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INTERPLANETARY MARKET INTELLIGENCE AND PRIVATE CLAIMS IN SPACE WITH CUBESAT CONSTELLATION

Abstract

To accelerate low-cost access to extraterrestrial ownership and usage rights, we present a small satellite constellation architecture with accompanying software for supporting the needs of public and private actors' access to space-based appropriations. Accessible interfaces that serve to streamline the functionalities necessary to support independent claims on property, which is currently a missing essential layer preventing humanity's expedited progress in space exploration and development of an in-space economy. The proposed system integrates software and hardware—a closed-loop management and control system—that codifies in-space activities' attributes and may lend to a novel protocol standardization heuristic for asserting and reinforcing independent claims for ownership of celestial matter and rights for performing activities in pre-designated regions of space. The proposed system software provides a streamlined process, through which: timestamped transmissions may be decrypted, encrypted, handled, and stored; global positioning system (GPS) information may be accurately calculated and recorded; secure communications may be transmitted between relay points in the network and with third-party communications services providers; mission-ready software may be used for tracking and navigation; and qualification documentation may be generated for validating ownership and usage rights claims (to be further evaluated by authoritative agencies, such as international governing and sovereign nation-state level agencies, including regulatory bodies). The proposed system hardware is comprised of such integral components both typical of a traditional satellite network and, also, specific to the requirements of the newly proposed picosatellite constellation: CubeSat construction materials; mission-defined picosatellite-mounted sensors and instrumentation; solar arrays; gyroscopes; miniature ion thrusters; and antennae, among other instruments. The physical satellite hardware consists primarily of lightweight tracking sensors and relay communications hardware aboard eight (8) picosatellite chassis (each between 0.25U and .5U in size) housed within a larger CubeSat locker (between 4U and 6U in size). Each picosat is individually deployable from its parent housing (nanosatellite-sized lockers) and deployed to small bodies. Once the host launch vehicle reaches geostationary transfer orbit (GTO), individual picosatellites are precisely deployed to rendezvous with strategically pre-selected natural small bodies (e.g., NEAs). The proposed system works with external larger scale interplanetary and/or interstellar communications networks, to offload higher-level tasks. Future advancements for this system's technology are also explored, including improvements in secure communication using quantum key distribution and modularity in the CubeSat design and construction for data/signal interpretation, such as sensors for composition analysis; and interplanetary navigation.