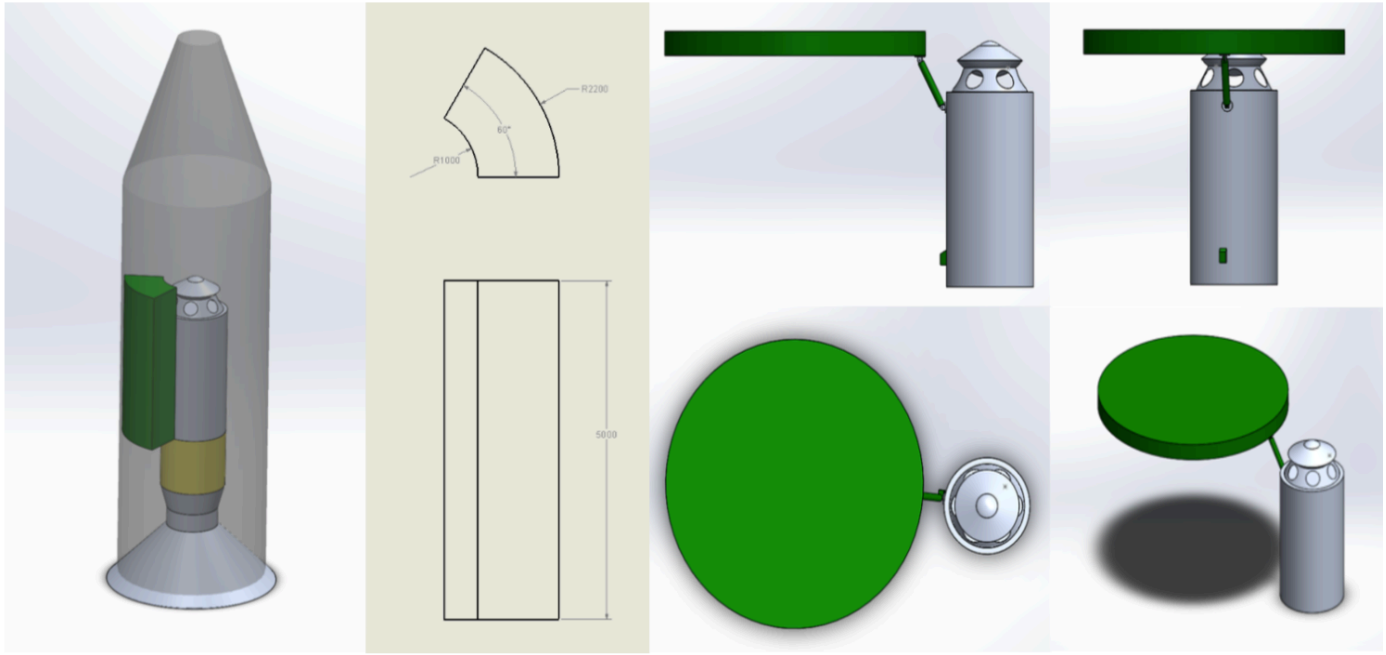

Virtual Research Presentation Conference

ENABLING HIGHER DATA RATES WITH A NEW GENERATION OF HIGHER FREQUENCY ANTENNAS

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Program: Strategic Initiative

Jet Propulsion Laboratory
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Assigned Presentation # RPC-287

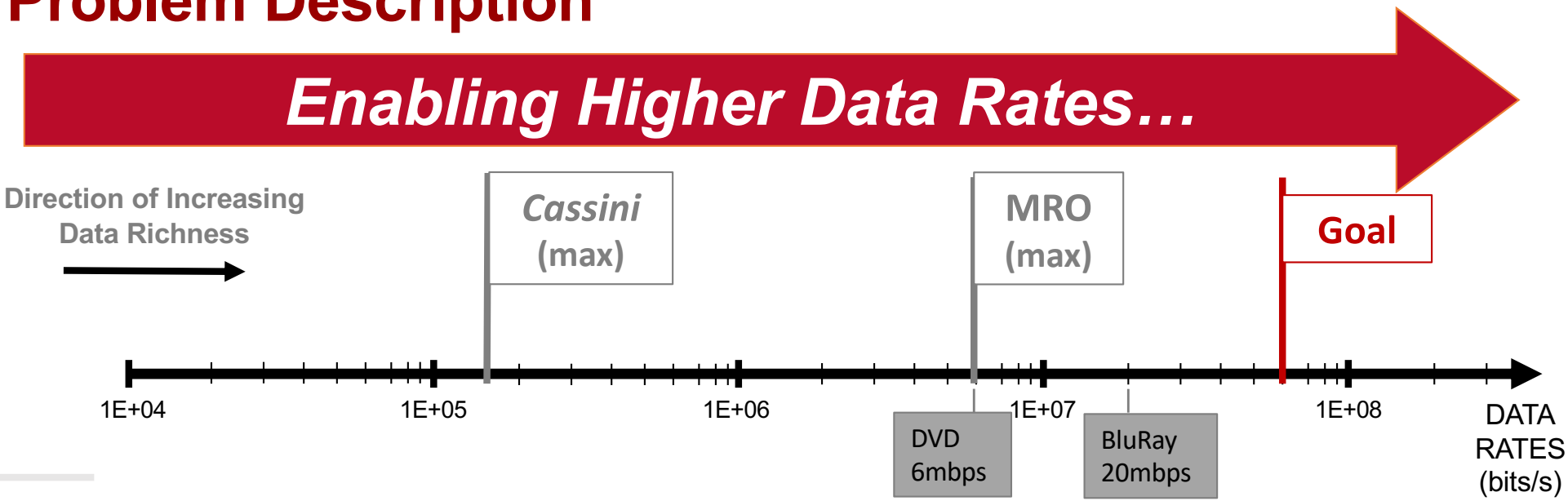
Introduction

Abstract

The goal of this Task is to identify if and how an order of magnitude improvement in data delivery capability from the outer solar system could be enabled by taking advantage of recent advances in large (> 5 m), Ka-band (~ 32 GHz) capable radio antennas for spacecraft.

Historically, the data rate from deep space missions has increased by approximately one order of magnitude every decade.

Problem Description



New Horizons (1kbit/sec) took 16 months to download data

JPL should not be designing 21st Century missions with 20th Century data rates and volumes.

Proposed near-term solution: large RF aperture operating at Ka band

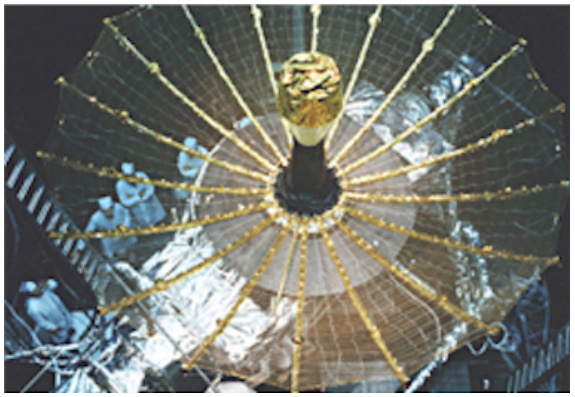
Methodology

1. Investigate commercially available antenna architectures and define an outer planet antenna system

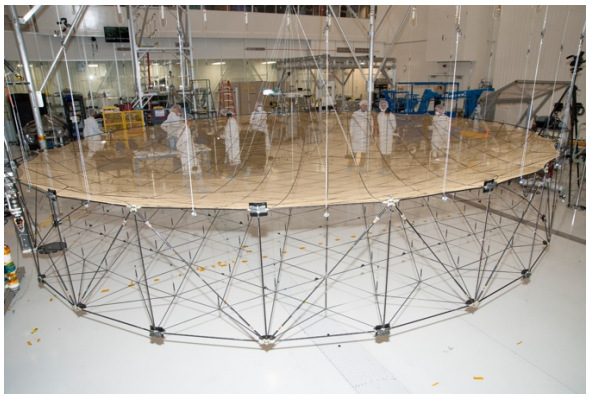
- **Ka-band** (32GHz / 1cm)
- > **6 m** (comparable to SMAP, TDRS A-G, NISAR, BIOMASS)
- **10x data rate of MRO** (>60kbits/s by the 2024 timeframe)

2. Enable higher data rates by leveraging current vendor capabilities for earth-orbiting satellites (sample mesh antenna systems at right)

3. Provide the Foundry with the necessary tools to incorporate these designs into future formulation activities



5m Ku-band antenna, (TDRS A-G), Harris.



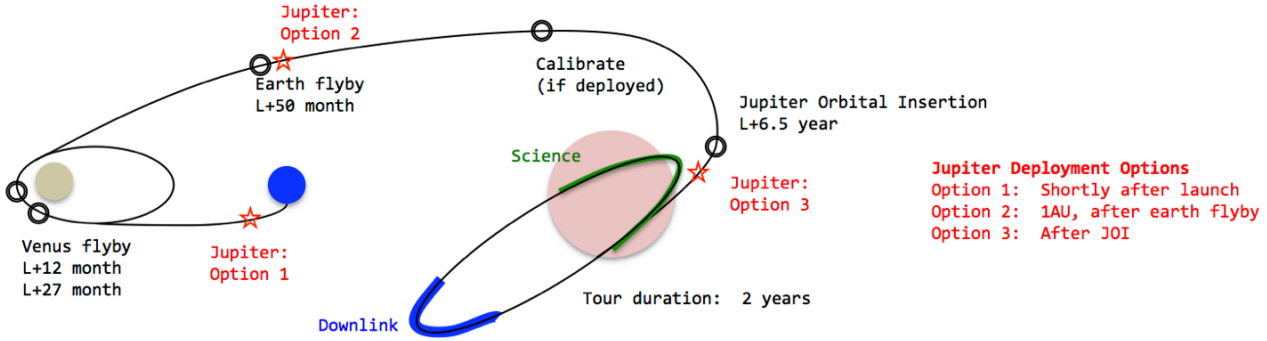
6m L-band antenna (SMAP), NG Astro.

Methodology

In summer FY17, 9X supported an A-Team study that defined key mission parameters for two notional outer planet missions. Our R&TD team turned this into an RFI to assess capabilities of industry.

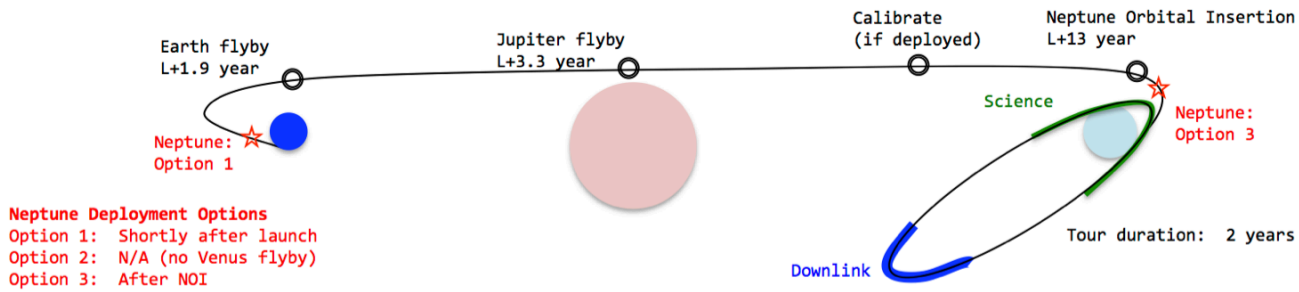
JUPITER CONCEPT

JUPTER	Time	Deployment Notes
Launch	L	Option 1: Shortly after launch
Venus Flyby 1	L + 1yr	
Venus Flyby 2	L + 2.3yr	
Earth Flyby (includes burn)	L + 4.2yr	Option 2: On the way out, at 1AU
Calibrate antenna	(prior to JOI)	(assumes Option 1 or 2)
Jupiter Orbit Insertion (JOI)	L + 6.5yr	Option 3: After JOI
Io Tour	2yr duration	(no further use of main engines) (orbits are 60d long)



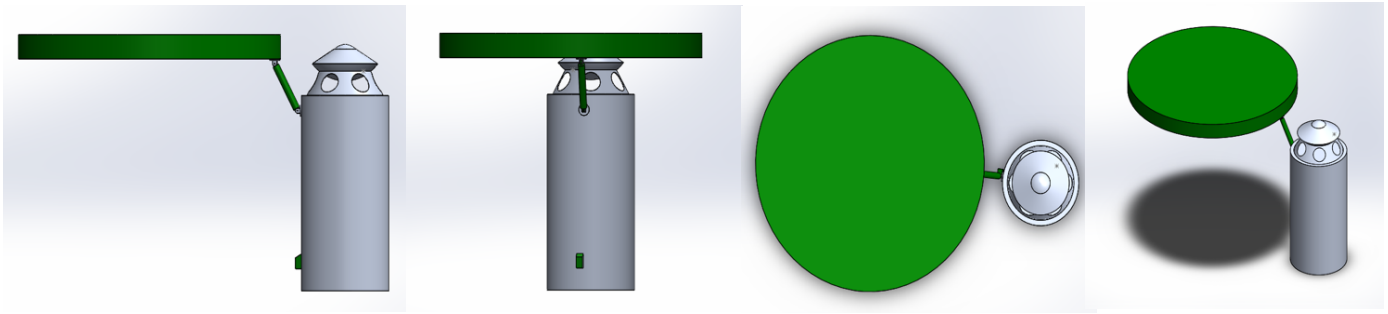
NEPTUNE CONCEPT

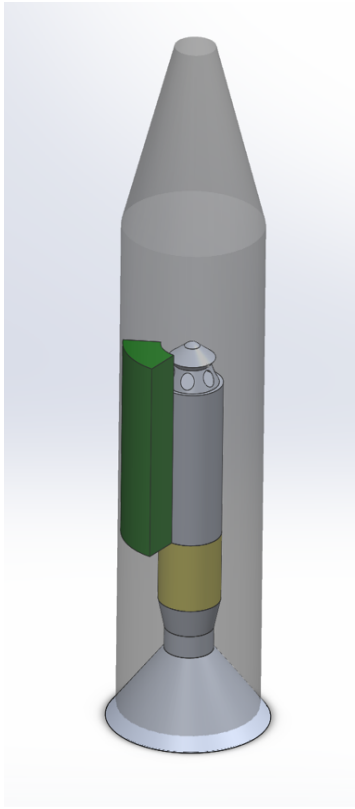
NEPTUNE	Time	Deployment Notes
Launch	L	Option 1: Shortly after launch
Earth Flyby	L + 1.9yr	(Option 2 not relevant, no Venus flyby)
Jupiter Flyby	L + 3.3yr	
Maneuvers		(6 total, with main engines)
Calibrate antenna	(prior to NOI)	(assumes Option 1)
Neptune Orbit Insertion (NOI)	L + 13yr	(NOI ~1hr duration, with main engines) Option 3: After NOI
Tour	2yr duration	(Many maneuvers involve main engines; could probably use smaller thrusters, take mass penalty)

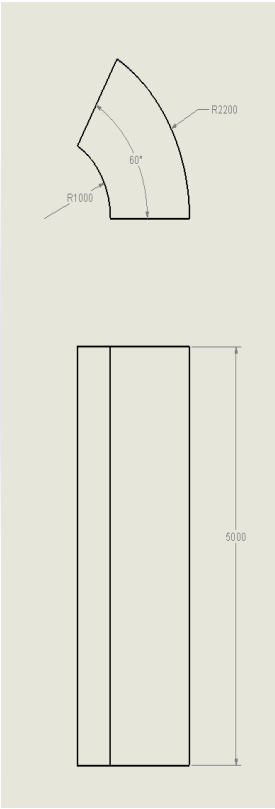


Methodology

Industry vendors were invited to submit deployable antenna systems compatible with future missions.







RFI was posted to the public, two responses selected for complete evaluation.

https://www.fbo.gov/notices/1ed179cb9abf65574eef8f248bcdb0df

Results

a) Detailed system study of applying commercially-available mesh antenna systems for an outer planet mission. Life-limiting factors include the thermal environment, radiation environment, and potential dynamic environments which all are different than and possibly more stressing than their Earth counterparts. Operational concerns included pointing requirements and modal requirements for communications from Jupiter/Neptune which introduced new system constraints on systems that were designed for an Earth orbit.

b) We have worked with the JPL Foundry to socialize the results as well as prepare an “input deck” for future formulation activities, outlining the capabilities that can be considered when generating new mission proposals.

c) This third year of the activity was focused on confirming that the inputs we provided to the Foundry were correct and complete. We will continue to provide sensitivity studies, link budget, and other system analysis for future studies as needed.