Spectrum Allocation and NOAA Satellite Downlinks Receiver Impacts

Microcom Design, Inc.
July 2017
Founded in 1975 by Harry E. Betsill and William M. Pulford
- RF Communications, Data Acquisition, Systems Design, Real-Time Software and Database Applications.

Brett H. Betsill, President and Craig M. Pulford, Vice-President

Experience with GOES Data Collection System (DCS) since the early 1980’s - Assumed Lead DCS Ground Station Role in 2000’s.

Three Major DCS Receive Sites
- Wallops Command and Data Acquisition Station (WCDAS), VA
- NOAA’s Satellite Operations Facility (NSOF), MD
- USGS’s Emergency Data Distribution Network (EDDN)

Over 20 Other Smaller DCS Receive Sites Across GOES Footprint
- USACOE, NIFC, BLM, Florida DOT, South Florida WMD
- Canada, Mexico, Caribbean, South America

Over 40 LRIT/HRIT Receivers in Operation, Most in CONUS

2015/2016 Investigated Potential for LTE Interference Due to Auctions and Proposed Spectrum Sharing
Demodulators need to be updated (DCS/HRIT) or replaced (GRB) for GOES-16 changes.

Front End may need to be changed or updated due to spectrum allocation and/or GOES-16 changes.

- Receives L-Band Downlink from reflector, amplifies signal (LNA), and translates to lower frequency (BDC).
GOES-NOP versus GOES-R Spectrums

Ref -20 dBm

1670-1675 MHz LTE Towers

Proposed Sharing LTE Towers

1675-1680 MHz

SDD 1676.0

MDL 1681.5

GVAR 1685.7

LRIT 1691.0

DCS 1694.5

PAvg

Start 1.675 GHz 1680 MHz to 1695 MHz Stop 1.7 GHz

1695-1710 MHz Shared AWS-3 Polar Satellites LTE Handsets

1675-1680 MHz

TELEM

1686.6

DCS 1679.8

GRB 1686.6

HRIT/EMWIN 1694.1

PAvg

Start 1.675 GHz 1680 MHz to 1695 MHz Stop 1.7 GHz

1695-1710 MHz Shared AWS-3 Polar Satellites LTE Handsets

Microcom Design, Inc.
LTE In Band Interference Animation

Agilent 15:38:12 17 Feb 2016

Microcom Design, Inc.
LTE In Band Interference Animation

Agilent 15:38:12 17 Feb 2016

Ref -10 dBm  Atten 5 dB
Samp Log 5 dB/

LRIT

1693 MHz OFF

DCS

Center 76 MHz  VBW 30 kHz  Span 5 MHz
Res BW 30 kHz  Sweep 11.32 ms (401 pts)

Microcom Design, Inc.
Front End Limiting Animation

Agilent 16:28:54 19 Feb 2016

Ref 20 dBm Atten 20 dB
Samp Log 10 dB/
Offst 10 dB

VAvg 50 W1 S2
S3 FC AA

RF OFF

Center 74 MHz Span 100 MHz
Res BW 1 MHz VBW 1 MHz
Sweep 4 ms (401 pts)
Site Aerial View

49°

250 FEET
Improved Front End Filtering

- Microcom can already see adjacent band signals above 1720 MHz.
  - Short burst LTE signals can only be captured using spectrum analyzer in “Max Hold” mode and allowing capture to run for several minutes.
- Readily filtered with external cavity filter between Feed and LNA/BDC.
- Significant improvement provided, but may not be good enough for AWS-3 (1695-1710 MHz) and/or proposed use of 1675-1680 MHz.
Filter Improvements – Other Options

- New LRIT/HRIT LNA/BDC from Quorum places HRIT signal at edge of passband providing attenuation beginning at 1695 MHz.
- Narrower and sharper cavity filters are possible, but will be larger and generally have more passband ripple.

Microcom Design, Inc.
Summary and Conclusions

- LTE Handset transmissions from 250 feet away ...
  - ... can cause adjacent band interference when transmitting with more than +10 dBm (0.01 Watts) of power.
  - ... will cause in band interference when transmitting with more then -11 dBm (0.00008 Watts) of power.

- Towers can transmit 1500 Watts (32 dBW or 62 dBm).
  - 52 dB (160,000) above observed adjacent band interference.
  - 73 dB (20,000,000) above observed in band interference.

- Mitigating in band interference is impractical/impossible.

- Mitigating adjacent band interference ...
  - is possible with improved filtering at Front End of earth station if LTE is limited to handsets.
  - is highly doubtful, if not impossible, for the higher powered tower transmissions.

- Front End improvements will most likely need to be signal specific (DCS, GRB, or HRIT) for optimum performance.