



NOAA Satellites and Information

National Environmental Satellite, Data, and Information Service



GOES DCS RFI Investigation



Wallops Command and Data Acquisition Station

Project Goals

- Identify degraded channels/frequencies in DCS
- Characterize interfering signal(s)/RF energy
- Determine source(s) (local, satellite, etc.)
- Identify ground-based location of RFI source(s)
- Eliminate interfering signal(s) if possible



Problem Description

- DCS channels blocked by RFI
 - Initially channels 65, 66
 - Most recently noticed by WCDAS personnel on Ch 166
- Interference probably present for >10 yrs
 - RFI has been occasionally logged on these same channels
 - RFI was listed as sporadic and/or ‘rogue’ emitters
 - Occasional checks logged RFI as sporadic
- DCS carrier detect indicator lights
 - Cannot process legitimate signal
 - Channel is ‘locked-up’ by low level carrier
- RFI present on all GOES Spacecraft DCS systems
 - Levels differ
 - Frequencies differ



DCS Team Est.

- JSC/Alion requested to provide technical support
- Coordination with OSD/WCDAS engineering staffs
- Spectrum survey programs and equipment deployed to take measurements at WCDAS
 - Documented presence of narrow band carrier on channels 66, 166
 - Identified & documented narrow band RFI on Ch 200, & 266 and other channels at lower levels
 - Energy detected using 1 & 10 Hz bandwidths
 - RFI waveform was CW signal

DCS/RFI Resolution Process

- Attacked problem on four fronts:
 1. Ground-based RF receive system
 2. Satellite self-generated RFI
 3. Geo-location for terrestrial RFI emitter
 4. Search transmitter database for candidates

1. RF Receive System

DCS Channelized system

RFI present at 74 & 5 MHz lfs

- Bandwidth of RFI signals = 1 Hz
- Continuing to characterize RFI to find identifying characteristics

Local RFI

- Looked for local RFI using 13-meter polar antenna
- Demonstrated RFI present at other sites (FCDAS)

Antennas and down converters

- RFI present at LNA output

2. Satellite Generated RFI

- Satellite self-generated RFI
 - RFI stable, tracked spacecraft LO & AGC
 - RFI frequency identical on multiple spacecraft on some channels
 - RFI frequencies not related to on-board oscillators
- Investigated RFI from other geo-stationary spacecraft
 - Similarity of RFI signatures in Ch 266 on GOES-10 & 9 suggested geo-stationary source
 - Possible Space Ops (S-E) at 401-402 MHz – no match
 - No allocations to space at subharmonics – no matches
 - Checked ITU space frequency database – no conflicts found

3. Geo-location for Terrestrial RFI

- Utilized assets available through JSC Operations-Satellite triangulation
- Identified multiple potential RFI sources and locations
- Identified uplink CW RF sources within the DCS band, additional RFI located on new channels
 - Will further investigate frequencies at WCDAS



4. Transmitter Database

- Government, FCC, ITU, and Intelligence databases examined
- Investigated Wind Profile Radar(404 MHz) system
 - Amplitude, frequency spacings
 - Potential RFI to SAR (406 MHz) and DCS (402 MHz)
 - No change to RFI in DCS system when WPRs turned **off**
- Data obtained for geolocated regions
 - 10 km radii
 - Frequency range \approx 31 - 500 MHz
 - No good matches in databases
 - Some DCPs found (not RFI)
 - Will support on-site investigations



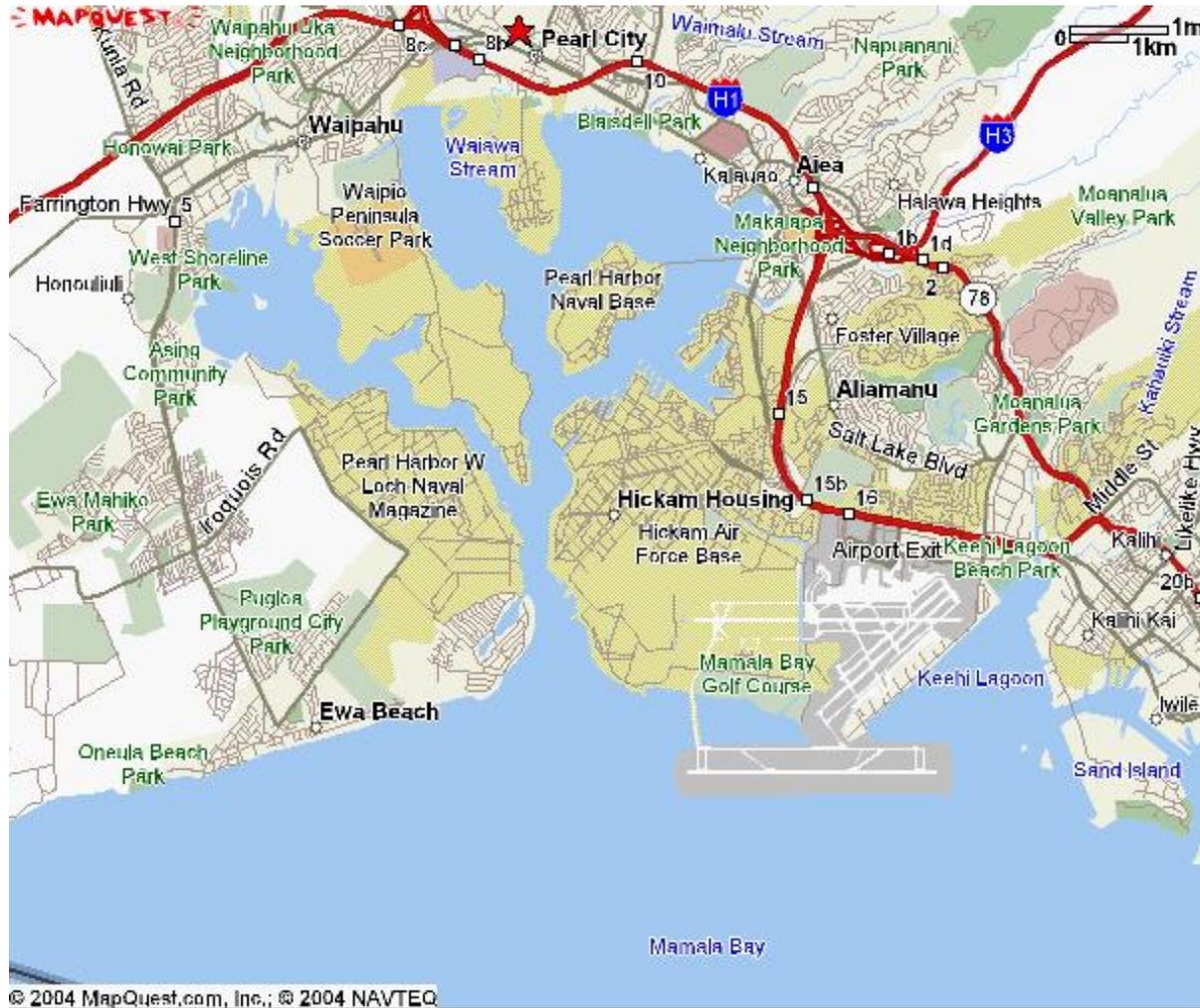
Geo-location Results

GOES Channel # (RFI Date)	Chanl BDW (KHz)	Uplink Frequency (MHz)	Latitude (D M S)	Longitude (D M S)	Nearby Location	Mod &/or BW
01 Jun 04	1.5	401.7010 401.6000	N 00 13 34	W 078 47 42	EC	Null
14 Oct 04	1.5	401.7205 401.721	S 01 13 27	W 078 38 07	EC	FM
15	1.5	401.722	S 01 29 28	W 078 45 09	EC	FM
34 May-Jul	1.5	401.7505	S 00 24 45	W 090 59 00	EC	FM
48 May-Jul	1.5	401.7715 401.771	S 01 02 52	W 080 31 48	EC	FM
65 Jul 04 May-Jul Oct 04	1.5	401.7970 401.797 401.797 401.797	S 00 45 04 S 00 43 30 S 00 45 33	W 078 51 50 W 078 53 04 W 078 51 08	EC EC EC	Null FM <1.5
66 July 04	1.5	401.7985 401.799	N 08 08 20	W 063 32 51	VE	Null
67 May-Jul	1.5	401.8000 401.800	S 02 25 35	W 079 00 35	EC	FM
68 May-Jul	1.5	401.8015 401.801	S 02 27 32	W 079 02 49	EC	FM
133 May-Jul	1.5	401.8990 401.899	S 00 03 08	W 078 02 36	EC	FM
134 May-Jul	1.5	401.9005 401.9000	S 00 02 00	W 078 04 18	EC	FM
166 May-Jul Sep 04	1.5	401.9485 401.948 401.948	S 00 39 49 S 00 42 26	W 078 28 26 W 078 24 02	EC EC	FM CW
266 Jan 04 Jun 04 Jul 04 May-Jul Aug 04 Oct 04	3.0	402.0985 402.099 402.100 402.100 402.100 402.100 402.097	S 00 07 00 N 00 07 57 S 15 19 51 S 00 07 57 N 00 06 12 N 00 08 30	W 078 44 00 W 078 44 31 W 068 15 28 W 078 44 31 W 078 40 31 W 078 41 39	Miraflores, EC EC BL Miraflores, EC Miraflores, EC Miraflores, EC	FM FM FM FM FM >3.1





Geo-location Results Ch 266





Hawaii-Ewa Beach Field Investigation

- Contacted PACCOM Frequency Manager, Pacific Theatre for area support to locate RFI emitter
- Team travel to Ewa Beach, HI commenced 11/12/04
- On-site testing confirmed pilot tone transmitter for Japanese DCS-GMS located at the NWS Pacific Tsunami Warning Center identified as source of signal on Ch 266 for GOES West and Far West via field testing – not on GOES East
- Team returned on on 11/19/04
- Further coordination with GMS sponsor at NASA GSFC continuing for frequency management

Vitel Model GR3170 Pilot Transmitter on Ch266 and rack containing old microwave gear



building, antenna, and transmitter





E

EC-Chs 1,15,34,48,65,67,68,133,&266; VE Ch-66

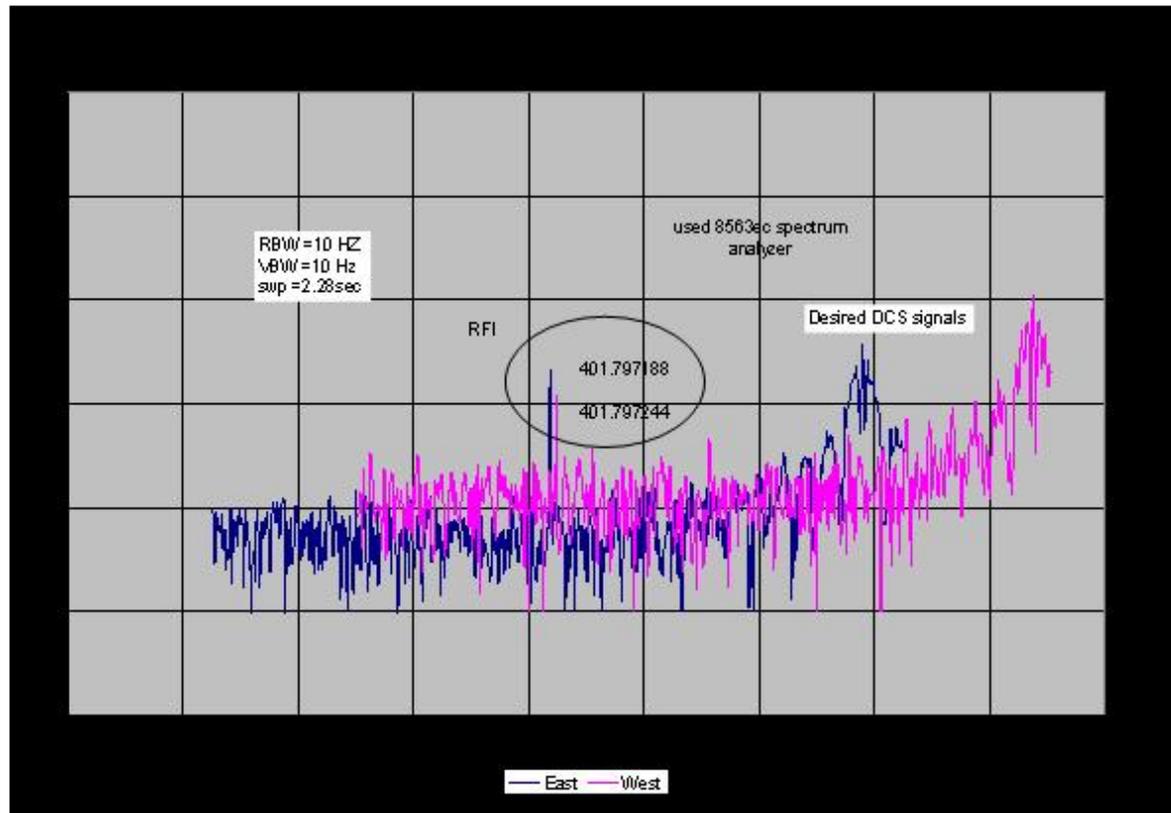
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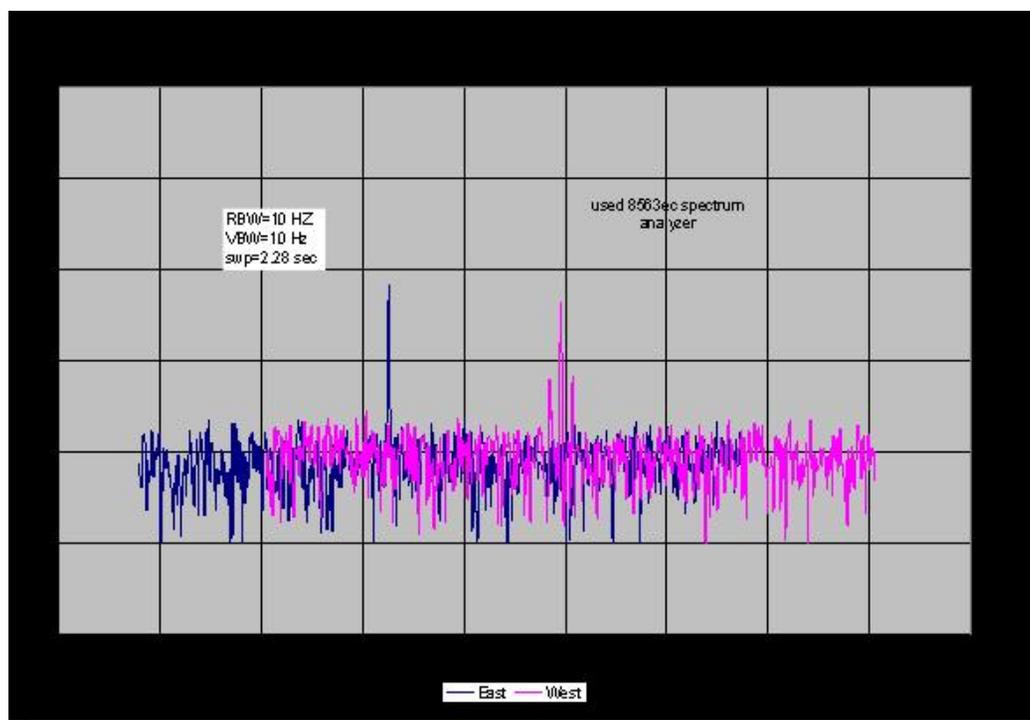


Channel 65 (GOES 10 & 12) Single RFI Source





Channel 266 (GOES 10 & 12) Multiple RFI Sources



Summary/Conclusions

- Narrowband RFI is widespread throughout DCS system
 - RFI not local or GOES generated
 - Frequency shifts differ through GOES spacecraft
- JSC still searching for matches with system characteristics and geolocations
- Identification of Ewa Beach RFI source successful utilizing geolocation
- Continue pursuing other identified locations for interference sources