Satellite Communications Class Project:
DiSOPS: Distributed Sensing and Observation of Planetary Systems

ECE 6390 – Summer 2014

Synopsis:

All space missions to our solar system conceived by NASA follow the same template: a very expensive spacecraft travels to a distant location and places an orbiter or surface rover for single-point data collection. In the case of a surface rover, the rover slowly travels about one small area on the planet or moon surface and relays images and/or sensor data back to Earth. If the orbiter or rover fails, the entire mission fails.

Now consider another mode of data collection where, instead of a localized, single-point-of-failure system, a very large number of small, low-cost surface sensors are used to blanket a wide area of a moon or planet. In this call for proposals, we refer to this type of space mission as DiSOPS – a *distributed sensing and observation of planetary systems* approach.

The *National Aeronautics and Space Administration* (NASA) is selecting competitive proposals for a scientific mission to another planet or moon in our solar system that employs DiSOPS concepts. Your company will enter a proposal that illustrates the DiSOPS approach to collect data of your choice (e.g. images on MARS, chemical composition of Saturn's atmosphere, ocean currents on Titan, seismic data on Venus, etc.) The crucial point of the design is getting the low-cost sensors to send back data using minimal amounts of power, which will, in turn, minimize cost and weight and maximize lifetime and utility of the system.

Proposals will be competitively ranked according to which mission concept best illustrates the DiSOPS concept. Objective evaluation of these proposals will pay close attention to the following features:

- Demonstration of a space mission that collects scientific data that could not possibly be conducted with a single spacecraft or rover.
- The number of locations on the planetary surface that data is collected from during the course of a mission.
- The estimate energy-per-bit power consumption of the sensor nodes used to measure and transmit data back to Earth.

Team-Member Assignments:

I will assign 7 teams with 4-5 members each to constitute a "company". Once formed, the teams must elect a team-leader, choose a company name, and submit an 80 x 80 pixel icon for their

web link. I expect everyone to contribute to the final design and documentation and will solicit internal rankings of team-member efforts.

System Components:

Due to the multiplicity of talents within each group and the "systems"-nature of the class, *all* aspects of the mission design should be explored in the final proposal. Communication systems should receive the most design focus, but the final project should address the following systems:

- Communication Systems – antennas, RF hardware, modulation, spectral usage, peak data output, bit rate, coding, etc. Take into account the site-specific attenuation factors for getting signals out of the planet's or moon's atmosphere.
- Propulsion System – engine type, trajectory, and voyage time, single craft system or additional (and more expensive) relay orbiter
- Power Systems – power source, peak power output, estimated lifetime, etc.
- Resiliency of Electronics – Briefly discuss strategies for space-hardening the electronics for the duration of the mission. Identify the likely points of failure.
- Budget and Timeline – total research and development costs broken into materials, equipment, supplies, people costs, space resources, and other miscellaneous costs.

This list is not necessarily exhaustive. The level of detail for each system is left up to the groups. However, increased descriptions will enhance the competitiveness of your design. *Verbose* descriptions will degrade the competitiveness of your design.

Deliverables:

You must prepare a concise, well-written technical report detailing your team's mission design. The report should be in html-format with all files submitted in-class on a CD or through e-mail (e-mail submissions are strongly preferred; they must be ZIPped and are only possible for files less than 20 MB total; an externally hosted server for your website is also permissible, but must be "frozen" at the project deadline – extraordinary grade penalties if I detect changes). Projects must be submitted by noon on Friday, 25 July 2014. Late projects will not be accepted.

Grading:

Your final proposal will be graded on the technical criteria listed above. Deductions from these base scores will then be made based on the following areas: Completeness, Technical Writing, Professional Content, Research/References, and Conciseness. Each team member may also receive a small, variable downward adjustment to their individual project scores based on internal rankings of contribution and effort.

Additionally, a portion of the project grade will be based on peer evaluations. The projects will be placed online and each member of the class will submit an evaluation for each project (other than their own). These individual evaluations will be held confidential; they will also count as a homework assignment. Thus, the projects will be posted online over the weekend and evaluations will be submitted electronically during exam week. Look online for the evaluation sheet.