

SEDS-SSPI 2017 Chapter Competition

Connecting the Space Economy

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Commercial satellite operators are already thinking about designs for communications satellites that not only point their antennas down at Earth but upward to support future communication requirements of the Space Economy. As asteroid mining, lunar mining and transport, in-orbit manufacturing and in-orbit assembly move from science fiction to the beginnings of development, what communication capability will be needed to support operations in Earth orbit and far beyond? How much can existing technology contribute and what technology advances may be required? What will it cost to create a basic network capability and see it deployed?

Project Specifications

Your assignment is to:

- Define the expected communications requirements of the Space Economy to support asteroid and lunar mining, transport of materials to Earth orbit and in-orbit manufacturing and assembly at LEO, MEO and/or GEO.
- Research the existing capabilities of Earth-based and satellite communications systems to support these communications requirements.
- Identify gaps that can be filled by space-based communications assets.
- Develop a conceptual design, timeline and cost estimate for a network of satellites capable of filling these gaps, whether it is a dedicated Space Economy network or dual-use satellites capable of meeting terrestrial communications needs as well.

In addition to existing satellite, launch and propulsion technology, your design may take advantage of new developments that are likely to become commercially feasible as a result of the early development of the Space Economy. (For example, you may assume that in-orbit assembly or manufacturing has become a commercial reality.)

Submissions will be judged first on the quality, depth, and rigor of the work presented, and secondly by the breadth of the work in terms of topics covered. This is potentially enormous topic, and your team may benefit by carving out a specific problem, such as support for lunar mining or asteroid mining, and devoting yourself to that solution.

Team Specifications

Teams must be comprised entirely of students at one university (for institutions such as state universities with many campuses, the general rule is that each campus is considered a separate university: e.g., UT Austin, UT Dallas, and UT Houston must keep their teams separate). Teams will be limited to one per university, and team candidacy must be submitted through that university's SEDS chapter (SEDS chapters are each responsible for coordinating their own



teams). We recommend between 3 and 10 members per team, but we encourage team leadership to include as many interested chapter members as possible. Individual team members must maintain student status at the university naming the team, and may only contribute to one project at a time.

Since this is a student project, SSPI and SEDS-USA expect student team members to do the vast majority of the work. Mentors are assigned to assist teams with overcoming the learning curve, but should not do substantial work on the project, except when necessity dictates (driven by, e.g., proprietary software). All contributing team members should be credited on the team roster, which is submitted with the project.

Sources

The following offer a starting point for research:

Today's Space Economy, from Space Safety magazine

<http://www.spacesafetymagazine.com/space-on-earth/space-economy/>

"Asteroid Mining: Key to the Space Economy"

<http://www.nss.org/settlement/asteroids/key.html>

"Space Manufacturing and the Last Mile"

<http://spacenews.com/space-manufacturing-and-the-last-mile/>

"Manufacturing in Space"

<http://www.tctmagazine.com/3D-printing-news/manufacturing-in-space/>

Planetary Resources technology description

<http://www.planetaryresources.com/technology/#technology-value-statement>

"The Future of Moon Mining"

<https://phys.org/news/2016-11-future-moon.html>

"Lunar Commercial Communications Enabled by the International Lunar Observatory"

https://www.researchgate.net/publication/253043527_Lunar_Commercial_Communications_Enabled_by_the_International_Lunar_Observatory_ILO_Association

"A Communications Network for Cislunar Operations"

<https://info.aiaa.org/tac/SMG/SOSTC/Workshop%20Documents/2012/2012%20Workshop%20Presentations/Commercial%20Operations%20Presentations/Burleigh.pdf>

"NASA Laser Communication System Sets Record"

<http://www.kurzweilai.net/nasa-laser-communication-system-sets-record-with-data-transmissions-to-and-from-moon>



Timeline for Submissions

Through discussion with SEDS' leadership, we have identified the following timeline as workable within the academic year.

Activity	Responsible	Target Date
Project announcement to chapters	SEDS-USA	10 March 2017
Team Registration Deadline	SEDS-USA	31 March
Mentor assignment deadline (internal)	SSPI	5 April
Deadline for first meeting with mentor	Teams	15 April
First mentor meeting documentation due (brief minutes, project overview)	Teams	17 April
Team Hangouts and Conference Calls (cooperative online session with all teams, mandatory)	SEDS-USA/Teams	18 April – 31 August
Reports due to SEDS for review; SEDS passes on to SSPI; SEDS-USA awards travel funding for Spacevision 2017 as appropriate in coming month	SEDS	15 Sept
Judging results from SSPI returned to SEDS, which passes feedback to teams (winners decided but not announced)	SSPI	15 Oct
Final posters/presentations & awards	SEDS	SpaceVision (Nov)

Submission Details

Teams are expected to thoroughly document their progress through their project. A good example of the level of final documentation desired is a USAF University Nanosatellite Program submission. We can provide example submissions from previous years, on request.

First Meeting

Team leadership should meet with their assigned mentor by April 15, and submit brief documentation thereof by April 17. The documentation should include the following:

- Project overview (round-number estimates of basic engineering goals)
- Team roster



- How you will address each bullet point under “Project Specifications” (above), which you expect to be most challenging (and why), and a couple of scope reduction options.
- Brief timeline for project completion
- “Wish List” from SSPI/SEDS-USA

These items should all be discussed among team leadership before the mentor meeting.

Final Submission

The final submission should address each bullet point under “Project Specifications” (above), including brief descriptions where appropriate of why items were not treated in the project as a whole. Your submission should “tell a story,” more or less. The overall submission should be built around a Project Overview document, which should reference documents like:

- Technical Drawings
- Case-studies
- Orbit scenarios
- Launch simulations

Final submission should reference modern scientific literature, much like a research paper. Additionally, the project must include a team roster, preferably with each team member credited with general areas of contribution. Teams are encouraged to assist and seek assistance from one another during that session.

How to Structure the Report

Use the following outline as a template for your report. You need not follow this exact order or include every item, but an effective report will use this outline as a guideline.

1. Introduction
 - a. Description of the Space Economy to be served by your communications network
 - b. Description of the communications requirements of the Space Economy
 - c. Outline of current capabilities to support the Space Economy and identification of gaps
2. Conceptual design
 - a. Specification of requirements for gap-filling assets
 - b. Identification of existing and new technologies that will be applied to the design
 - c. Design concepts for individual spacecraft and constellation
3. Satellite hardware
 - a. Requirements and constraints
 - b. Power generation systems
 - c. Power transmission systems



- d. Telemetry, tracking and control systems
- e. Propulsion station-keeping and fuel
4. Launch and orbital insertion technologies and processes
5. Production schedule through deployment of full constellation
6. Cost analysis
7. Risk analysis
8. Conclusions

Poster Presentation

SpaceVision 2017 will include opportunities for students to present aspects of their work to students and recruiters. Participation is strongly encouraged, and SEDS will endeavor to provide limited travel funding. Funding will be awarded based on demonstrated need, competition performance, and demonstrated effort towards finding other funding sources (from university, corporate, Space Grant, or other sources). SEDS-USA will offer at least one grant-writing help session in the spring or summer.

Awards

SSPI is making available up to three cash prizes payable to the top-scoring teams in the competition. The first prize is \$750, second prize is \$500 and third prize is \$250. SSPI will also conduct video interviews with the winning teams and promote them and their project to its global membership of 4,000 satellite professionals in more than 40 nations.



SEDS-SSPI 2017 Chapter Competition
Connecting the Space Economy
Registration Form

Please submit this form to Olivia Scharfman (olivia.scharfman@seds.org), Sam Albert (sam.albert@seds.org), and Robert Bell (rbell@sspi.org) on or before March 31, 2017.

University

Check with your chapter's leadership that no team has already registered.

Address

(we recommend a listing your student activities bureau, student government, home academic department, or as a last resort, a team lead's personal mailing address)

Team Lead 1 Email Phone

Team Lead 2 Email Phone

