A Survey on Impact of Various Network Attacks on Time Synchronization in Cognitive Radio

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Abstract—
Time synchronization in CRNs is a demanding task due to the dynamic and cooperative nature of these networks. DCR-Sync, a novel time synchronization protocol for CRNs is proposed. DCR-Sync is fully distributed and resilient towards failure of root nodes, i.e., the nodes which play the role of master on the synchronization process. We present DCR-Sync in two versions. The first version is static in nature, and the second version can adapt dynamically to network changes. This protocol aims to be distributed and reliable even in DCR-Sync following two versions, called DCRSync1 and DCR-Sync2. The former deals mainly with static networks in nature, and it is more suitable for physical time synchronization. The latter considers dynamic face of synchronization root node failures. We describe network topologies, and it is more suitable for logical time synchronization. Both versions offer easy adaptation to changes in network topology, a feature not supported by other existing protocols. Hence, our proposal is better congruous to the needs of networks with mobile topologies.

Keywords: Cognitive Radio Networks, Distributed Cognitive Radio (DCR-1, DCR-2)

I. INTRODUCTION
Cognitive radio systems are radios with the ability to exploit their environment to increase spectral efficiency and capacity. As spectral resources become more limited the FCC1 has recommended that significantly greater spectral efficiency could be realized by deploying wireless devices that can coexist with primary users, generating minimal interference while somehow taking advantage of the available resources. Such devices, known as cognitive radios, would have the ability to sense their communication environment and adapt the parameters of their communication scheme to maximize rate, while minimizing the interference to the primary users. Thus the two most popular research areas when it comes to cognitive radios are spectrum sensing and interference management and resource Allocation. Spectrum sensing is the ability to detect the presence of licensed users and available frequencies/timeslots to transmit in. The problem is then that the algorithms need to have as little delay as possible so that once channels are available one can transmit immediately. And of course one would want as few false detections and false no-detections as possible. Research in the area of interference management and resource allocation consists of how to allocate power in channels to maximize capacity while minimizing interference to other users. One way is of course to transmit when no one else is using that frequency/timeslot, but given a scenario where there are multiple cognitive users in the same environment this may not be possible and certainly not the way to maximize capacity. Cognitive radio is an intelligent wireless communication system that is aware of its surrounding environment (i.e., outside world), and uses the methodology of understanding-by-building to learn from the environment and adapt its internal states to statistical variations in the incoming RF stimuli by making corresponding changes in certain operating parameters (e.g., transmit-power, carrier-frequency, and modulation strategy) in real-time, with two primary objectives in mind:

• highly reliable communications whenever and wherever needed;
• efficient utilization of the radio spectrum.
II. FEATURES

- An intelligent wireless communications system
- Based on SDR technology
- Reconfigurable
- Agile Functionality
- Aware of its environment
- RF spectrum occupancy
- Network traffic
- Transmission quality
- Learns from its environment and adapts to new scenarios based on previous experiences

The term Cognitive Radio was firstly described by Joseph Mitola. From his description we can define the Cognitive Radio as a radio capable of analyzing the environment (as channels and users), learning and predicting the most suitable and efficient way of using the available spectrum and adapting all of its operation parameters [1-3]. The main reason for introducing the cognitive radio is the inefficient use of the radio resources and particularly the spectrum.

Software Defined Radio (SDR):

As mentioned before, Cognitive Radio is not expected to be fully implemented until 2030 [5] until the complete Software Defined Radio (SDR) hardware become available in a suitable size. The term SDR was introduced in the late 1990s by some manufacturers who created radio terminals capable of using more than one communication technique (e.g., GSM and CDMA); that is the terminals can alter their operation mode or technique by means of software. Thus this techniques is known as Software Defined Radio (SDR).

The desired cognitive radio system should have the ability to freely switch between the techniques. Thus, an SDR with all the latest communication techniques is the core of cognitive radio.

III. LITERATURE SURVEY

In this paper, we propose DCR-Sync, a novel time synchronization protocol for CRNs. Differently from existing proposals, DCR-Sync is fully distributed and resilient towards failure of root nodes, i.e., the nodes which play the role of master on the synchronization process. We present DCR-Sync in two versions. The first version is static in nature, and the second version can adapt dynamically to network changes. Through extensive simulations, it is shown that both versions outperform the performance of existing synchronization protocols. Precisely, both versions of DCR-Sync are simulated using NS2 simulator and are compared to the TPSN protocol. Simulation results show the improvements obtained by DCR-Sync in terms of network overhead and convergence time. [1]

In this paper, a novel synchronization protocol is proposed especially for Cognitive Radio (CR) networks called CR-Sync. In a CR network, time synchronization is indispensable because of the requirements for coordinated and simultaneous quiet periods for spectrum sensing, as well as the common understanding of time frame/slot in many CR MAC designs. The proposed CR-Sync achieves network-wide time synchronization in a fully distributed manner, i.e., each node performs synchronization individually using CR-Sync. Contrary to many existing synchronization protocols that do not exploit CR attributes, the proposed protocol takes advantage of the potential multiple spectrum holes that are discovered by CR and distributes the synchronization of different pairs of nodes to distinct channels and thus reduces the synchronization time significantly. Detailed analyses of synchronization error and convergence time are provided. Results show that the proposed CR-Sync out-performs other protocols such as TPSN in CR networks. [2]

This paper proposes a general framework to effectively estimate the unknown timing and channel parameters, as well as design efficient timing resynchronization algorithms for asynchronous amplify-and-forward (AF) cooperative communication systems. In order to obtain reliable timing and channel parameters, a least squares (LS) estimator is proposed for initial estimation and an iterative maximum-likelihood (ML) estimator is derived to refine the LS estimates. Furthermore, a timing and channel uncertainty analysis based on the Cramér–Rao bounds (CRB) is presented to provide insights into the system uncertainties resulted from estimation. Using the parameter estimates and uncertainty information in our analysis, timing resynchronization algorithms that are robust to estimation errors are designed jointly at the relays and the destination. The proposed framework is developed for different AF systems with varying degrees of timing misalignment and channel uncertainties and is numerically shown to provide excellent performances that approach the synchronized case with perfect channel information. [3]
collaborate to process such information, forming the so-called WSNs. WSNs are a special case of wireless ad hoc network and assume a multihop communication without a common infrastructure, where the sensors spontaneously cooperate to deliver information by forwarding packets from a source to a destination. The feasibility of WSNs keeps growing rapidly, and WSNs have been regarded as fundamental infrastructures for future ubiquitous communications due to a variety of promising potential applications: monitoring the health status of humans, animals, plants, and the environment; control and instrumentation of industrial machines and home appliances; homeland security; and detection of chemical and biological threats. [4]

In this paper they have shown specified that harnessing the full power of the paradigm-shifting cognitive radio ad hoc networks (CRAHNs) hinges on solving the problem of time synchronization between the radios during the different stages of the cognitive radio cycle. The dynamic network topology, the temporal and spatial variations in spectrum availability, and the distributed multi-hop architecture of CRAHNs mandate novel solutions to achieve time synchronization and efficiently support spectrum sensing, access, decision and mobility. In this paper, we advance this research agenda by proposing the novel Bio-inspired time Synchronization protocol for CRAHNs (BSynC). The protocol draws on the spontaneous flys synchronization observed in parts of Southeast Asia. The significance of BSynC lies in its capability of promoting symmetric time synchronization between pairs of network nodes independent of the network topology or a predefined sequence for synchronization. It enabes the nodes in CRAHNs to synchronize in a decentralized manner efficiently, and is reliably. The findings suggest that BSynC improves convergence time, thereby favoring deployment in dynamic network scenarios. [5]

**IV. PROBLEM DEFINITION**

DCR-Sync is a novel protocol for time synchronization in Cognitive Radio Networks (CRNs) presented in two versions. Both of them are distributed and resilient against root node failure but the impact of various network attacks on time synchronization is not studied. I will try to endeavour a solution to these problems.

**V. OBJECTIVE**

To provide time synchronization protocol for cognitive radio networks along with sharing wireless channels with licensed holders. The protocol aims to be distributed and reliable even in face of synchronization root node failures.

**A survey on MAC protocols for cognitive radio networks**

In cognitive radio (CR) networks, identifying the available spectrum resource through spectrum sensing, deciding on the optimal sensing and transmission times, and coordinating with the other users for spectrum access are the important functions of the medium access control (MAC) protocols. In this survey, the characteristic features, advantages, and the limiting factors of the existing CR MAC protocols are thoroughly investigated for both infrastructure-based and ad hoc networks. First, an overview of the spectrum sensing is given, as it ensures that the channel access does not result in interference to the licensed users of the spectrum. Next, a detailed classification of the MAC protocols is presented while considering the infrastructure support, integration of spectrum sensing functionalities, the need for time synchronization, and the number of radio transceivers. The main challenges and future research directions are presented, while highlighting the close coupling of the MAC protocol design with the other layers of the protocol stack.

**The DCR-Sync1 Protocol:**

DCR-Sync version 1 (DCR-Sync1) is a kind of master-slave protocol where all the nodes are synchronized to the predefined root nodes, i.e., those nodes equipped with a GPS receiver. The synchronization protocol has two phases: level discovery phase and the synchronization phase.

**The DCR-Sync2 Protocol:**

The DCR-Sync, version 2, (DCR-Sync2) is also a kind of master-slave time synchronization protocol aiming to mitigate delay effects on large distributed CR ad hoc networks. DCRSync2 consists of the two phases: Hierarchical-cum-Leader Discovery phase (HLD) and synchronization phase. The HLD phase is used to create synchronization hierarchy, keep the hierarchy up to date and dynamically determine new leaders (pseudo-root nodes) to initiate and regulate HLD.
Flow Diagram:

REFERENCES


