CERTIFICATE

I hereby certify that the thesis entitled, "**A STUDY ON DELAY ANALYSIS ON WIRELESS SENSOR NETWORKS"** revised and resubmitted to the St. Peter's University, for the award of Degree of Doctor of Philosophy is the record of research work done by the candidate K. Ramesh under my guidance and that the thesis has not formed previously the basis for the award of my degree, diploma, associateship, fellowship or other similar titles.

Place: **Dr. V. KANNAN**

Date: **SUPERVISOR**

DECLARATION

Certified that the thesis entitled "**A STUDY ON DELAY ANALYSIS ON WIRELESS SENSOR NETWORKS"** is the bonafide record of independent work done by me under the supervision of Dr.V.Kannan. Certified further that the work reported herein does not from part of any other thesis or dissertation on the basis of which a degree or award was conferred earlier.

Dr. V. KANNAN **K. RAMESH**

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Date:

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ABSTRACT

Smart and green environment represents the next evolutionary development steps in disaster management, industrial automation, home modernization, environmental and health monitoring. Real-time requirements depending on the application, it may be necessary for sensor nodes within the sensor network to respond quickly to detected events. These sensor networks introduce different types of errors, which are due to the unpredictable nature of the wireless channel delays. The end-to-end delay is one of the most critical and fundamental issues for wireless sensor networks.

Where sensor node generates and propagates data only when an event of interest occurs, here by producing unpredictable traffic load. Meanwhile, the end-to-end delay is tightly bounded with many other factors, e.g., sensor energy and network capacity. In this research work analyzed the quantitative relation among the end-to-end delay including event detection delay, queuing delay, propagation delay and transmission delay. An event detection delay analysis of the communication model is done by Non-Homogeneous Poisson Point Process and is used for model the communication process by any-cast protocol.

Characterization of the queuing delay, distribution is fundamental for real-time communication applications with probabilistic quality of service guarantees. The diffusion approximation method have used for solving an open

G/G/1 queuing network provided that all the sensor nodes in the network be the single server with first-come- first-serve service strategy.

Then analyzed the throughput of the ALOHA protocol through space-time uncertainty have been handled by the addition of extra guard time with respect of the transmission time in time slots. In addition of guard times are added to ensure the overlap of single slot at the receiver side and hence minimizing the propagation delay. Through this analysis achieving with the merits of performance, maintained expected quality of service in the guard time slot, and maximum successful throughput.

And finally, selective and predictable algorithm is used, Selective Random Back-off (SRB) which is based on modifications of the IEEE 802.11 Binary Exponential Back-off (BEB). The motivation of Selective Random Back-off (SRB) is the enhancement of BEB performance for correlated traffic generated from multiple sensor nodes of the same neighborhood when these sensor nodes sensing an event in the event-driven scenarios and hence analyzing normalized throughput, packet dropping probability and transmission delay with different contention window. It is better way to analysis the delay model with ns-2 (Network Simulator-2.27), simulation for repeatedly several times and fixing the problems with analytical approximations. Comparing these simulation results with analytical results through MATLAB tool and also used for this research work.

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LIST OF SYMBOLS AND ABBREVATIONS

W_{sj}	-	Average delay of packets at node *i*
W_s	-	Average end-to-end delay a packet
G	-	Average generation rate
Λ	-	Average no. of nodes with in the area
l_m	-	Beacon and CTS Message
lp	-	Data packet size
DCF	-	Distributed Co-ordination Function
DFD	-	Distributed fault detection
ξ	-	Duty cycle
r_e	-	Event detection range
Fx	-	Feasible forwarding region
FIFO	-	First in first out
T_f	-	Frame length
B	-	Guard time
T_{rx}	-	Listening phase
LOC	-	Line of sight
MAC	-	Medium Access Control
ρ	-	Node density
n	-	Number of nodes
QNA	-	Queuing Network Analyzer
λ	-	Packet arrival rate
τ_m	-	Propagation time
t_e	-	Reporting interval
T	-	Scheduling period
ψ^{th}	-	Threshold level
p_t	-	Transmit Power
r^{th}	-	Threshold radius
R	-	Transmission range

W	-	Transmission rate of each node
S	-	Traversing area
p_i	-	Traffic load of sensor node *i*
T_{tx_sleep}	-	Transmission and sleeping slot
TCP	-	Transport Control Protocol
UDP	-	User Datagram Protocol
L	-	Width