

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.

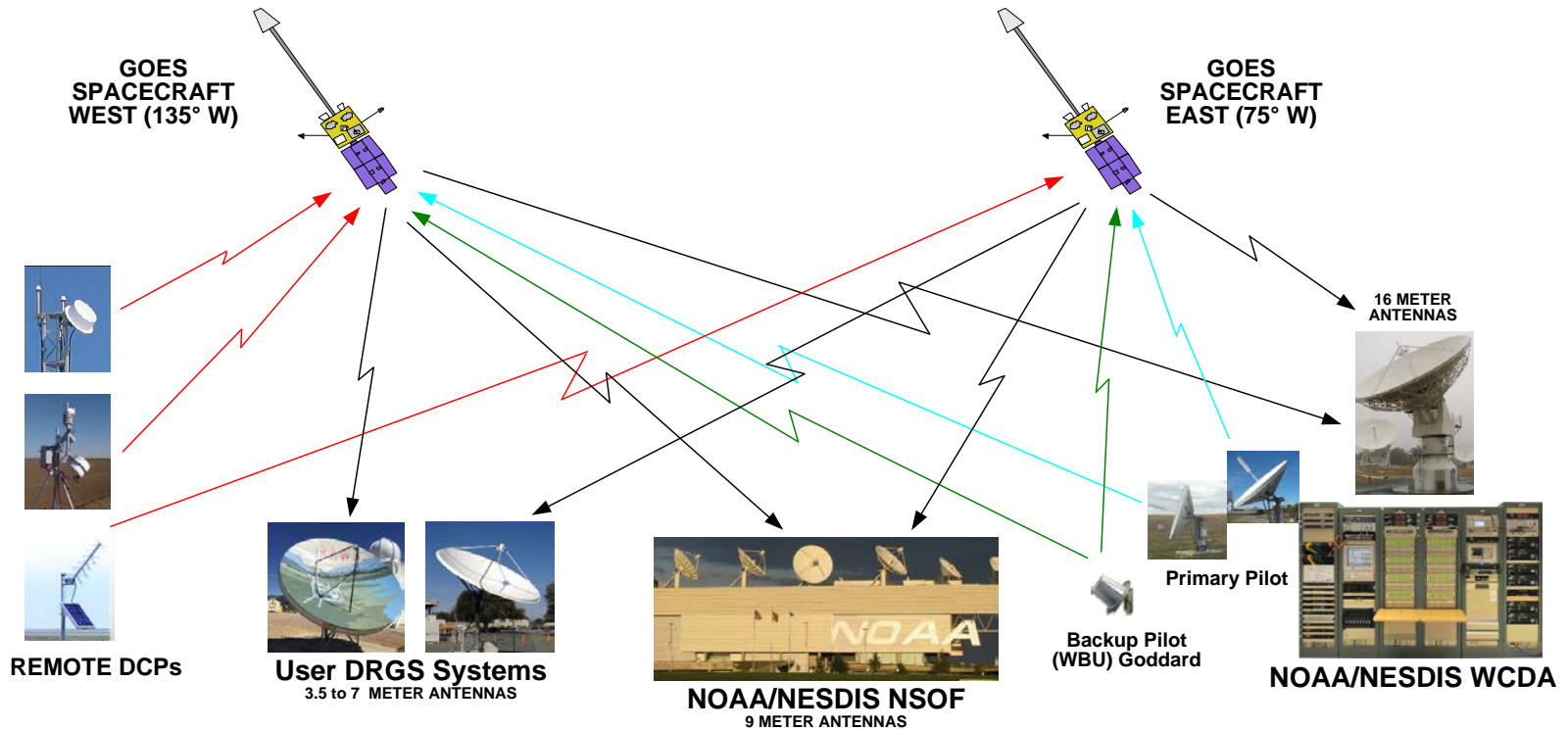
➤ U.S. Geological Survey (USGS)

- 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

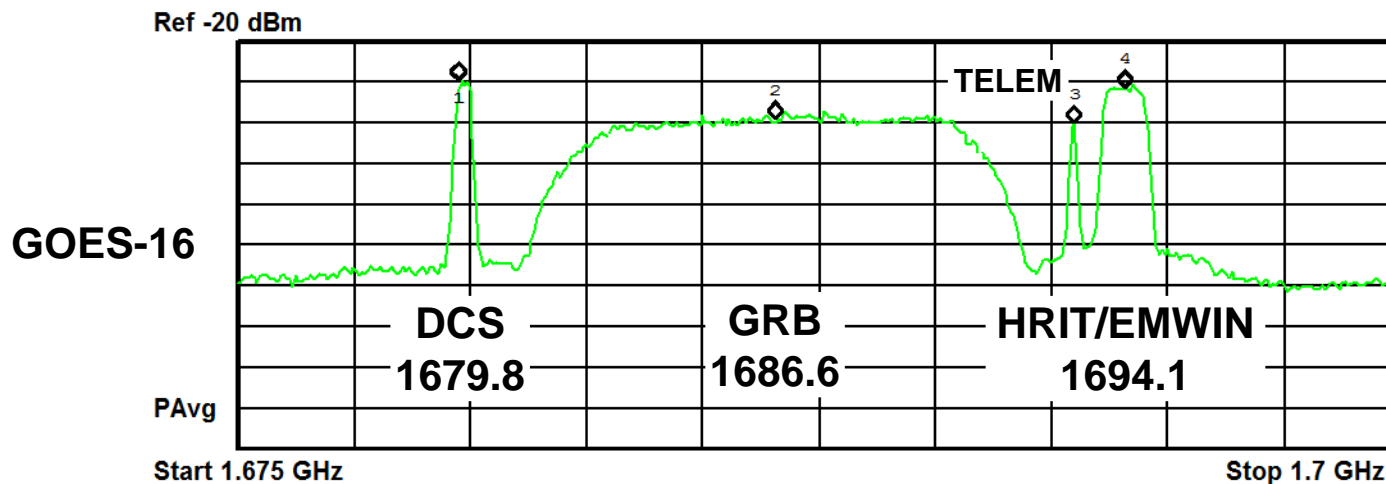
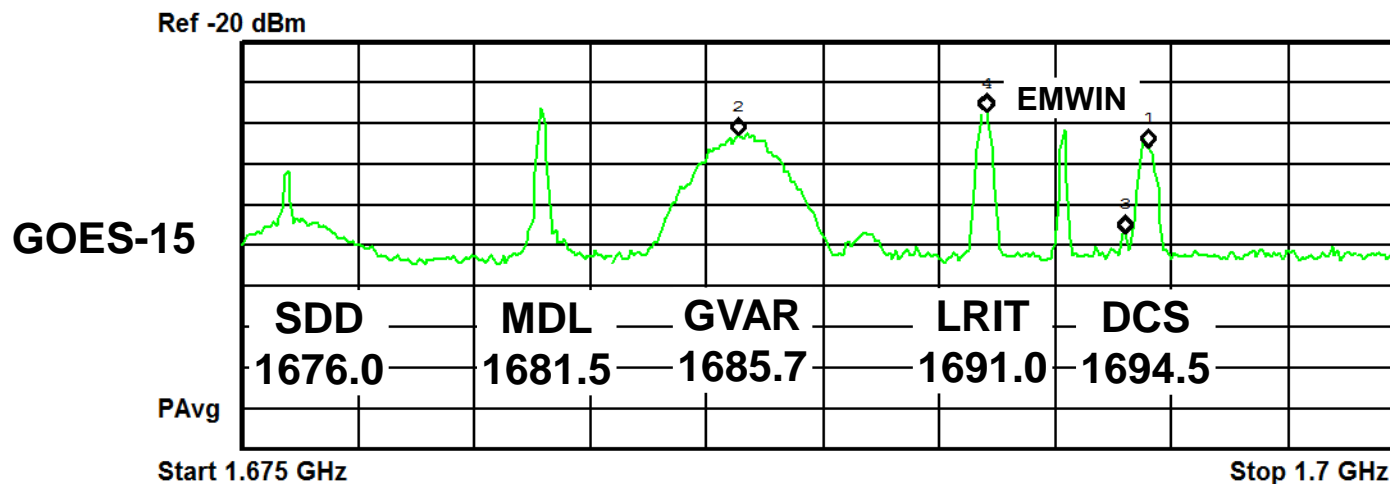


- Geostationary Satellites: GOES East @ 75° W and GOES West @ 135° W
- WCDA – Primary Receive Site NSOF – Alternate Receive Site
- DCPs Uplink at UHF (~402 MHz) & Downlink is L Band (~1680 or 1694 MHz)
- Primary Pilot: Uplink = 401.85 MHz G15 = 1694.45 MHz G15 = 1679.85 MHz
- Backup Pilot: Uplink = 401.70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

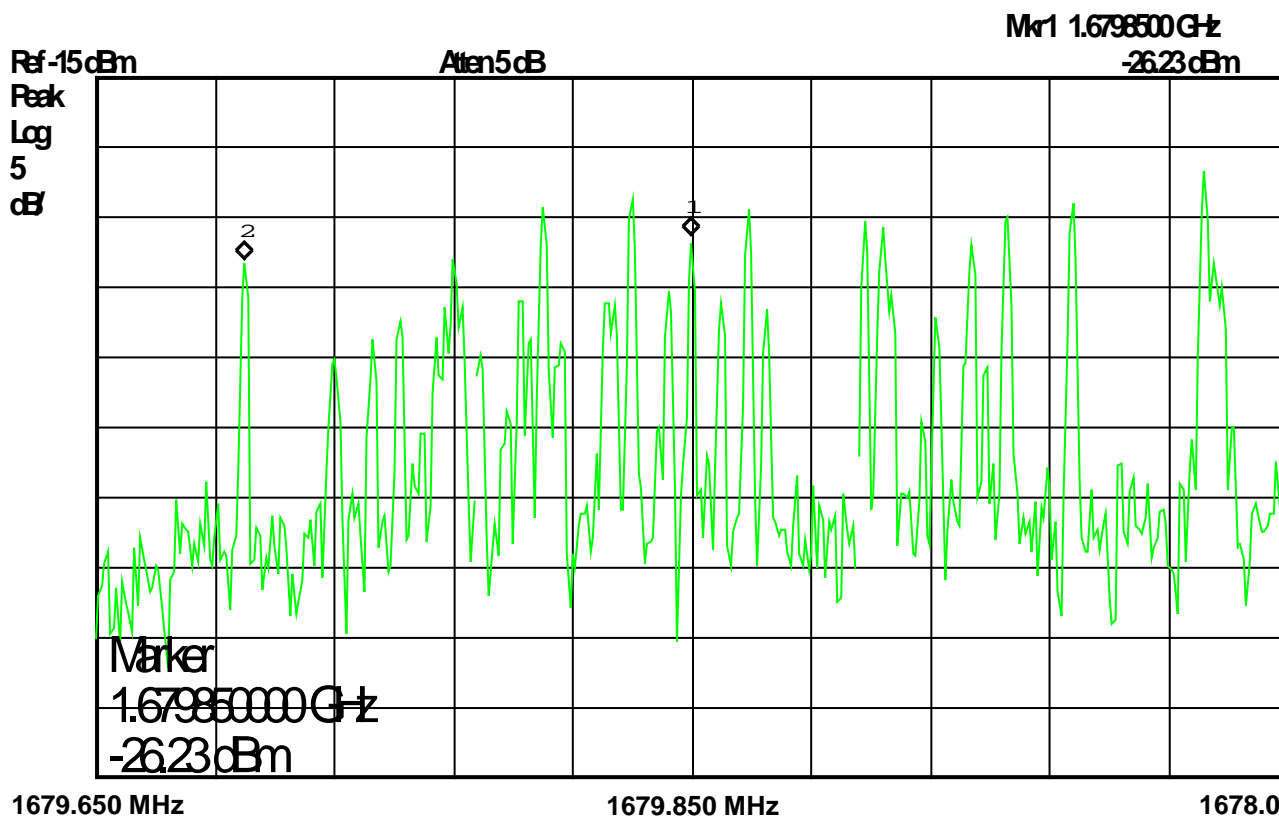




GOES Satellite Spectrums

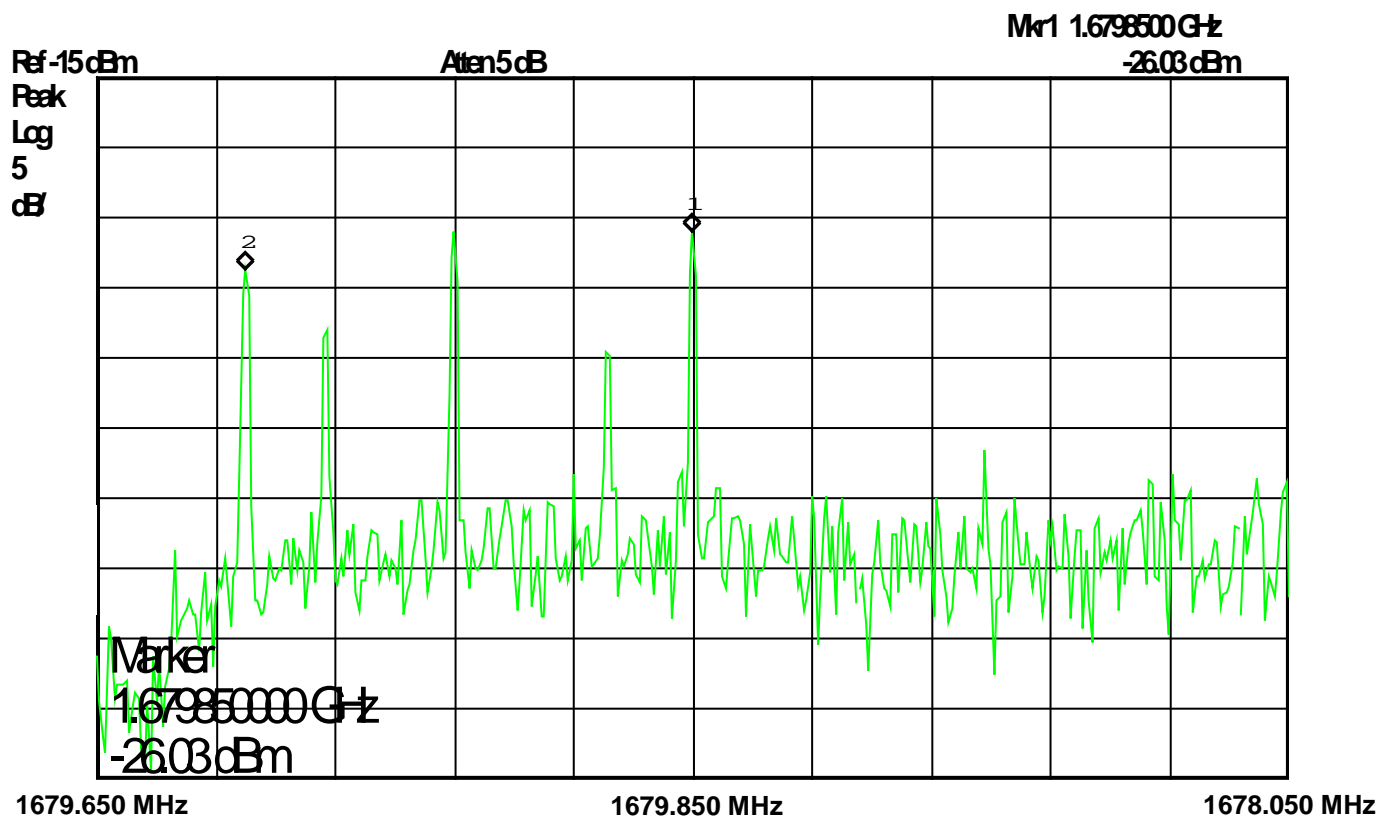


GOES DCS Spectrum – Heavily Loaded



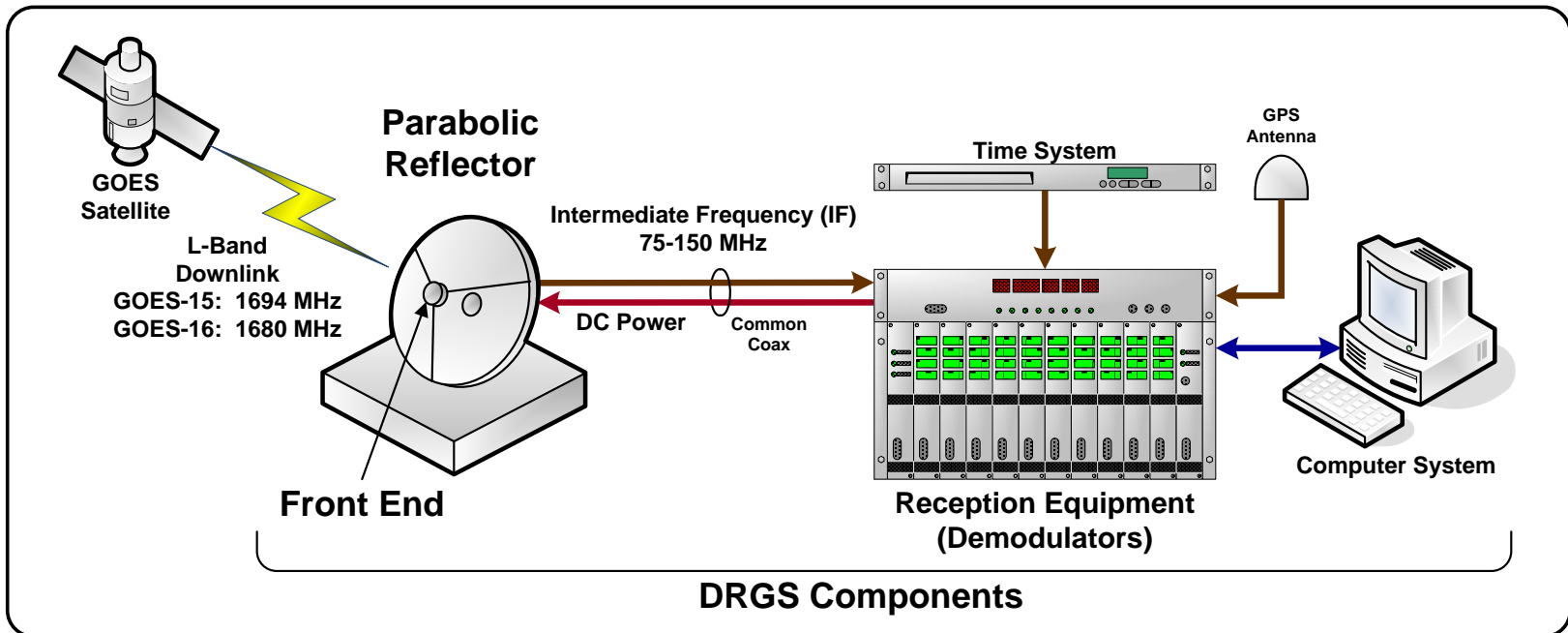
- DCS Spectrum encompasses ~330 kHz, and consists of over 400 channels.
- DRGS must be able to simultaneously monitor all of the channels of interest.
- Sometimes the DCS is heavily loaded as in spectrum above.

GOES DCS Spectrum – Lightly Loaded



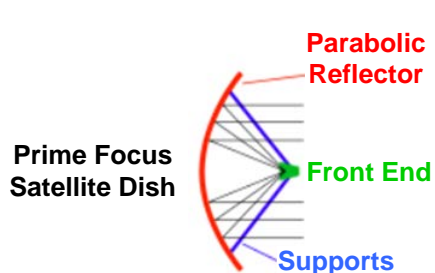
- And, sometimes the DCS it is lightly loaded as in spectrum above.
- Pilots are always present.
- Satellite downlink power is held constant regardless of the number of active platforms, which results in *received* Pilot levels varying significantly.

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



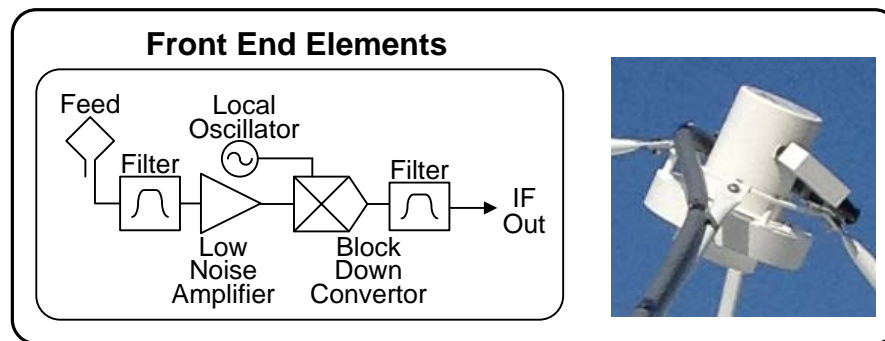
- DRGS systems utilize a Prime Focus arrangement.
- Incoming signal reflects off dish to the focal point of the parabola where the Front End is located.
- Dish sizes vary: 3.6M-uCom; 5M-NIFC; 5M & 7M-RI; 7M-BR; 7.5M & 8.1M-EDDN; 9M-NSOF; 16M-WDCA
- Older GOES satellites (8-12) required larger dishes;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

- Primary function is to translate received signal to lower frequency to minimize cable loss.



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



DAMS-NT Server v1-47 [RTA East] [A SERVER: PRIME] [B Server: Backup]

File Setup Operations View Graph Window Help

DPCM East Status

Operation | Demod | Alarms | Setup

Main Status

Pilot 1: LOCK ACTIVE PS A OK WIDE BAND AGC PS B OK

Pilot 2: LOCK ACTIVE

DPCM State: S: Pilot Locked

IRIG Out: Using IRIG IN IRIG In: Present

GPS Status: Need GPS Time

Main Functions

Swap Pilots

DPCM Idle

Pilot Search

ALARM

IF Status

Frequency [MHz]

62.95022

222.7434

164.8992

VCO, Pilot, & Gain Levels

VCO Freq [Hz]: -45.5 VCO Voltage [V]: +2.006

Wide Band Gain: +15.8 Active Pilot Level: +47.0

WB Level [dBm]: -28.9 Noise Floor: +12.9

Connected to 192.168.54.217 S/N 3001 M: V3.02 I: V1.05 Rack. Receiving Data - 18/074.20.04.28

DPCM East Pilot Level / Noise Floor

RTA East

DPCM East Pilot Level / Noise Floor

dBm EIRP

Phase Noise (RMS)

UTC

Slot Status

Card	Slot	Mode	Chan	Baud	State	Stat	GDP	Info
0	0	CS1	1E	AUTO	C	S	P	100.0
0	1	CS1	3E	AUTO	C	S	P	100.0
0	2	Dual	5E	300	C	S	P	99.9
0	3	CS1	7E	AUTO	C	S	P	100.0
1	4	CS1	9E	AUTO	C	S	P	99.9
1	5	CS1	11E	AUTO	C	S	P	100.0
1	6	Dual	13E	300	C	S	P	100.0
1	7	Dual	15E	300	C	S	P	100.0
2	8	Dual	17E	300	C	S	P	100.0
2	9	Dual	19E	300	C	S	P	100.0
2	10	Dual	21E	300	C	S	P	99.9
2	11	CS1	23E	300	C	S	P	100.0
3	12	CS1	25E	AUTO	C	S	P	100.0
3	13	CS1	27E	AUTO	C	S	P	99.9
3	14	CS1	29E	300	C	S	P	100.0
3	15	Dual	31E	300	C	S	P	100.0
4	16	CS1	33E	AUTO	C	S	P	100.0
4	17	CS1	35E	AUTO	C	S	P	99.9
4	18	Dual	37E	300	C	S	P	100.0
4	19	Dual	39E	300	C	S	P	100.0
5	20	CS1	41E	AUTO	C	S	P	99.9
5	21	Dual	43E	300	C	S	P	100.0
5	22	Dual	45E	300	C	S	P	100.0
5	23	Dual	47E	300	C	S	P	100.0

Cage Status

Device	CAGE0	CAGE1	CAGE2
NICMLK	192.168.54.19	192.168.54.20	192.168.54.21
IRIG	20.04.28.000	20.04.27.250	20.04.27.500
FLT LVL	47.0	47.0	47.0
FLT LCK	Flx1	Flx1	Flx1
AGC LCK			
NOISE LVL	17.9	13.4	18.6
CARD0			
CARD1			
CARD2			
CARD3			
CARD4			
CARD5			

System Events

4 18074195848 078 [DAMS-NT: RTA East] APPLICATION OPENED

5 18074195848 002 [CAGE 2] TCP/IP CONNECTED

5 18074195848 002 [CAGE 0] TCP/IP CONNECTED

5 18074195848 002 [CAGE 1] TCP/IP CONNECTED

4 18074200157 047 [DAMS-NT: RTA East] SERVER A IS PRIME

4 18074200157 070 [DAMS-NT: RTA East] SERVER B IS BACKUP

4 18074195922 047 [DPCM East] DPCM CONNECTED : 192.168.54.217

4 18074195923 050 [DPCM East] PILOT LOCK : PILOT 1

4 18074195923 052 [DPCM East] PILOT AGC LOCK : PILOT 1

RTA East | CPU Usage: 2% | MEMORY | Total: 6,953 KB | Allocated: 4,725 KB | Overhead: 1,829 KB | ALLOCATIONS | Total: 88,956 | [Alloc./Sec: 40.013]

WINDOWS | CPU Usage: 9% | MEMORY | Commit Size: 22,130 KB | [Working Set: 31,096 KB] | UP TIME: 00:05:44 | UP SINCE: 18/074.19:58:46 | CAGE UTC: 18/074.20:04:27





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

