MISSION DESIGN FOR ECONOMICALLY SELF-SUPPORTING LARGE SCALE LUNAR TELEPRESENCE
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Telepresence provides the ability to sense and interact with a potentially hostile environment without the difficulties of getting there, being there, and then returning. Given the limitations of the speed of light, the Moon, which is approximately two and a half seconds round trip distant, is accessible to near-real time telepresence. In addition to the obvious scientific motivations to further explore the surface of the Moon, there is also substantial mass appeal among the general public to interact. The popular access of “live” pictures over the internet from various Mars Rover missions exemplifies this and demonstrated a level of internet activity that was (and still is) without precedent.

A mission design is presented to provide on-going large scale telepresence opportunities on the lunar surface at various levels of interaction with an access fee structure to provide economic self-support. A baseline study includes 10 rover vehicles, each carrying 50 independently controlled stereoscopic camera heads, collectively supporting 500 simultaneous Earth-bound users. A Lander acts as an Earth relay link, permitting the rovers to be relatively simple, light weight, and low cost. The Lander, which provides terminal transport of the rover fleet to the lunar surface, can be relocated, expanding the exploration area. The entire operation is solar powered and without consumables. Rover steering and camera pan and tilt commands are up linked from Earth-bound users over a relatively low bandwidth RF to the Lander, and relayed to the rover fleet. Stereoscopic camera feeds from the 50 camera heads on each rover are relayed to the Lander, which combines them with those of the other rovers, and down links them to the Earth over a high bandwidth optical data link. A one watt Laser (820 nm) on the Moon, transmitted through a one meter telescope, and received on the Earth by a similar sized telescope, results in a positive link margin.

Levels of telepresence are organized into a hierarchy of interaction, with associated access fees. Remote steering command of a given rover represents the highest level, with the highest associated access fee. Prior “driver’s education” and demonstration of proficiency on a simulator are needed. A remote co-pilot monitors actual lunar navigation, and may intervene to prevent potentially disastrous maneuvers. Areas of historic importance on the Moon must be treated with respect, and we must be careful not to run over Neil Armstrong’s footprints. The next level of telepresence interaction involves active viewing where an Earth-bound user can direct the pan and tilt of a given stereoscopic camera head on a given rover to visually explore the surrounding lunar landscape. The lowest level of telepresence is the passive user, where the user simply goes along for the ride, looking wherever the active viewer (or driver) has chosen. An essentially unlimited number of users can share a given camera feed, or hop among the 500 channels.

Operational availability, due to the solar powered nature of this mission, occurs for at most 14 Earth days every synodic month, and low sun angle limits this to perhaps 12 working days. 13 synodic months per year yields 156 working Earth days and since a lunar day is in continuous sunlight 24 hours per Earth day, there are 3744 working hours per year. If we partition user access into 15 minute time slices then there are 14,976 15 minute time slices per year per active channel from the Moon. An example of an access fee structure is that drivers are charged $100, active viewers $10, and passive viewers $1 per 15 minute time slice. A 10 vehicle fleet with 500 viewer channels will receive about $15 million from driver revenue, and almost $75 million from active viewers. If there are 10 passive viewers per active viewer, an additional roughly $75 million is added. If there are 100, this number is closer to $750 million. Additional income may derive from cable access television (“The Moon Channel”), theme park sites, and so on.

In conclusion, this proposed mission design provides near-real time telepresence exploration to a large number of simultaneous users, with an access fee structure to make it economically self-supporting. An additional and perhaps greater benefit in personal access to space and the surface of another world is the enhanced desire to significantly expand human presence there. Need a 15 minute break? Why not spend it on the Moon?