SECONDARY PAYLOAD ARCHITECTURE FOR LUNAR COMM RELAY SATELLITES. K. Kroening[1], L. S. Sollitt[1], T. Segura[1], and C. Spittler[1] [1]Northrop Grumman, One Space Park, Redondo Beach, CA, 90278.

Introduction: Future manned and unmanned exploration of the Moon will require the return of large amounts of data from the lunar surface, with constant coverage of any manned systems. A comm. satellite system based on the seconday payload concept used by the Lunar CRatering Observation and Sensing Satellite (LCROSS) could provide a low-cost solution. Such a satellite could be delivered to lunar orbit from any commercial MEO or higher mission; with appropriate planning, it may be possible to use certain LEO launches, extending the versatility of this system. Obviating the need for a dedicated launch vehicle would represent a large cost savings to NASA for this program.

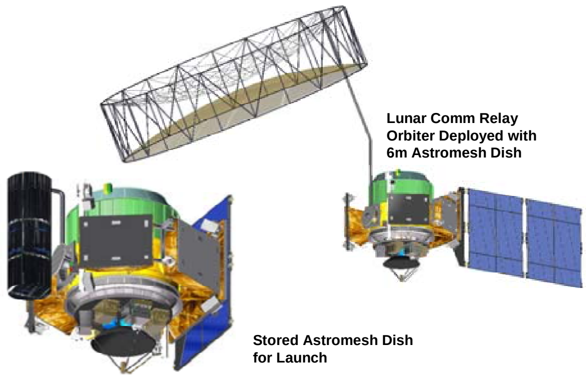

Figure 1. LCROSS-based satellite

An ESPA-based architecture: LCROSS is an existing example of a secondary payload built by Northrop Grumman. This spacecraft is built around an EELV Secondary Payload Adapter (ESPA), using the ports of the ESPA not for individual payloads, but rather as attachment points for spacecraft hardware. All of the various systems are separately installed on panels which fit into the ports; this allows for parallel integration of the spacecraft systems. For instance, the LCROSS science payload was integrated and tested at NASA/ARC on the actual flight panel while the rest of the spacecraft was assembled at NG facilities in Southern California. A notional comm. satellite based on this architecture is shown in Figure 1. Such a system might use avionics similar to those on NASA's Lunar Reconnaissance Orbiter (LRO) and have a 3-5 year mission life. The antenna shown is an Astromesh deployable perimeter truss type; larger examples than the one shown here have flown previously.

Options to extend mission lifetime: Mission life can be extended by a variety of parameter changes. This poster will explore these options and rate their feasibility vs cost supporting architecture trades. Simple methods such as adding enclosing panels to reduce micrometeoroid impact and improvement of the Faraday Cage electric protection can slightly increase lifespan. More complex modifications such as adding internal redundancy and component watchdog software to trigger swap to back-up work well for higher NRE dollar custom development. A more inclusive yet less costly approach would be to swap the LRO avionics out for another fully developed set. These three methods, their impacts and potential mission impacts will be presented in this poster.

System Architecture Example: Many different comm. systems are possible with the secondary architecture, including those presented in [1]. For a manned base at the lunar South Pole, one architecture example would use satellites in Molniya orbits with apolunes above the South Pole, as shown in Figure 2. These "locked orbits" are stable against perturbations arising from fluctuations in the Moon's gravitational field, and would allow satellites to use minimal delta-V to maintain a long service life. We find that two satellites in 12-hour orbits would provide 100% coverage between the Earth and any spot south of approximately 65° South latitude on the lunar surface.

References:

[1] Space Communication Architecture Working Group (SCAWG) (2006) *NASA Space Communication and Navigation Architecture Recommendations for 2005-2030.*

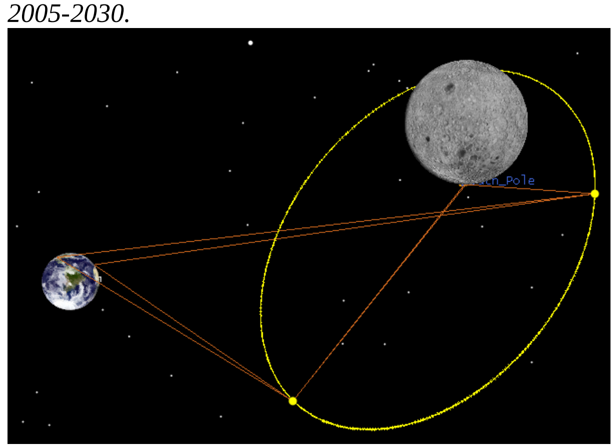

Figure 2. Comm example for a South Pole station

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