

# Timestamp Synchronization of Received Frames among Multiple Wireless LAN Nodes for Robust Access Point Coordination

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**Abstract**—Timestamp of frame reception timing of each wireless communication node is useful information to realize effective access control in a coordinated manner among multiple nodes. In order to obtain fine frame reception timestamp from multiple nodes with an independent clock, this paper proposed a method to compensate for the timestamp error due to clock drift among multiple nodes. The proposed method forms a node tree to determine the order of timestamp synchronization using the information of the commonly received frames among the nodes. From the root to the leaf node(s) in the formed tree, the timestamps are synchronized applying linear regression to the timestamps of commonly received frames for the parent and child nodes. The tree is formed so that the number of commonly received frames increases in order to improve the accuracy of the linear regression. Then, the jitter performance of the original timestamp obtained at each node is evaluated by experimental evaluation in an anechoic chamber using four different node configurations. This experimental evaluation revealed that timing synchronization function (TSF) timestamp is obtained with a jitter of a few  $\mu\text{s}$ . Finally, the system-level simulation assuming IEEE 802.11n WLAN was conducted to evaluate the residual timestamp error among the coordinating nodes. The simulation results revealed that the proposed method can keep the residual timestamp error around 1  $\mu\text{s}$  if TSF stamp is available and the clock drift rate is stable in a couple of minutes.

**Keyword**— Access point coordination, IEEE 802.11, timestamp synchronization, TSF timestamp, wireless LAN

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