Time Synchronization in Sparse and Highly Mobile Sensor Networks

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In mobile sensor networks, many applications depend on the availability of a global time reference. For instance, the order of occurrence of events detected by different sensors may affect the interpretation of the data. This can be done easily with timestamps, but requires that clocks be properly synchronized. The system with lack of appropriate synchronization will operate in wrong condition, or even ends up with causing failure of the system. To solve this problem, time synchronization protocols for sensor networks is used in order to maintain clock synchronization in the system. Since existing protocol cannot provide the efficient solution for mobile system, this research presents two different scheme protocols for sparse and highly mobile sensor network. First, Mobility Prediction Time Protocol (MPTP), which utilizes the method of mobility prediction to estimate the connection lifetime between any two nodes, then follows the proposed parent choosing criteria in order to construct the strong connected time synchronized hierarchical topology in the system. MPTP tries to make the rare change in the topology and provides dynamic connection re-establish mechanism before any connection loss. Second, Population-based Time Protocol (POP-B), which is adapted from opportunistic scheme protocol to spread the clock information over the entire network. POP-B utilizes the high opportunity

to meet other nodes due to node's high mobility, thus, the reference clock information can be quickly spreaded and cover all though the system.

To measure the performance of protocol, we derive analytical model and conducted the simulations. SNTP, the basic hierarchical time synchronization protocol in sensor network, and RTSP, the protocol which maintains node list to tackle the mobility problem, are simulated as the reference protocol to compare against to. The simulation results show that MPTP and POP-B can achieve very high clock synchronization accuracy and stability compared to SNTP and RTSP, and both protocols can perform even better when mobility increases. However, POP-B, which uses opportunistic and non-structural scheme provides the higher accuracy, and even more stable than MPTP does.