NASA SBIR/STTR Technologies

H9.02-9004 - Cognitive Engine enabled Mission-aware Intelligent Communication System for Space Networking

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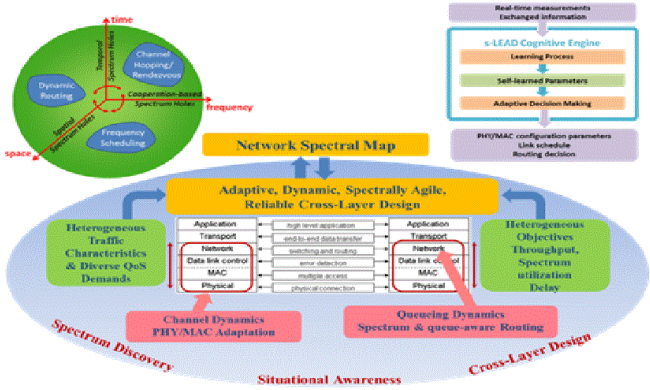
Identification and Significance of Innovation

Cognitive radio technology provides spectrum agility to increase the level of cognition and automation. However, spectrum agility alone is not enough to achieve reliable communications for space networks. Mission success often requires network agility across the protocol layers for environmental awareness and autonomous reconfiguration. This is still an unsolved problem. Specifically, multi-hop wireless/satellite networks with dynamic radio spectrum calls for the development of novel spectrum-aware routing and scheduling algorithms. Most recent work has focused on traditional wireless networks. The effort is still at an early stage and their results cannot be directly applied to the space networks due to the unique characteristics such as large propagation delay, intermittent and asymmetric links, and limited storage space. Thus, further investigation is needed to understand how and where to apply cognitive and automation technologies to enable the network agility in space networks.



Estimated TRL at beginning and end of contract: (Begin: 1 End: 3)

Technical Objectives and Work Plan

The overall objective of this project is to develop a self-learning and adaptive communication system (s-LEAD) architecture to advance cognitive space network technologies, and enhance future NASA mission capabilities. Our approach aims to support high-throughput operation with reliability in terms of meeting QoS requirements and avoiding performance fluctuations in a dynamic space network environment. s-LEAD allows space communication systems to adaptively reconfigure its network elements based upon awareness of network conditions, policies, and mission requirements. Our work plan includes: 1) meet with NASA personnel to refine system requirements and application scenarios; 2) develop self-learning algorithm taking into account feedback delay and imperfect sensing results; 3) develop adaptive decision making algorithm to jointly optimize spectrum resource allocation, routing and scheduling in a cross-layer fashion; 4) implement s-LEAD capability on STRS-compliant SDR platforms; 5) prototype s-LEAD and execute performance evaluation; and 6) develop phase II plan and technical transition plan.

NASA Applications

s-LEAD has great potential to reduce operation costs and enhance the reliability for the NASA missions. Due to the heterogeneous nature of network assets and the lack of autonomy, the developed solution can be applied to the NASA's efforts on the integration of its current agency networks. The potential customers of our solution include robotic and human missions at locations ranging from the near Earth (e.g., EO-1) to deep space (e.g., Mars exploration).

Non-NASA Applications

The proposed solution also has great potential in dynamic military applications. Some example applications include Air Force Airborne Networks, and Joint Tactical Radio System Ground Mobile Radio. The proposed system provides new design guidelines for SDR system development and opens new market opportunities regarding spectrum awareness and cyber security in wireless networks.

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