

Class Project: Deep-Penetration Neptune Probes

Due Date: 7 December 2004 (Tuesday)

ECE 6390: Satellite Communications and Navigation Systems

1 Introduction

Due to their extreme distances from earth, we have sent relatively few probes to the outer gas giants of our solar system (Jupiter, Saturn, Uranus, and Neptune). NASA is proposing an ambitious mission to Neptune within 10 years that will insert 3 probes into the atmosphere, at latitudes of 0° , $+45^\circ$, and -45° . Due to the size and density of the atmosphere, the probes will take 50 hours to descend to a pressure of 1000 bar. During this time, the probes' scientific instruments will be measuring and recording data and sending it back to earth (presumably through a relay satellite) at a rate of 8 kbps each.

2 Design Goal

You have been contracted to design the satellite system that collects probe data and sends it real-time back to the earth. Not only is Neptune extremely distant from the earth, but the probes must report back through miles and miles of the planet's dense, exotic atmosphere of hydrogen, helium, and methane. You may assume that earth stations in NASA's Deep Space Network (DSN) (<http://deepspace.jpl.nasa.gov>) are available for you to transmit and receive data. Each DSN site contains a 34m diameter dish antenna with $T_{\text{sys}} = 20\text{K}$ and aperture efficiency of 0.94. The DSN transmitters are capable of transmitting up to 500,000 watts and at least one station is always visible to Neptune.

3 Preparation Details

The purpose of this project is to give the student exposure to overall system design and hardware design (on a system level). Thus, design of individual hardware modules within a system is not required if the required modules (or ones similar in performance) are commercially available as assembled units (e.g. oscillators, amplifiers, antennas, etc.) The student is required to work *individually* on his/her own project. While discussions with individuals in industry who produce components/systems are encouraged, as well as discussions with other students, the project must result from your own effort. Any design using all or part of other openly published designs must give references to those authors/designers; failing to do so will be considered plagiarism. Sharing of designs with other students is not permitted and will be considered a violation of the honor code.

4 Deliverables

You must prepare a technical report detailing the communication system design. The report should be in html-format with all files submitted in-class on a CD or through e-mail¹. Your report will be

¹e-mail submissions must be ZIPped and are only recommended for files less than 2 MB total

graded on the following:

- Completeness
- **Technical Writing**
- Technical Correctness
- Professional Content
- Research (cite all references)
- Conciseness

I will offer +5% bonus points to superlative reports in the following categories:

- Best Technical Writing
- Most Thorough Technical Research
- Creative Use of Web Presentation

Late projects will not be accepted. I will likely post some of the unique solutions and high-quality projects to the web, unless the author requests otherwise.