A multi-radio, multi-hop ad-hoc radio communication network for Communications-Based Train Control (CBTC): Introducing frequency separation for train-to-trackside communication

Communications-Based Train Control (CBTC) is a modern signalling system that uses radio communication to transfer train control information between train and wayside. The trackside networks in these systems are mostly based on conventional infrastructure Wi-Fi (IEEE802.11). It means a train has to continuously associate (i.e. perform handshake) with the trackside Wi-Fi Access Points (AP) as it moves, which incurs communication delays. Additionally, these APs are connected to the wayside infrastructure via optical fiber cables that incur considerable installation costs. Our earlier work presented a novel design in which trackside nodes function in ad-hoc WiFi mode, which means no handshake has to be performed with them prior to transmitting. A node upon receiving packets from a train forwards these packets to the next node, forming a chain of nodes. Following this chain, packets reach the destination. To make the design resilient against interference between the nodes, transmissions are separated on multiple frequencies, ensuring a certain separation between the transmissions. Our previous results exposed a limitation of the design. Since a train node is required to transmit on all frequencies to be able to communicate to the chain with a high probability, the frequency separation guaranteed inside the chain is not achievable in the train-to-chain communication. As a result, the train node’s transmissions cause a significant amount of interference on the chain nodes. This paper proposes an extension to the design in which an additional, dedicated frequency is employed for the train-to-chain communication and presents the results from an extensive simulation study.