

IAF SPACE SYSTEMS SYMPOSIUM (D1)  
Space Systems Architectures (2)

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ASSURED ACCESS TO SPACE CAPABILITIES: INCREASING RESILIENCY IN AUTONOMOUS  
SMALL SATELLITE CONSTELLATIONS.**Abstract**

Australian Commercial and Government entities, including Defence, are increasingly reliant on space-based capabilities including communications; Position, Navigation and Timing (PNT); Earth Observation (EO); and Space Domain Awareness (SDA). However, Space is a harsh environment that is becoming increasingly congested, contested and competitive; threatening both assured access and mission success for both civil and Defence applications.

The Resilient Multi-Mission Space Science Technology and Research (STaR) Shot, lead by the Defence Science and Technology Group (DSTG), aims to provide resilient, agile and assured space capabilities for Defence. This will be achieved by undertaking exemplar small satellite missions to explore and demonstrate ‘leap ahead’ space-based technologies; and autonomous, resilient, multi-mission capabilities and operating concepts.

The two cross-technology themes of the RMS STaR Shot are Resilience and Autonomy. Over the past 2 years, DSTG has been investigating the key themes and capability gaps needed to ensure ‘Physical Resilience’ of small satellite constellations; which excludes data, cyber and information resilience/security. In this respect resilience is defined as the satellite and/or constellation being able to complete its mission in a congested and naturally hostile operating environment. Physical Resilience means increasing the durability and survivability of the physical assets over the required lifetime as well as measures to ensure the constellation can maintain operations in a degraded environment or with a degraded system.

This paper will discuss the key threats to Physical Resilience as well as the key themes and research areas that needed to be addressed to ensure resilient autonomous operations for small satellite constellations in Low Earth Orbit:

- Autonomous agility – manoeuvring, formation flying, and propulsion
- Autonomous operations
- Health monitoring, and fault detection and mitigation
- Environmental survivability
- Advanced materials and structures, and rapid integration and testing

This will cover and balance a broad range of scales and factors including ensuring: sensors are working when required; a single satellite can maintain its mission requirements; the constellation as a whole is operationally ready and able; and that Defence has mission specific capabilities on an as needed basis. For Defence to be a space-enabled force, having a resilient, agile and reliable capability is critical.