

# ***ABSTRACT***

Hybrid Communication Networks have becoming more and more popular Networks. They provide both the advantages, wired and wireless communication. In these types of networks, Wireless Sensor Networks (WSNs) become very advancing and interesting topic in various applications.

WSN consists of battery operated portable devices which cause the limitations on capacity, bandwidth and computing power. Sustaining a route from a source to a destination may consume more bandwidth than is required to support the data traffic flow. Hence, packet routing techniques must be applied to provide long-range and large-scale communication in WSNs. Power consumption required by WSN Motes, topological features and traffic characteristics are the main constrains considered for analysis of WSN using simulation tools. In order to optimize the communication, it is important to know the characteristics of the traffic in advance.

WSN services are greatly supported by IEEE 802.15.4 Standard. This protocol grants exclusive use of a wireless channel for time-critical traffic load through a very attractive feature Guaranteed Time Slot (GTS) medium access control mechanism activated in the beacon-enabled mode based on the Superframe Structure. In this thesis, methodology for setting the relevant parameters of IEEE 802.15.4- compliant WSNs is analyzed and proposed. Considering the improvisations required in overcoming the flaw of traditional methods; Soft computing methods are used which differs from conventional (hard) computing in that, it is tolerant of imprecision, uncertainty, partial truth, and approximation. Here Traffic parameters of GTS Mechanism are optimized through soft computing techniques like Artificial Neural Network (ANN), Adaptive Neuro Fuzzy Inference System (ANFIS).

The effort took to examine the reliability of IEEE 802.15.4 OPNET simulation model through simulating wireless sensor network. In Hardware implementation, real WSN experiments were setup by using two MICAz nodes and one MIB520 gateway to evaluate the simulator's reliability. The results collected from MICAz test-bed experiments were compared with the results collected from the simulation experiments of the same scenarios. Also hardware implementation of soft computing algorithm is configured on Atlys Spartan 6 kit XC6SLX45 CSG324C FPGA platform using Xilinx ISE.