DCS DRGS Overview

Presented by
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Direct Readout Ground Station

- Whether users get their DCS data from LRIT/HRIT, DOMSAT, NOAAPORT, or the Internet (DDS); all DCS messages first come through a Direct Readout Ground Station (DRGS).

- Provides **direct** reception of DCS messages via DCPR transponder on GOES satellites.

- Satellite acts essentially as a “bent pipe”.
  - What is sent up from the remote DCPs, is effectively just sent back down.
  - DCPR transponder simply performs a frequency translation from UHF to L Band.

- Only the GOES satellite is between the remote DCPs and a DRGS.
Major US DRGS Sites

- **NOAA/NESDIS DRGS Sites**
  - Wallops Command and Data Acquisition Station (WCDAS); Wallops Island, Virginia.
  - NOAA’s Satellite Operations Facility (NSOF); Suitland, Maryland.
  - Both sites have complete East and West channel coverage with a total of 360 DCS demodulators at each site.

- **U.S. Geological Survey (USGS)**
  - Emergency Data Distribution Network (EROS)
  - Located at the Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota
  - Complete East and West channel coverage with a total of 320 DCS demodulators (160 East & 160 West).

- **Others**
  - National Interagency Fire Center (NIFC) – 80 Channels on West
  - USACE Rock Island – 40 Channels on East and West each.
  - Bureau of Reclamation – 80 Channels on West.
GOES DCS Overview

- **Geostationary Satellites:** GOES East @ 75° W and GOES West @ 135° W
- **WCDA – Primary Receive Site**
- **NSOF – Alternate Receive Site**
- **DCPs Uplink at UHF (~402 MHz) & Downlink is L Band (~1680 or 1694 MHz)**
- **Primary Pilot:** Uplink = 401.85 MHz  G15 = 1694.45 MHz  G15 = 1679.85 MHz
- **Backup Pilot:** Uplink = 401.70 MHz  G15 = 1694.30 MHz  G15 = 1679.70 MHz
GOES Satellite Spectrums

GOES-15

GOES-16

Start 1.675 GHz

Stop 1.7 GHz

Ref -20 dBm

PAvg

SDD 1676.0
MDL 1681.5
GVAR 1685.7
LRIT 1691.0
DCS 1694.5

EMWIN

TELEM

DCS 1679.8
GRB 1686.6
HRIT/EMWIN 1694.1
DCS Spectrum encompasses ~330 kHz, and consists of over 400 channels.

DRGS must be able to simultaneously monitor all of the channels of interest.

Sometimes the DCS is heavily loaded as in spectrum above.
And, sometimes the DCS it is lightly loaded as in spectrum above.
Pilots are always present.
Satellite downlink power is held constant regardless of the number of active platforms, which results in received Pilot levels varying significantly.
Satellite Dish – Parabolic Reflector transfers signal to Front End.

Front End – Receives the L-Band signal and down converts it to a lower IF.

Receiving Equipment – Consists of the Front End interface (DPCM) and the DCS demodulators (*DigiTrak*). Often has timing input or integral GPS module.

Computer System – Connects to the Receiving Equipment (typically via a network interface), ingest the DCS messages, monitors the system performance, and disseminates the messages data.
Satellite Dish and Front End

- DRGS systems utilize a Prime Focus arrangement.
- Incoming signal reflects off dish to the focal point of the parabola where the Front End is located.
- Dish sizes vary: 3.6M–uCom; 5M–NIFC; 5M & 7M–RI; 7M–BR; 7.5M & 8.1M–EDDN; 9M–NSOF; 16M–WDCA
- Older GOES satellites (8-12) required larger dishes; DCS was downlink limited (more noise on downlink vs uplink).

- GOES-13 increased transmit power and the DCS became uplink limited.
- GOES-16 provided further improvement in power and reduced phase noise.
- Today very good message reception is possible with a 3-4M dish.

- Front End Includes:
  - Antenna element or feed
  - Filters
  - Low Noise Amplifier (LNA)
  - Block Down Convertor (BDC)
  - Local Oscillator

- Primary function is to translate received signal to lower frequency to minimize cable loss.
GOES DCS Pilots
- Provide an Amplitude and Frequency reference for DRGS.
- Critical to system operation. No Pilot ⇒ No DCS.
- Dual Pilots (Primary & Backup) provide redundancy and reliability.

Dual Pilot Control Module
- Inputs composite IF spectrum from the Front End
- Can provide required DC Power to the Front End
- Locates and Locks to both Pilots in IF spectrum.
- One Pilot is used to provide both frequency and amplitude control.
- If Lock on the Active Pilot is lost, DPCM switches over to other Pilot.
- Down converts the Front End IF to 5 MHz IF for demodulators.
- Provides Timing Outputs – Station Time Input and/or Integral GPS Module.
Receiving Equipment – DAMS-NT Demod Cage

- Utilized at WDCA, NSOF, EDDN, etc.
- Each DAMS-NT Cage can support 40 DCS channels and be independently configured for baud rate and modulation format (CS1 vs. CS2).
- Demodulators use Digital Signal Processing (DSP) algorithms to receive and score messages.
- As messages are received, the message data and message quality statistics are passed on to the DAMS-NT Server application via a network interface.
Computer System – DAMS-NT Server
Computer System – DAMS-NT Server

- Connects to DAMS-NT Cage(s) and ingests DCS message data and quality statistics from demodulators.
- Disseminates message information to network connected clients (DADDS, DAMS-NT Client, LRGS, OpenDCS).
- Provides real-time monitoring of:
  - Message reception quality.
  - DCS Pilot status.
  - DPCM hardware status.
  - DAMS-NT Cage status.
  - System events.
- Redundancy and failover features:
  - Dual DAMS-NT Server configuration.
  - Preferred Pilot for DPCM and Cages.
  - Auto transfer of channel configuration from failed demod to a spare, or even from a failed cage to another cage.
Comparison to Other DCS Reception Systems

➢ DRGS Advantages
  ▪ No latency.
  ▪ Allows monitoring of system performance in addition to platforms.
  ▪ Reliability; does not depend on rebroadcast system and reception is unaffected by weather fading.

➢ LRIT/HRIT
  ▪ L Band rebroadcast via GOES satellites.
  ▪ Lower cost satellite reception with full channel coverage.
  ▪ Smaller dish size (1.2M to 2.4M).
  ▪ Latency is 20-25 seconds.

➢ DCS Data Service (DDS) – LRGS/OpenDCS
  ▪ Internet based message ingest.
  ▪ Low cost; minimal latency (3-5 seconds; with good broadband connection).

➢ DOMSAT
  ▪ Ku Band rebroadcast subject to weather fading.
  ▪ Slated to be terminated in May 2019.

Microcom Design, Inc.
END OF PRESENTATION

“THANK YOU” FOR YOUR ATTENTION