Poster: Realizing All-spectrum Cognitive Networking on a Software-defined Radio Testbed

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ABSTRACT

We implement and real-time demonstrate for the first time ROCH; a decentralized cognitive algorithm that maximizes secondary network throughput while at the same time satisfies quality-of-service (QoS) requirements for co-existing primary and secondary users through joint Routing and cOde-waveform CHannelization. ROCH performance is evaluated on a 7-node software-defined radio testbed by using the open-source radio framework, GNU Radio, and Universal Software Radio Peripherals (USRP-N210s). The implementation of ROCH is facilitated by the architectural abstractions of the RcUBe radio framework, that provides real-time reconfigurability at the PHY, MAC, and network layers of the protocol stack.

1. ROCH: DISTRIBUTED JOINT ROUTING & ALL-SPECTRUM CHANNELIZATION

ROCH [1, 2, 3] is a novel cross-layer cognitive algorithm that achieves throughput maximization in a cognitive secondary multi-hop network by jointly and dynamically optimizing the code-waveform, transmit power, and routes for each secondary link. Dynamic code-waveform and transmit power allocation maximizes the pre-detection secondary signal-to-interference-plus-noise ratio (SINR) without requiring a-priori knowledge of the transmission characteristics of the primary users [3]. This is achieved by designing waveforms that span the whole continuum of available/device-accessible spectrum, while satisfying peak power for the secondary users and an interference temperature constraint for the primary users [1, 2, 3]. At the same time, ROCH dynamically allocates routes based on the network traffic dynamics and the achievable data rates on different secondary links.

2. RcUBe FRAMEWORK

The implementation of ROCH in GNU Radio is facilitated by the RcUBe framework [4]. RcUBe provides abstractions and building blocks necessary to prototype complex cross-layer protocols based on a high level, abstract representation of the software radio platform. RcUBe is based on the idea of decomposing communication protocols into primitive building blocks. Its design is modular, in the sense that a layered protocol stack is preserved. Particularly, RcUBe divides the architecture of a network node into four distinct, but interacting "planes", i.e. decision, control, data, and register planes, each in charge of coordinating a different group of functionalities.

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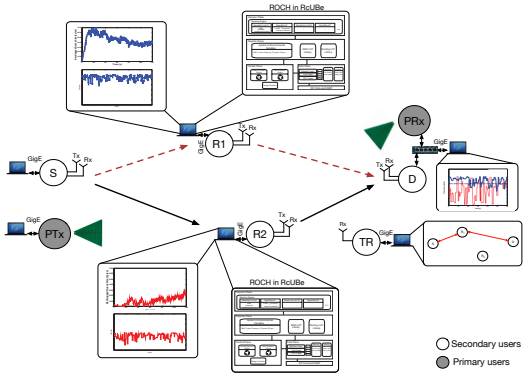

Figure 1: Network-level experimental demonstration of ROCH in a software-defined radio testbed with decentralized control.

3. EXPERIMENTAL NETWORK SETUP

Figure 1 depicts the testbed setup. ROCH capabilities are demonstrated through multiple graphical user interfaces (GUIs) at the relay (R_1, R_2), destination (D), and trace recorder (TR) nodes. Particularly, GUIs at both secondary relay nodes illustrate real-time SINR and queueing information, while the laptop-PC, that controls the secondary destination and primary receiver (PRx) nodes, compares the instantaneous throughput between the primary link (PTx–PRx) and the secondary two-hop network. Finally, the trace recorder node provides an illustration of the secondary routing connections by overhearing the control packets exchanged between the secondary nodes.

4. REFERENCES

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