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SIMULATION AND IMPLEMENTATION OF COGNITIVE RADIO ALGORITHMS FOR SATELLITE COMMUNICATIONS

Abstract

The massification of mobile access and services has increased the demand for faster, reliable and ubiquitous networks, which has been leading to additional pressure on satellite service providers to provide larger throughput. This inherently raises the challenge of bandwidth management. Regulatory activities have led to frequency allocation charts that are growing more complex and harder to manage. Such problem needs therefore to be addressed in order to achieve a more efficient use of resources and cope with the escalating traffic in satellite communications in the sub-5GHz bands. The H2020 SCREEN project is addressing this challenge by resorting to cognitive radio (CR) technology at S-band. SCREEN is working towards maturing several CR enabling technologies up to TRL4/5, considering two reference scenarios: Satcom-enabled UAV constellations and Inter-Satellite Links for satellite networks.

This paper focuses on the design, development, simulation and implementation of the proposed cognitive radio algorithms in SCREEN, namely spectrum sensing, dynamic spectrum manager (DSM), and learning techniques, presenting the most promising results achieved thus far.

In CR environments, communication conditions may show a considerable variability, and therefore, adaptable and reconfigurable spectrum sensing architectures can bring valuable benefits. In this paper, we describe a multi-resolution spectrum sensing architecture, compatible with the proposed approach for dynamic spectrum management, which considers a local and a global DSM and how to combine both methods to offer a higher level of performance. Regarding learning techniques, SCREEN defined two

principal strategies: Centralized learning and de-centralized learning that lend themselves to different protocol architectures, namely in terms of medium-access control.

Additionally, a novel simulation framework for evaluating cognitive radio for Satcom applications is presented, which is based on the open source network simulator (ns-3). The simulator considers realistic satellite orbits, propagation loss and propagation delay models and supports the placement of interferer nodes. The simulation results are output in the open KMZ format, allowing visualization in Google Earth and other GIS. The integrated simulation tool is one of the major novelties of SCREEN. Simulation results and implications are presented on the comparison of both centralized and decentralized MAC approaches with different learning and channel assignment strategies, e.g. based on greedy or reinforcement learning.

Finally, early implementation results of these algorithms in an off-the-shelf space Software-Defined Radio platform will be discussed, as a pioneer step into showing the true applicability of cognitive radio for a new generation of flexible and versatile space-bound transceivers.