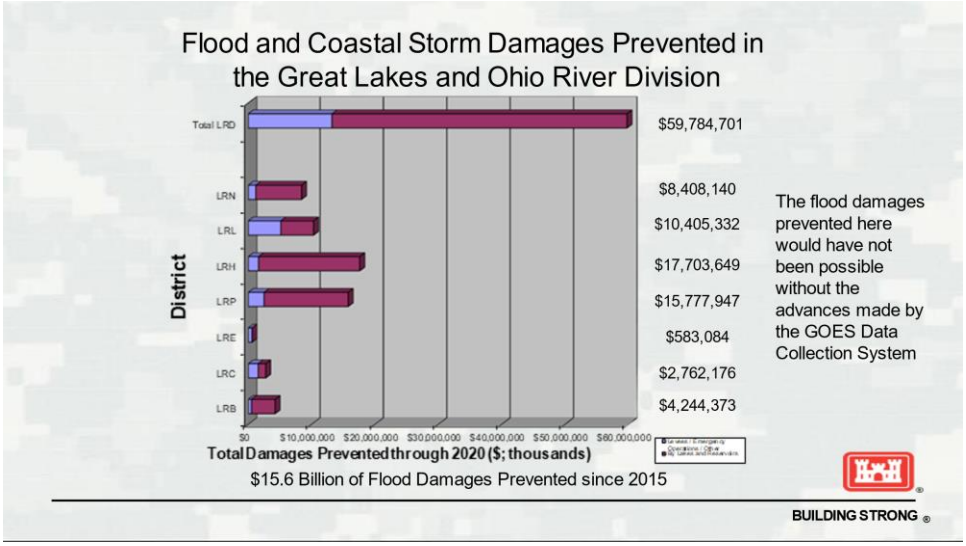
User Reports – (GOES DCS Users)

UCACE – (LySanias Broyles - STIWG Chair-USACE Rock Island District, IL)

LySanias began by showing the UCACE Regions and a map of the CONUS DCP locations. He briefed that USACE is undergoing a modernization of their DRGS systems. He noted that they have, through their own study, detected interfering signals at their sites. He noted that some of the current sites are over 30 years old. The list of the DRGS sites with their update status is:

- Rock Island, IL - GOES East/West – Scheduled to begin ~Aug 2020
- St. Louis, MO - GOES East – Site visit and EME analysis complete
- Vicksburg, MS - GOES East – Site visit and EME analysis complete
- Columbia, MS - GOES East – Site visit and EME analysis complete
- Cincinnati, OH - GOES East – Site visit and EME analysis complete
- Omaha, NE - GOES East – Phase 1 projected to begin ~Summer/Fall 2020
- Sacramento, CA - GOES West – Phase 1 complete

LySanias noted that due to the COVID-19 pandemic, they were pushed to improve their telecommuting activities. They needed to access their data just like they had in the office. He noted that they had a significant "Derecho" event that affected some Midwest states including Nebraska, Iowa, Illinois, Wisconsin, and Indiana. The top winds were measured at 126 mph. It caused significant damage to communications resulting in no internet service for a period of time. This again highlights why they rely on direct receive capabilities. LySanias showed a slide noting damage prevented in the Great Lakes and Ohio River Division. He stated that they would not have been able to produce this information without the GOES DCS system. This is shown in the graphic below.



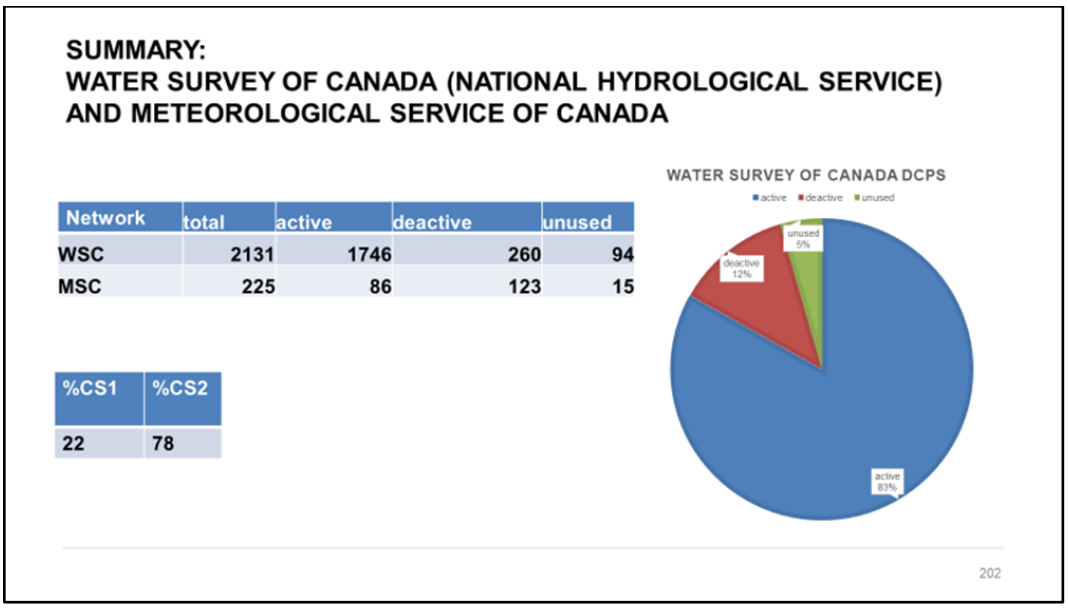
Robert Moyer from the USACE Great Lakes and Ohio River Division stated that they depend on GOES data. They occupy 2.5 DCS channels. They wanted to show how the impacts of the GOES data affects their system. They wanted to mention that they are going to replace the entire system in June and will have a short outage. This replacement is for the whole system from antenna to workstations.

In summary, LySanias briefed the following points noting especially that they want to receive Iridium messages over the HRIT feed and that a HydroDCS (Open DCS) Appliance developed by the Portland office has been released. This is a one-stop DCS application.

- ~2936 owned GOES Id's
- ~2527 active GOES platforms (all 300 baud)
- Channels: 17, 25, 31, 49, 58, 73, 88, 161, 162, 177
- Divested nearly all primary terrestrial radio infrastructure
- Of 38 districts, over ~90% have at least one on premise L/HRIT receive system
- Still a desire for more frequent transmissions at critical locations
    - Some also transmit on random channel while exceeding observation threshold
- Supplementing GOES DCP's with r/t DAMS-NT over LAN at project offices.
- Resolving Corps-wide firewall issues granting access to all CDADATA and EDDN LRGS servers
- Continuing to add new locations and requesting new assignments
- Awaiting 2-Way GOES DCP's
- Anticipating Iridium observations over HRIT
- Ongoing USACE DRGS modernization
- Release of Portland District developed HydroDCS (OpenDCS) Appliance for project offices

Canada Environment and Climate Change (Paul Campbell)

Paul Campbell began his presentation with a map of the locations of the DCPs from the National Hydrological Service and then by briefing the DCPs belonging to the National Hydrological Service and the Meteorological Service of Canada. He noted that they were progressing well with the CS1 To CS2 conversion with seventy eight percent of the DCPs having been converted. The status of their DCPs is contained in the graphic below.



He then briefed that they are in a cooperative effort with the Canadian federal and provincial governments to reduce telecommunications risks to their national networks. They have formed a working group to evaluate the risks and develop a national strategy. Paul then briefed that the project is being conducted in four phases:

- Telemetry Systems Inventory
- Risk inventory and assessment
- Identification and assessment of mitigation options
- Drafting and publication of a National Telemetry Strategy

They are using a software package developed in Holland for emergency management systems that shows risks to telemetry uplinks etc.

Dept of the Interior – Bureau of Reclamation (Philip Dayton)

Philip briefed that they have over 300 sites mainly monitoring waterflow into and out of dams. There has not been as much snow in the mountains as usual so this monitoring will be critical.

Brian Jackson – NWS

Brian briefed that he is the Program Manager at the U.S. National Weather Service (NWS) Hydrometeorological Automated Data System (HADS). He noted that they do not have their own DCPs but are secondary processors of all the DCPs. They currently monitor 17,800 DCPs and send the data to the NWS field Offices. The data is used in forecast models. He noted that only 2 people run HADS thus they are reliant on the accuracy of the PDT files. He emphasized that timely updates to the PDTs are critical to HADS and the weather service offices as they are used in forecasts to save lives and protect property.

United States Geological Survey (Dan Schwitalla)

Dan noted that they manage 12,825 DCPs. They have 360 Iridium stations and cell transmitters. At the EDDN station, they have three external LRGSs. The USGS has two HRIT stations; one at EDDN in Sioux Falls in South Dakota and another in Reston, Virginia. They may put a third HRIT station at Tuscaloosa, Alabama. They are also planning a RFIMS installation at Sioux Falls in approximately 2024.

Hydro Quebec (Maxime Pare) (accent mark on e) – Hydro Quebec

Maxime briefed that this was his first year attending the conference. He noted that Hydro Quebec has over 500 DCPs. First year at the conference. Over 500 stations.

Manufacturers Reports (GOES DCS Equipment Manufacturers)

Terrell Fletcher – Campbell Scientific Get slides from Habtam

Terrell briefed that they have spent a lot of time and effort getting GOES products out on the market. He noted that they have improved their transmitter. They are seeing an uptick in interest, primarily from the USGS.

He noted that they have a Hydro-Link interface that helps with setup and programming and also contains a trailing package. They are doing training with USGS offices to improve their performance in the field. The list of features showing the Hydro-Link Advantage is below:

- **Complete GUI DCP Configuration Tool**
  - **Point and Click User Interface**
  - **Multiple Communication Options**
  - **Compatible on all CR300 Loggers**
- **Field Tool Options**
  - **Real-Time Measurements**
  - **Calibration Options**
  - **Diagnostic Tools**
- **Other Advantages**
  - **Free and easy to download**
  - **Independent of PC / works on smart phones**

He noted that their DCPs work with both cell phones and Iridium. There is a field tool that shows real-time information on the DCPs that is free for users and is easily installed. The DCPs have a flexible interface that can accommodate both digital and analog sensors. There is also a device configuration utility that is the "Swiss Army Knife" for the data loggers. He briefed that they are doing outreach for prospective users. Their systems are fully accredited. There are tutorials available that allow you to connect to a system on the bench so you can simulate a setup.

https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Microcom Environmental (Perry West)

Perry opened his presentation with a history of Microcom. The highlighted items are:

- 1975 – Founded as Microcom Design, Inc.
    - Headquartered in Hunt Valley, MD
    - Focused on Design Engineering, RF Engineering, & Electrical Engineering
- 2003 – Contracted by NOAA to design and build the then-new GOES DCS Receive Systems at National Satellite Operations Facility (NSOF) & National Environmental Satellite, Data, & Information Service (NESDIS)
- 2003 – Developed Microcom's first GOES DCS Transmitter
- 2008 – Hired personnel with over 90 years of collective experience in Hydrology, Oceanography, & Meteorology to head product development & system design for Microcom Environmental
- 2017 – Formally separated the company into two divisions: Microcom Design & Microcom Environmental

Perry briefed that they now have over 3,500 DCPs, 55 HRIT systems and 34 DRGS systems in the field. They also have monitoring systems deployed in the Caribbean, Central and South America and Europe. He noted that all manufacturing is done in their Hunt Valley, Md. facility. Microcom offers complete data solutions containing data collections platforms, data reception systems and data presentation tools.

Perry noted that the future product is the Xpress. The Xpress system is an integrated systems comprised of

- Fully integrated GOES DCS Data Collection Platform
    - GTX-2.0 Satellite Data Transmitter & Logger
    - UB6 Satellite Transmit Antenna
    - 5-Watt Solar Panel
    - GPS Antenna
    - Internal Battery Pack
    - Solar Regulator
- Lightweight
- IP66 Enclosure
- Mounting & Solar Panel options available
- Extremely cost-effective

Xpress can link to EUMETSAT and Himawari, is quick and easy to set-up, cost effective and replaces the need for a gage house and enclosure, which saves funds. It can be used as a permanent station, seasonal deployment, rapid deployment and in extreme applications. Perry noted that one use case in Yellow Knife was in sub-zero temperatures and heavy snow conditions. Another was a network in Florida with some along the Overseas Highway that goes to the Keys and some in the Panhandle both of which sustained strong, hurricane winds. One feature of the Xpress system is that the only routine maintenance is changing the battery pack every five years. A graphic of four installations is below.

Microcom also offers two receive systems; the DigiRIT HRIT Receive System and the DAMS-NT DigiTrak Direct Readout Ground System (DRGS)

The DigiRIT HRIT Receive System is a low-cost system that receives a rebroadcast of all DCS messages with an approximate latency of 20 – 25 seconds that can be received on a 1.5-meter dish.

The DAMS-NT DigiTrak Direct Readout Ground System or DRGS offers direct reception from the GOES Satellite. This is the lowest latency available from any data source and is the most reliable. The DRGS requires a greater than or equal to 3.7-meter dish, depending on location and individual installation.

A copy of the slide presentations can be found at:
https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_meeting.html

Review of Action Items: (Richard Antoine and All)

While there were no new action items from the meeting it is noted that ***all users should report significant missing reports per channel as an aid to identifying interference.***

The list of open action items from previous meetings can be found in Appendix I.

The meeting was adjourned at 15:15 EDT.

Appendix I: TWG 125th (Tuesday - Wednesday April 27 - 28th, 2021) Actions

There were no new actions noted at this meeting - TWG 125 (April 27 - 28th, 2021).

A list of open action items from previous meetings follows.

- 123-3 (122-2): Investigate how to make configuration files available in the USACE DCP Monitor system.
    - Status: This action is In Progress and will be addressed at the Spring 2021 meeting. Action LySanias Broyles.
    - Update: will deal with this during the STIWG on Thursday. ?????. See Page 18.
- 123-4 (122-3): As WCDAS puts WMO headers on 89% of messages and sends them to the NWSTG, consider putting WMO headers on all the messages; or assess whether we should be doing this at all by seeing if there are user requirements for this. This needs clarification or a statement of need then NOAA will scope the task. See Pages 01-02.
    - Status: Still in Progress. The Program needs to validate that all messages are being sent to the NWSTG with a WMO header. (Letecia Reeves)
- 123-6 (122-8): DCS Program to prepare some vehicle for getting user input on the DCPI two-way communication project. See Pages 01-02
    - Status: This action is In Progress. The Program will include this in a questionnaire within the next month or so. (Letecia Reeves)
- 123-7 (122-9): DCS Program manager to prepare a briefing for OSPO and NESDIS Management on estimates on the costs to bring the DCPI two-way communication project to completion for GOES-R Series and the next generation of satellites. NOAA and Microcom are in progress of executing a project plan. See Pages 01-02.
    - Status: This action is In Progress and a roadmap to completion need to be discussed with Microcom. (Richard Antoine)
- 123-8 (122-10): NOAA to investigate back-up (remote) pilot options including reuse of Goddard equipment or a new system for the CBU. Short term project complete; long term solution in progress. See Pages 01-02.
    - Status: This action is in progress under the CBU Pilot Antenna Project and should be resolved by March of 2022. (Richard Antoine)

Appendix II: 125th GOES DCS Technical Working Group (TWG) Agenda

TWG Day 1 – April 27, 2021

	TWG Agenda (all times are Eastern Standard)	Presenter
10:30	Introduction and Logistics	R. Antoine
10:45	TWG Agenda Review	R. Antoine
11:00	DCS Update	R. Antoine
11:30	Customer Service Update	L. Reeves
12:00	Wallops Update	M. Sullivan
12:30	***Health Break***	
13:00	HRIT Update	S. Clevenstine
13:30	Two Way Comms	B. Betsill
14:00	Small Sat Update	B. Backus
14:30	Random Reporting Doc Refresh	B.Kopp
15:00	Action Items	R. Antoine
15:15	Adjourn Day 1	

TWG Day 2 – April 28, 2021

	TWG Day 2: April 28th, 2021	Presenter
10:30	Introduction and Logistics	R. Antoine
10:45	Spectrum Sharing Challenges (FCC Rule Making Status/RF Interference/HE360)	D. Lubar
11:15	Radio Frequency Interference Monitoring System (RFIMS)	S.Grippando
11:45	***Health Break***	
12:15	User Reports	Users
13:15	Manufacturers Reports	Manufacturers
14:15	Review of Action Items	
14:30	Adjourn Day 2	

Appendix III - A: April 27-28, 2021 - 125th TWG (Virtual) Attendees

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Appendix III - B: April 27-28, 2021 - 125th TWG (Virtual) Attendees

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