23rd IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 23rd IAA SYMPOSIUM ON SPACE DEBRIS (IP)

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INTERNET-OF-THINGS INTERNATIONAL UNIVERSITY PARTNERSHIP ACTIONS FOR CURRENT AND FUTURE SPACE TRAFFIC MANAGEMENT AND SPACE SUSTAINABILITY RESEARCH: THE SMILE-IOT INITIATIVE

Abstract

The current research on miniaturized transmitters and receivers for Internet-of-Things (IoT) networking has brought to orbit a number of technology demonstrators and various constellations able to provide services for network connection and resources monitoring. Within Space Traffic Management, a large number of critical topics can be addressed by managing a network of IoT sensors. As an example, formation flying can be managed through inter-satellite communication via low-power chips, spectrum sharing and Electro-Magnetic Interference (EMI) avoidance can be critically addressed by constituting communication systems networks. Within future tasks, nano-tugs, Just in time Collision Avoidance (JCA) systems and Active Debris Removal handles can be equipped with such active hardware to better coordinate the operations. In 2024, Sapienza University of Rome (S5Lab research team) has started the SMILE-IoT project, addressing Space Sustainability issues through international university partnerships in IoT research. The project addresses at creating an international university network for joint research and it features 7 Nations (Italy, Japan, South Korea, Albania, France, Panama, Dominican Republic) in its first iteration. The project has been funded by the Rome Technopole foundation through the Sapienza-Rome Technopole call for Internationalization 2024. Within the project, many possible tasks devoted to IoT research, including joint evaluation of nano-satellite mission results, resource monitoring for critical climate change tasks and other are addressed. A Work Package of the project includes the evaluation of IoT performances when directed towards Space Traffic Management tasks. This includes:

- Inter- and Intra-satellite communication with autonomous units for improving the overall reliability of a spacecraft
- Formation flying and rendez vous management, which can be done together with other technologies developed at S5Lab such as Light Emitting Diodes (LEDs)
- Development of fault-tree chips that can be included in Active Debris Removal hardware, such as handles and anchor point, that can help in steering the spacecraft capture in the feature.

S5Lab is at the moment deploying its expertise gained through the four years of in-orbit operations of the WildTrackCube-SIMBA CubeSat, which equips IoT chips for wildlife monitoring, and the future

operations of CORAL, to be launched in 2025, for the test of interconnected sensor networks for Inter-Satellite Link (ISL). This paper will deal with the SMILE-IoT project and the development of partnerships and capabilities for the utilization of IoT systems for Space Sustainability and Space Traffic Management. In the paper, the possible utilization of technologies will be discussed alongside the obtained results by the project.