**DEEP SPACE ORBITAL SERVICE MODEL FOR VIRTUAL PLANETARY SCIENCE MISSIONS.** J. Straub[1], [1]Department of Computer Science, University of North Dakota, 3950 Campus Road, Stop 9015, Grand Forks, ND 58202 United States, jeremy.straub@my.und.edu.

**Introduction:** Previous work [1, 2] presented the concept of the use of an orbital services model to facilitate missions that could be spread across multiple spacecraft. Power might be provided by one craft and long-distance communications and onboard processing by another. Figure 1 shows how a network of provider and consumer craft (flattened to 2D) might be oriented, at a given moment, and might interact.

In [3], a model for this communications was presented and a variety of service negotiation and provisioning messages were described. This process consisted of:

- Service description broadcast
- Service searching
- Service selection
- Service negotiation / procurement
- Service use
- Service evaluation
- Service termination

For some Earth-based applications a final mechanism was also incorporated for service payment.

A variety of prospective service provider types were also discussed. These included:

- Communications
- Imaging and other sensing
- Computational processing
- Data storage
- Power
- Physical servicing
- Orbit raising and maneuvering
- Application services

Based on the availability of all or a subset of these services, collaborative and virtual missions were discussed. A distributed data model which facilitates distributed computational processing and data storage is presented in [4].

**Planetary Science Virtual Mission:** The virtual mission mentioned in [3] could potentially have been an Earth-science mission. Similar concepts could be applied in orbit of other planets or moons. The concept of the virtual mission facilitates NASA and other national agencies making large missions to these locations with equipment manifests based on decadal survey goals without deciding a priori exactly what will be studied and who will be performing the study. Instead, a variety of app-missions can be uploaded to the spacecraft which will command appropriate resources on a single craft or across a collection of craft to collect data and analyzed it as necessary to perform the mission. For example, the model-based transmission reduction approach and a multi-tier [5] mission could both run within the context of a large orbital services model-style deployment to a remote planet or moon.

**Conclusions:** The orbital services model presents an opportunity for space missions to be developed on an on-demand basis both in Earth orbit and beyond. This allows missions to be responsive to changing science needs and new discoveries. The mission-is-an-app concept enables low-budget (perhaps student generated) missions to fly alongside higher budget ones.

**References:** [1] Straub, J., A. Mohammad, J. Berk, A. Nervold. 2013 Above the Cloud Computing: Creating an Orbital Service Model Using Cloud Computing Techniques. Proceedings of the SPIE Defense, Security + Sensing Conference. [2] Straub, J. 2013. Spatial Computing in an Orbital Environment: An Exploration of the Unique Constraints of this Special Case to other Spatial Computing Environments. Proceedings of the 2013 Spatial Computing Workshop at the Autonomous Agents and Multi-Agent Systems (AAMAS) 2013 Conference. [3] Straub, J. 2014. Extending the Orbital Services Model beyond Computing, Communications and Sensing. Proceedings of the 2104 IEEE Aerospace Conference. [4] Straub, J. 2014. Above the Cloud Computing Orbital Services Distributed Data Model. Accepted for publication in the Proceedings of the SPIE Sensing Technology + Applications Conference. [5] Straub, J. 2013. Integrating Model-Based Transmission Reduction into a Multi-Tier Architecture. Proceedings of the 2013 IEEE Aerospace Conference.

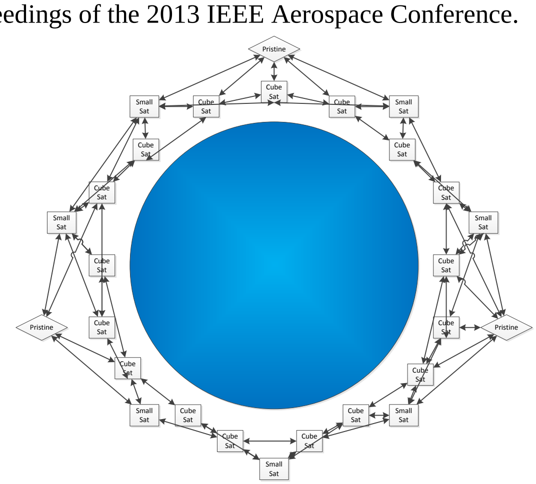


Figure 1. Collaboration Between Spacecraft of Various Sizes and Configurations [1].