

Ground-Based Preparatory Activities (11)
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SATELLITE OPERATIONS SIMULATOR FOR CYBER EXERCISES

Abstract

The cybersecurity of space infrastructure is now more critical than ever. Space assets, including both ground systems and satellites, are fundamentals of the space environment that underpin the world's economy and military presence. The ability to impact multiple systems by compromising a single space item, is an attractive target for cyber attacks. Therefore, cyber defence training and exercises based on space technology, have become crucial for space and defence community.

Satellite Operations Simulator for Cyber Exercises (SatOpSim) is a fully functional virtual simulator for satellite operations and together with a cyber range, an environment for cyber exercises. This state-of-the-art solution enables cyber exercise participants to simulate attacking and defending a satellite mission, expanding their cybersecurity skills into the space domain. Furthermore, the SatOpSim is to empower development, testing and validation of satellite communication systems in controlled environments and allow building cyber defence skills of satellite operators, system administrators and IT security experts.

The SatOpSim provides software-based components simulating hardware assets in a communication link between mission control and satellite firmware. The aim is to deploy the SatOpSim in a realistic environment for hosting the cyber security related training courses and exercises. By their nature, software-based systems are much easier to scale and replicate than actual hardware, allowing for a cost-effective solution for various sizes and types of cyber-exercises. This makes the SatOpSim very attractive for multi-user setups – various cloud environments and cyber ranges.

In addition to space and ground operations, the SatOpSim supports instantiation of a full mission environment, including mission control systems, ground and satellite simulators, data segments and operations, as well as development of networks. It allows flexible insertion of attack sequences that are used throughout the training sessions and exercises. It familiarizes the space community with incident detection and management tools, along with forensics capabilities hosted in the virtual environment.

The SatOpSim benefits the following domains:

- space operations development. Specifically, satellite and ground segment communication protocol development, testing and validation. It makes possible to conduct named activities in a controlled environment without relying on hardware components (ground station, satellite, etc.);

- satellite fleet operations planning and simulations. Although the number of (small) satellite launches has increased in recent years, bigger constellations are yet to be launched. According to Euroconsult, over 8,000 satellites will be launched by 2027, out of which 80

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testing and validation of ground station network operations and hardware. According to Euroconsult, the upstream segment of the space industry is valued around 10bn, including the ground operations sub-segment of 3bn. Since the technology, software and operations requirements are in constant change, similarly to satellites, it is beneficial to develop, test and validate ground station networks virtually.

Although cybersecurity has become an important topic in the space industry, not many organisations have implemented sufficient measures to minimize related threats. One way to address cyber threats is to conduct exercises and use affordable off-the-shelf tools to create knowledge and simulate different operations in controlled environment without risking any physical assets.