Novel Time-Sharing Scheme to Virtually Eliminate Locata-WiFi Interference Issues

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INTRODUCTION

Solution accuracy of GNSS systems is often compromised by the system geometry, weak signal levels and system outages. Locata Corporation's positioning technology potentially bridges such gaps, providing cm-level accuracy in challenging positioning environments. A Locata network consists of time-synchronized terrestrial transceivers (called LocataLites) operating in the 2.4 GHz ISM band, transmitting signals appropriate for positioning. However, operation in a license-free band suffers from RF interference from various other communications and radio systems using the same portion of frequency spectrum. Among various other interfering systems, WiFi devices are of special concern. Although there has been a significant improvement in Locata's immunity to WiFi jamming, in the latest hardware release, interference from WiFi may still hamper Locata's performance. This paper proposes a novel scheme to virtually eliminate WiFi interference to Locata. This scheme exploits the underlying TDMA-based functionality of both systems to force them to operate in a pseudo-synchronized manner, without any direct connectivity between systems. A new signal is proposed to be added to the Locata system, which will dictate the level of inter-system interference.

NETWORK CHARACTERISTICS

The most effective way to virtually eliminate all inter-system interference issues requires either of the systems to stop its transmissions while the other is accessing the channel. Locata and WiFi, both employ TDMA-based scheme, allocating time-slots to their nodes. If overlapping of these time-slots can be avoided, inter-system interference between WiFi and Locata can virtually be eliminated.

In this scheme, we positively exploit the channel sensing mechanism (CSM) of WiFi, to achieve time-synchronization among two systems. CSM requires every WiFi node to 'sense' the channel before starting its transmission. This is done by reading the 'duration' field present in frames currently being transmitted on the channel. It has been identified that if WiFi packets, with appropriate values in 'duration' field, are periodically injected in the channel, any WiFi network can be silenced for the desired amount of time. This silencing of WiFi network can help in virtually eliminating inter-system interference issues between Locata and WiFi.

PROPOSED SCHEME

In a Locata network, each LocataLite transmits during only allocated Locata slots. In the proposed time-sharing scheme it is proposed that Locata time-slots be divided between Locata and WiFi. Implementation requires every LocataLite to transmit a probe, before transmitting its own data. This probe will be a WiFi-type packet defining a duration long enough to cover time for Locatalite's own packet transmission and some additional time. This additional time will be used by the next LocataLite to transmit its probe. As a response to this probe, all WiFi devices within the coverage area would refrain from accessing the channel, re-setting their internal counter (NAV) according to the duration defined in the probe. This would prevent WiFi devices from transmitting while their NAV counter counts down to zero. Consecutive probes will keep resetting the NAV, until all LocataLites transmit in their allocated slots. When all Locata slots allocated to LocataLites are elapsed, no more probes would be transmitted until the start of the next transmission cycle, letting the NAV counter to reach zero value. Once the NAV counter reaches zero, WiFi devices will be allowed to transmit, according to their protocol, in a Locata-interference-free environment, until the start of the next transmission cycle.

IMPLEMENTATION OUTCOMES

Experiments and simulations were performed to determine how Locata and WiFi performance are affected on implementation of the proposed scheme. Results depicted that potential improvement can be achieved by implementing this scheme. It was observed that after implementation of the proposed scheme, correlation output powers from Locata receiver's tracking channels remained much above the required thresholds. It was noticed that the implementation of the proposed scheme can significantly improve a Locata receiver's performance. Also, WiFi data throughput was predicted using simulation results, in presence of proposed scheme. A trade-off is suggested, in the paper, between WiFi and Locata performance, which if not considered carefully, may lead to sub-optimal performance of either of the networks. Results predict that, if carefully implemented, the proposed scheme can virtually eliminate inter-system interference.

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