GOES DCS Technical Working Group Spring 2023 Meeting
April 25, 2023

TWG Morning Session I:

Welcome and Introduction – William "Skip" Dronen – NOAA DCS Program Manager

This presentation begins at hour/minute 0:01:08 on the audio file.

Skip Dronen opened the meeting at 9:00AM PDT/12:00PM EDT. He went over the program agenda which will occur over three days. He went over the meeting logistics and asked that if anyone attending virtually would like to participate, please use the chat function. He noted that the meeting materials will be posted online on the NOAASIS website.

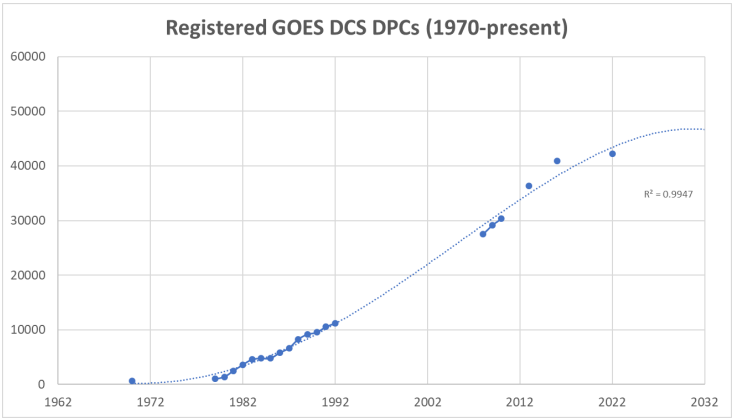
DCS Program Updates – William "Skip" Dronen – NOAA DCS Program Manager

This presentation begins at hour/minute 0:05:23 on the audio file.

Skip began his presentation with a list of topics to be covered.

- Current Status
- System Changes and Improvements
    - Batch Processing
    - Field Test / Data Users
    - Communication Protocols
    - DCP Latitude / Longitude Reporting
    - Two-Way Communication / Forward Link
- Spectrum Pipeline Reallocation Engineering Study Follow-on (SPRES)

He noted that there are approximately 42,000 assigned DCPS, approximately 33,000 active platforms that up-link to GOES East or West. These are then retransmitted to two NOAA facilities or to users' ground systems. The graphic on the right shows a plot of the number of DCPs over time from 1970 to the present.



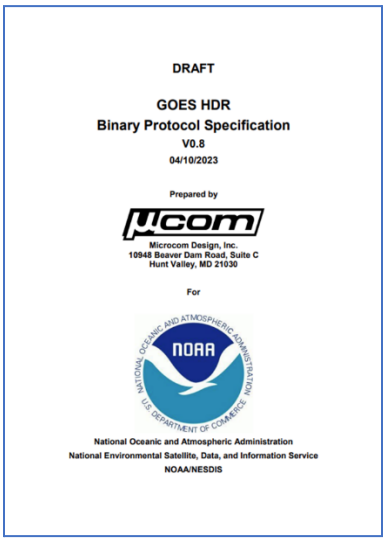
DADDS is tracking about 960,000 messages per day. There are over 700 DADDS accounts. Over 1,000 of those are field test accounts.

Overall, the system operations are extremely reliable, although radio frequency interference is a challenging issue.

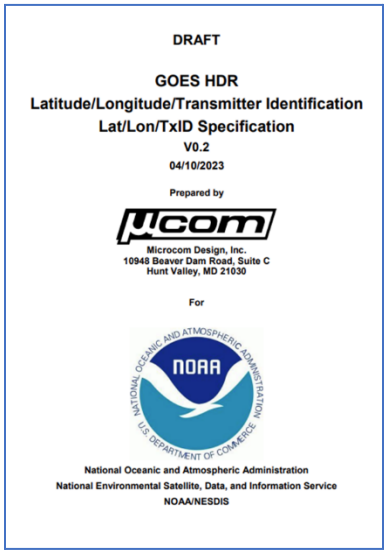
Next, Skip began a series of updates to DCS Program initiatives. The first of these projects is "batch processing." There are over 40,000 DCPs. The biggest users can have over 12,000 DCPs, each of which has its own platform description table (PDT). If you need to update the PDTs, it is a manual process. The batch algorithm allows users to do mass or batch updates to the PDTs. Aside from finalizing the SFTP access and completing internal testing, this project is complete.

The second update is related to the "field test" and "data-only users" functions. Field test allows a technician in the field to check functionality of a DCP deployed in the field. Security concerns drove a change requiring field test users to establish accounts and logins. We need to improve the system to be able to monitor the user accounts and review them annually, as we need to inactivate the accounts if they are not being used.

The question is whether technicians are using this function for field tests or for other purposes. We believe that a lot of the use is for data access. There is nothing inherently wrong with this. This means we have two data access methods from DADDS: the normal DADDS access and this field test function. We are looking to implement some functionality within DADDS to allow for field tests but if you are accessing data, we may create an account structure without going through the SUA or system use agreement process that is meant for users that deploy DCPs. We will create stricter account management for field test users. We do not want to take away something that people have now and are using. We may have to change DADDS to allow this new system. NOAA is requesting input, so any changes we make do not negatively impact our users.



Thirdly, we are considering new communication protocols. We are looking to make things more efficient and modern. This includes implementing an open binary standard. The proposal has been posted on our public website. We need user feedback, especially during our Standards meeting tomorrow. Microcom is working on this under our sustainment contract to help develop this standard. The graphic to the right is an image of the study cover page. The link to the study is at https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_archive.html then click on – Binary Protocol Specification (pdf)



Fourth is a proposal for automatic position reporting by DCP's. There is also a draft proposal for this project. There are over 6,000 DCPs with blank entries in the DADDS PDT table. We want to implement automatic position reporting for platforms to the extent that it becomes mandatory. We have so many DCPs with so much RFI that it is challenging enough that we feel we may have to make this mandatory. There are many questions around how this could be implemented. This could include more data than latitude-longitude that might help all of us. We will be discussing this tomorrow and are welcoming discussion and will be looking for input going forward. The graphic to the left shows the cover page of the proposal. The link is at https://www.noaasis.noaa.gov/GOES/GOES_DCS/twg_archive.html then click on – Lat/Lon/TxID Specification (pdf).

The fifth topic is Two-way Communications / Commanding. We remain committed to establishing a command capability for GOES DCS on GOES-R series satellites. We will explore the feasibility of other options (e.g., commercial) primarily focused on DCP's. The restoration of GOES DCS Two-way commanding is underway using the previously developed two-way modulator that is connected to the DADDS Development Rail. Test and monitoring software is being updated with a preliminary "command" table. The next step is TCP/IP interface documentation and intermediate frequency (IF)

interface connection. The GOES DCS Program has engaged with GOES-R/GeoXO Program on making this operational on GOES-R so that in 2025, we have sufficient information to support a decision on having a two-way transponder on GeoXO.

Due to poor audio quality, the slide for this, the sixth topic, is copied below. There will be a presentation on this topic later in the program.

- In 2016, the Federal Communications Commission (FCC) issued a Notice of Proposed Rulemaking to consider sharing of the 1675-1680 MHz band between new commercial mobile operators and incumbent NOAA satellite operations.
- In January 2018, NOAA received funding under the Spectrum Pipeline Act authority to address the potential impact of spectrum sharing on its operations and awarded several task order contracts to three companies to perform the Spectrum Pipeline Reallocation Engineering Study (SPRES).
- The May 2021 SPRES report finds that…
  - ….sharing presents low risk of causing impacts to HRIT given the frequency separation.
  - ….the GRB signal is also at some risk of RFI at the ground stations, more so from commercial base station operations (downlinks) than from commercial user devices ("uplinks")
  - …**DCS, the report finds that, if the commercial operations are limited to uplinks, sharing would be manageable with modest protection zones**.

- The May 2021 SPRES report recommends.
  - Task #1. Reach a conclusion on the feasibility…required to establish appropriate redundant facilities for the DCS at key sites…. to ensure that the DCS data can be received and further distributed without interruption, high reliability, and low latency in the event that any one of these facilities experiences harmful RFI.
  - Task #2. Reach a conclusion on the feasibility… to provide a robust, high reliability and low-latency alternative means of near real-time distribution of the DCS data from the key sites to both federal and non-federal users -- one possible alternative is disseminating the data by streaming it from one or more of the key DCS facilities.
  - Task #3. Conduct further technical compatibility analysis to determine specific technical limits on commercial mobile operations to ensure protection for the key DCS sites and certain GRB and HRIT sites.
  - Task #4. Determine what DCS, GRB and HRIT sites require protection for NOAA to meet its mission and where those sites are located. Part of that consideration would include a review of the availability of online access by GRB users.

- Spectrum Reallocation
  - https://docs.google.com/forms/d/e/1FAIpQLScPHLSzU5UnL0iAKftnNMSRMza91lB0rtEkAVJRtEE_8yAU9g/viewform

The final topic is DADDS Replacement. The focus of DADDS replacement contains three areas for improvement or modernization

1. Align / Design for NOAA Common Cloud Framework (NCCF)
2. Preserve & Improve upon Administrative and User Functionality
3. Restore Previous (DAPS) System Capabilities, including two-way Communication w/ DCP Commanding via forward link

We are hoping to award the development contract for this in September of this year (2023).

In closing, Skip noted that GOES DCS continues to be highly reliable and is important to the critical operational decisions of the user agencies. There are a number of efforts underway to enhance the system.

Skip requested that users continue to provide your user stories. Getting user needs and impacts are always important. Also, the GOES DCS Program is trying to do user site visits. If you would like a site visit, let us know.

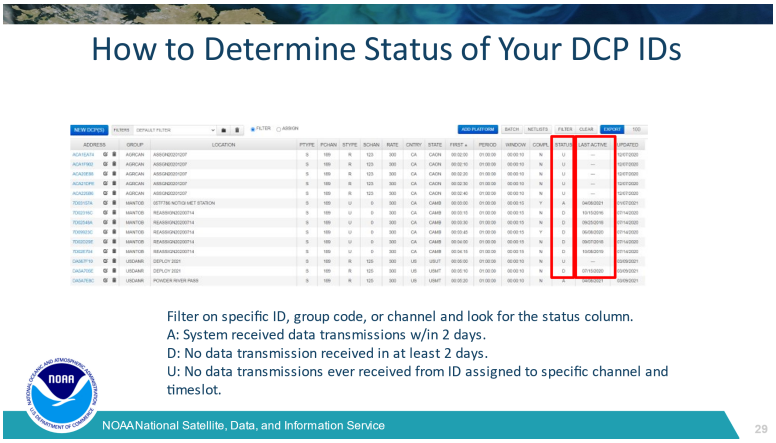
DCS Customer Service Update – Letecia Reeves - NOAA DCS Customer Service Manager

This presentation begins at hour/minute 0:21:53 on the audio file.

Letecia began by reminding the attendees of the GOES DCS channel assignment policy.

- Time Slot assignments can only be requested for definite deployments that will happen within 6 months
  - Units should already be purchased
- IDs that remain unused for 1 year will be reclaimed
  - These are new assignment with no transmissions for 1 year
- IDs that are inactive for 3 years are being reclaimed
  - We are making slow process but have reclaimed over 750 timeslots
- Before using an ID that has been unused or inactive for a long period of time,
  - log into DADDS to verify that it is still on an active channel
  - If you see "parked" next to the channel number, the assignment has been reclaimed. You can consult Letecia for reassignment)

Letecia showed a slide from DADDS showing how to determine the status of your ID. The status column and the last active columns go hand in hand. If a platform ID is marked "D" for inactive, you can look at the last active column to see how long it has been since its last transmission. If it is a "U", that indicates that the DCP never transmitted. The graphic to the right shows an example of this.



Letecia continued with a transmitter status. There are 40,972 total DCPs assigned in the system. This does not include "parked" DCPs. She noted that since our last meeting, we have assigned 949 new transmitter time slots. The graphic to the left shows the total numbers for the transmitters assigned time slots in the system. She noted that the inactive and unused numbers are slowly falling as the DCS Program reclaims the assignments.

DCP Status	300 Baud	1200 Baud	Totals
Active DCPs	31,472	558	32,030
Inactive DCPs	7,239	525	7,764
Unused DCPs	1,124	54	1,178
Totals	39,835	1,137	40,972

Letecia briefed that the CS1 to CS2 transition is going well. There are 3,580 more CS2 platforms transmitting since the Spring 2022 meeting. A total of 24,707 transmitters are now CS2. That is a compliance rate of 77%. There are three years left until the deadline to complete the transition, which is May 31, 2026. She also noted that no CS1 transmitters should be deployed.

Letecia briefed that there were two successful PDT Weeks in 2022. Nearly 2,000 PDTs have been updated since June 2022. She noted that it is very important to have the metadata within the DADDS updated with accurate information for each PDT. It is beneficial to NOAA, Users, and Manufacturers. The 2023 PDT weeks will be held on June 12-16 and November 13-17. Users can contact us to request assistance with creating and uploading batch files. We will also be reaching out to our users.

NOAA IT Security now requires that all DADDS User Accounts be reviewed within a specific time period. All accounts that have become inactive, unused or have an invalid email address will be made inactive and eventually removed. She reminded users that for all password resets they need to answer their security question. The default answer to both questions is your last name and 4-digit PIN number. If you cannot remember your pin number, please contact the WCDAS 24/7 help desk to retrieve your PIN.

In closing, she reminded the attendees of the GOES DCS Program Customer Service points of contact are listed below.

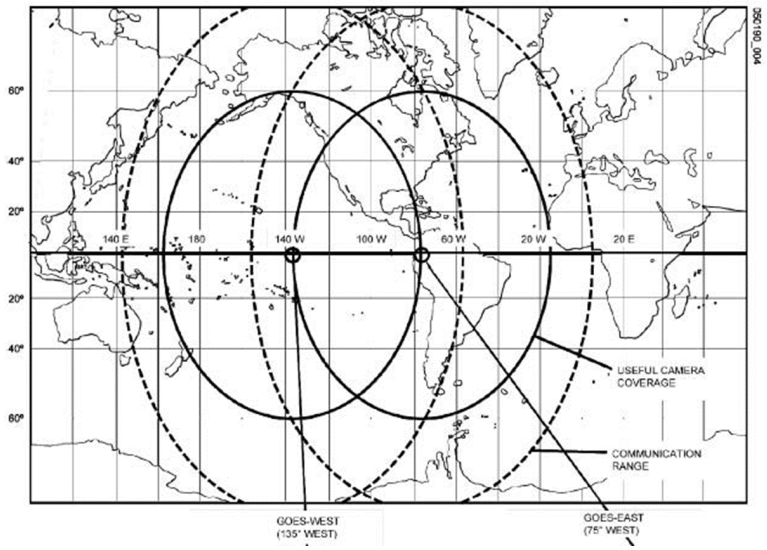
- Letecia.Reeves@noaa.gov
- Valerie.Randall@noaa.gov
- Wallops 24/7 Help Desk at 757-824-7450

Wallops Update – Matt Sullivan – Wallops Command and Acquisition Station &
Brett Betsill – Microcom Design

This presentation begins at hour/minute 0:30:13 on the audio file.

Matt began his brief by reviewing the GOES Constellation. The details are listed below.

- GOES-16: Prime East Spacecraft
    - Located at 75.2° W Longitude
        - Replaced G13 18 Dec, 2017
- GOES-18: Prime West Spacecraft
    - Located at 137.2° W Longitude
        - Replaced G17 1 Jan, 2023
- GOES-17: Storage Spacecraft
    - Located at 105° W Longitude
- GOES-14: Storage Spacecraft
    - Located at 108.2° W Longitude
- GOES-13: Transferred to USSF to support the GOES Indian Ocean mission
    - Became operational 9 Sep 2020
    - Renamed EWS-G1 (Electro-optical Infrared Weather System Geostationary)
- GOES-15: Being transferred to the support the GOES Indian Ocean mission

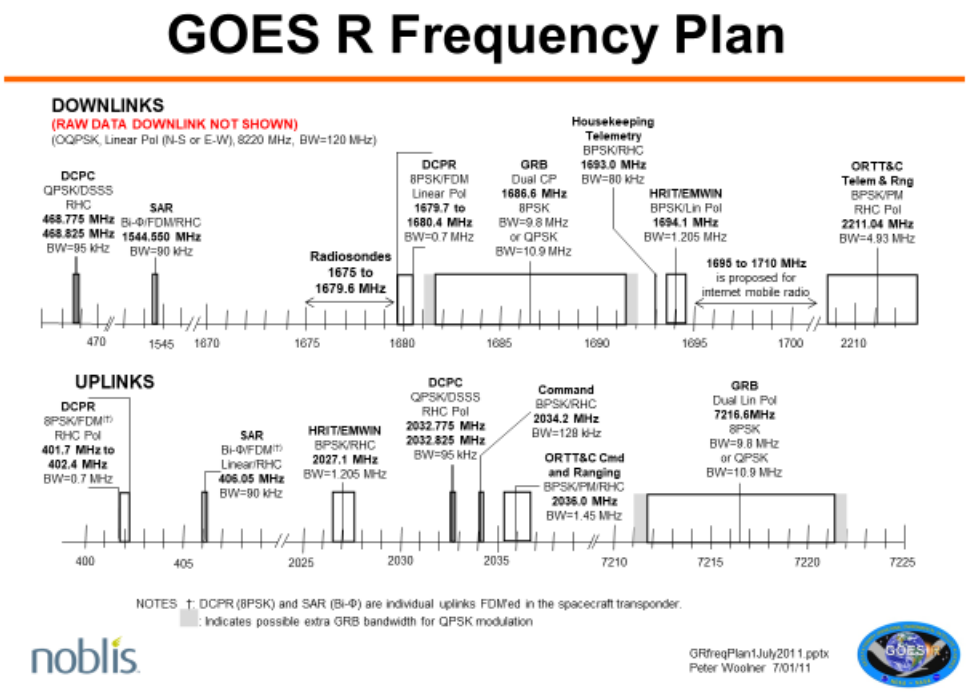


- Following arrival and checkout, it will become EWS-G2

He noted that the next and last GOES-R Series which is GOES-U will launch in April 2024 and will become GOES-19 after it becomes operational. The GeoXO series of satellites will begin to replace the GOES-R series by the early 2030s.

Matt then showed the GOES Series footprints. He noted that it shows solid lines for the useful camera coverage and the dashed lines indicate the communications range. A graphic of the GOES footprints is located above.

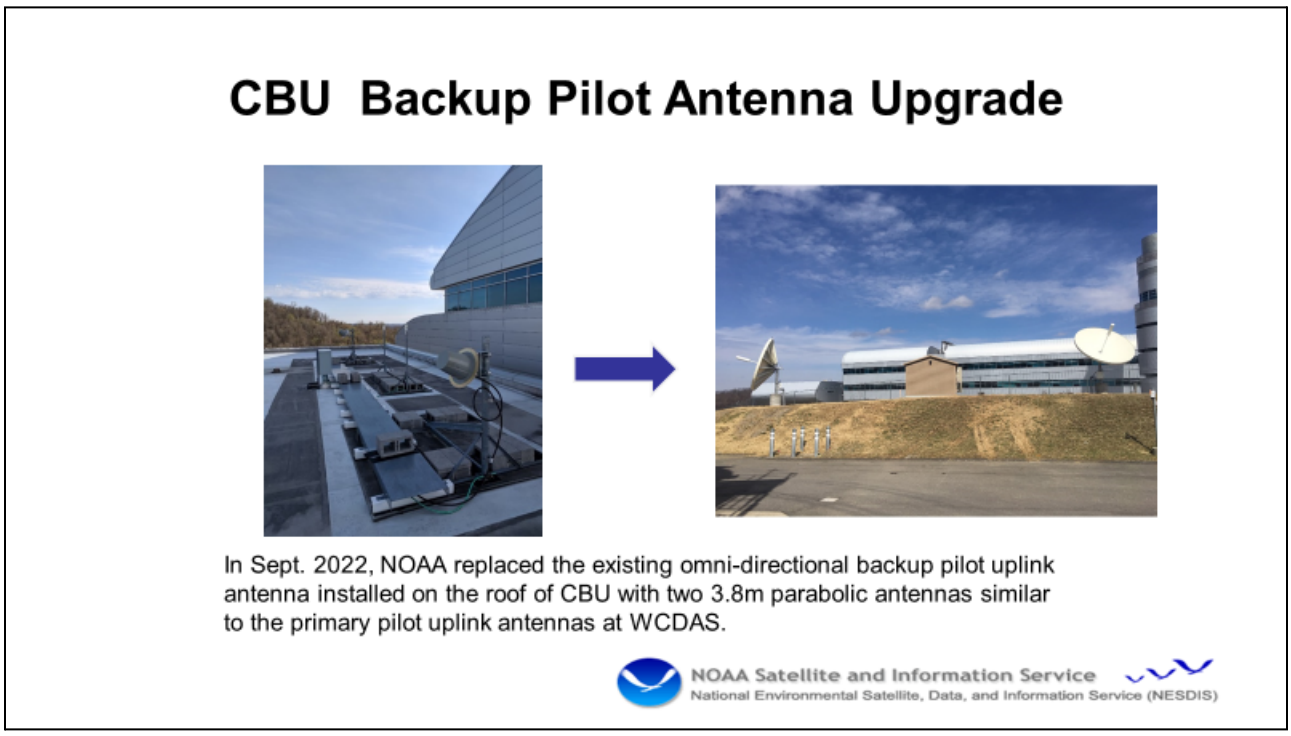
Matt showed the GOES-R frequency plan. The graphic is located below. The upper layer shows the space to ground downlinks and the ground to space uplinks are on the bottom row.



Matt then briefed the GOES ground system operated by the Wallops Command and Data Acquisition Station (WCDAS) located in Virginia. He noted that the primary GOES antennas are the 16.4-meter hurricane rated (HR) parabolic antennas. There are 9 of them. Three are located at WCDAS and three at the NESDIS backup site at the Combined Backup site (CBU) in Fairmont, WV. There are two legacy antennas at WCDAS that are being upgraded for L and S-band support for GOES-R. HR2 is complete. The HR1 upgrade is ongoing to be completed this late Spring. He also noted the locations of the GOES DCS pilot antennas. There are currently three pilot antennas located at WCDAS. There is one for GOES East, one for GOES West and one on standby.

Matt then briefed the WCDAS backup sites for the GOES DCS service. The primary backup site is the CBU in Fairmont, WV. It has full mission capability, except for the DCS receive ground system which is located at the NSOF. He reiterated that the backup pilot antennas are at CBU. The NSOF located in Suitland, MD has a DCS receive system (DAMS-NT, DADDS and two LRGSs). These systems will eventually move to the CBU. That project is postponed until after the next GOES launch in the Spring of 2024.

Matt showed a picture of the new pilot antennas along with the roof location of the legacy top-hat antenna. This project was just completed. Matt noted that the parabolic antennas provide increased signal stability and enhanced system redundancy. A side-by-side graphic of the new and old pilot systems is located below.



Matt continued by outlining the GOES DCS dissemination services managed by WCDAS, which are the National Weather Service Telecommunication Gateway (NWSTG), Local Readout Ground System (LRGS), High Rate Information Transmission (HRIT) /Emergency Managers Weather Information Network (EMWIN), and GOES Data Collection Service (GOES DCS) Administration and Data Distribution System (DADDS).

- National Weather Service Telecommunication Gateway (NWSTG)
    - Embedded with a WMO Header service from Wallops or NSOF DADDS
    - Sent to the National Weather Service (NWS) for distribution. Gateway can switch between two redundant feeds
    - Data customers for NWSTG feed are largely unknown to NOAA/NESDIS
        - It has been reported that the DCS message data is included on SBN/NOAAPORT and that the source is the NESDIS feed to the NWSTG

- Local Readout Ground System (LRGS)
    - DCS message distribution service from Wallops CDAS, EDDN & NSOF utilizing the OpenDCS software in a client-server model
    - NOAA Wallops CDAS hosts 2 LRGS,
        - CDADATA:
            - LRGS Address ; cdadata.wcda.noaa.gov
            - DRGS input from Wallops East & West DAMS NT demodulator applications, Primary & Backup
            - DDS Primary is NLRGS1, DDS Backup is EDDN1

        - CDABACKUP:
            - LRGS Address ; cdabackup.wcda.noaa.gov
            - DRGS input from Wallops East & West DAMS NT demodulator applications, Primary & Backup
            - DDS Primary is CDADATA, DDS Backup is EDDN2

    - NOAA Suitland NSOF hosts 2 LRGS,
        - NLRGS1:
            - LRGS Address ; nlrgs1.noaa.gov
            - DRGS input from NSOF East & West DAMS NT demodulator applications, Primary & Backup
            - DDS Receive Primary is NLRGS2, DDS Receive Backup is CDADATA
        - NLRGS2:
            - LRGS Address ; nlrgs2.noaa.gov
            - DRGS input from NSOF East & West DAMS NT demodulator applications, Primary & Backup
            - DDS Receive Primary is EDDN2, DDS Receive Backup is CDADATA

- High Rate Information Transmission (HRIT) / Emergency Managers Weather Information Network
    - HRIT is a GOES-R series broadcast that provides the following services:
        - Reduced resolution Imagery Data
        - Emergency Managers Weather Information Network (EMWIN)
        - Data Collection System (DCS) messages
            - GOES East & West DCS data is provided by the DADDS for inclusion in the GOES East and West HRIT broadcasts.
        - GOES HRIT services can be supported by a 1m to 1.2m receive antenna system, which is a Very Small Satellite Terminal (VSAT).
        - For more information on the GOES HRIT system:
            - https://noaasis.noaa.gov/GOES/HRIT/about_hrit.html
            - https://www.goes-r.gov/users/hrit.html

- DCS Administration and Data Distribution System (DADDS)
    - Supports message ingest, processing and distribution and provides system administration functions
    - There are 4 DADDS Servers. The link to them is https://dcsx.noaa.gov/, with the x being 1, 2, 3, or 4
    - On the left side of the home page in the blue bar on the left, there is a tab for System Information.

Matt noted that there is a WCDAS ground system diagram located on DADDS. It can be found on the DADDS web pages 1-4 at https://dcsx.noaa.gov/ (with x being 1-4), then under System Diagrams, then NOAA DCS System Diagram (PDF) • Mar 2020 - https://dcs1.noaa.gov/documents/NOAA%20DCS%20Mar%202020.pdf .

Matt finished with a slide with the WCDAS POCs for DCS. He noted that the Wallops Help Desk Site provides access to the Satellite and DCS Operators. They can provide some technical support for the DCS, LRGS, DADDS, and HRIT broadcasts and systems.

- 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 Supervisor
    - DCS Operations Team Lead
- Matthew Sullivan: 757-824-7360, matt.g.sullivan@noaa.gov
    - DCS RF Systems Specialist
    - WCDAS Frequency Spectrum Manager

NOAA GOES DCS Radio Frequency Interference and Mitigation - Brett Betsill – Microcom Design

This presentation begins at hour/minute 1:07:40 on the audio file.

Brett noted that radio frequency interference (RFI) can come from anywhere within the GOES footprints. RFI has been interfering with GOES DCS since the beginning of the program. Spacecraft are more susceptible to interference than other systems due to their wide coverage. The two GOES cover most of the Western Hemisphere including the Atlantic Ocean, most of the Pacific Ocean and from the tip of Antarctica to very northern Canada.

He noted that RFI can take many forms. It can be local interference. This refers to user receive stations, including DRGS and HRIT. The RFI can be uplink or downlink. The uplink can be interfered with by handheld walkie-talkie radios. It can also be atmospheric. It can also be systemic. This can occur due to a mis-programmed DCP. The DCS team monitors the statistics and tries to find ways to mitigate them.

Brett then went over ionospheric scintillation, which is an atmospheric effect. This happens mostly around the equinoxes and is worse during solar maxima. This was first identified in 2011 and 2012. The sun is on an 11-year cycle of maxima. We are seeing it again this year. The effect is to garble the radio signal. It is localized interference and happens during the evening when temperatures fall. It is worse around the magnetic equator. This effect is higher over South America with the continental United States not being affected as much. He noted that this affects the GPS as well. It can affect both the downlink and uplink and is path specific. He showed a graph of the diurnal effect of the signal loss. He noted that there is not much that users can do about it. Since it is isolated, you can lessen the effect by sending multiple transmissions. A long-term solution, which is difficult to do, is to send to and monitor both satellites. Another option is to share the data sets from multiple DRGS's. The DCS Program could change to a linear polarized antenna vice the circular polarization we now use, although there is a tradeoff in power. A two-way link could also help as you could command the DCP to re-transmit the data. We can also just wait it out for a few years as it mostly happens during equinoxes and mostly around the equator and mostly in the evenings.

The next type of interference is wideband interference. This is when another satellite operation uses the same frequencies. This also includes the FM transitions from mobile radios. This is also known as the General Mobile Radio Service. We are being impacted by this now. This can affect the primary pilot which then superimposes the RFI on all the channels. We have not been able to identify the source or the language in the mobile radio RFI that is currently affecting our signal. We know that it is not affecting the GOES West footprint. The NOAA/Microcom team is monitoring the RFI and can switch to the alternate pilot uplinks located at the CBU backup site. The worst case is if the RFI impacts both pilots. WCDAS can also tune some of the affected channels to the West. Hundreds of messages have been saved this way. The CGMS has also been notified as they may be able to help identify the source.

The last type of RFI is narrowband interference. This generally resembles a pilot signal. They are constant signals with no modulation meaning they are not carrying any information. They could be faulty DCP's, although some of them are two to three years old. That is counterintuitive, as why would an operator leave faulty DCP's in service. We are tracking half a dozen of these. Some of the interference is negligible

and some is not even in our band. The one that is impacting us the most is on channel 121. We have adjusted the demodulators to raise the lock-limit so it does not stay locked on this signal. Another thought is that channel 121 is a random channel so the operator may not know they are missing data. The narrowband RFI causes parity errors. Brett also noted that there is a lot of RFI in the frequency of the backup pilot. Some of this RFI could be a ghosted signal from channel 121. One mitigation is to have an alternate DCS receive system like an HRIT system.

Question: Could this ghosting issue be a design issue? Answer: It seems to be a single unit failure. If it was a design fault, it would fix the ghosting problem, although a design that allowed this would not pass certification as manufacturers certify that their transmitters do not allow this.

Question: Are we encouraging users to transmit to both spacecraft? Answer: No. That would require a system and policy change. The antennas are not very directional. Yagi antennas are more directional than the top hats. Due to this, 70% of the messages can be received from both satellites, even though the signal is lower from the opposite or second satellite. Also, in South America there are many places that cannot see GOES West.

TWG Morning Session II:

HRIT/EMWIN Update – Ian Avruch – NOAA HRIT/EMWIN Program Manager

This presentation begins at hour/minute 1:38:40 on the audio file.

Ian began by reviewing the GOES constellation. He noted that GOES-17 and GOES-14 are now in standby positions. They can both be used in case there are issues with GOES East and West. GOES-17 would be the first to be used, but it has an imager problem. When the sector gets warm the imagery is degraded. So, if the GOES East or West anomaly occurs during the warm period, GOES-14 would be used. During a standby scenario, the HRIT broadcast will still come from GOES East or West. Just the imagery feed would change. GOES 17 does have an HRIT transponder but GOES-14 does not.

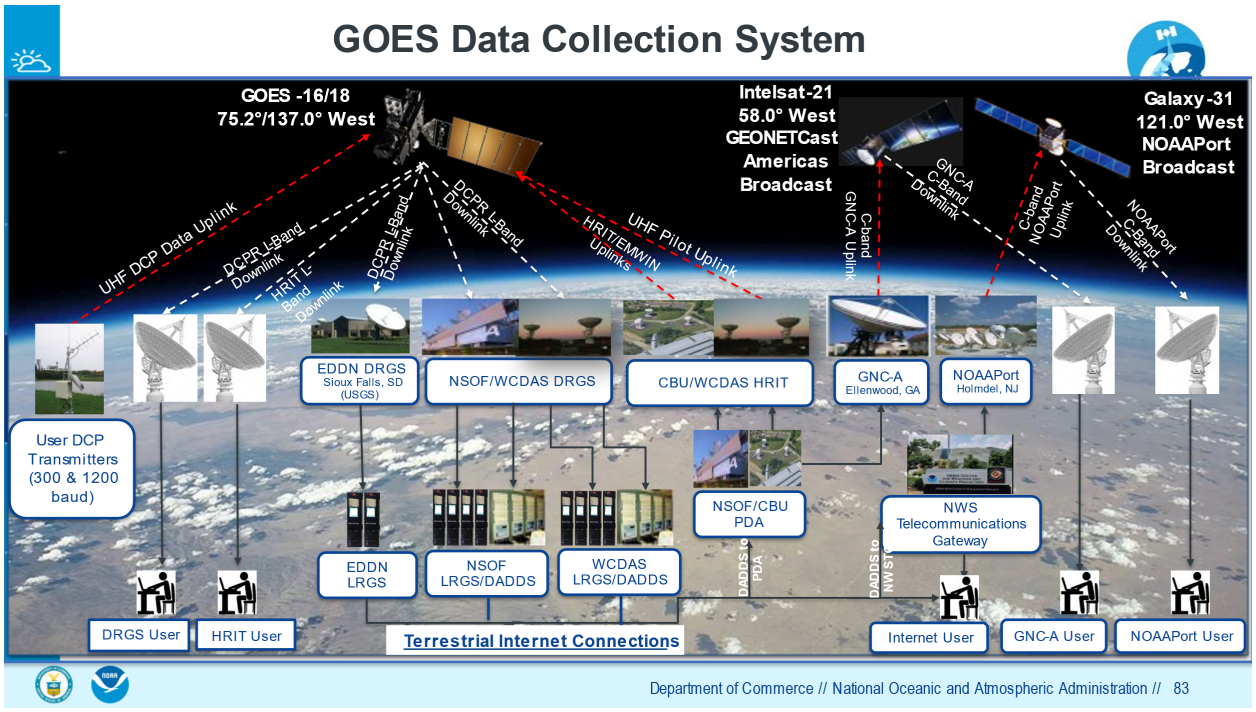
Acronym	System Name	Description
GRB	GOES Rebroadcast	The primary near-real-time broadcast relay of GOES-R Level-1b data products (all instruments L1b and Geostationary Lightning Mapper L2). These data are available to all users with GRB receivers in view of a GOES-R series satellite at the East or West operational longitudes.
HRIT/ EMWIN	High Rate Information Transmission/ Emergency Managers Weather Information Network	The HRIT/EMWIN service is a high data rate (400 Kbps) broadcast for GOES-R satellite imagery and selected products to remotely-located user terminals. Combines LRIT and the EMWIN direct broadcast service that provides users with weather forecasts, warnings, graphics and other information directly from the NWS in near real-time. Also included is a copy of GOES-DCS.
GNC-A	GEONETCast-Americas	GEONETCast-Americas is the Western Hemisphere component of GEONETCast, a near-real-time global network of satellite-based data dissemination systems designed to distribute space-based, air-borne, and in situ data, metadata, and products to diverse communities. Data are broadcast from a commercial satellite under contract with NOAA.

Ian briefly reviewed the NOAA/NESDIS GOES-R dissemination systems. He noted that GRB is the most direct path. This is data processed at WCDAS and then uplinked back to GOES-R and broadcast to users. HRIT/EMWIN is further downstream. This feed is generated in the NESDIS PDA (Product Distribution and Access System) and then rebroadcast from GOES-R satellites. GEONETCast Americas (GNC-A) also gets its products from the PDA. It uses a C-band downlink frequency and is broadcast from a commercial satellite. It has a much higher broadcast data rate. The imagery is in the NetCDF image format. GNC-A also carries DCS messages.

He continued with a description of the ways to get DCS from a satellite feed from space. This is shown in the graphic below. You can get them from a NOAA spacecraft by looking at the GOES DCS downlink or

you can look at the HRIT/EMWIN broadcast. The same DCS feed is broadcast through both the GOES East and West. If you want to go to a C-band downlink on a commercial broadcast, you can get the DCS data from GNC-A. It is the same DCS feed. Also, it is on the SBN/NOAAPORT broadcast. The National Weather Service SBN will soon switch to a single broadcast from the Galaxy 31 commercial spacecraft. Two links about the Galaxy 31 transition are below and a graphic of the three broadcasts is also below.

- https://www.weather.gov/nwws/notices, or
- https://www.weather.gov/nwws/SBNConfig.



Ian continued with a description of the HRIT/EMWIN virtual channel listing. He noted that this was set up for ease of use by users. All of the DCS data is on one channel, which is channel 32 on both the GOES East and West. He briefed that there are soft limits to the portions of the broadcast that carry the three groups of information: 1) EMWIN, 2) DCS and 3) Imagery. EMWIN has the highest priority as it carries tornado warnings, tsunami alerts and other important messages that are used for automated warning sirens and other emergency uses. DCS has the second priority, and the imagery has the third priority. DCS has a guaranteed 5% of the broadcast, which is plenty of capacity, as DCS is using about a peak of 3.7% of the broadcast. You can see there is a diurnal pattern to the bandwidth usage. That is due to the higher compressibility of the imagery at night. The DCS messages that come to the HRIT broadcast are gathered into 8-kilobyte files. That is between 40 and 50 messages. We do not wait to fill the file. The file either fills or it is sent after a predetermined length of time. 20,000 of these files are broadcast per day at a rate of one file every two seconds.

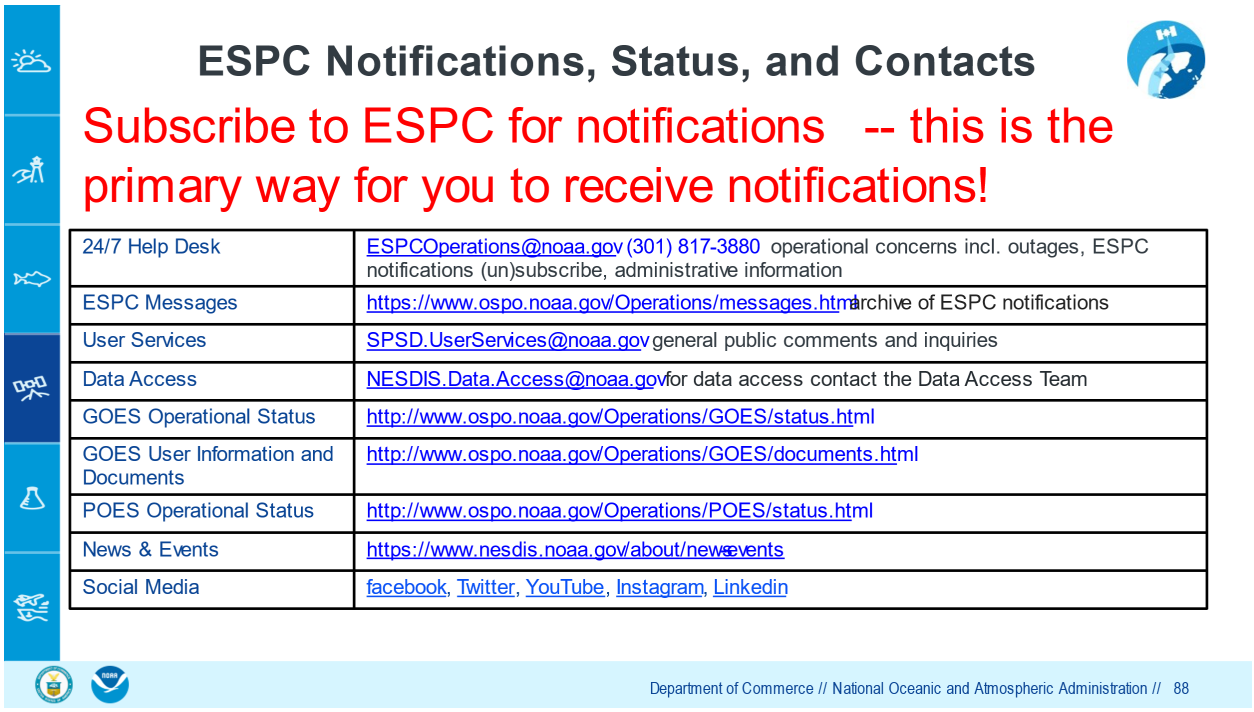
The latency of the DCS messages depends on when the last DCS message is collected into the 8 KB file. This “last file” represents the longest latency. The median latency of the last file is about 11.7 seconds. 99.5% of the last files have a latency of less than 17 seconds.

In summary, Ian noted the following:

- GOES-15 will no longer be available for supplemental operations as it being transferred to the Air Force

    - That role is now GOES-14 and GOES-17
- Global Lightning Mapper (GLM) data has been requested
    - We are evaluating that possibility within available HRIT bandwidth
- Any changes to virtual channels will be announced well in advance

Ian showed a list of links for NESDIS information. He noted that there is a feed of notifications about any NESDIS issues or outages. You can subscribe by sending an email to the ESPC Operations Center. He forwards the notifications that are of interest to the HRIT community. The list of links is shown below.



ESPC Notifications, Status, and Contacts

Subscribe to ESPC for notifications -- this is the primary way for you to receive notifications!

24/7 Help Desk	ESPCOperations@noaa.gov (301) 817-3880 operational concerns incl. outages, ESPC notifications (un)subscribe, administrative information
ESPC Messages	https://www.ospo.noaa.gov/Operations/messages.html archive of ESPC notifications
User Services	SPSD.UserServices@noaa.gov general public comments and inquiries
Data Access	NESDIS.Data.Access@noaa.gov for data access contact the Data Access Team
GOES Operational Status	http://www.ospo.noaa.gov/Operations/GOES/status.html
GOES User Information and Documents	http://www.ospo.noaa.gov/Operations/GOES/documents.html
POES Operational Status	http://www.ospo.noaa.gov/Operations/POES/status.html
News & Events	https://www.nesdis.noaa.gov/about/news-events
Social Media	facebook, Twitter, YouTube, Instagram, Linkedin

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Question: Can we get the reflectivity and snow and ice products and the standing water products on HRIT? Answer: Please send the links to the files to Ian and we will evaluate.

The points of contact for GRB and HRIT/EMWIN are listed below:

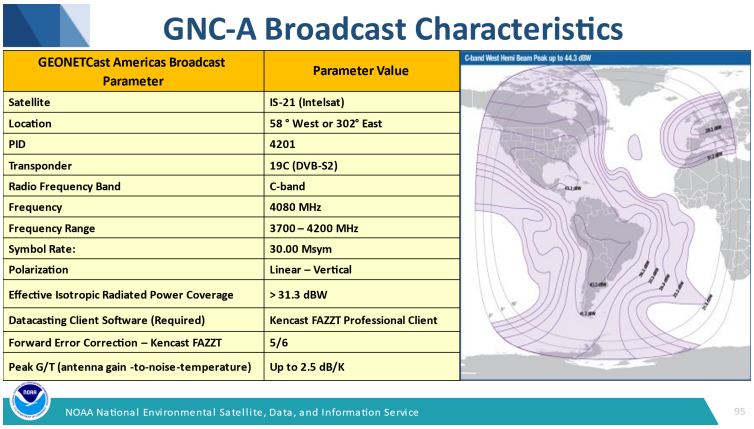
- Toby Hutchings, Direct Readout Program Manager
    - NOAA/NESDIS/OSPO/SPSD
    - Email: grb.pm@noaa.gov
    - toby.hutchings@noaa.gov
    - Phone: (301) 817-4422 (Office)

- Ian Avruch, HRIT/EMWIN Program Manager
    - NOAA (NESDIS/OSPO/SPSD/DSB)
    - Email: hrit.manager@noaa.gov
    - Ian.Avruch@noaa.gov
    - Phone: (240) 410-3546 (Office)

GEONETCast Americas – John Cornicelli – NOAA GEONETCast Americas Program Manager

This presentation begins at hour/minute 2:01:48 on the audio file.

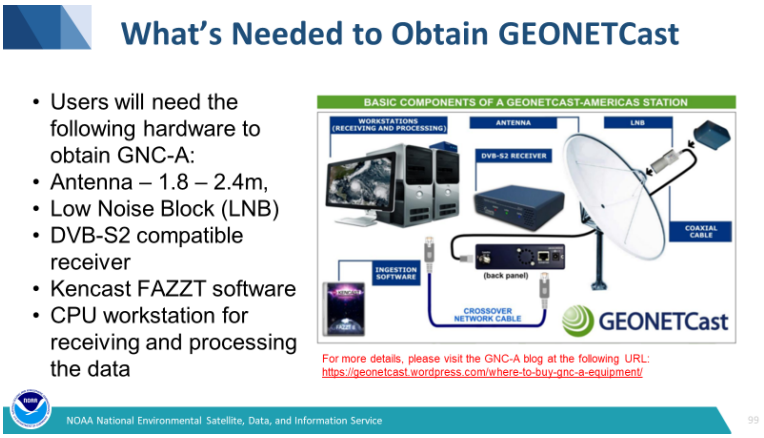
John Cornicelli introduced himself as the new GEONETCast Americas (GNC-A) Program Manager. He showed a slide detailing the GNC-A broadcast system then showed the characteristics of the GNC-A broadcast. GNC-A is C-band at 4080 MHz. He noted that C-band is not affected by ionospheric RFI as much as the L-band. The GNC-A community is growing. There are 150 users in the western hemisphere. GNC-A is part of global GNC along with the China Meteorological Agency and EUMETSAT.



GNC-A Broadcast Characteristics

GEONETCast Americas Broadcast Parameter	Parameter Value
Satellite	IS-21 (Intelsat)
Location	58 ° West or 302° East
PID	4201
Transponder	19C (DVB-S2)
Radio Frequency Band	C-band
Frequency	4080 MHz
Frequency Range	3700 – 4200 MHz
Symbol Rate:	30.00 Msym
Polarization	Linear – Vertical
Effective Isotropic Radiated Power Coverage	> 31.3 dBW
Datacasting Client Software (Required)	Kencast FAZZT Professional Client
Forward Error Correction – Kencast FAZZT	5/6
Peak G/T (antenna gain -to-noise-temperature)	Up to 2.5 dB/K

One highlight is that a new GNC-A station is being installed at the French Meteo facility at Lanion in France. They are testing it to see if they can plan stations for the French speaking islands in the Caribbean region such as Martinique. The GNC-A footprint covers most of the Americas. GNC-A receive stations are quite inexpensive compared to some other systems.



What's Needed to Obtain GEONETCast

- Users will need the following hardware to obtain GNC-A:
- Antenna – 1.8 – 2.4m,
- Low Noise Block (LNB)
- DVB-S2 compatible receiver
- Kencast FAZZT software
- CPU workstation for receiving and processing the data

For more details, please visit the GNC-A blog at the following URL:
https://geonetcast.wordpress.com/where-to-buy-gnc-a-equipment/

John noted that the receive stations do not need internet. A graphic to the left shows a basic component list. The only brand specific component is the Kencast FAZZT client software.

He noted that there is a user group that is held virtually each quarter. The last one was on March 7th. At that meeting there was an OpenDCS briefing by Mr. Mike Neilson from the USACE.

GNC-A data is received from our data providers via the internet, including from the NESDIS PDA. We are able to access three different receive terminals allowing us to monitor the performance of the system. We have receive systems in both the Instelsat teleport in Georgia and at the contractor facility in Maryland. We also have two systems at the NSOF in Suitland, MD. He then gave a demonstration of the monitoring system used by us called "Splunk." This is a COTS network monitoring application that allows us to monitor the product suite and the system performance.

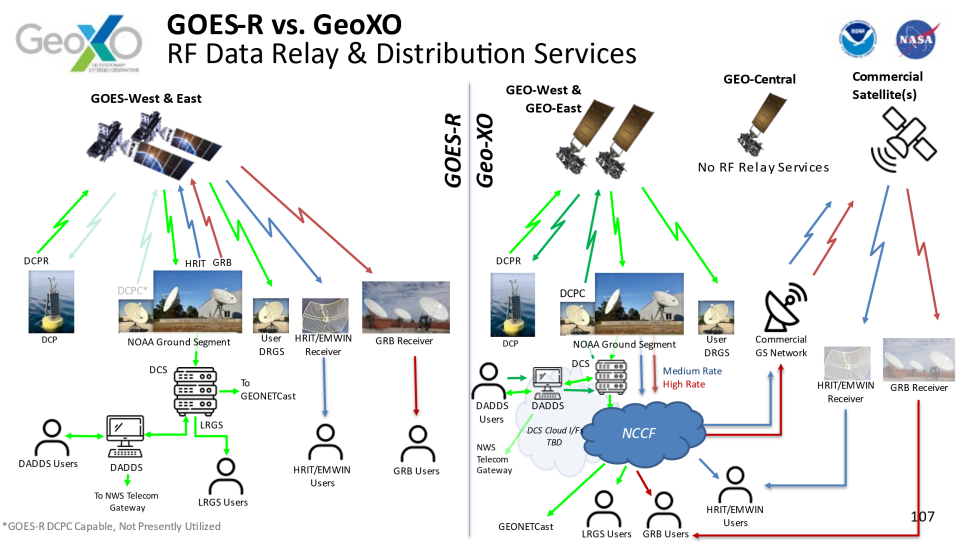
John also highlighted how one user, the Ministerio De Medio Ambiente Y recoursos Naturals or (MARM), uses GNC-A to capture GOES-R imagery and overlay the hurricane forecasts to improve their own forecasting programming.

GeoXO – Daniel Gillies – NASA GOES-R and GeoXO Deputy Program Systems Engineer

This presentation begins at hour/minute 2:14:46 on the audio file.

Daniel Gillies introduced himself as the GOES-R and GeoXO Deputy Program Systems Engineer. He is replacing Craig Keeler, who is here today, but is retiring this year. He will be focusing on DCS and radio frequency user services in general. He noted that they are working on a "forward link" on GeoXO for DCS. They are also working on the environmental data broadcast to replace the HRIT/EMWIN broadcast using a commercial satellite service. They are also transitioning much of the distribution to the GeoXO cloud services.

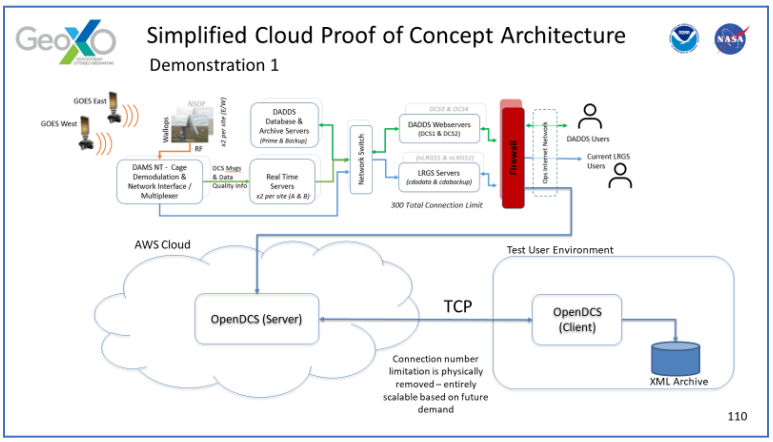
GeoXO is the Geostationary Extended Observations Program. It is a NOAA-NASA partnership that is the follow-on mission to the GOES-R program. There will be a series of six satellites, operated in a constellation of three. We are right between formulation and preliminary design phases with a preliminary design review (PDR) coming up in about two years. The PDR is a major decision point where we will have to lock down the design and have received feedback from all of the users.



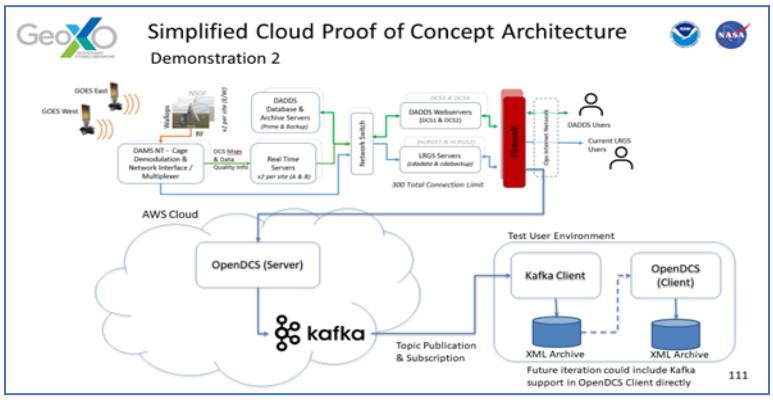
Daniel then went over a graphic showing the current version of the distribution services. The graphic is to the left. There is a comparison between GOES-R and GeoXO proposed distribution. The green lines on the GOES-R side are the DCS uplink. The grayed-out lines represent the latent DCPC two-way link. On the GeoXO side, you can see the addition of the NOAA Common Cloud Framework (NCCF). It is being prototyped today. The intent is to move data distribution to a common cloud environment. There is also a depiction of the planned commercial broadcast. There will continue to be a DCS downlink to the DRGS's. There will also be a medium-rate commercial broadcast that will resemble the GOES-R HRIT broadcast and a high-rate commercial broadcast that will resemble the current GRB broadcast. The data for the commercial broadcast will come from the PDA/cloud. There may be a separate DCS cloud. What elements of the DADDS will migrate to the cloud is still to be defined. Both the DCPR and DCPC data will likely pass through the cloud. The LRGS will probably move to the cloud along with OpenDCS and is part of the proof of concept that is currently being undertaken.

GeoXO is currently conducting proof of concept activities for the provision of DCS data via terrestrial cloud services. The cloud will not be limited to a fixed number of current connections, as DADDS is today. Data retrieval can be scaled to user needs and allows for processing of data within the cloud. Initial demonstrations are utilizing LRGS data (NOAA LRGS server AWS Cloud). NOAA National Ocean Service is already utilizing a similar architecture and is acting as test user for the proof of concept prototype. OpenDCS is installed in Cloud environment to ingest from LRGS servers and push to an external OpenDCS client. They are also looking at a proof of concept evaluating new distribution streaming protocols like Kafka, although OpenDCS does not support that at the present time.

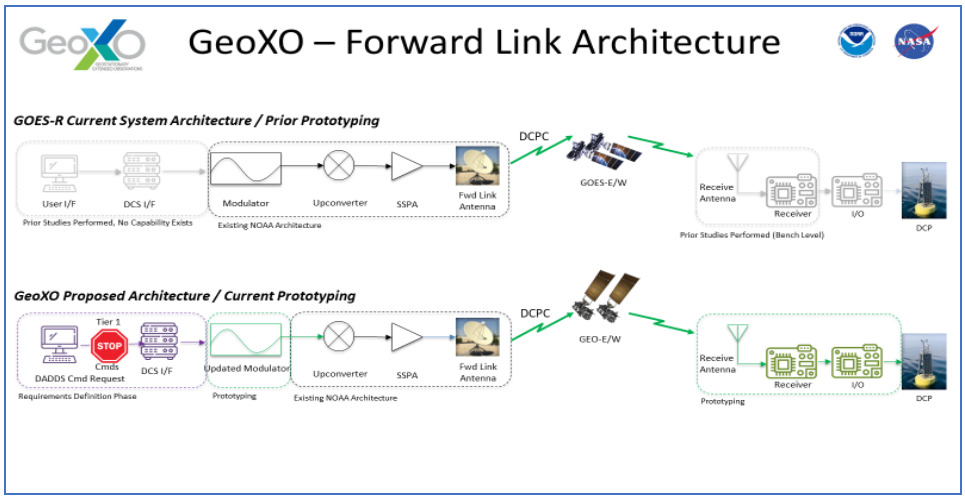
He continued by noting future work will be to generate an architecture and CONOPS and to help the DCS Program to generate requirements to support DADDS cloud compatibility. They are looking to expand the number of LRGS cloud test users in further proof of concept. They are also looking to incrementally push the data access further upstream including to get it directly from DAMS-NT.



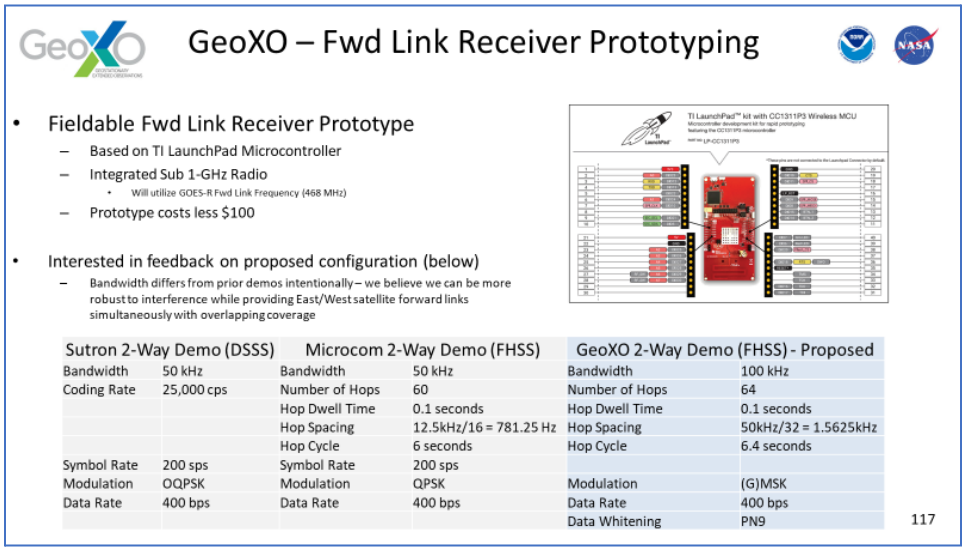
Daniel showed a simplified diagram to both the cloud OpenDCS and the DCS proofs of concept data distribution. This is the architecture that NOAA NOS is using today as a test. This is shown in the graphic to the left.
He then showed the utilization of a streaming service named Kafka. This is shown in the graphic below. This is a path that they may use for other data distribution as well.



He then briefed the current status of the forward link. The forward link is now part of the GeoXO baseline. This is identical to what is on GOES-R. They are working to take the "bench level" system and create a reference design for a fieldable system with a price point in the $500 to $600 range. The GeoXO Program will do benchmarking and functional testing with GOES-R. They are also working to perform field demonstrations later this year at Wallops CDAS. It is important to note that the forward link is not "set in stone." They are looking for "traceable" user demand to help justify the expenditures for this service. They will work with the DCS Program to identify users with their use case and what will amount to a commitment to use the service. A diagram of the current GOES-R architecture over the proposed GeoXO architecture is shown in the graphic below.



He noted that on GOES-R we do not have the user interface to send the command nor a fieldable receiver at this time, but there are studies and prototype efforts that are part of the way there. We do have existing NOAA architecture from modulation to the forward link. In GeoXO we are bringing in the user interface. That is in the requirements definition phase. We will also bring in an updated modulation and develop the receive and I/O interface to the receiver. There will be two tiers of commands. A tier one command will be reviewed by the DCS staff, then queued and issued, which is highly dependent on how the DCP receiver is configured. Tier two commands will be stored but will not have to be reviewed. Daniel then went over a slide on the forward link receiver prototyping effort. It is intended to be fieldable. It is based on a TI LaunchPad microcontroller that is integrated to a sub-1 GHz radio, which will utilize our existing GOES-R frequency at 468 MHz. The current development price is less than $100 which will convert to something like a commercial price of $500 to $600. The parameters are shown in the graphic below using the spread spectrum frequency hop built off of the prior two demos. We are looking for feedback from manufacturers, or from anyone who might have a stake in this effort. He noted that the bandwidth will be 100 KHz. GeoXO believes that we can be more robust to interference while providing East/West satellite forward links simultaneously with overlapping coverage. The Sutron and Microcom demonstration characteristics are compared with the GeoXO proposal on the graphic below.



He briefed that GeoXO is exploring commercial links for the forward link. These services are already offered. It could be cellular or currently available satellite services. There are also satellites in the "internet of things" services that may offer a low cost forward link alternative. Currently, hardware costs are less than $100, with network costs as low as $60 per year. There is hemispheric coverage and in fact it is global. Availability is still being built up but in the next few years the gaps in coverage will be closed.

Daniel ended his presentation by noting that there will be no return link. GeoXO's assumption is that this will be a forward link only. The return path and return CONOPS are that the existing DCP allocation for DCPR will be used. Daniel noted the following links for more information.

- For more information visit www.goes-r.gov
- www.facebook.com/GOESRsatellite
  www.youtube.com/user/NOAASatellites
  twitter.com/NOAASatellites
  www.flickr.com/photos/noaasatellites

CO-OPS DCP Command – Nathan Holcomb - NOAA National Ocean Service
Engineering Division (ED) - Center for Operational Products and Services (CO-OPS)

This presentation begins at hour/minute 3:08:27 on the audio file.

This was the second part of a presentation that began with their user report, which can be found with the other User Reports at the end of the minutes.

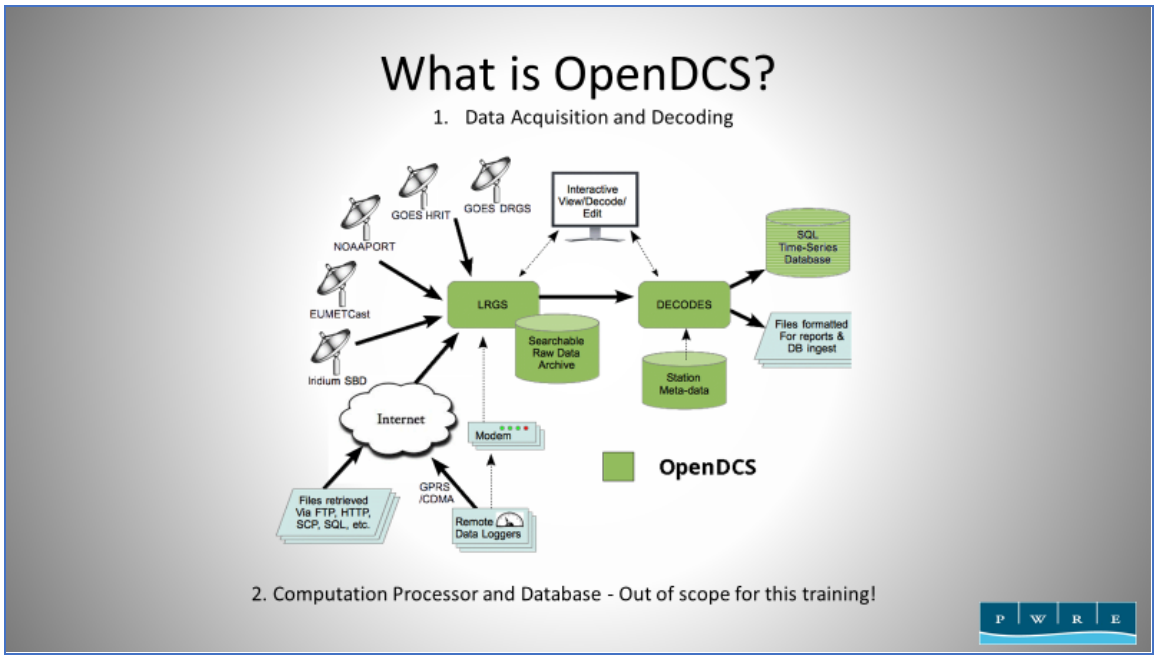
Nathan briefed how they use a cell modem so that they can connect to DCP's. They have a serial output and an ethernet output. Even though they have a higher cost upfront, they are able to utilize this on both DCP's. They have up to five DCP's at a station and sometimes they use an IP router to get to all those DCP's. They are also working on a lower cost system for partners to use. They want to meet their own internal, high standards and achieve lower costs.

TWG Afternoon Session:

Open DCS Primer – Mike Neilson - USARMY CEIWR-HEC / Andrew Gilmore –
Precision Water Resources Engineering (PWRE) / Bureau of Land Management (BLM)

This presentation begins at hour/minute 3:15:25 on the audio file.

Andrew began his presentation by showing a graphic that illustrates "What is OpenDCS." The green boxes in the graphic below represent OpenDCS. Essentially, OpenDCS begins with LRGS. This is the data front end offering data services. It pulls in a raw data feed, primarily from DAMS-NT/DRGS's or from across the internet. You can store the data and can be selective using filters. Secondly, it is a decoding system. It pulls down the channel and platform description tables from NOAA. This is the metadata. It shows you what stations are around you and will then allow you to figure out how you want to decode. This includes a platform decoding language that is loosely based on Fortran. It includes the ability to read in csv files and SHEF codes. There is a raw data archive and there is a station metadata database maintained by OpenDCS. There is also the concept of a computation processor and a time series database that is optional.



He then went over the benefits of using OpenDCS. The number one reason is the concept of shared scripts. Other people that want to decode your data can use your decode script to read your data. It is an open-source platform with community support. It has been adopted widely, including the following.

- USACE
- NOAA
- Bureau of Reclamation
- States and Provinces
- Many others

He continued by sharing the OpenDCS Requirements. They include the following.

- Java 8+ running anywhere.
    - They are not yet adopting a 9+ option
- Data Source from somewhere
    - LRGS (Local Readout Ground System)
    - Internet from NOAA, USGS
    - Host your own feed from the Internet, HRIT, DRGS, Iridium, etc.
    - Data Files and Web Sources
- Configuration
    - Decode scripts with knowledge of platforms and how to schedule
- Data Sink
    - Where you are going to store the data like databases, Files, etc.

Andrew continued by showing the links associated with OpenDCS including where you can get it. It is located on GitHub. This is where releases are published. There are discussion groups and documentation available.

- GitHub for code, discussions, issues and releases
    - https://github.com/opendcs/opendcs
    - https://github.com/opendcs/opendcs/releases
- OpenDCS mailing list

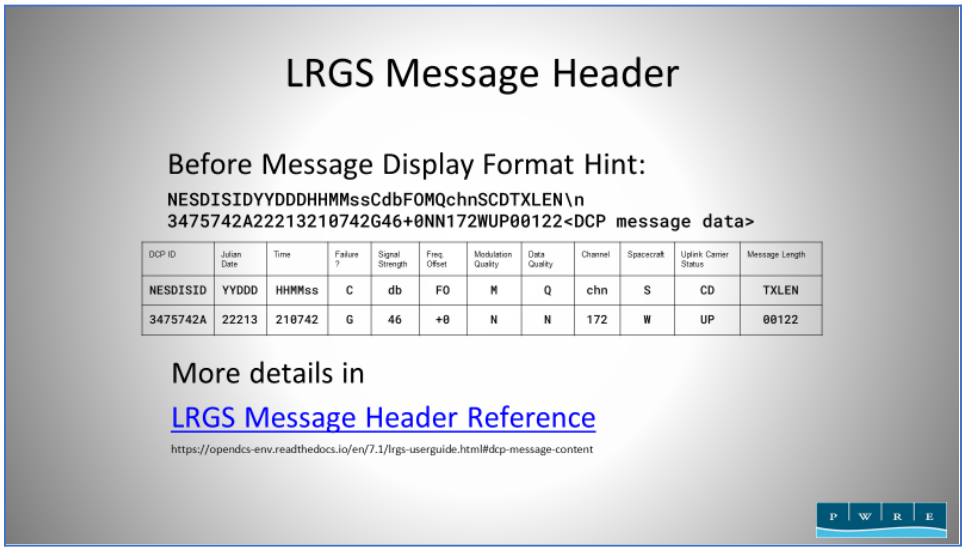
    - https://www.freelists.org/list/opendcs
- Documentation installed as PDF, also online at
    - https://opendcs-env.readthedocs.io/en/7.1/

He continued by noting how you configure the decoding. You have data storage and site location where you describe how it is related to other sites. Also included is platform information, which is an aggregation of sites or DCP's and also how the DCP's are transmitting the data. You then need a configuration. You can configure using a script that is applicable to many platforms.

He showed an example of a message that has been decoded. It is detailed in the graphic below. There is a link to the specific details of the LRGS messages header for raw data at the link shown below. You can cut and paste the text as part of the decode so you can see what each character means. https://opendcs-env.readthedocs.io/en/7.1/lrgs-userguide.html#dcp-message-content

He continued with a live demonstration. *The demonstration presentation begins at hour/minute 3:29:24 on the audio file and on approximately slide 10 of his presentation and slide 150 of the TWG Slide Deck.*

In conclusion, Andrew noted the following. Decoding scripts is the real crux of the solution and is the hardest to do. OpenDCS is heavily used in many forms. It is a Computation Processor and SQL Database storage and a Java Open-Source project. There is community support and contributions are welcome.



Michael Neilson noted that he invites people to chime in on the discussion group. Your ideas are very useful for the project.

Question: Where in the data processing does the data decoding belong? Answer: It depends on how critical the data is to you. If you own your own downlink and DRGS, you might want to invest in your own decoding.

Michael Neilson noted there is a Wiki on getting vendor support. There are currently two companies listed, although there are more out there.

SPRES Update – Renee Leduc – Narayan Strategy

This presentation begins at hour/minute 3:46:22 on the audio file.

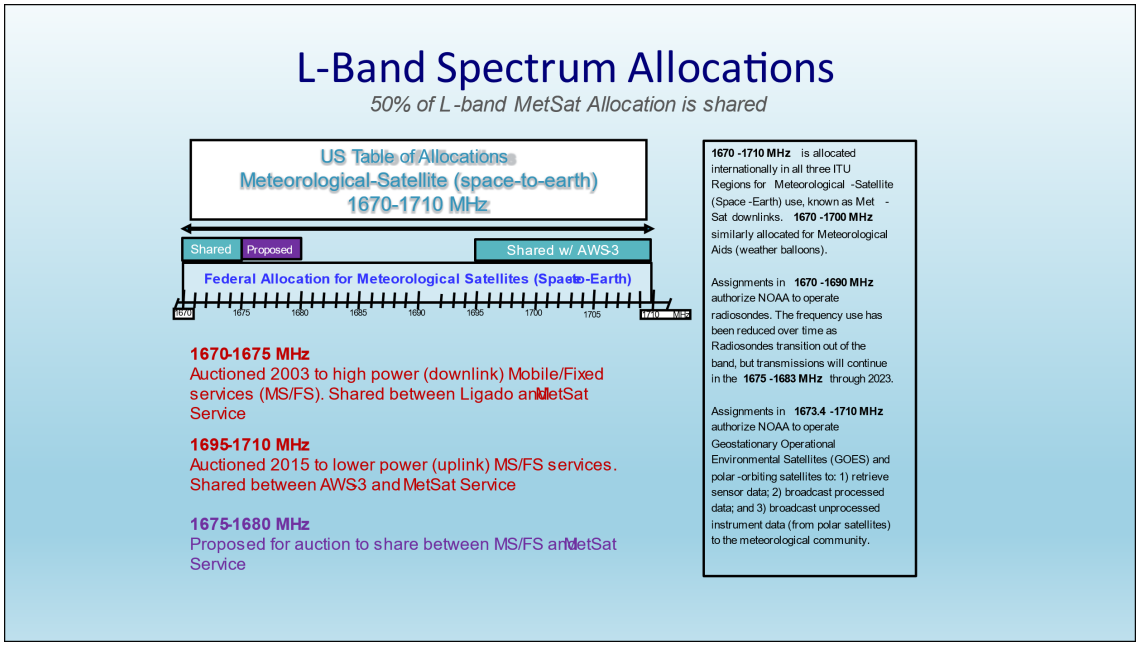
Renee noted that she is speaking in her capacity as a business owner and not for or as NOAA. She began with a discussion of the current spectrum allocation policy environment that we have now. She noted that there are only four4 FCC commissioners at the present, which means that if there is a tie in voting it means that certain proceedings will be stuck. One of these decisions that is stuck is the Ligado 1675 – 1680 MHz application. She noted that there is currently no nominee to be voted on by the Senate to fill the open FCC position.

The Spectrum Pipeline Reallocation Engineering Study or SPRES Report was requested by NOAA in 2017 to explore whether sharing the 1675 – 1680 MHz was feasible. It was funded with $12.03 million dollars from the Spectrum Relocation Fund. The study was kicked-off in 2017 and completed in 2020. It was released in September of 2022. The scope and objectives of the study are presented below with the objectives quoted from NOAA documents.

- **Scope:** The Spectrum Pipeline Reallocation Engineering Study (SPRES) assessed the potential for sharing the 1675-1680 MHz Meteorological Satellite (MetSat) band with commercial fixed and mobile wireless services nationwide while ensuring no impacts to NOAA and other federal user mission capabilities.

- **Objectives:**
  - GOES Data Use
    - Map the flow of GOES data to users and applications
    - Determine the impact of loss or degradation of data
    - Derive MetSat user requirements for receiving the data transmitted in the 1675-1680 MHz band, and in the adjacent affected bands
  - Radio Frequency Interference (RFI) Modalities and Risks
    - Characterize any RFI to GOES receivers and quantify the RFI risks
  - Mitigation Options and Feasibilities to Facilitate Sharing
    - Identify possible RFI mitigations
    - Assess the feasibility and effectiveness of this sharing between 1675 – 1680 MHz given its impact specifically on GOES Communications Services, specifically DCS but also the adjacent band services like GRB, EMWIN, etc.

Renee continued by noting that Ligado Networks, LLC requested an auction to share the L-band between 1670 – 1675 MHz for terrestrial wireless operations. Adjacent to that is the 1695 – 1710 MHz that was already shared due to the AWS-3 auctions. That is adjacent to other GOES data services and other meteorological aids. 1670 – 1675 MHz is already leased by Ligado Networks, which is why they are interested in 1675 – 1680 MHz. A graphical representation of the above discussion is below.



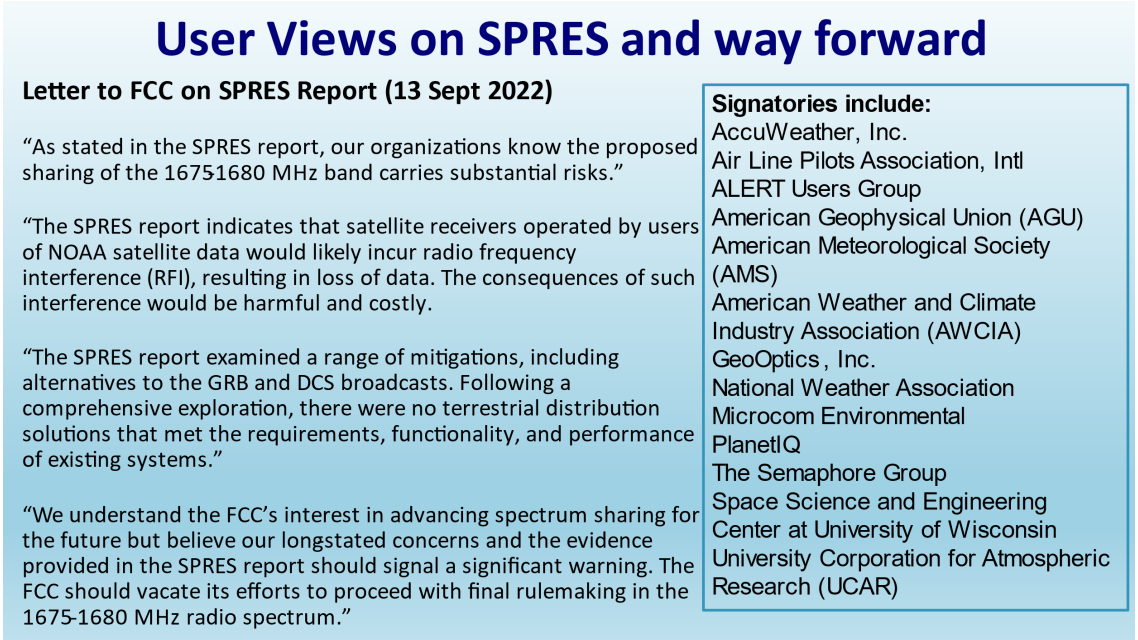
She then discussed the four specific outcomes from the SPRES report which are listed below.

1. Evaluation of alternative data distribution architectures
   - o DCS Administration and Data Distribution System (DADDS)
2. Alternative GOES downlink design recommendations
   - o Combinations of various technologies that were leveraged to meet GeoXO requirements
3. GOES receive site RFI monitoring approaches
   - o Items to consider: Sub-noise detection and classification, angle of arrival determination, aggregate RFI performance, real-time capabilities of monitoring system and notifications to wireless carriers
4. GOES downlink protection mechanisms and RFI mitigation methods
   - o Protection mechanisms are location-specific
   - o Sharing rules are driven by population density, commercial deployment type, severity of anomalous propagation, terrain effects

What the stakeholders have noticed is that the report lays out a good case of why 1675MHz – 1680 MHz is not feasible to be shared. It says it in quite a compelling way which may not have been what some regulatory agencies may have been anticipating. At the time it was released, it was said that the report analysis needed to be refined. There is also going to be SPRES-FO or Follow-on. The SPRES-FO report will propose solutions in the four main SPRES-FO tasks.

- o Risk assessment analysis and risk impacts in outcomes of SPRES-FO
- o RFI modeling assumptions may impact sharing rules/protection criteria and assessments of alternative DCS facilities
- o RFI modeling assumptions will have different levels of impact based on the earth station location
  - ▪ Surface duct assumptions
  - ▪ Clutter modeling is location-specific
- o End-user outreach, degree of responses, and response time
  - ▪ Understanding end-user technical requirements

A group of stakeholders submitted a letter to the FCC specifically saying that they liked the contents of the SPRES report and that it shows that this bandwidth cannot be shared. Quotes from the letter and a list of stakeholders is shown in the graphic below.



The SPRES-FO study is ongoing. NOAA sent out a survey asking for information that will go into the follow-on study.

Currently, there is no action moving forward on the 1675 – 1680 MHz issue. However, three years ago another Ligado proposal was approved. It was to operate close to the GPS frequency. A letter signed by 91 organizations highlighted their continued opposition to Ligado's proposals.

Renee continued by highlighting the National Spectrum Strategy. NCIA is putting this together by the end of the calendar year. They held two public hearings and requested written comments. An overview of the project is shown in the graphic below.

What the Spectrum Strategy is trying to do is identify a minimum of 1500 MHz of spectrum for Auction. Three excerpts from the comments are listed below.

Comments at Public Event from American Meteorological Society (AMS):

> "The prediction and early warning of weather and climate hazards like hurricanes, tornadoes, wildfires and winter storms are reliant on environmental technologies like satellites, buoys, stream gauges, balloons and radars. RF spectrum is crucial to the continuous operation of these technologies."

Written Comments from ALERT Users Group:

> "On behalf of the ALERT Users Group (AUG), I am writing to you in order to urge you to safeguard the 1675-1680 MHz spectrum band currently used to receive and transmit hydrologic data for public safety."

Written Comments from AMS:

> "The hydrology and flood management community are specifically concerned with the delivery of real-time stream gage data and other crucial hydrologic and meteorological information that is transmitted near 1680 MHz and provides high flood risk communities throughout the U.S. and its territories with situational awareness and decision support during flood emergencies."

The links to all of the comments, etc. are on the American Meteorological Society website.

She noted that it is incredibly important that the stories we submit are made available to policymakers on Capitol Hill and the regulatory agencies.

Question: What is the likelihood of a fifth person being confirmed in the near future and vacating the follow-on process? Answer: There is no nomination at this point. Nominations are slower during election

years. It is probably not going to happen until next calendar year. The SPRES Follow-on study may be a way to justify the change to the report. Also noted is that Ligado is on the verge of having financial problems again as they have had to wait a very long time. There are lots of possibilities.

Question from the Chat: Renee, can you speak to existing protection schemes in place for other spectrum areas and how they may apply to a future protection scheme on this topic? For example, there are a number of DRGS sites in Mexico, the U.S. and Canada. How would future DRGS sites for critical safety purposes be treated if an agency had a need for a new site? How are (or would) commercial and government interests be adjudicated? Answer: This may be a question for a government representative. I know there is a desire for protection zones for non-federal users. This is hard to advocate for, especially for NTIA. She noted that she knows that Environment Canada is especially concerned.

Dave Lubar comment: We are an international group. It should be obvious that these are national spectrum actions. The decision may not determine what Canada or Mexico will do. The safety use of DRGS needs to continually be emphasized. Receive earth stations typically do not get the protections they should. Regulators sometimes prioritize transmitters. We need to keep stressing how important these sites are, especially for states and counties and how crucial they have become, especially in the days of changing climate and added flooding, etc.

Renee comment: There is this new SPRES follow-on survey. It queries folks that have and rely on these systems. It is extremely important to reply to the survey. There are some particular questions like how you use this information. The NTIA will analyze the survey answers. They will want to validate things like are there really that many users and do they really need the data and cannot rely on the Internet. She gets the sense that at the NTIA and White House Science and Technology that they think there is such a small community so why are we going to cause all of these problems for such a small number of users?

There is a question on characterizing who the downstream users are.

Manufacturers Report – Brett Betsill - Microcom

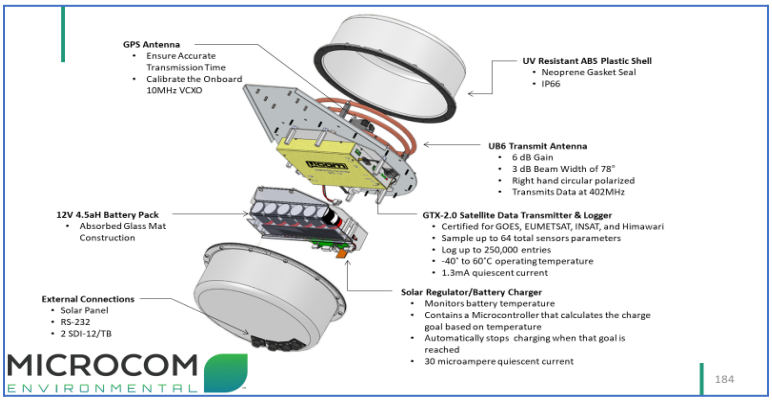
This presentation begins at hour/minute 4:22:13 on the audio file.
Brett went over the history of the company noting that 2025 will be the 50th anniversary of the company. He noted that they worked in the background through the 1990s and assumed a lead DCS role in the 2000's. November will be the 20th anniversary of the first deployment of the DAMS-NT at Wallops CDAS.

He went over their flagship receiver called DigiTrak. Lately, they have been doing upgrades and installations for the U.S. Army Corps of Engineers. This is also tied to RFI monitoring where the U.S. Army Corp now has a permanent RFI monitoring capability. He noted that they sold 5 of their desktop DAMS-NT systems to Ott Hydromet where they were then deployed to New Hampshire, the University of Puerto Rico, Panama, Honduras and the Colorado River Authority. He had to ask to find out where the sites were highlighting the fact the FCC does not require registration of receive systems.

Brett also went over the DigiRit HRIT Receive system characteristics noting that if the GeoXO Program decides to end HRIT, the DigiRit may be at end of life although the existing systems will continue to work for about 10 years. Brett continued with a description of the DAMS-NT server application software. They also have a DAMS-NT client which is a way to monitor the system. He also noted that it does DDS so it can ingest and also decode and present the data.

Brett continued by noting that Microcom does make DCP's. Their main line is XPress. It is an all-in-one integrated DCP. Everything is inside except for the sensors and solar panel. He highlighted that they have

a solar regulator that only requires 30 microamps of power. A graphic showing the components is shown to the right.



This is primarily focused on the hydrology market. The GTX Utility is provided with all units and can be downloaded on the GTX webpage that tutorials on using the GTX Utility can be found on Microcom Environmental's YouTube Page. He also went over the various deployment options.

- Long-Term
    - Quick and easy set-up
    - Cost-effective and versatile mounting options for various applications
- Seasonal – He gave an example of the California lettuce fields where they can move the systems from field to field to monitor evaporative transpiration
    - Monitor rivers impacted by snowmelt in spring and early summer
    - Change sensors and monitor drought and fire conditions in summer and fall
- Rapid
    - Additional sensing in advance of extreme weather
    - Post-flooding and post-wildfire monitoring
    - Temporary replacement for destroyed DCPs
- Extreme Applications
    - Monitor rivers impacted by snowmelt in spring and early summer
    - Change sensors and monitor drought and fire conditions in summer and fall

He continued with a description of the GTX and GTXO 2.0 satellite transmitter and datalogger. They are now developing a GTXO. This is a transmitter only that is targeting the international market that will be used by them to connect to native dataloggers.

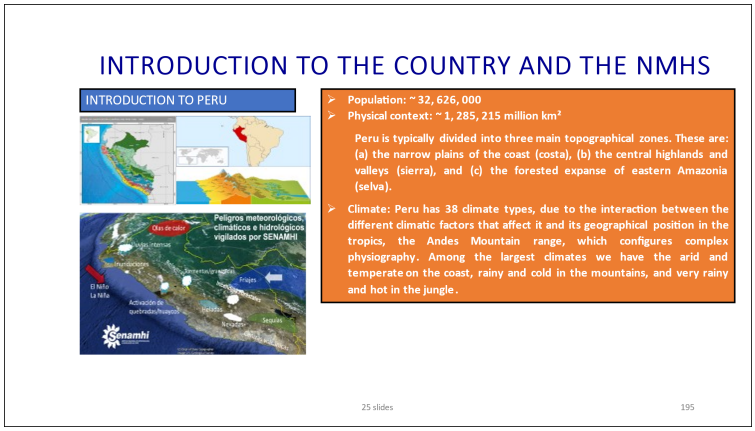
He also described the SDI-12 Interfaces and Sensors. They also offer a unique product called the MagShaft encoder. This product uses magnetic technology which does not require gearing, has very low torque and there is no physical contact between the sensing and the wheel. There are lithium batteries that will last 10 years.

Question: Can the users swap the batteries themselves? Answer: Yes.

Question: What is the resolution? Answer: Very small - Sub .01, and it has an optional display.
In conclusion, Brett noted that Microcom does everything including collecting data, transmitting data and receiving data. A list of Microcom Design and Microcom Environmental points of contact is copied below.

User Report – Jorge Chira de la Rosa - PERÚ SERVICIO NACIONAL DE METEOROLOGÍA E HIDROLOGIA (SENAMHI)

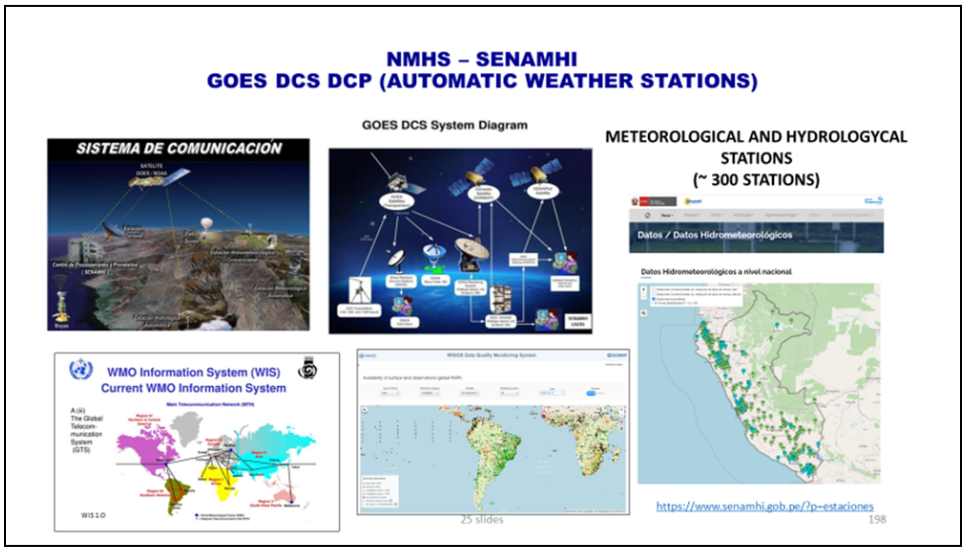
This presentation begins at hour/minute 4:40:31 on the audio file.



Jorge began his presentation with a description of the country of Perú and the National Meteorological and Hydrological Service (NMHS). He noted that Perú has a population of approximately 32,626,000 and covers an area of approximately 1,285,215 million km². There are three main topographical zones. These are: (a) the narrow plains of the coast (costa), (b) the central highlands and valleys (sierra), and (c) the forested expanse of eastern Amazonia (selva). There are 38 climate types, due to the interaction between the different climatic factors that affect it and its geographical position in the tropics along with the Andes Mountain range, which results in a complex physiography. Among the largest climates are the arid and temperate climate on the coast, rainy and cold in the mountains, and very rainy and hot in the jungle. This is depicted in the graphic in the above right.

The NMHS is known as – SENAMHI. It is a public agency under the Ministry of the Environment. SENAMHI aims to generate and provide information and meteorological, hydrological and climatological knowledge in a reliable, timely and accessible manner for the benefit of Peruvian society. It has several regional branches and a staff of over 1,000.

There are more than 1,000 DCS stations. 340 stations are automated weather stations using DCS. This is depicted in the graphic below.



Jorge then went over a list of GOES DCS applications, which are listed below. He highlighted that they contribute to the WMO Regional Basic Observing Network (RBON) and are a candidate for the new Global Basic Observing Network (GBON) WMO network. A list of user agencies are also listed below.

- Weather Forecasting
- Water resource management
- Flood warning
- Climate monitoring
- Water level monitoring
- Weather observations (RBON/GBON WMO NETWORKS)

- National Service of Meteorology and Hydrology of Peru
- National Water Authority
- Ministry of Agriculture and Irrigation (PSI project)
- Ministry of Transport and Communications
- Power Generation Company (EDEGEL)
- Drinking Water and Sewerage Service of Lima (SEDAPAL)
- Regional Governments (Apurimac, Ayacucho)

As an example of how SENAMI was affected by a rollover event, Jorge noted that SENAMI was notified by NOAA in September 2022 and was told there would be a rollover event but that only one type of transmitter would be affected. They were also contacted by Signal Engineering, the manufacturer. These transmitters are in many of their DCP stations. They faced many challenges to overcome the event including budgetary, expertise in all offices and travel challenges due to the rainy season, cyclone events and political events. Jorge also noted the actions taken by the NMHS. These are copied below.

- Potential drawbacks were identified to carry out this activity (lack of budget, roads blocked due to protests against the government, lack of technical personnel in the regions, beginning of the rainy season that could generate roadblocks due to rainwater flooding).

- Every detail was carefully planned to carry out the firmware update of DCP. Resources were mobilized, optimizing travel commissions, the respective laboratory tests were carried out and the technical personnel of each region to be affected were trained.
- 31 DCP's with OMNISAT 1 satellite transmitters or equivalent that could be affected were identified.
- Coordination was made with local offices to solve the Rollover problem.
- Laboratory tests and on-site verification were carried out.
- A firmware repository was organized, and firmware requested from vendors was shared with local offices.
- The local offices performed the firmware update for each DCP, except one that was supported by the central office.
- The performance of each DCP was monitored by the central office.
- A satellite transmitter was replaced because it failed when technicians tried to update the DCP firmware.

Nº	Name	ID GOES	Latitude	Longitude	Altitude	Type	Brand	TX Model	Owner
1	CORRAL_QUEMADO	472B007A	-5.754511	-78.592083	427	EHA	OTT	Omnisat 1	NMHS
2	CUMBA	472B3006	-5.941353	-78.664133	449	EHA	OTT	Omnisat 1	NMHS
3	HUALLAPE	472A571A	-5.450769	-76.695792	409	EHA	OTT	Omnisat 1	NMHS
4	MAGUNCHAL	472B2370	-5.589972	-78.180783	616	EHA	OTT	Omnisat 1	NMHS
5	NARANJITO	472327D6	-5.819681	-78.275983	500	EHA	OTT	Omnisat 1	NMHS
6	PUENTE_SALINAS_AMOJAO	472B5503	-5.450861	-76.489480	381	EHA	OTT	Omnisat 1	NMHS
7	CRISNEJAS	472A32FC	-7.463889	-78.113056	1991	EHA	OTT	Omnisat 1	NMHS
8	ANTONIO_RAIMONDI	472A216A	-11.778060	-77.191390	47	EMA	Vaisala	V10012200	NMHS
9	CAÑETE	472A0766	-13.074672	-76.330490	110	EMA	Vaisala	V10012200	NMHS
10	BETA_SANTIAGO	47B9F498	-14.237409	-75.070244	370	EMA	Vaisala	V10012200	NMHS
11	PAMPA_DE_MAJES	472BE39A	-16.335523	-72.152478	1503	EMA	Vaisala	V10012200	NMHS
12	CHINCHAVITO	472D0552	-9.034825	-76.249058	795	EHA	OTT	Omnisat 1	NMHS
13	PUENTE_TARUCA	47287380	-9.349995	-76.982347	1525	EHA	OTT	Omnisat 1	NMHS
14	PAMPA_CANGALLO	472D0080	-13.555400	-74.197890	3355	EMA	Vaisala	V10012200	NMHS
15	CALCA	472D59BA	-13.313298	-71.953792	2921	EMA	Vaisala	V10012200	NMHS
16	CASACANCHA	472A1410	-13.988233	-72.286319	4050	EMA	Vaisala	V10012200	NMHS
17	HUAYLLABAMBA	472D37C	-13.205806	-72.448806	2995	EMA	Vaisala	V10012200	NMHS
18	INTIHUATANA_II	472939F2	-13.185185	-72.523232	2196	EHA	Vaisala	V10012200	NMHS
19	INTIHUATANA_M	4728E2EE	-13.174140	-72.540496	1788	EMA	Vaisala	V10012200	NMHS
20	MACHUPICCHU	472D06E6	-13.166550	-72.545850	2399	EMA	Vaisala	V10012200	NMHS
21	NUEVO_PISAC	472A6280	-13.420639	-71.853881	2966	EHMA	Vaisala	V10012200	NMHS
22	PACAYMAYO	472B605A	-13.234159	-72.494488	3615	EMA	Vaisala	V10012200	NMHS
23	QORIHUAYRACHINA	472D6D90	-13.224194	-72.433833	2517	EMA	Vaisala	V10012200	NMHS
24	SAN_PABLO	472D8EF2	-13.025060	-72.516690	1228	EMA	Vaisala	V10012200	NMHS
25	SANTO_TOMAS	472BA090	-14.449361	-72.096450	3671	EMA	Vaisala	V10012200	NMHS
26	SORAYAMPA	472B6B1C	-13.394777	-72.577644	3894	EMA	Vaisala	V10012200	NMHS
27	PUNO	472D033A	-15.826342	-70.012133	3812	EMA	Vaisala	V10012200	NMHS
28	PUNAMQUI	472AFTE2	-13.95139	-72.10047	2701	EHA	Vaisala	V10012200	RG
29	SANTA ROSA	472AE494	13.99163	-73.17481	2263	EHA	Vaisala	V10012200	RG
30	ABTAMAMBA	472B0590	-14.38483	-72.05635	3545	EMA	Vaisala	V10012200	RG
31	HUACULLO	472B195A	-14.65289	-72.57275	4572	EMA	Vaisala	V10012200	RG

NMHS: National Meteorological and Hydrological Service
RG: Regional Government

Picture: Jonathan Sanchez

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They were fortunate in that all but one DCP only needed a firmware update. This case shows the value of the forward link capability.

In summary, Jorge made the following points.

- The data generated by the DCPs that use the GOES DCS are important for several organizations that generate services for decision-making in Peru, in addition to contributing to the international exchange of data with the World Meteorological Organization (WMO), in support of numerical weather prediction.
- NOAA warned of the possible impact of Rollover on DCPs in Peru, specifically the Omnisat satellite transmitter model of the company Signal Engineering, Inc., SIGNAL ENGINEERING, INC., which had to be updated before the Rollover impact date.
- NMHS of Peru identified the possible DCPs to be affected, and which should be updated before the Rollover impact date. Solving this event meant a great effort on the part of SENAMHI, due to several obstacles that arose including budgetary, political agitation, severe weather, among others.
- From the initial list of 31 DCPs that required attention, 26 were updated with firmware; one DCP is inoperative and the rest continue to work and have not been affected by the Rollover event but

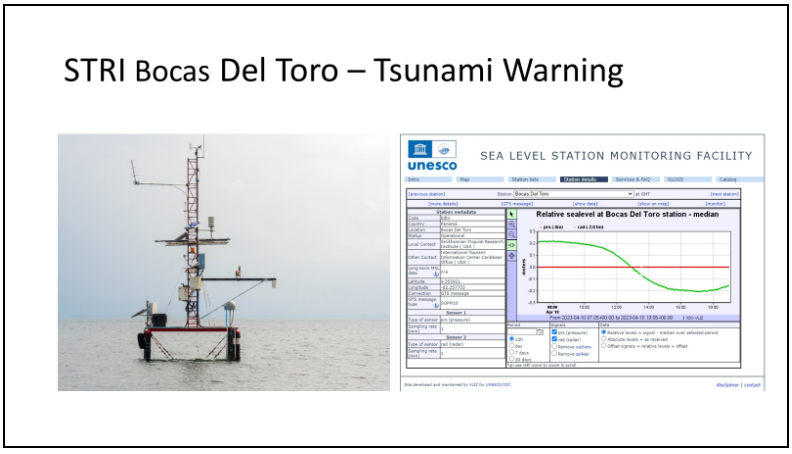
they can fail at any time if they have an electrical fault, so SENAMHI is expected to update the 5 remaining DCP firmware shortly.

- Thanks to the actions carried out and the notice from NOAA, the Rollover impact has been minimal and the data from the DCP can continue to support decision-making at the national level and contribute to the international exchange of data with WMO.

User Report – Sergio Dos Santos – Smithsonian Tropical Research Institute

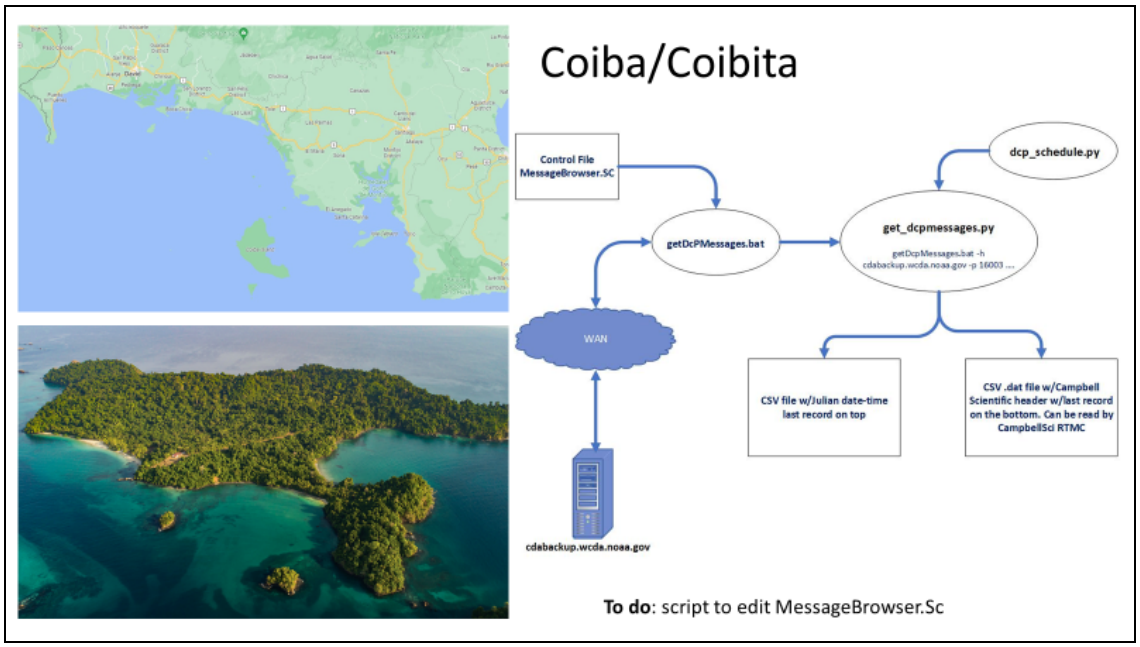
This presentation begins at hour/minute 4:51:58 on the audio file.

Sergio began by going over the Smithsonian Tropical Research Institute projects. They are dedicated to study tropical ecology and biology in Panama which is considered to be a natural laboratory to study species evolution. Most of their sites are in Central Panama. There are some sites in the Northwest of the country. These are shown in the graphic to the right.

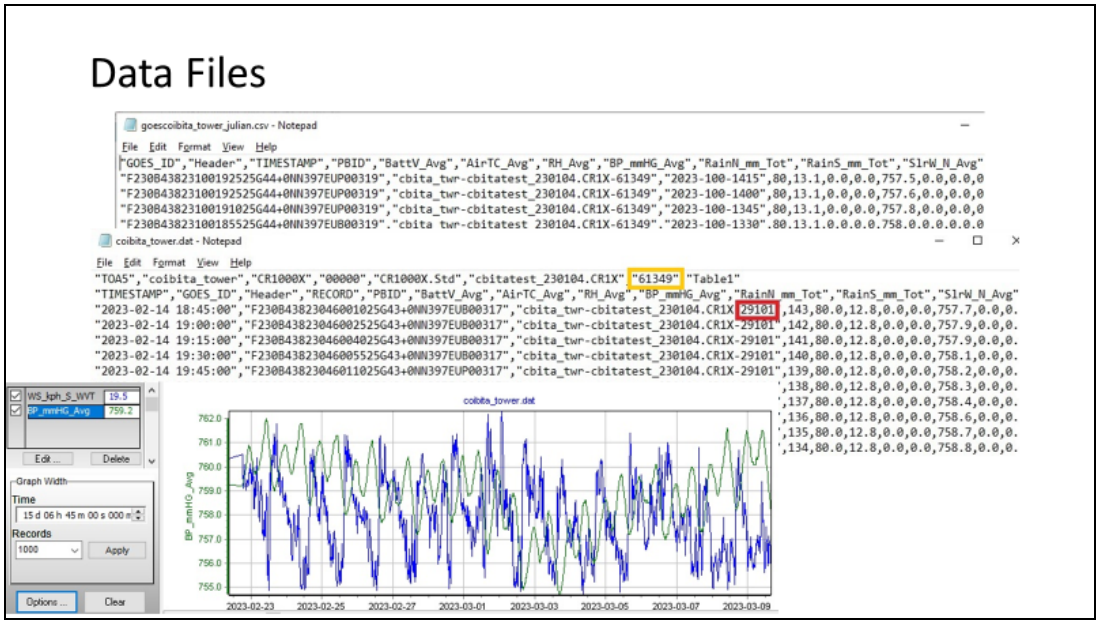


At Bocas del Toro they have a research station that has a weather station and tide gauges. The data is transmitted through GOES. The data is used for tsunami warnings as well as for sea level studies. A graphic depiction of the platform is shown to the left.

There is an expansion onto the small island of Coibita. There is no infrastructure including cell service. They are using the LRGS system and the Campbell Scientific software to graph the data. Their workflow is shown in the graphic below.



Sergio also showed an example of the message file. It is shown in the graphic below. The messages include information on the datalogger and the station identification. They also include the timestamp of the exact time of the data collection in Julian format.



User Report – Lucas Keserich - California Department of Water Resources

This presentation begins at hour/minute 4:59:19 on the audio file.

Lucas began his presentation by describing who the California Department of Water Resources is. They were founded in 1956 to consolidate water rights and respond to the state's growth. In 1959, 1.5 billion

dollars were allocated to establish the state water project. They currently operate 34 lakes, storage facilities, and reservoirs. They also operate 20 pumping plants and other facilities and approximately 701 miles of canals and pipelines. They generate 8.57 billion kilowatts of energy. Their main goal is to transport water from Northern California to Central California for agriculture.

They use GOES DCS for remote stations. They have about 70 stations, mostly in Northern California but also in Central California and in the Bay/Delta area. There is a graphic to the left showing the Alleghany, CA weather stations. It is designed in the pyramid shape on purpose for snow load. There is a door at the back that is near the top of the building. The snow has been so high that they need to crawl through the top door due to the height of the snow.

This station uses a GOES transmitter. There are no other options for stations like this. Some of these stations date to the late 60s to early 70s. They gather the snow data to predict where the water is and where it will go. They use the data to allocate the water to the farmers and housing area. They also share water with other agencies, cities, and counties.

The impact of having this data is to be able to plan operations and maintenance. They have to plan around "water." Everything has to be in good condition to balance the water. They have a flood operations center that is a coordinated operation between many government entities. They have a long history of flood issues. The city of Sacramento flooded in 2014. Much of the city was under 6 feet of water. They also have drought years. They use the DCP data to accommodate the residents trying to distribute the water to all. This year they are dealing with continued drought while having flood events.

The graphic to the right shows the California State Water project. Lake Oroville is in the North and Lake Paris is in the South. There is a link to the project at www.water.ca.gov .

He noted in response to a question that they are using a tipping gauge using timed events. Our DCP's have been changed to the waterlogger versions.

Question from the Chat: What is the total number of platforms operated? Answer: We operate 26 platforms but work with other agencies. There are 70 sites between three agencies.

Question: Finally, you mentioned cellular. Do you use it at any sites or is all data sent via GOES only? Answer: We are not using cellular at any of our sites. We have been tasked to survey our sites to see if it is an option. We have not had much success to date. We have found that the system is robust and reliable the way it is now.

Question: How often have you had to go out to service your DCPs? Answer: We service our DCPs a minimum of yearly. We try to go every 6 months during or after our rainy season and try to visit prior to the next one.

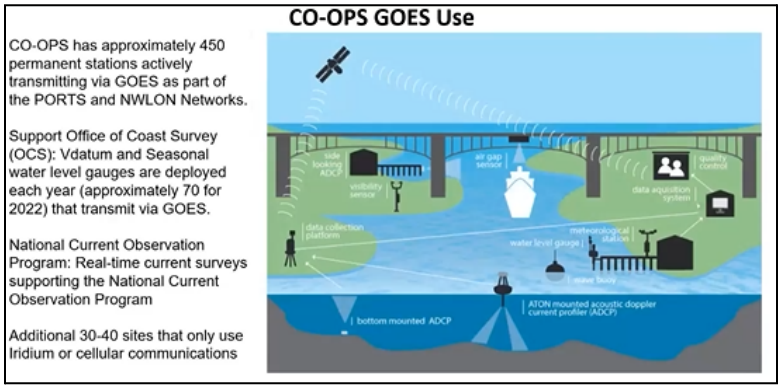
Can you say which DCP transmitters you use (all one type, mixed)? Answer: We use waterlogger systems with built-in transmitters for all sites.

User Report - Nathan Holcomb - NOAA National Ocean Service
Engineering Division (ED) - Center for Operational Products and Services (CO-OPS)

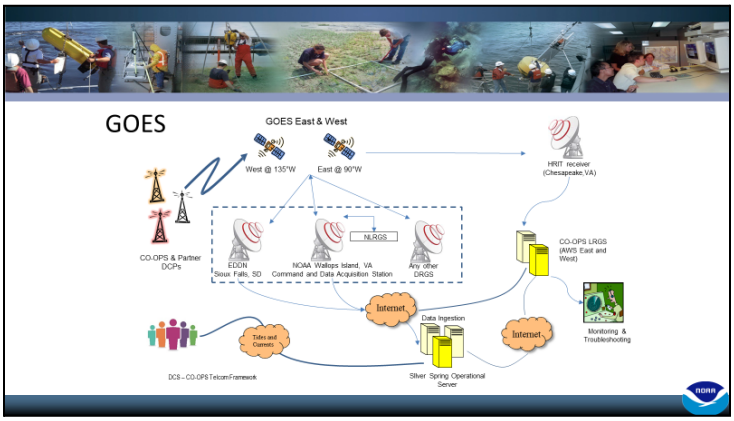
This presentation begins at hour/minute 2:46:30 on the audio file. This was the first section of a brief that contained the National Ocean Service (NOS) COOPS use of two-way transmissions.

Nathan began by noting that all of their data and information can be found at tidesandcurrents.noaa.gov. They have about 475 permanent stations within the PORTS and NWLON networks. They have 40 – 50 sites that transmit through Iridium only. They also have 50 - 70 seasonal stations that are out for about 3 months. They use these to validate models and to determine where to put out permanent stations. They also support the national current observation program with some real-time monitoring of their data and are beginning to transmit that data in real-time.

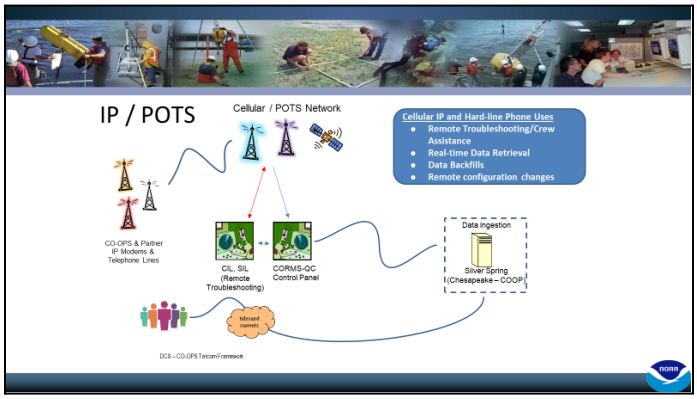
Nathan showed a diagram of PORTS Program. It is paid for by the users. There are air-gap sensors, current meters, and water level stations. The water level and air-gap sensors are used in coordination to get a clearance measurement beneath obstacles. This is shown in the graphic to the right.



He went over some examples of their DCP Stations. He noted that they have 53 stations along the coast of the Great Lakes. They are treated like ocean ports. These stations are still connected via hardline phones. GOES is used for most of their communications but they have different redundant communications. He noted that ocean current measurements are becoming more of a focus for them. He emphasized the need for redundancy both in telecommunications and in sensor arrays.

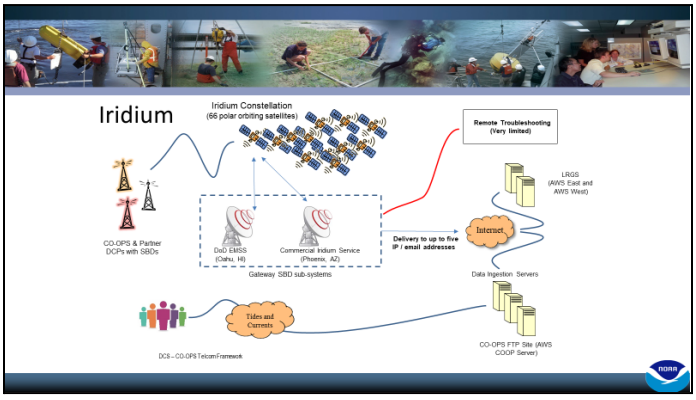


Nathan then showed diagrams of their networks. The first is of their GOES Network. It is shown in a graphic to the above right. He noted that they point to all the available DRGS's. They have an OpenDCS set up and point to everything that is available on the DADDS web page. This provides a hot backup. Since we moved to this system, we have not lost any data. Their LRGS's have been moved to the cloud. They receive data from the Amazon Web Services (AWS) East and West to mitigate cloud outages. They also have an HRIT receiver. This mitigates internet outages. He noted that you can still get their data over the telephone.

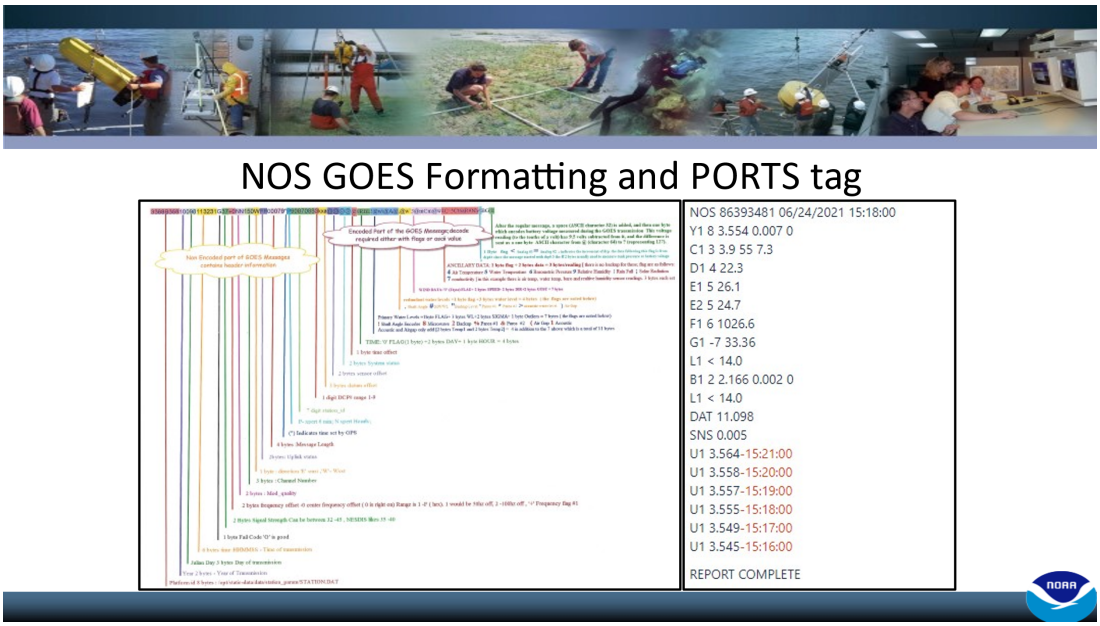


They also have a telephone network. This is shown in the graphic to the left. They use this for true two-way troubleshooting. They get immediate responses from the DCP's. It is a little more costly than GOES, which is free after equipment set-up. Their recurring monthly costs are $30 to $50 a month for typical cellular data costs. The initial setup cost is approximately $1,500 for the hardware including solar panel and battery. They grab data every 6 minutes. They use this after storm events. If they lose equipment after a storm, they can pull the data.

Nathan continued with a description of their Iridium Network. This is shown in the graphic to the right. This network relies on the internet. He noted that they are open to working with any partner to share Iridium resources. This allows for some minor troubleshooting, similar to the proposed forward link in GeoXO. They can send a message but, unless an action is requested, they cannot confirm receipt. What they can do is turn on an IP modem, enabling troubleshooting. They can also shut the system down completely. They post their data on an FTP site but are contemplating moving this to OpenDCS. He noted that they use the DoD gateway. Their setup costs are approximately $2,500 for the initial hardware. This does not include a solar panel and battery. This is due to their lower power use. They can take their power from the station battery. They have an annual fee of approximately $1,000 per modem. The Iridium system is more resilient during storms.

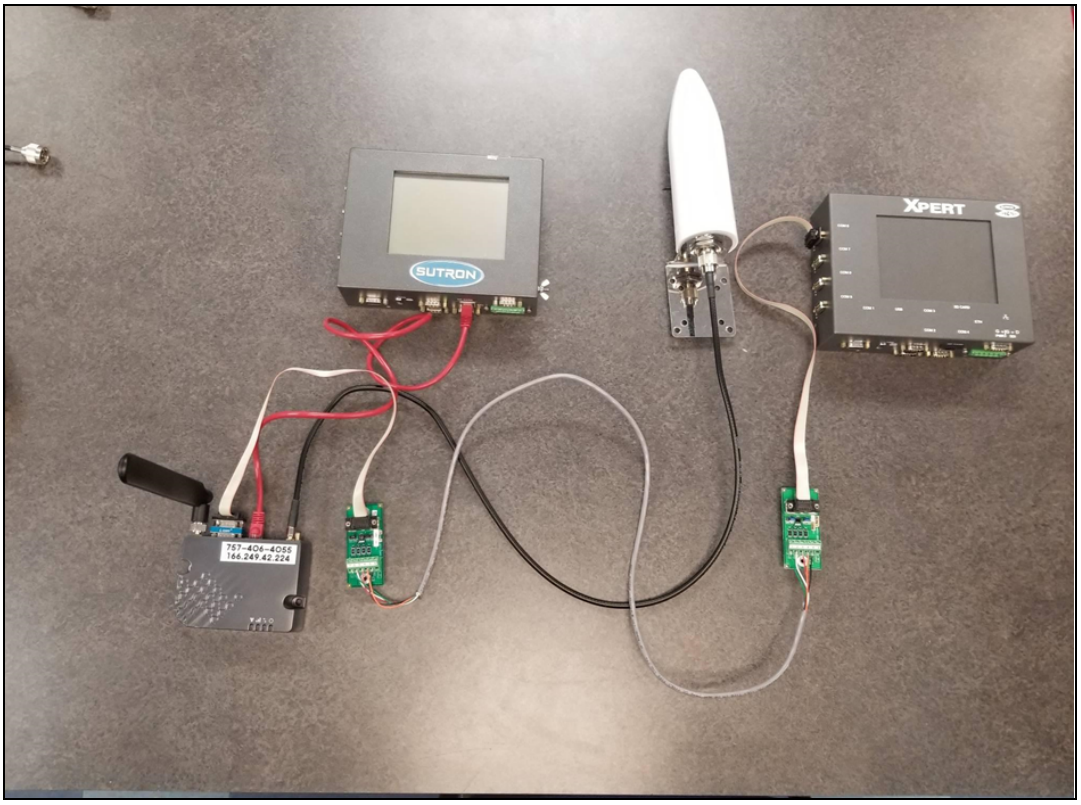


He showed a graphic of their GOES Formatting and PORTS tag. He noted that they flag each sensor and then have their data in binary. This allows them to use messages that have been interfered with. The PORTS tag on the right. This is what gets generated when they go out to the DCP and ask for the data. This is shown in the graphic below.



This is a repeat of the brief on two-way communications from approximately 2:46:30 on the audio file.

Nathan briefed how they use a cell modem. A graphic of the components' connections is shown below. They get a connection to DCP's. They have a serial output and an ethernet output. Even though they have a higher cost upfront, they are able to utilize this on both DCP's. They have up to five DCP's at a station and sometimes they use an IP router to get to all those DCP's. They are also working on a lower cost system for partners to use. They want to meet their high standards and lower costs.



Conclusion and Wrap Up – William "Skip" Dronen – NOAA DCS Program Manager

This presentation begins at hour/minute 5:18:25 on the audio file.

Skip closed the session down by thanking the DCS team and all the presenters and noted to please submit requests for topics or if you want to present your system at the next Technical Working Group.

The session ended at 15:30 PDT/18:30 EDT.

Appendix I: Action Items

There were no action items from this session.

Appendix II: Agenda

	GOES DCS Technical Working Group (TWG) AGENDA	
	Tuesday – April 25, 2023 (All times are Pacific Daylight Times	
09:00	Welcome and Introduction	Skip Dronen
09:10	DCS Update	Skip Dronen
09:40	Customer Service Update	Letecia Reeves
09:55	Wallops CDAS & Radio Freq. Interference Updates	Matt Sullivan/Brett Betsill
10:40	Break	
10:50	HRIT/EMWIN Update	Ian Avruch
11:05	GEONETCast Americas	John Cornicelli
11:20	GeoXO	Daniel Gillies
11:50	DCP Command	Nathan Holcomb
12:20	Break	
13:20	OpenDCS Primer	Mike Neilson/Andrew Gilmore
14:20	SPRES Update	Renee Leduc
14:30	User Update	Jorge Chira
14:45	User Update	Sergio Dos Santos
15:00	User Update	Lucas Keserich
15:15	Conclusion and Wrap UP	Skip Dronen

Appendix III: Attendees

Adrian	Cortez	adrian.cortez@ibwc.gov	USIBWC
Alison	Burnop	alison.c.burnop@water.oregon.gov	Oregon Water Resources Department
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