CGMS XXXIII NOAA-WP-18
Prepared by NOAA
Agenda Item: IV/1.1

Report on the Analysis of the Study Result Concerning Interference Between Polar –orbiting Meteorological Satellites - Interference Analysis between NPOESS and METOP at L-Band

NOAA's assessment of interference between NPOESS and METOP at L-band indicates there is interference when METOP operates on their secondary downlink frequency which occurs only in the event of a failure of their primary downlink. In this case, EUMETSAT previously indicated that ~3 % outage appeared to be acceptable.

October 14, 2005

Report on the Analysis of the Study Result Concerning Interference Between Polar –orbiting Meteorological Satellites - Interference Analysis between NPOESS and METOP at L-Band

1. Introduction

At the CGMS XXXII Meeting in Sochi, Russian Federation, 17-20 May 2004, NOAA received the following action relating to interference from the NPOESS LRD downlink to the METOP HRPT downlink:

> Action 32.07: NOAA to report back on the analysis of study results [by EUMETSAT] concerning potential interference between polar orbiting meteorological satellites. Deadline: 31 December 2004.

EUMETSAT reported on studies [[1]] performed by EUMETSAT to estimate the impact of interference from NPOESS into METOP Earth stations at ~1.7 GHz. These studies assumed one METOP satellite and three NPOESS satellites. The main results of the studies were as follows [1]:

- "Worst cases are obtained when both satellites have the same equatorial crossing times as the orbits will occasionally overlap. For the selected orbit heights, this would occur approximately every 113 days."
- "Significant data loss for up to 3% of time will occur around 1.7 GHz"
- "Interference levels and statistics are rather independent of station locations."

EUMETSAT said: "…. data losses of up to 3% every 113 days at HRUS and HRD user stations appear to be acceptable…."

NOAA repeated this analysis using the current NPOESS parameters with the METOP space and ground parameters provided by EUMETSAT, and this analysis showed no interference when METOP operates on its primary downlink frequency of 1701.3 MHz and ~3 % interference, as predicted by METOP, when METOP operates on its secondary downlink frequency of 1707 MHz. At SFCG-24, NOAA requested that EUMETSAT provide any updates to the METOP space and ground parameters, and since NPOESS hasn't received any additional information, NOAA assumes the previously provided parameters are accurate and correct. The purpose of this document is to present the results of the interference analysis performed by NOAA.

[1] Report on Potential Problems for Operational Orbit Scenarios Caused by Frequency Overlap, CGMS-XXXII EUM-WP-19, Prepared by EUMETSAT.

2. Orbital Parameters

Both NPOESS and METOP are in sun synchronous orbits. METOP has one satellite in the 21:30 LTAN, and NPOESS has three satellites in the 21:30, 17:30, and 13:30 LTANs. The characteristics of the NPOESS and METOP orbits are shown in Table 2-1.

Table 2-1. Orbital Parameters

	NPOESS	METOP
Orbit	**Sun Synchronous**	**Sun Synchronous**
Number of Satellites	**3**	**1**
Repeating Ground Track	**Yes**	**Yes**
Repeat Cycle (Days)	**17**	**29**
Repeat Cycle (Orbits)	**241**	**412**
LTAN	**2130, 1730, 1330**	**2130**
In-Plane Phasing (deg)	**280, 0, 80**	**NA**
Altitude (km)	**827.768**	**817.455**
Period (hrs) **Period (min)**	**1.6929** **(101.577)**	**1.6893** **(101.359)**

Interference can occur between the 21:30 NPOESS satellite and the 21:30 METOP satellite since these satellites are in the same orbit plane but at difference altitudes. The 21:30 METOP and 21:30 NPOESS satellites can be spatially aligned every ~33 days.

3. NPOESS and METOP RF Characteristics

The NPOESS and METOP RF characteristics are summarized in Table 3-1. The METOP HRPT downlink and the NPOESS LRD downlink are operated worldwide. Both NPOESS and METOP employ bandwidth-efficient square-root raised cosine (SRRC) pulse shaping.

Table 3-1. NPOESS and METOP RF Parameters

	NPOESS	METOP
Carrier Frequency (MHz)	**1707.0**	**1701.3 (P) or 1707 (S)**
Modulation	**SQPSK**	**QPSK**
Information Rate (Mbps)	**NA**	**3.50**
Signaling Rate (Msps)	**3.88**	**2.33**
Pulse Shaping	**SRRC, α = 0.5**	**SRRC, α = 0.6**
Detection Filter	**NA**	**SRRC, α = 0.6**
Minimum Elevation Angle (deg)	**5.0**	**5.0**
GS Location	**Worldwide**	**Worldwide**
GS Antenna Pattern	**NA**	**RR. Appendix 8 S.731 (Modified)**
GS Antenna Peak Gain (dBi)	**NA**	**27**
GS System Noise Temperature (K)	**NA**	**150/140**
Threshold E_b/N_o (dB)	**NA**	**7.0**
Theory (dB)		4.0
Implementation Loss (dB)		2.0
ESA Margin (dB)		1.0

4. NPOESS Transmit Spectrum

The NPOESS LRD transmit spectrum and the METOP HRD detection filter frequency responses are shown in Figures 4-1 and 4-2 for the primary and secondary METOP carrier frequencies. The NPOESS LRD transmit spectrum was obtained by simulation.

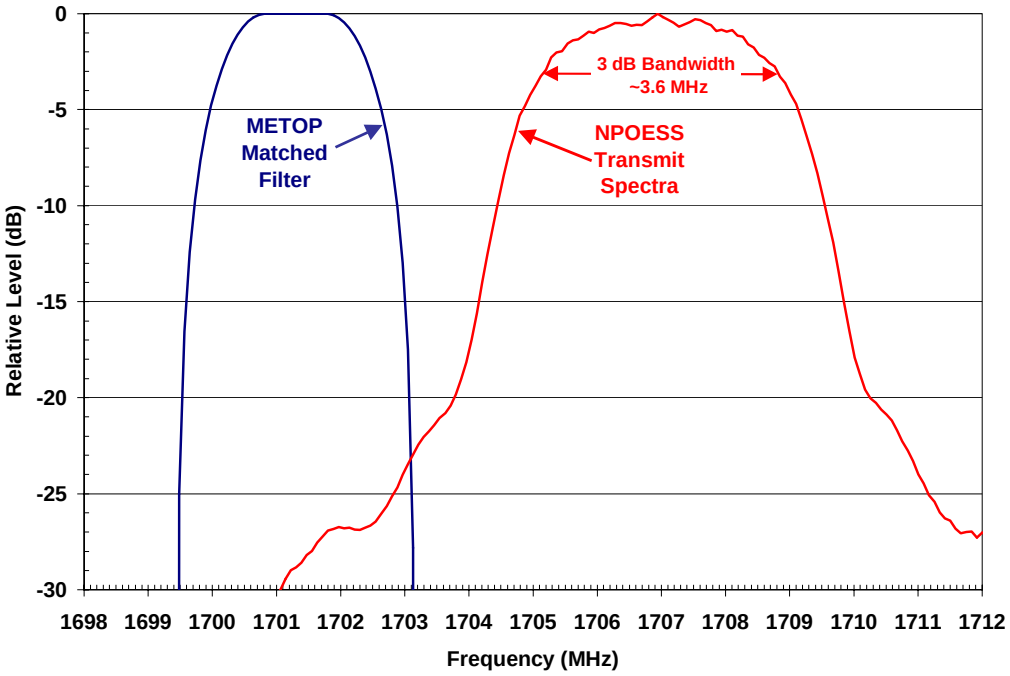

Figure 4-1. NPOESS Transmit Spectra and METOP Primary Matched Filter Response

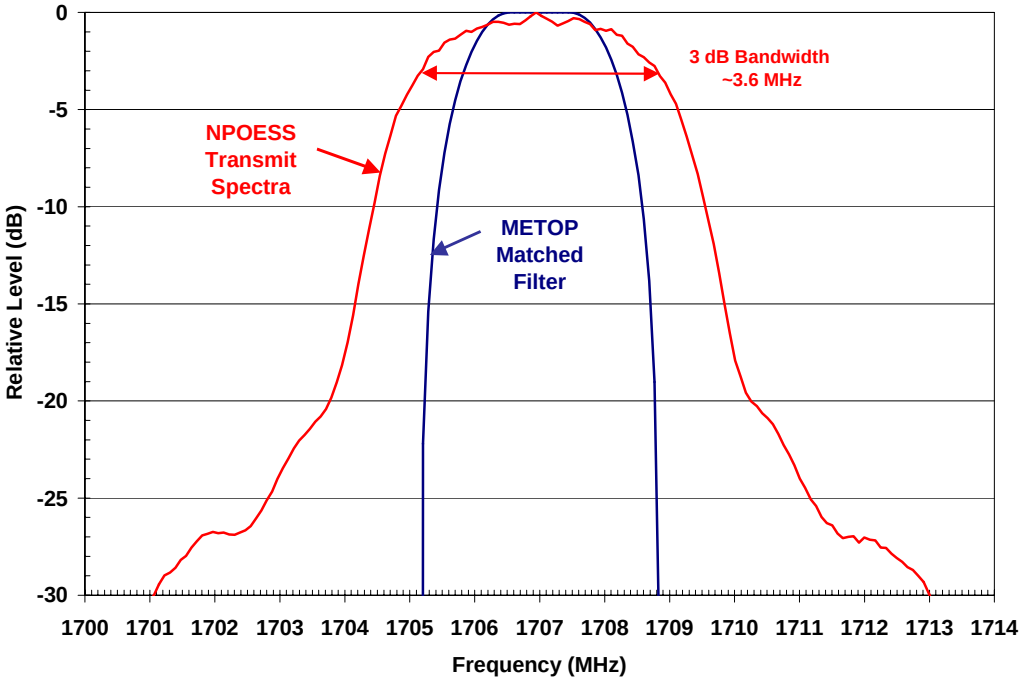

Figure 4-2. NPOESS Transmit Spectra and METOP Secondary Matched Filter Response

5. Interference Assessment

NOAA performed an independent interference assessment from three NPOESS satellites to one METOP satellite. This simulation was run for a period of one year in one second increments. As long as METOP operates on their primary downlink frequency of 1701.3 MHz, there is no interference between NPOESS and METOP. If METOP operates on their secondary downlink frequency of 1707 MHz, NOAA concurs with EUMETSAT's assessment of ~3 % outage.

Discussions with EUMETSAT indicated that METOP intends to use their secondary downlink frequency only in the unlikely event of a failure of their primary downlink. In this case, there will only be interference between NPOESS and METOP if METOP experiences a failure of their primary downlink and switches to their secondary downlink. In this case, EUMETSAT indicated in this previous submission to CGMS that "….data losses of up to 3 % every 113 days at HRUS and HRD user stations appear to be acceptable."