Resilient Emergency and Search and Rescue Communications (RESARC)

Project Case Study

Project Partners

University of South Australia (UniSA), Flinders University, Safety from Space, Black Art Technologies (BAT), Myriota, Australian Maritime Safety Authority (AMSA), NASA Search and Rescue Office, Defence Science and Technology Group (DSTG)

Project Overview

Emergency services require reliable, ubiquitous, and seamless communication systems to ensure rescue efforts and disaster response capabilities are effective and prevent loss of life. Significant gaps in emergency management exist that can be filled by new generation space-based technologies working in tandem with current ground-based emergency management systems. Coordination between multiple agencies in a timely manner is often critical but is seriously compromised by use of stand-alone communications systems which are not easily integrated. In this project, working with emergency services and technology developers, the information needs of first responders were considered and it was explored how this could be addressed by next generation satellite systems.

Extensive consultation with emergency services was undertaken within Australia and project stakeholders AMSA and NASA. Specific functional requirements apply to raising alarms (avoiding false alarms), broadcasting alerts to users within a geographical region, providing adequate command and control (C2), and sending incident reports both manually and automatically generated. Key challenges are created when there is poor coverage from 4G services in remote areas, damage to vulnerable cellular infrastructure (e.g. bush fire, earthquake, flood) and terrain dependent transmission limits the range of conventional VHF/UHF radios. Current commercial satellite services are generally too expensive to be widely deployed and typically are only available for a handful of crew members. Based on initial operating concepts and use cases, the first phase of the project has developed a set of enhanced system requirements and resilient architectures to enable a data-centric approach. This presents automation opportunities through use of data analytics and Artificial Intelligence (AI) techniques.

The project team is preparing to demonstrate a satellite-based proof-of-concept radio device. This will provide valuable reference data for development of a commercial product, designed for high volume manufacture with low Size Weight and Power (SWaP) to send and receive sensor data from vehicle or personal platforms. The demonstration will operate over an existing constellation of high availability Medium Earth Orbiting satellites, as an overlay to the current EPIRB/PLB beacon systems. This will allow collection and dissemination of situational awareness to those needing the information in real time. Technologies to be showcased include an enhanced highly robust waveform, secure two-way messaging protocol, a novel dual band antenna and transmitter geolocation. Combined, these significantly increase functionality and reliability of operation to support new and effective use cases based on resilient and secure bi-directional communications.

Due to close engagement with NASA, a related opportunity has also been identified to apply the same core technology for the safety of astronauts operating on the surface of the moon. The solution could, for example, provide astronauts with advanced warning of dangerous solar activity and real-time alarms for other safety critical information.

Utilisation

The technologies demonstrated by this project are:

- Enablers for resilient communications to maintain contact with distributed teams of emergency crews operating in dangerous environments with damaged or poor terrestrial communications infrastructure.
- Enablers for enhanced communications for astronauts and safety related sensors operating in the lunar environment.

In both applications, the priorities are instant distress alerting to and from a beacon, distribution of critical data for situational awareness and transmission of safety incident reports. The technology is scalable to support the operating constraints and requirements

Collaboration

AMSA and NASA both supported the investigation of existing spectrum allocation and space segment to support enhanced resilient communications. AMSA supported the project's successful application for a scientific spectrum licence to run experiments, and NASA has shared insights into its LunaSAR program and suggested potential use cases for future Moon to Mars missions.

DST Group has provided subject matter expert input and review of technologies under development. Investigation of a highly robust waveform together with dual band antenna was led by Safety from Space with technology contributions from UniSA, Flinders University and BAT. In addition, Myriota provided a unique and complimentary sensor to satellite service for non-real time tracking assets before and during an incident.

SmartSat supported the project R&D team, facilitated discussions with key stakeholders AMSA and NASA, and a Memorandum of Agreement with NASA is being finalised. This will formalise cooperation for search and rescue, as well as astronaut safety in the Moon to Mars program and help guide future directions.

The technologies demonstrated by this project are enablers for a nationwide resilient emergency communications capability, specifically tailored to the needs of Australia's many emergency services organisations, as well as further potential to extend for worldwide coverage. In addition, it presents a new opportunity for Australia to participate in the Artemis mission for astronaut safety in lunar operations.

Mark Rice, Safety in Space

We're proud to lend the engineering expertise of our Search and Rescue office as SmartSat CRC works on next-generation rescue technologies. Goddard is excited about this new partnership and the new capabilities that it will foster.

Christyl Johnson, Goddard Deputy Director for Research and Technology Investments

SmartSat's research could result in enormous benefits to the global search and rescue effort. This collaboration has the chance to further revolutionise beacon technology and may pursue bold future augmentations of the search and rescue network.

Lisa Mazzuca, NASA Search and Rescue Mission Manager