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CONCEPT ARCHITECTURE OF CIS-LUNAR SATELLITE CONSTELLATION FOR UNINTERRUPTED COMMUNICATION LINK BETWEEN A SINGLE GROUND-BASED TRACKING STATION AND A LUNAR POLAR OUTPOST

Abstract

A new era of Moon rush is coming to our doorsteps, thanks to a renewed interest in the lunar exploration from the space-faring nations all over the world. And with the significant upper hand in this rush led by NASA's Artemis CLPS program, a huge growth has suddenly spurred a number of new lunar-tech oriented space companies, many of which will be quite harshly competing to establish a strong foothold in the upcoming multi-billion dollar industry.

It then becomes important to discuss about the need of strong foundational technical baselines in terms of the way we will be connecting with the deep space ventures from here to the Moon, quite literally. A lunar base upon the polar regions raises the already important question of human survivability and requires the need of a constant human oversight in order to minimize risks and provide a constant connectivity with the Earth based ground stations.

And for the majority of these companies, there would be a choice to either collaborate with the space agencies and utilize their Deep Space Networks or opt out and self-develop their own communication systems from the scratch. While the space conglomerates may have the opportunity to easily avail the incentives of the first option, the still blooming NewSpace ventures may not be as fortunate. So for them, it then raises the question of innovating smart communication solutions based upon both affordability and simplicity in their construction and maintenance approaches.

This paper is written as a response to introduce one such novel approach and put forward an idea of developing a rather simple and unique solution to maintaining constant communications between Earth and the Moon without the need of multiple ground tracking stations.

Here, an architecture of multiple satellites is presented that are grouped in two batches- Lunar bound and Earth bound. While the lunar bound satellites are near-polar in nature and revolve around the Moon in a timely synchronized manner, the ones bound to Earth are geostationary in position and always stay relatively locked to each other as well as with the desired ground center. Together, this system is studied and rigorously simulated over GMAT across various dynamic configurations, its trade-offs are analyzed and subsequently a well-rounded result is then presented. In the end strongly proving that such a constellation could very well be a cost-effective alternative for any space venture to utilize and scale-up the existence of their cis-lunar communication systems.