

Title: Cognitive Radio and Networks in coalition deployments through the dual use of IEEE 802.11h

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Abstract: In this contribution we introduce an experimental work in progress carried out in Barcelona at CTTC, where ns-3 emulation capabilities are exploited for rapid prototyping, since the same code will be used in simulations and in the testbed. The work is funded by the Spanish Ministry of Research, in the context of the Coincidente program. The project funding the work started in December 2015. In addition, the work is aligned with the NATO RTG group on *Cognitive Radio Networks - Efficient Solutions for Routing, Topology Control, Data Transport, and Network Management* (IST 140), where CTTC acts as the Spanish national representative.

The talk proposes an overview of the objectives and the updated status of the work oriented to build a testbed for the proof of concept of cognitive networking in tactical scenarios, in which two levels of cognition are deployed, namely cognitive radio and load-aware routing. In particular, the 802.11ac-based ad-hoc testbed aims at exploiting DFS (Dynamic Frequency Selection) and Transmission Power Control (TPC) available in IEEE 802.11k for spectral coexistence and interference management in coalition deployments, where platoons of soldiers from different nations communicate using the same frequency bands, and hence can interfere with each other. Traditional static channel allocation strategies are not effective in this scenario, due to the high degree of mobility of the platoons. In addition, platoons belonging to different nations often employ radios by different manufacturers, which are completely incompatible with each other; furthermore, even in the case of nations adopting devices by the same manufacturer, the waveforms in use by each nation are usually customized for security reasons. As a consequence, it is not possible for the radios of the platoons belonging to different nations to coordinate among themselves for spectrum access; rather, if operating in the same channel, the radios will interfere with each other. The project aims to solve the interference problem at link level, but also the connectivity and multi-hop routing at networking level. For that, we propose a backpressure routing approach, adequate to this environment due to the scalability, low overhead, and maximization of resource usage in high mobility and dynamic wireless contexts, and low requirements in terms of state stored at nodes. The work is evaluated in the context of vignettes and scenarios proposed by different NATO IST groups active in the area of cognitive radio and networks, namely (IST077, IST 104 and IST 140). In this case in particular, the approach is to implement an important functional part of the required prototype within ns-3. This is conducted by leveraging the ns-3 emulation framework for providing a rapid and functional evaluation of the ad-hoc testbed. Code reuse through ns-3 emulation enables cross-validation of simulated and experimental scenarios, hence offering the best of both worlds. That is, model validation for the simulator based on experimental evaluations and scalability assessment of the scheme in the simulator once models have been validated.

Biography of the speaker:

Lorenza Giupponi received the Telecommunications Engineering degree from University of Rome “La Sapienza” in July 2002 and the PhD from the Technical University of Catalonia (UPC) in 2007. She joined the Radio Communications Group of UPC in 2003 with a grant of the Spanish Ministry of Education. During 2006 and 2007 she was assistant professor in UPC. In September 2007 she joined the CTTC where she is currently a Senior Researcher in the Mobile Networks Department of the Communication Networks Division. Since 2007 she is also a member of the Executive Committee of CTTC, where she acts as the Director of Institutional Relations. She is the co-recipient of the IEEE Consumer Communications and Networking Conference 2010 (IEEE CCNC 2010) and of the IEEE third International workshop on Indoor and Outdoor Femto Cells 2011 best paper awards. Since 2015 she is a member of the Executive Committee of ns3 consortium. She is an IEEE Senior Member.

Background of the research group:

The Mobile Networks department is part of the Communication Networks Division of CTTC. As such, it deals with network infrastructure and service for mobile and wireless scenarios along three research lines, namely elastic mobile networks, big data and self-organization for mobile networks, and sustainable mobile networks. During the last decade, the group has acquired remarkable expertise on the two main tools it uses for its evaluations, namely the EXTREME Testbed and ns-3. The EXTREME Testbed is a multi-purpose experimental framework for evaluating arbitrary network scenarios in a SDN- and NFV-enabled environment. It features tools for fast deployment of host and guest OS images, experiment creation and management, and result gathering. Additionally, we have extensively used and contributed to the design of ns-3; for instance, as developers of parts of the Wi-Fi module, spectrum, and as main developers and maintainers of the ns-3 LTE module (LENA) in addition to other networking-related developments.

Most of its projects involved one or both of these tools. Some examples are: WALAA (project with the Wi-Fi alliance on LAA using ns-3/LENA), SCALE (project with Aviat Networks on self-organization in wireless backhaul networks using ns-3), LENA (industrial project with Ubiquisys for developing an ns-3-based LTE/EPC network simulator), COMBO (European FP7 project on fixed mobile convergence in which ns-3/LENA running in emulation mode generates data plane traffic and control plane traffic that triggers the automated creation of a transport connection to serve its bearers through calls to an SDN controller), flex5Gware (European 5GPPP project in which ns-3/LENA runs on top of an FPGA-based implementation of the LTE physical layer), 5G-Crosshaul (European 5GPPP project in which an SDN-controlled mmwave multi-hop wireless network is integrated with a multi-layer optical network to provide multi-domain end-to-end paths), BeFemto (European FP7 project in which a novel routing scheme for a mesh backhaul of small cells, which was developed over ns-3 running in emulation mode, was experimentally evaluated).

More information available at: <http://networks.cttc.cat/mobile-networks/>

http://networks.cttc.cat/mobile-networks/extreme_testbed/

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