

# Iris for INSPIRE CubeSat Compatible, DSN Compatible Transponder

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# Deep Space – “Huge”

- How to communicate and navigate
  - Distances 100 to > 10,000 X low earth orbit
  - GPS unavailable
- Deep Space Network
  - Large Apertures
  - High Power uplink
  - Low G/T (gain / temperature) downlink
  - Supports data up and down, navigation
- What about the flight end?

# Iris

- CubeSat Compatible / DSN Compatible Transponder
  - Comparable and compatible to JPL UST and Electra
  - Addresses need for low mass, low power, low cost DSN compatible radio that can do Nav
- First Iris prototype for INSPIRE, launch 2014
  - X-Band (8.4/7.2 GHz), 1.5 M km range required
    - CCSDS, standard DSN protocols
    - Doppler / Ranging / DOR Tones
  - PC 104 stack
    - Virtex V “Marina 2” backend, UST derived FW
    - Exciter, Receiver, and power supply boards
  - 0.5 U, 0.5 Kg, 10 W (w/ ~1W tx, 7 W rx-only)
  - FM delivery to INSPIRE November '13
    - Work started Feb '13



# INSPIRE will be the *world's first deep-space CubeSats*

## CubeSat Overview:

**Volume:** 3U (10x10x30cm)

**Mass:** 3.8 kg

**Power Generation:** 17 W

**Data Rate:** 100-1200 bps

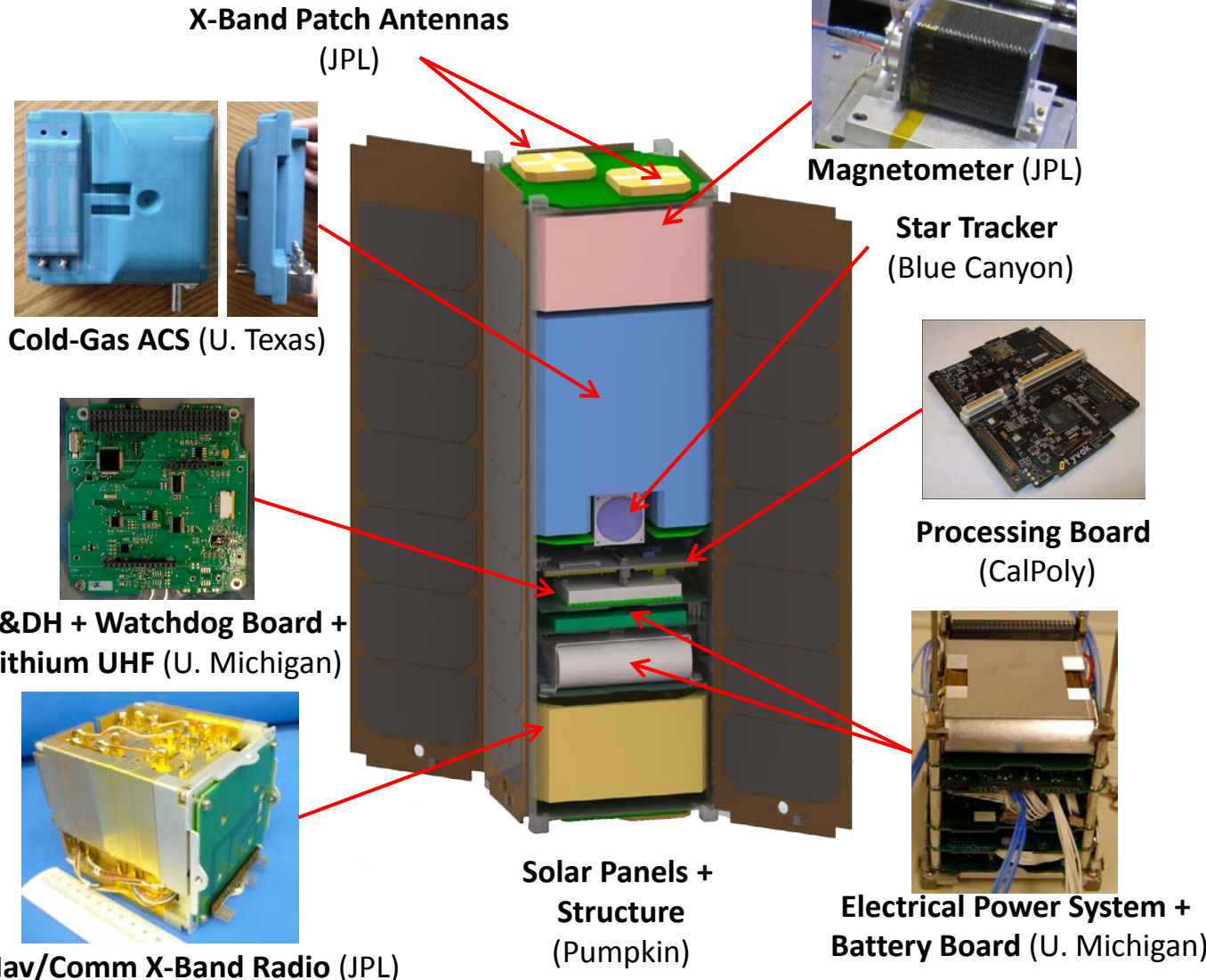
## Software:

Developed in-house

## Operations:

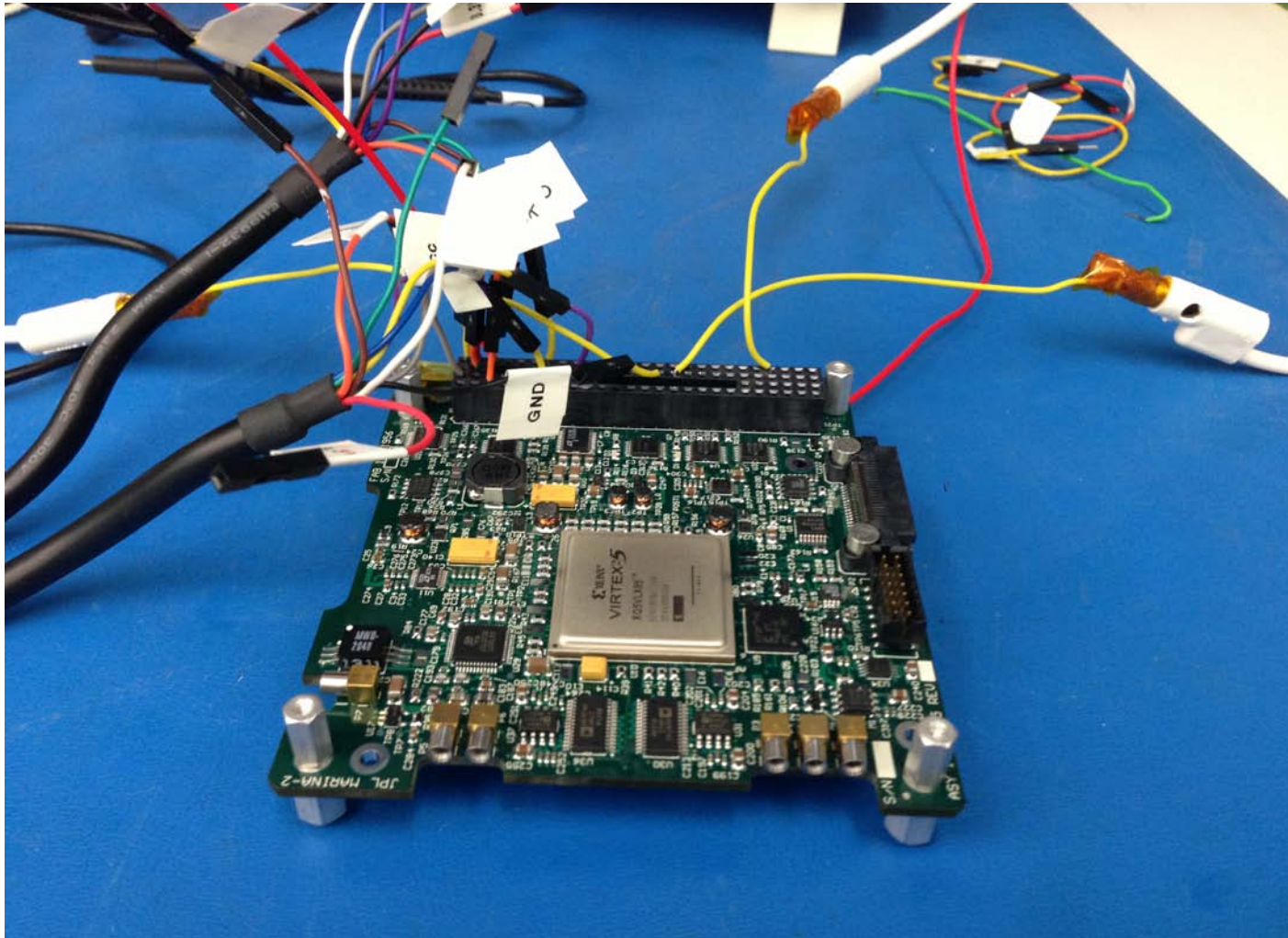
Peach Mountain (U. Michigan) & DSS-13 (JPL)

S/C components will provide *the basis for future high-capability, lower-cost-risk missions* beyond Earth expanding and *enabling NASA capabilities in an emergent domain.*



Pre-Decisional Information -- For Planning and Discussion Purposes Only

# Iris for INSPIRE Marina 2 Prototype

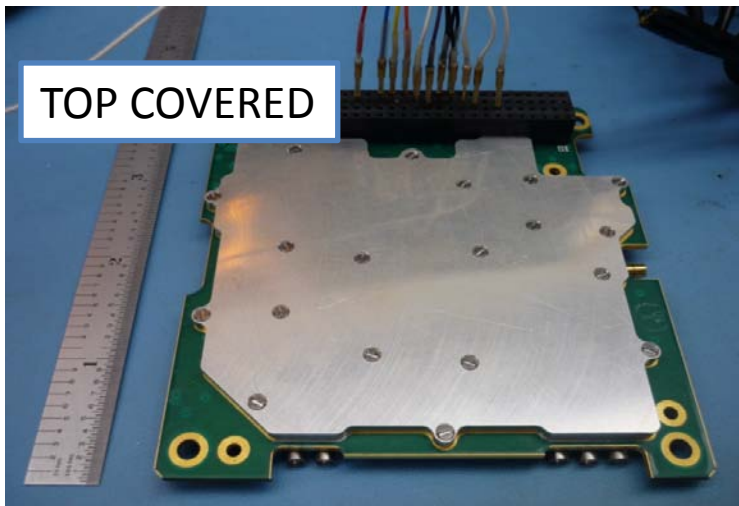
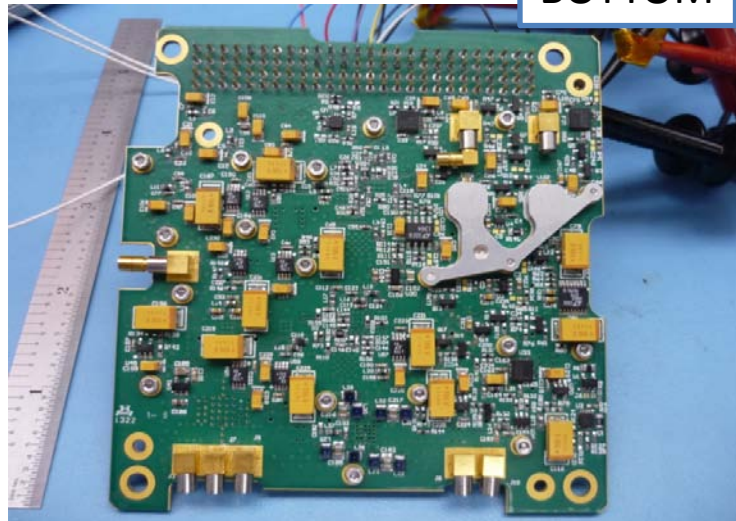
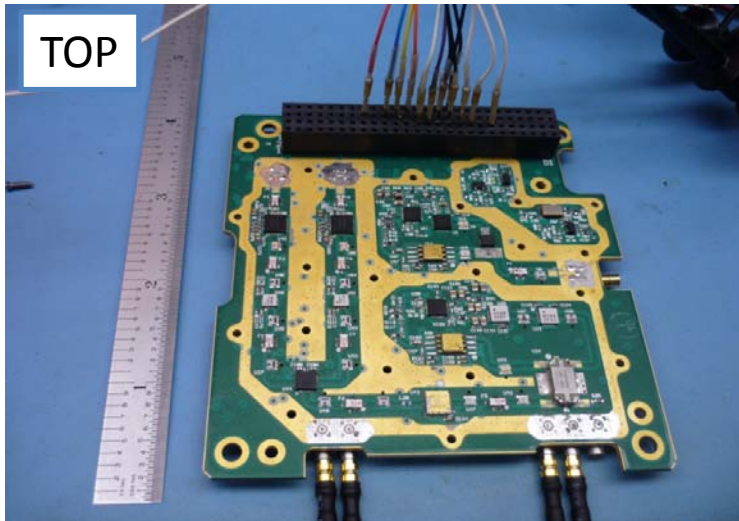


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Total Mass: 85.2 grams

# Iris Exciter

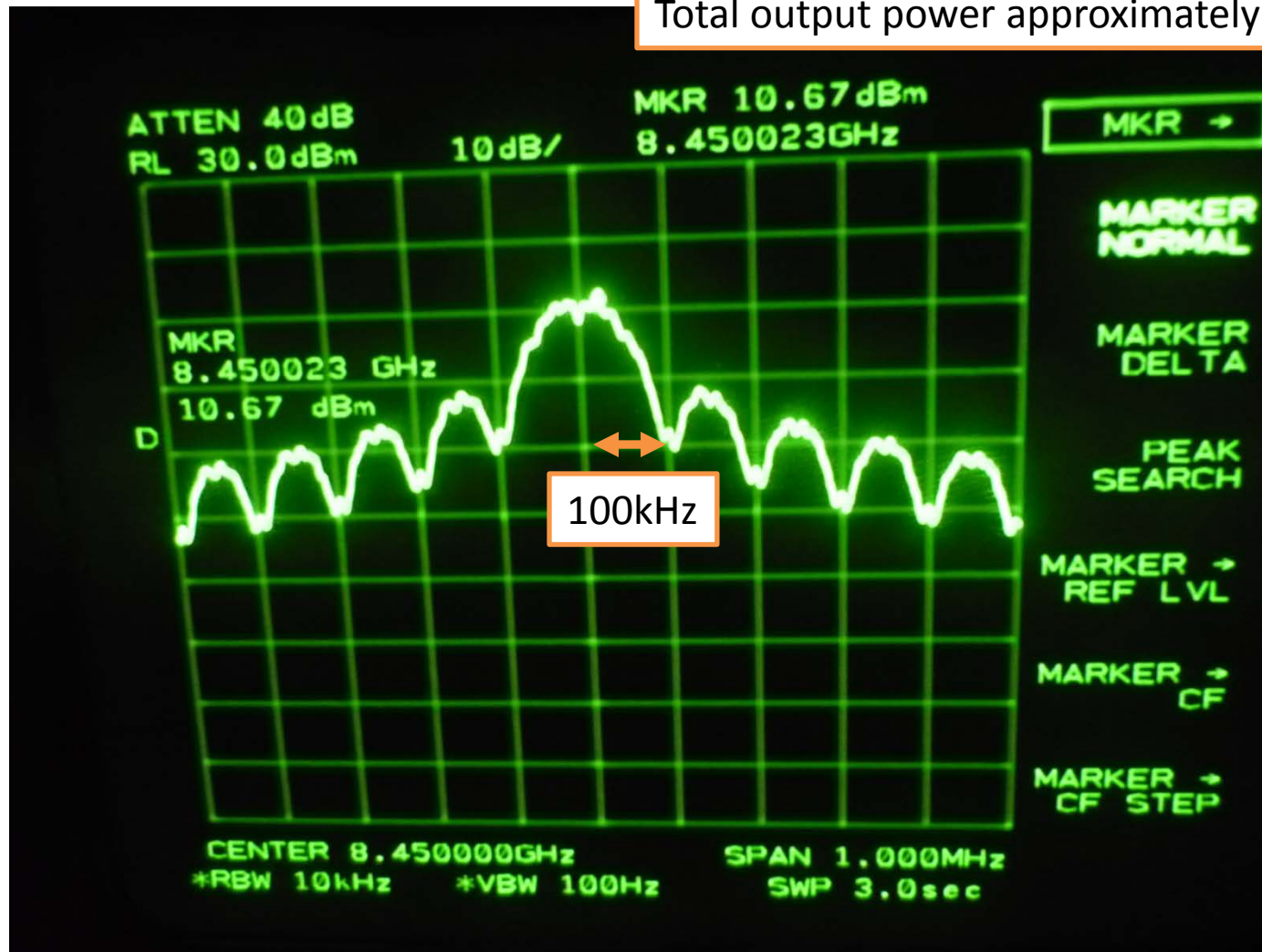
BOTTOM



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# Iris: 100kHz BPSK

Total output power approximately +24dBm



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# Small Satellite Challenges for Deep Space

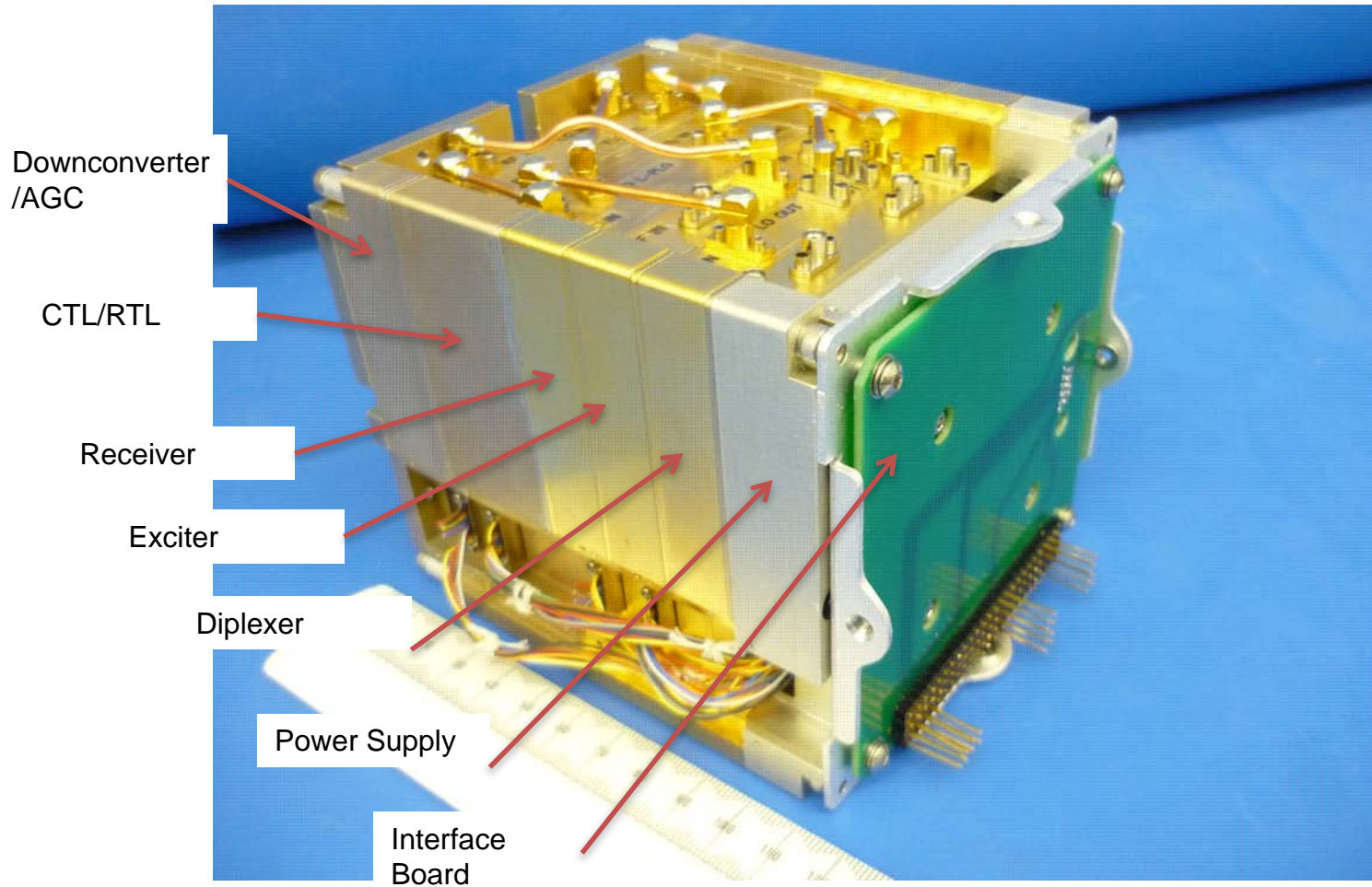
- Longevity
  - years of survival before or during use
- Environments
  - Radiation - not in LEO anymore
  - Hostile temperature ranges
- Professional versions not as low cost as educational



# Where is Iris heading after INSPIRE?

- Direct to Earth
  - 40 dB antenna would give ~kbps at one AU
  - Ka-Band downlink variant
- Proximity versions for hazardous duty daughter ships
  - Flybys, impacts, atmospheric entries, hostile environments
  - S-Band, UHF variants
  - Prox ranges can be 100,000 km (as in Europa Clipper)
    - So better antennas will be needed there in some cases too
- Rad Hard and Long Duration
- Earth orbit, high data rate version
  - Ground systems

# X/X-Band LMRST (Iris RF Heritage)



Analog Backend, Nav only (Doppler and Ranging)

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