INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The IPv6 over the TSCH mode of IEEE 802.15.4e (6TiSCH) network is standardized to meet high reliability, end-to-end latency, and network lifetime requirements of various IoT applications. The formation of 6TiSCH network should happen before establishing end-to-end data communication. So, the 6TiSCH Working Group published 6TiSCH Minimal Configuration (6TiSCH-MC) standard for 6TiSCH network formation. Basically, 6TiSCH network formation is started by the Join Registrar/Coordinator (JRC), and all the new nodes (aka pledges) join one-by-one in the multi-hop 6TiSCH networks. Faster formation of 6TiSCH network is challenging because of the inherent channel hopping feature of TSCH as the pledges do not know in which channel and at what time control packets are transmitted by the already joined nodes and/or the JRC. Apart from this, the resource allocated by 6TiSCH-MC standard is static in nature, and it did not provide any mechanism to handle congestion in shared cell and to regulate the transmission rates of different control packets used to form the network. Therefore, we set the objective of this thesis is to augment the 6TiSCH-MC standard by updated mechanisms for achieving faster formation of 6TiSCH IoT network. It is observed that congestion in shared cell becomes an inevitable problem when the number of joined nodes increases, and it degrades the performance of 6TiSCH network formation. Therefore, to reduce the congestion in shared cell, we proposed two schemes, namely, channel condition based dynamic beacon interval (C2DBI) and game theory based congestion control (GTCC). We further observe that due to fixed priority assignment to the control packets and insufficient transmission of routing control packet, formation of 6TiSCH network gets delayed. Therefore, for sufficient and efficient transmission of routing control packet, we propose another two schemes, namely, opportunistic transmission of control packets (OTCP) and adaptive control packet broadcasting (ACB). Further, we leverage all the available channels at a time in order to increase the number of shared cells per slotframe for quicker transmission of control packets. For this, we propose another two schemes i.e., autonomous allocation and scheduling of minimal cell (TACTILE) and time-variant RGB (TRGB) model. Finally, it is worthwhile to mention that all the proposed schemes are evaluated by Markov Chain based theoretical analysis, simulation, and testbed experiments. As a whole, this dissertation improves the performance of 6TiSCH network during its formation period in terms of joining time and energy consumption of the IoT nodes while maintaining stable network.