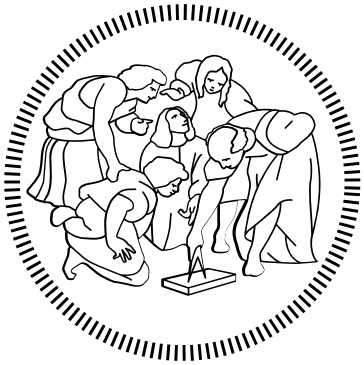

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Reverse Engineering of Juno Mission

Homework 3

Course of Space System Engineering & Operations
Academic Year 2023-2024

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Contents

Notation

TMTC	Telemetry and Telecommand
HGA	High Gain Antenna
MGA	Medium Gain Antenna
LGA	Low Gain Antenna
TLGA	Toroidal Low Gain Antenna
ALGA	Aft Low Gain Antenna
FLGA	Forward Low Gain Antenna
SYM	Symbol description[1]

1 TMTC architecture

The Juno TMTC subsystem purpose is to communicate data about the status of the spacecraft, download scientific data and to receive commands to and from the DSN antennas. Both the uplink and downlink are performed in X-band frequency: 7.15 GHz the downlink and 8.40 GHz the uplink. One of the main goals of the mission is to study Jupiter's gravity field: this is accomplished by exploiting the difference in doppler effect of the telecommunication from the model and the real jovian gravity field. Due to the harsh environment that Juno faces and the need to measure precisely the residual frequency, transmission on both X-band Ka-band during gravity science is needed. For this reason, the HGA can operate in 3 different modes:

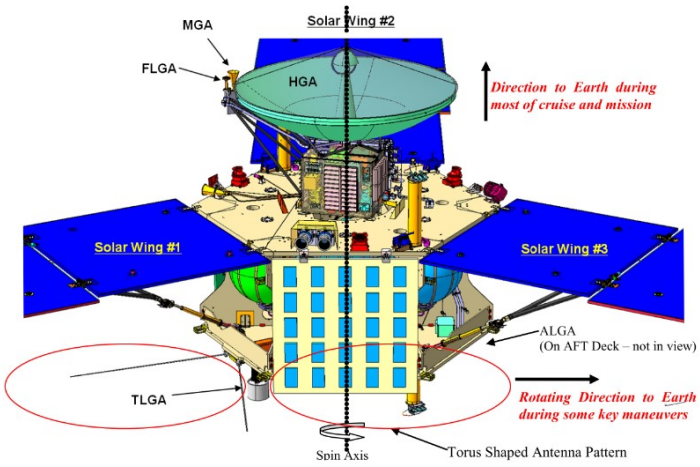

Figure 1: Location of telecommunication antennas

- **X/X**: uplink and downlink are coherent and performed in X-band;
- **X/X & X/Ka**: simultaneous transmission on X-band (uplink and downlink), together with a coherent Ka-band downlink at 32 GHz and X-band uplink;
- **X/X & Ka/Ka**: phase coherent X-band uplink and downlink together with a phase coherent Ka-band uplink at 34 GHz and downlink.

Five antennas are mounted onboard with different orientations, positions and capabilities: one HGA, one MGA, two LGAs and one TLGA.

1.1 HGA

1.2 MGH

1.3 LGA

1.4 TLGA

1.5 Ground stations

2 Rationale of TMTC system

3 Sizing of TMTC system

Bibliography

[1] Richard Grammier. *Overview of the Juno Mission to Jupiter*. Site: https://www.jpl.nasa.gov/missions/juno. 2006.