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SPACE SYSTEMS AS CRITICAL INFRASTRUCTURE: AN APPROACH TO DEMONSTRATE RELIABILITY, RESILIENCE, AND SECURITY

Abstract

Space systems are used for a variety of applications serving Canadian interests, such as resource management, weather, aviation, security, communications, finance, navigation, timing, and defence. Many of these space systems are developed and operated by third party operators, are made available through international partnerships, or are simply data licensing agreements from commercial service providers. This paradigm frames the means by which the government can ensure the reliability, resilience, and security of these services.

Heavy reliance on space systems exposes these major infrastructure sectors to the risks of anomalies in space systems. Disruptions to these systems are not only inconvenient; they can present significant risks to life and property. For example, an anomaly affecting the Anik F2 satellite in 2011 caused a loss of communications service to northern communities that resulted in the shutdown of banks, Automatic Teller Machines (ATMs), and credit card services, as well as numerous flight cancellations. Despite these consequences, Canada's definition of critical infrastructure, and the plan for ensuring the resilience of critical infrastructure, does not specifically mention space systems. In particular, space system service providers must ensure system resilience of their services. This enables the resilience of the services that Canadians depend upon as part of their critical infrastructure. Therefore, a means to characterize the resilience of space systems to the occurrence of these anomalies is necessary. Solutions should include analysis as well as experiments, trials, and "fire drills" similar to practices with other critical infrastructure.

Complexities arise when considering means for performing modelling and simulation as well as trials and drills to demonstrate space system resiliency. Many issues stem from the fact that space systems are implemented by various companies using different architectures and component technologies, and operated using different methodologies as well as the fact that the primary goal of these companies is profit. This paper explores the issue of space systems as critical infrastructure and explores methods for demonstrating their reliability, resilience, and security. It discusses current practices for testing, modelling and simulating space systems in Canada and highlights the deficiencies in these practices with a specific focus on ensuring resiliency of critical infrastructure. A recommended shift toward industry led standardisation of functional testing for demonstrating the effectiveness of anomaly mitigation techniques is presented.