

Table of Contents

List of Figures	V
List of Tables	XI
Acronyms	XI
1. Overview	1-8
2. Communication Network: An Introduction	9-20
2.1 IEEE 802.3: Ethernet	10
2.2 IEEE 802.11: Wireless Lan	11
2.3 Hybrid Communication Networks	14
2.4 Wireless Sensor Networks	15
Summary	20
3. WSN Simulators	21-39
3.1 Simulation Platforms for WSN	21
3.2 The Characteristics of WSN Simulation	21
3.2.1 NS-2	23
3.2.2 GloMoSim	24
3.2.3 QualNet	24
3.2.4 TOSSIM	25
3.2.5 Avrora	27
3.2.6 OMNET++	27
3.2.7 SENS	28
3.2.8 MATLAB: TrueTime toolbox	28
3.2.9 OPNET	30
3.2.9.1 Specification Editors	31
3.3 Network Simulation using OPNET	32
3.4 Simulation Setup And Results	32
3.4.1 Wired and Wireless Network Comparison	33
3.4.2 Hybrid Network	37
3.4.2.1 Model Outline	37

<i>Summary</i>	39
4. Development Support Tools	40-50
4.1 <i>MOTES</i>	41
4.2 <i>MATLAB</i>	42
4.3 <i>Simulink</i>	42
4.4 <i>Truetime Toolbox</i>	43
4.5 <i>Software Requirements</i>	45
4.6 <i>Compilation</i>	45
4.7 <i>SIMULATION SETUP</i>	46
4.7.1 <i>Process to run simulation model</i>	46
4.4.2 <i>Simulation Results</i>	48
<i>Summary</i>	50
5. IEEE 802.15.4 Structure	51-65
5.1 <i>Network Devices</i>	51
5.2 <i>Network Topologies</i>	52
5.3 <i>IEEE 802.15.4 Physical Layer (PHY)</i>	53
5.4 <i>IEEE 802.15.4 Medium Access Control</i>	53
5.5 <i>IEEE 802.15.4 Operational Modes</i>	54
5.6 <i>The Superframe Structure</i>	57
5.7 <i>Simulation Setup & Results</i>	59
<i>Summary</i>	65
6. IEEE 802.15.4 WSN: GTS Mechanism	66-82
6.1 <i>GTS Mechanism Evaluation</i>	66
6.2 <i>Related Work</i>	66
6.3 <i>The IEEE 802.15.4 Simulation Model</i>	67
6.4 <i>GTS Mechanism</i>	70
6.5 <i>Parameter Analysis</i>	73
6.5.1 <i>Throughput Analysis</i>	74
6.6 <i>Simulation Setup</i>	74
6.7 <i>Simulation Results And Discussion</i>	76
6.7.1 <i>Impact of Buffer size on GTS Throughput</i>	76
6.7.2 <i>Impact of Duty cycle on global statistics throughput.</i>	77

6.7.3	<i>Impact of Buffer size on Packet Medium Access Delay</i>	78
6.7.4	<i>Impact of the Superframe Orders on Wasted Bandwidth</i>	79
	<i>Summary</i>	82
7.	Soft Computing based WSN	83-98
7.1	<i>Soft Computing Models</i>	83
7.2	<i>Artificial neural networks</i>	83
7.2.1	<i>Basics of Artificial Neural Networks (ANN)</i>	85
7.2.2	<i>Types of ANN Learning</i>	85
7.2.3	<i>Back Propagation Network (BPN)</i>	86
7.3	<i>Adaptive Neuro Fuzzy Inference System (ANFIS)</i>	86
7.4	<i>Matlab Development tools</i>	87
7.4.1	<i>MATLAB</i>	87
7.4.2	<i>Simulink</i>	88
7.4.3	<i>Toolboxes</i>	89
7.5	<i>ANN based GTS Mechanism</i>	91
7.5.1	<i>Implementation of ANN GTS Mechanism</i>	92
7.6	<i>ANFIS based GTS Mechanism</i>	94
7.7	<i>Comparison of Traditional method, ANN, ANFIS</i>	95
7.8	<i>Soft GTS Mechanism Simulator</i>	96
	<i>Summary</i>	98
8.	Embedded Hardware: WSN	99-116
	SECTION A: Configuration of ANN on FPGA Kit	99
8.1	<i>Short introduction to FPGAs</i>	99
8.2	<i>FPGA design implementation of ANN</i>	100
8.3	<i>Design Implementation and Simulation Results</i>	101
8.4	<i>Test-bed Hardware Implementation</i>	103
	SECTION B: WSN Hardware implementation	105
8.5	<i>CROSSBOW MICA2 (MPR2400) MOTE Processor</i>	107
8.5.1	<i>CC2420 radio transceiver</i>	108
8.5.2	<i>MIB520 USB interface board</i>	108
8.5.3	<i>MDA100CA/MDA100CB</i>	109

8.5.4	<i>TinyOS</i>	109
8.6	<i>Software Description And Discussion</i>	110
8.6.1	<i>Software Development Tools</i>	110
8.6.2	<i>MOTE-VIEW Functionalities</i>	112
8.7	<i>Test-bed Hardware Setup and Implementation</i>	113
8.7.1	<i>Program Sensor Nodes</i>	113
8.7.2	<i>Experiment Results</i>	116
	<i>Summary</i>	116
9.	Conclusion & Future Scope	117-119
10.	Bibliography	120-135
	Appendix A: Development Environments	136-146
A.1	<i>Code Generation Using Xilinx ISE 14.6</i>	136
A.2	<i>Impact Setup</i>	139
A.3	<i>Atlys™ Board: Spartan-6 XC6SLX45 CSG324C</i>	142
A.4	<i>Programming WSN Motes</i>	142
	Appendix B: Photo gallery	147-150
	Appendix C: List of Programmed Files	151
	Appendix D: User Interface	152-153
	Appendix E: List of Papers Based on Research work	154-156
E1:	<i>Publications - Proceedings/Referred (National/International) Journals</i>	154
E2:	<i>Presentations -Regional/National/International Conferences</i>	155
E3:	<i>Awards/Prizes</i>	156