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# Can MRO Send 6 Mbps Telemetry Using X-band Channel 32?

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# Background on MRO

**JPL**

- MRO is the first mission to use both X-band and Ka-band to downlink telemetry
- X-band channel 32 and Ka-band channel 32(H) are assigned to MRO
- The X-band channel was selected based on an interference study conducted using inputs provided by the project, under the following conditions
  - Maximum symbol rate: 4 Msps
  - QPSK modulation
- MRO is planning to increase the X-band data rate to 6 Mbps
  - JPL Spectrum Manager's office was asked to investigate the feasibility from interference and SFCG point of view
  - A detailed interference study was performed by the Spectrum Engineering group



# The Need for Higher Data Rate on the X-band Link **JPL**

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- MRO is exploring ways to return more science data
  - The instruments onboard MRO are capable of generating science data much faster than it can send down
  - Increasing science return is a major mission objective
- What MRO is doing or plans to do
  - The MRO project has implemented the capability of simultaneously transmitting through X and Ka-band. This paves the way for MOR to later use Ka-band in addition to X-band to return science data, assuming a successful Ka-band operations demonstration during the early phase of the mission
    - By the year of 2005, there will be at least one 34m BWG antennas in each of the DSN complexes that can support both X-band and Ka-band simultaneously
  - MRO plans to increase X-band data rate from 4 Msps to 6 Mbps whenever the link can support it using a 70m antenna
    - With a 34m antenna, the data rate is approximately the same for Ka and X-band, because the Ka-band transmitter on board the spacecraft has a lower output power than the X-band transmitter: 35 W vs. 100 W
    - With a 70m antenna which currently does not have Ka-band capability, the supportable X-band data rate is much higher than the Ka-band data rate at a 34m antenna



## Issues Related to Sending 6 Mbps over X-band



- Potential interference to other deep-space missions, especially the Mars missions
  - Spacecraft operating in the Mars region are more susceptible to mutual interference because they do not have sufficient spatial separation between each other to protect against mutual interference
- A study was performed to determine periods of potential interference
  - Based on a signal to interference ratio (S/I) of 20 dB
  - Calculated pair-wise only interference
  - Considered effects of roll-off of the modulator and matched-filter detection



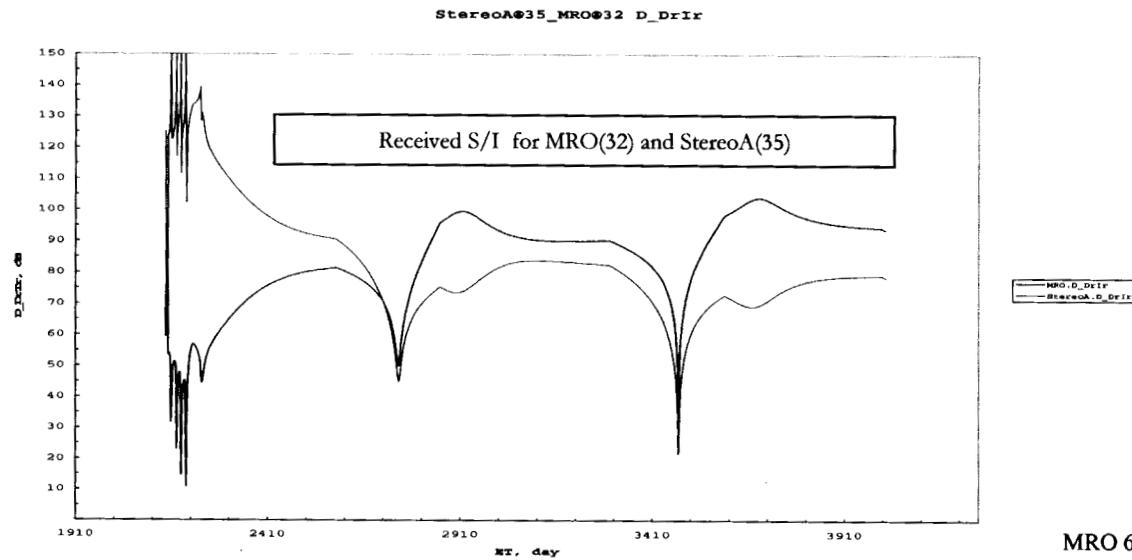
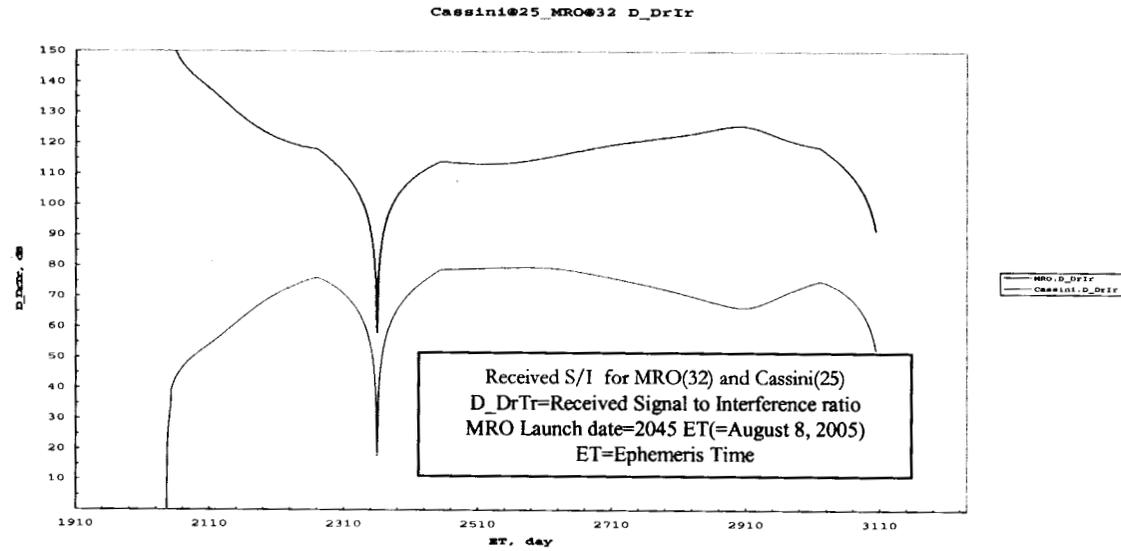
# Study Results



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- Results of the analysis indicate potential interference to the following missions:
    - Cassini- on June 18, 2006
    - StereoB- August 26-27, 2010
  - Based on the pair-wise analysis, there is no interference to other contemporary Mars missions which have been assigned a frequency channel (Mars Express, Odyssey, and MGS)



# Study Results (cont'd)

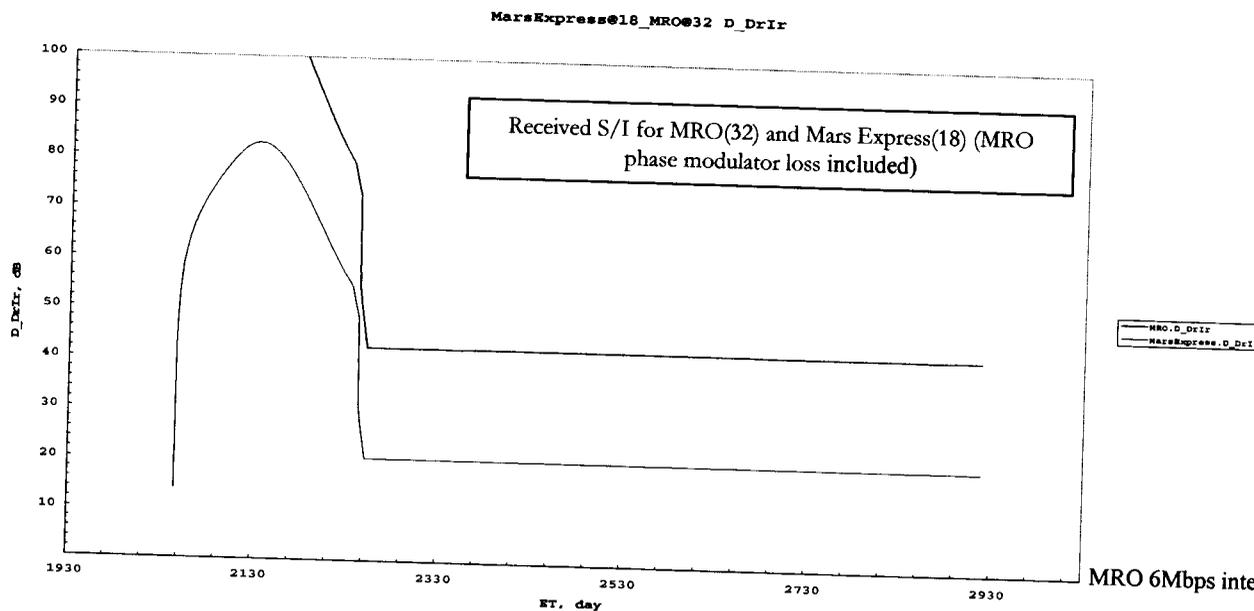
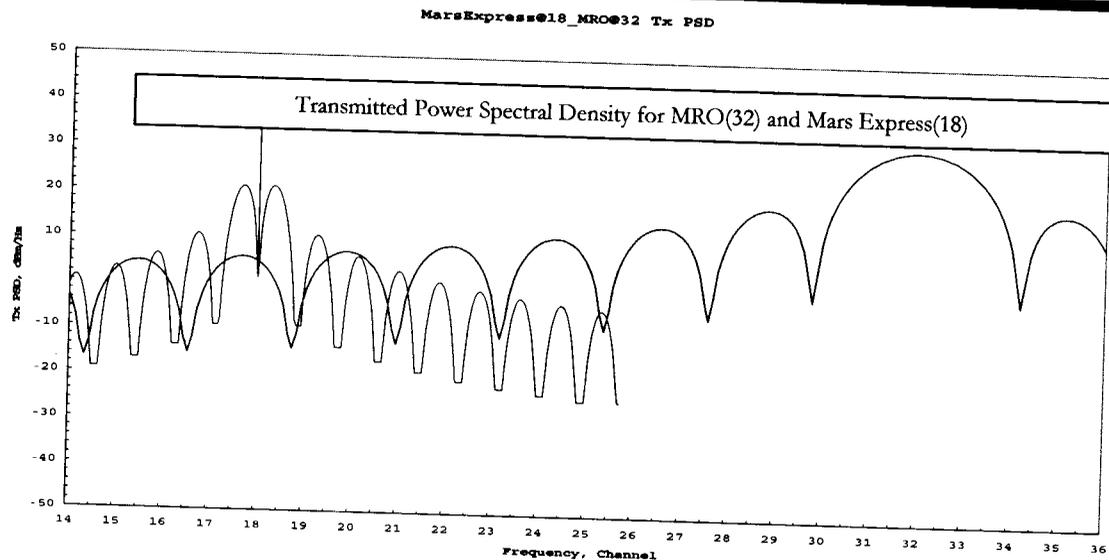


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MRO 6Mbps interference- 7



# Study Results (cont'd)



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MRO 6Mbps interference- 8



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- Additional study is planned to determine the aggregated interference level when more than two Mars missions are simultaneously in view of a ground station
  - Project agrees to operate the 6 Msps link on NIB, and investigate possible use of opposite polarization to avoid interference
    - All DSN antennas can selectively support RCP and LCP; but only some can do it simultaneously
    - The DSN is urged to include the simultaneous RCP/LCP reception capability on all stations
  - Channel selection study for missions not yet have an assigned channel will need to consider the wideband MRO downlink to avoid potential interference