DCS DRGS Overview

Presented by

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March 2018

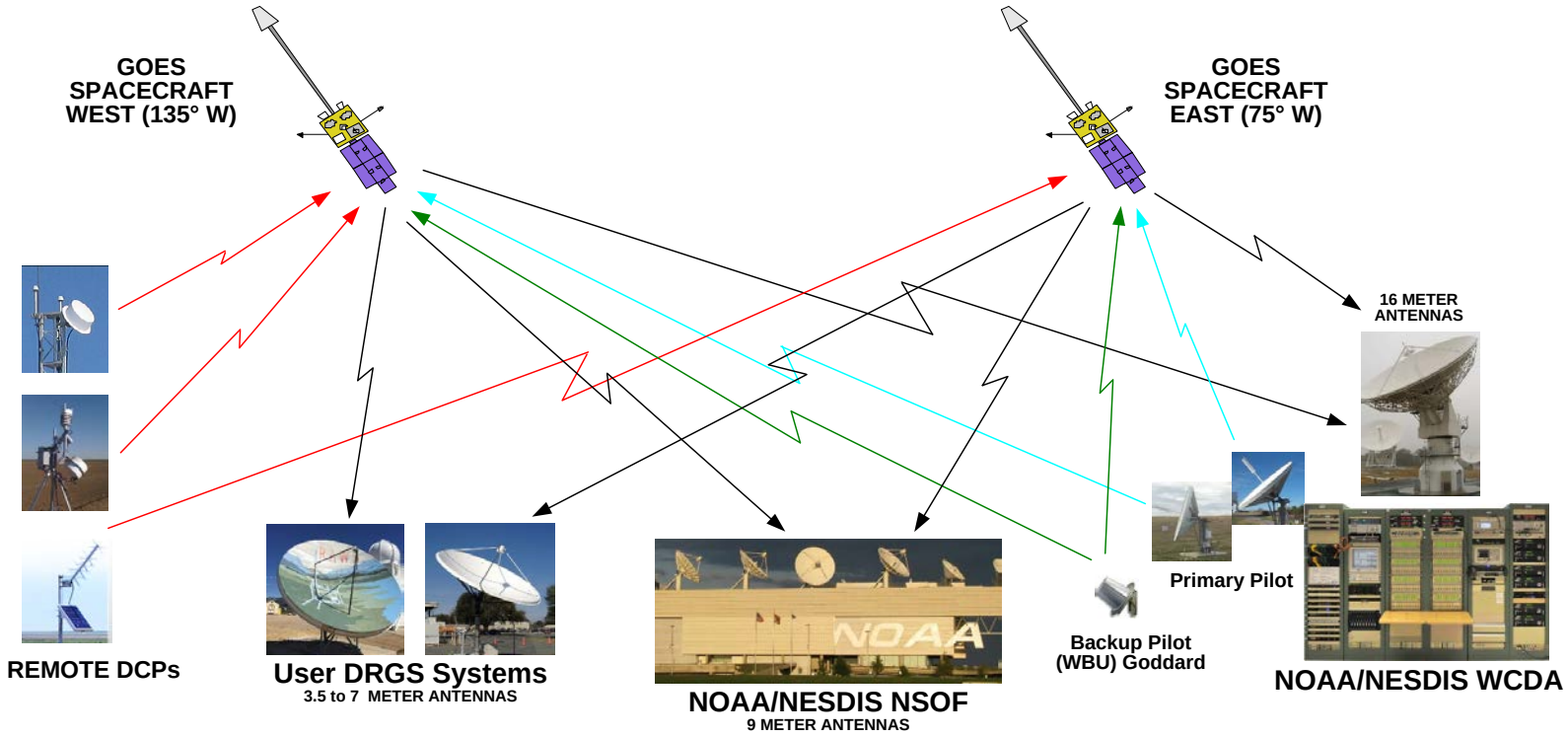
Direct Readout Ground Station

- 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

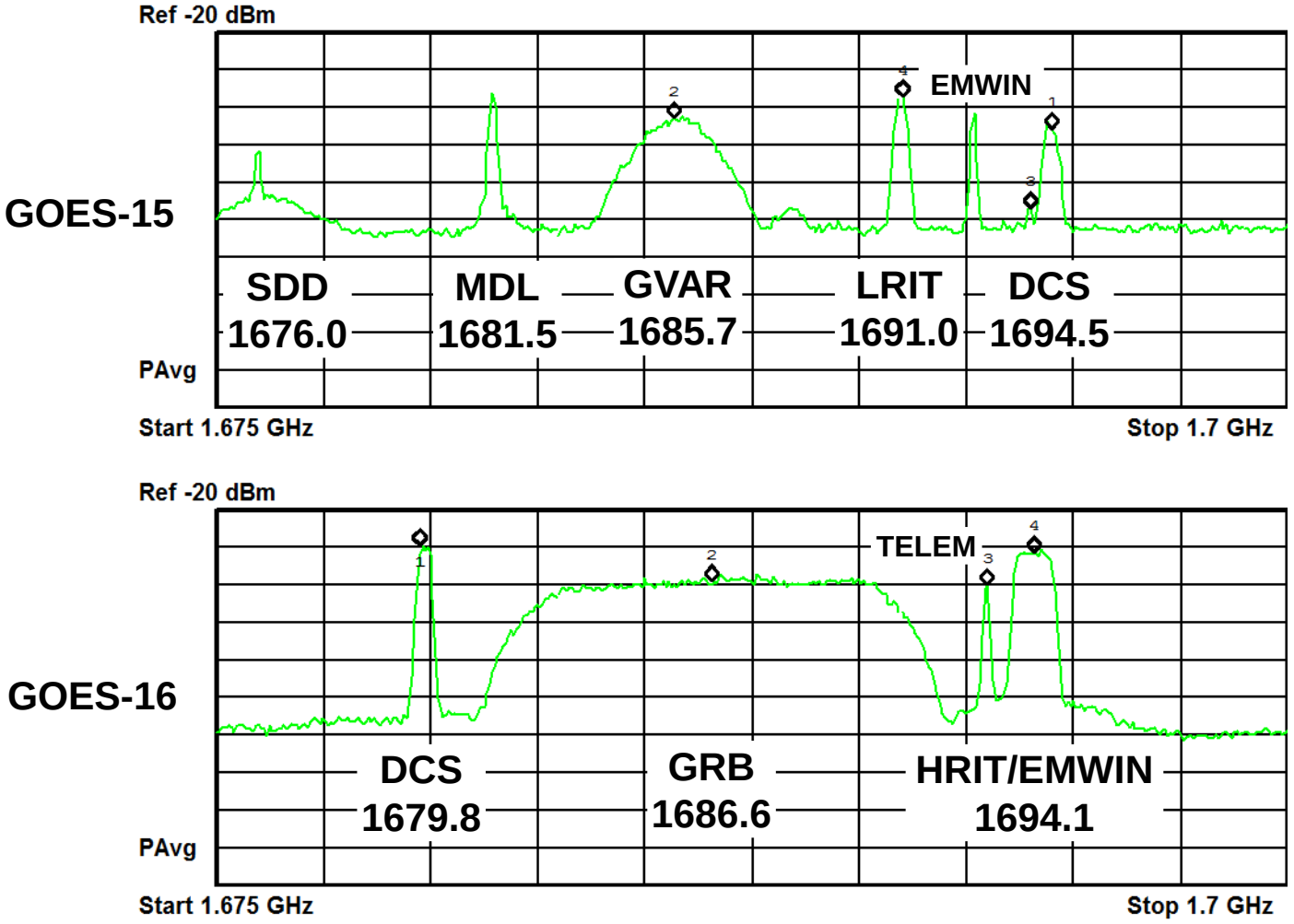
- NOAA/NESDIS DRGS Sites
  - Wallops Command and Data Acquisition Station (WCDAS); Wallops Island, Virginia.
  - NOAA's Satellite Operations Facility (NSOF); Suitland, Maryland.
  - Both sites have complete East and West channel coverage with a total of 360 DCS demodulators at each site.
- U.S. Geological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

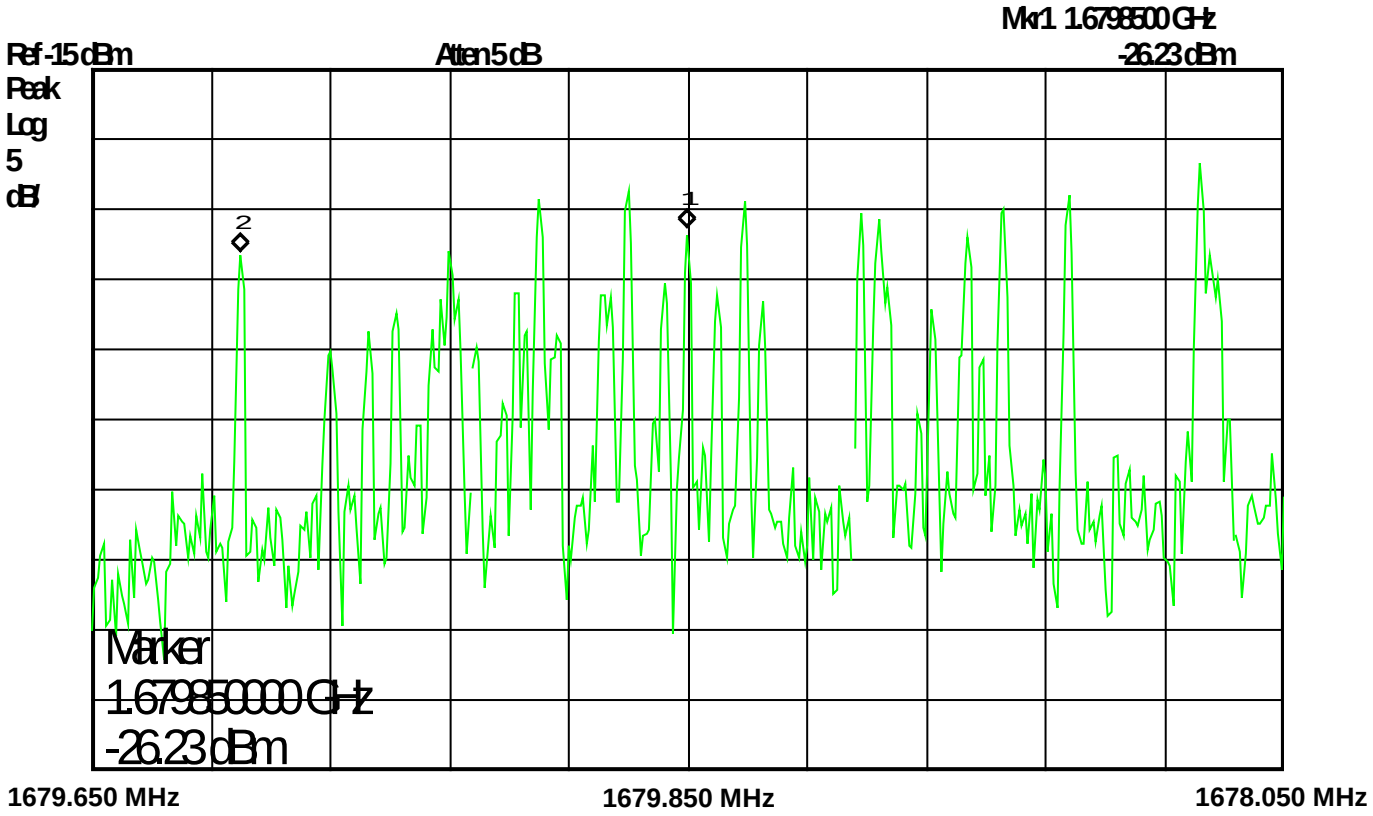


- Geostationary Satellites: GOES East @ 75° W and GOES West @ 135° W
- WCDA – Primary Receive Site NSOF – Alternate Receive Site
- DCPs Uplink at UHF (~402 MHz) & Downlink is L Band (~1680 or 1694 MHz)
- Primary Pilot: Uplink = 401.85 MHz G15 = 1694.45 MHz G15 = 1679.85 MHz
- Backup Pilot: Uplink = 401.70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

GOES Satellite Spectrums

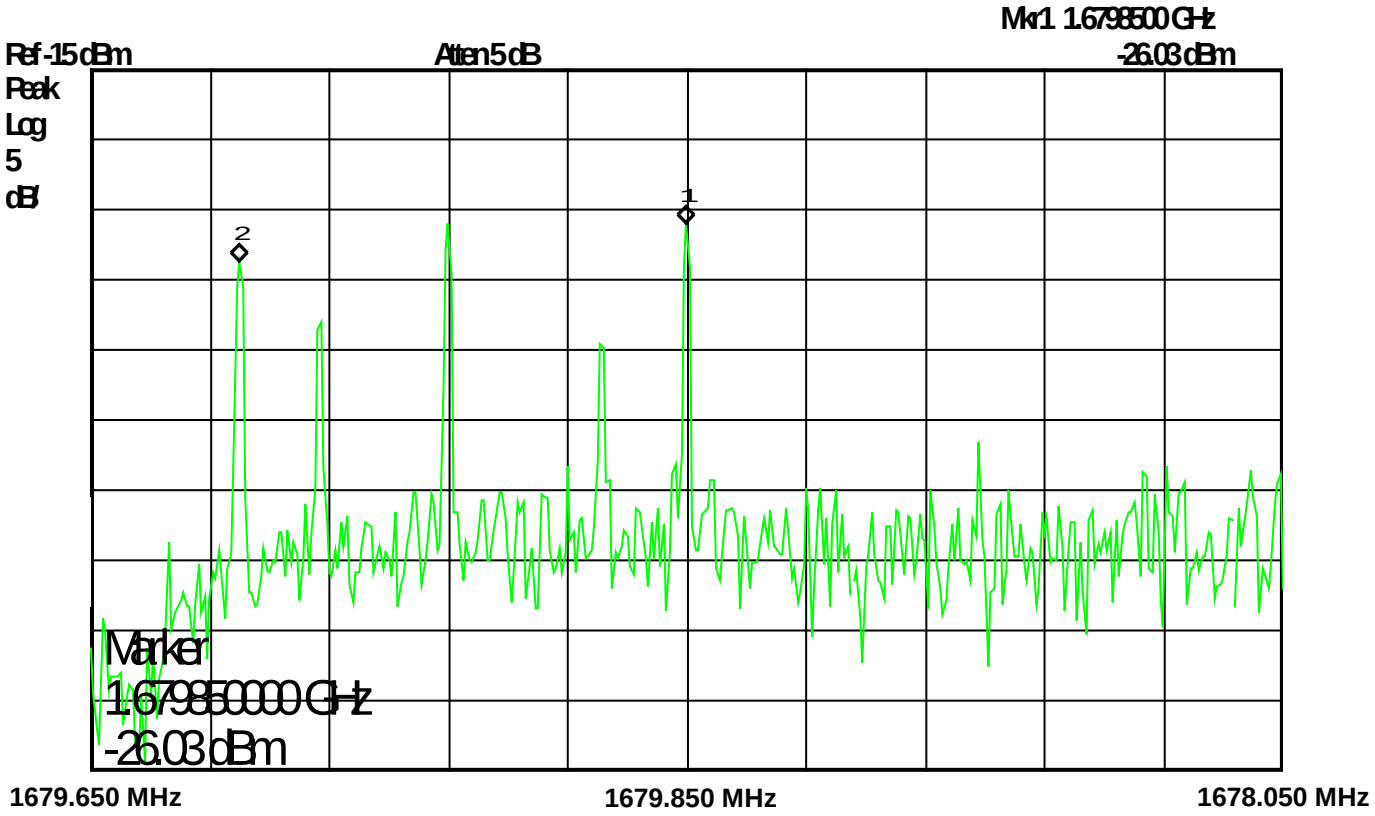


GOES DCS Spectrum – Heavily Loaded



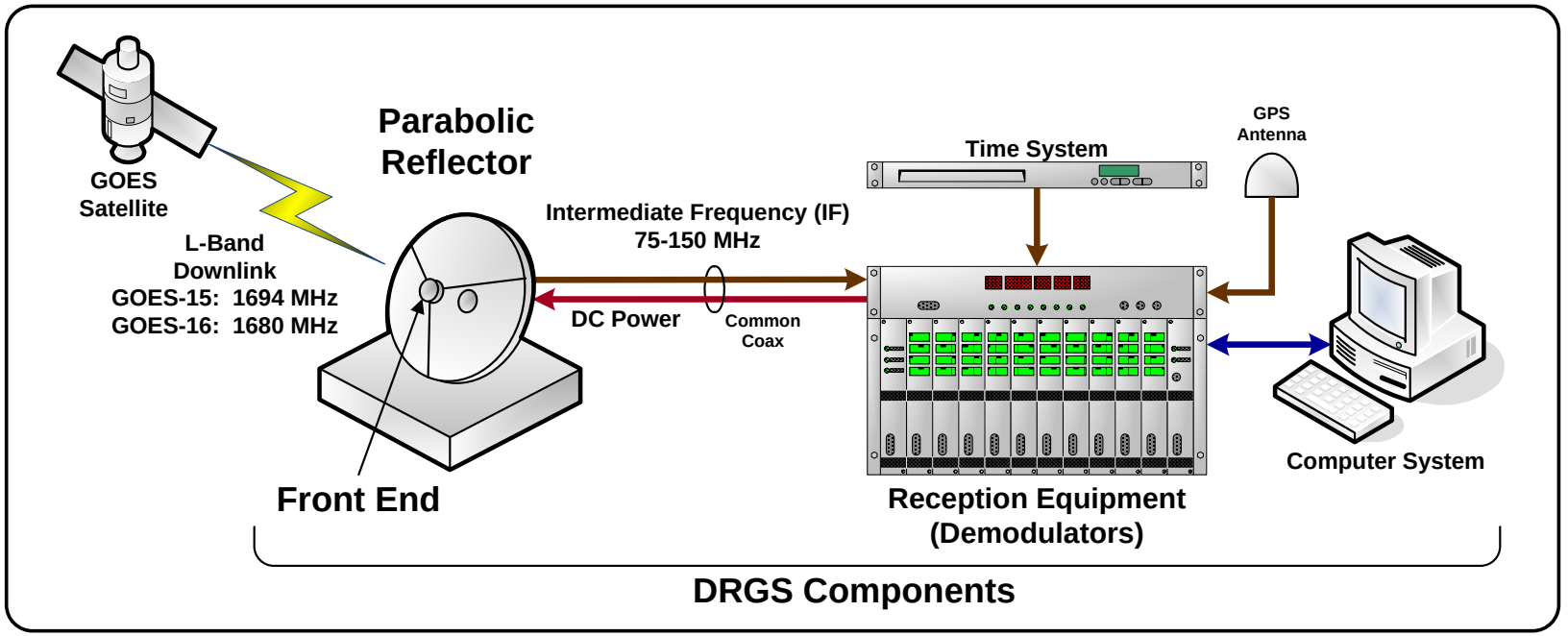
- DCS Spectrum encompasses ~330 kHz, and consists of over 400 channels.
- DRGS must be able to simultaneously monitor all of the channels of interest.
- Sometimes the DCS is heavily loaded as in spectrum above.

GOES DCS Spectrum – Lightly Loaded



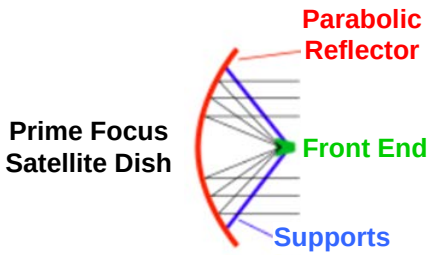
- And, sometimes the DCS it is lightly loaded as in spectrum above.
- Pilots are always present.
- Satellite downlink power is held constant regardless of the number of active platforms, which results in *received* Pilot levels varying significantly.

DRGS Components



- 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.

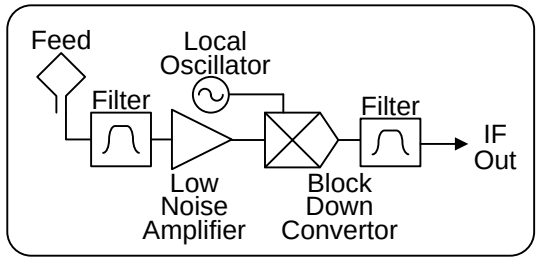
Satellite Dish and Front End



- 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.

Front End Elements



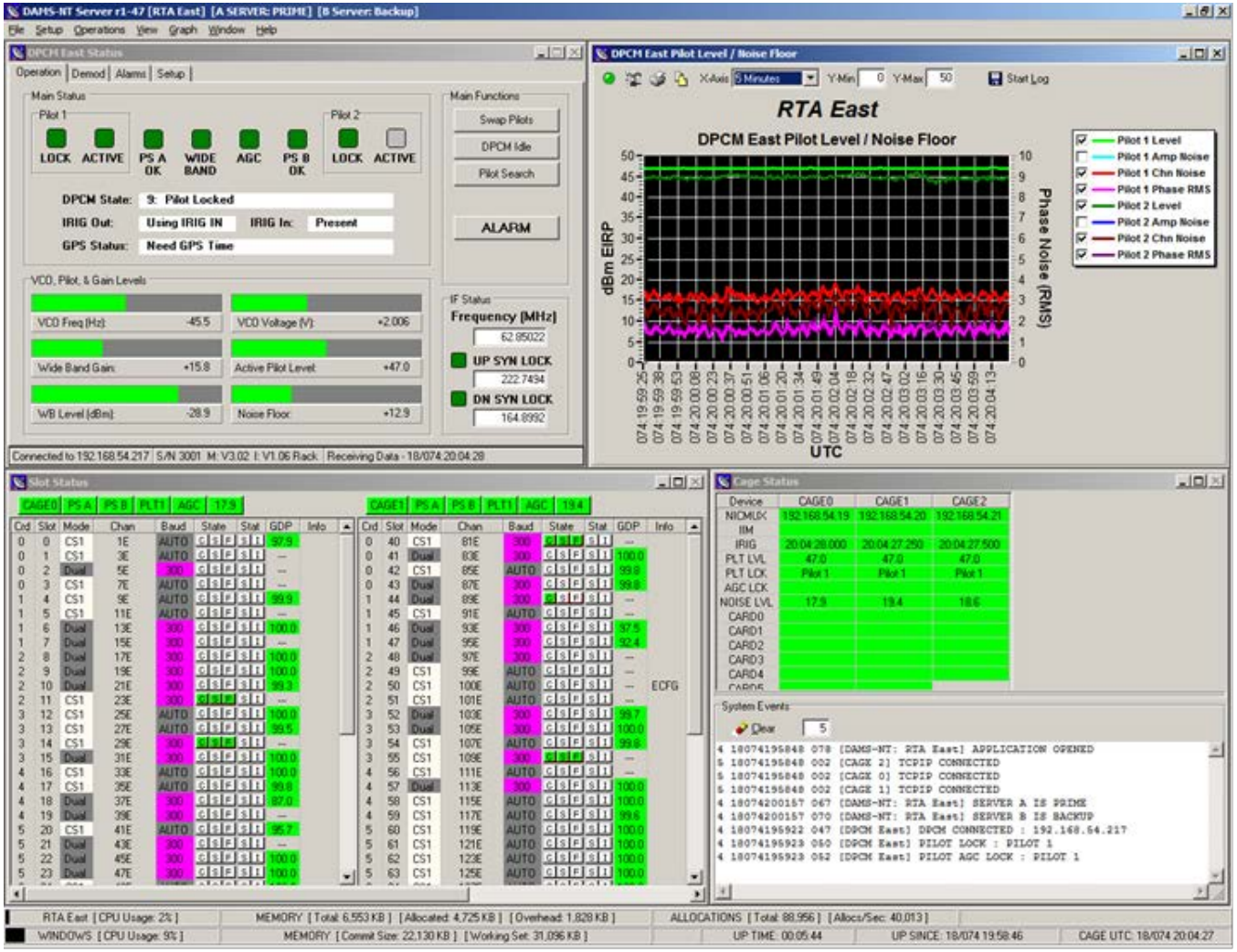
Receiving Equipment - DPCM

- 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.

END OF PRESENTATION

"THANK YOU" FOR YOUR ATTENTION