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ARCTIC FOX PROJECT - A FRAMEWORK TO PROVIDE SELF-ADAPTIVE SUPPORT TO SPACE GROUND SYSTEMS: A PROOF OF CONCEPT

Abstract

Space ground systems have become increasingly complex. Questions arise to meet requirements for different operational scenarios such as: In what conditions should use the data from GLONASS constellation to replace the GPS constellation data? Under what load conditions are needed to enable redundancy mechanisms? The above issues require that the systems have more autonomy to handle these scenarios. Self-adaptive systems are presented as a solution to adapt the system face changes in their operational environments. This paper presents a framework for dynamic adaptation. The proposed framework supports the entire system adaptation life cycle: Monitoring, Analysis, Planning and Execution. The framework bases its analysis on metrics collection and detection of service level agreements violations (SLA). An actuator (Executor) is activated on ground system when a contract violation is detected to promote needed architectural adaptations in order to maintain the system serving the purpose for which it was designed. The framework was named Arctic Fox, an animal with interesting adaptation properties, it adapts its coat to survive temperatures below 58° F (50° C). The framework consists of three elements: First, an API embedded in the ground system that provides mechanisms for monitoring and adaptation strategies implementation facilities; Second, an adaptation engine responsible for analyze and plan the changes to be executed at ground system and third, a reference implementation of a rule based engine for self-optimization adaptation. A proof of concept was developed to validate the framework features, there are two self-optimizing scenarios proposed for adaptation of a service-based system. The proof of concept goal is focus on change the system architectural topology after detection of two SLA Contracts violation. One scenario collect metrics from one service and change the execution to another service which betters fits data requirements. The second scenario change the architectural topology to handle a workload above the capacity planned for the service.