58th IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES (D5)
Cybersecurity in space systems, risks and countermeasures (4)

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A NOVEL SIMULATION PLATFORM FOR SPACE SYSTEMS CYBERSECURITY R&D

Abstract

As space systems become increasingly important to modern society, ensuring their cybersecurity and resilience is paramount. This study presents a novel technological solution designed to facilitate and enhance cybersecurity investigations for space systems. We introduce a new simulation platform, developed within CSS (Cybersecurity for Space Systems) project, led by IRT Saint-Exupéry in Toulouse. The platform, built on NASA's NOS3 simulator, can simulate a single spacecraft or constellations thereof, including flight software, mission control systems and space link communications (using CCSDS protocol stack). In this study a swarm of CubeSats with optical payload serves as the reference mission. The platform is composed by multiple software components: a realistic space system simulator, a cyber-range, penetration testing software and dedicated defense software. The cyber-range, based on Nexova CITEF (Cyber Integration, Test and Evaluation Field), hosts the simulation in a protected environment where dangerous software can be tested safely. This study details the architecture and contributions of the proposed framework, along with examples and demonstrations of its potential, including the development of

an onboard intrusion detection system (IDS) and a selection of cyber attacks that targets specific satellites or the constellation. The platform also allows for the integration of physical devices within the simulation, as showcased by investigations using Gatewatcher NDR solutions. The CSS simulation platform serves as a benchmark for cybersecurity research and development on space systems, providing a valuable tool for the community to advance cybersecurity investigations and to enhance the resilience of space-based infrastructures.