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Knowledge management for space activities in the digital transformation age (2)

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A BLOCKCHAIN-BASED SYSTEM FOR TRACKING AND COLLISION AVOIDANCE OF RESIDENT SPACE OBJECTS

Abstract

The knowledge related to objects orbiting Earth has become a critical component of any space-based operation. Space Situational Awareness (SSA) refers to the capability of detecting and tracking objects in orbit and predicting their position to avoid collisions. Particularly, the term Resident Space Object (RSO) refers to Earth-orbiting natural or artificial objects. The current solutions for RSO tracking, acquisition and data collection are based on a centralized architecture, which are a bottleneck and a single point of failure due to the scalability issues in any distributed environment composed of a large number of nodes. Consequently, as artificial space objects are managed by many companies, a challenge is to build a decentralized system for SSA able to contrast data security risks, such as information theft and data alteration. This distributed system should allow only authenticated and authorized entities to provide the data and to use the services. The Blockchain technology has the capacity for enhancing and changing various aspects of economy and society, including the space sector. A Blockchain is a distributed database of records, a public ledger of all transactions or digital events that have been executed and shared among participating parties, named nodes. In this public ledger, each transaction is verified by the consensus of a majority of nodes and is immutable and transparent. Ethereum is a Blockchain 2.0 that enables the possibility to create and run smart contracts, digital protocols with the aim of verifying or digitally enforcing the negotiation of a contract, with no need of an intermediary. We propose a solution based on a Public Blockchain to build a decentralized system able to manage the information about resident space objects. Specifically, the adoption of Blockchain results in the need for integrity and authentication of generated data. Concerning data integrity, it is guaranteed by the consensus mechanism of Blockchain that makes all nodes agree on which data are legitimate to be added to the Blockchain. The use of X.509 certificates allows us to implement a mechanism for the authentication of data, in such a way that unauthenticated data in the Blockchain are ignored. An implementation of this solution by an Ethereum smart contract is shown to prove the effectiveness of our solution.