

TDMA based MAC protocol to assist in Wide area Sensor Network Deployment



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the University of Moratuwa in partial fulfillment for the degree of Master of
Science

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DECLARATION

The work included in this thesis, in part or whole has not been submitted for any other academic qualification at any institution.

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ABSTRACT

Wireless sensor networks are an emerging area of interest among research groups around the globe. It is envisioned that these low power computers will become the enabling technology in pervasive computing and bring about the next paradigm shift in computing.

The purpose of this work has been the development of enabling technologies for a sensor network deployment over a wide geographical area. Chief among these is the development of a time division multiple access (TDMA) based MAC protocol for a special type of mobile wireless sensor network. In this network, mobile sensor nodes will sense the environment, and buffer the measured data for later retrieval. Once within range of the base station, the mobile mote will upload the buffered data to the base station. Such a system could be used in applications such as analyzing migration patterns of animals (ex. Elephants) or offline monitoring of vehicle fleets. We present a MAC protocol developed by combining floor acquisition multiple access (FAMA) and TDMA that will maximize the throughput of the said network, and thereby ensure that the maximum amount of data can be uploaded by the mobile mote to the base station in a given time.

The proposed protocol is implemented as TinyOS components, targeted for the MICA2 sensor network platform. Simulation results are presented that benchmark the proposed FAMA/TDMA Hybrid MAC against a CSMA based MAC (B-MAC) protocol as well as a demand assigned TDMA protocol.

In addition to the above MICA2 motes were built locally for the purpose of testing the protocol on real hardware. A study was carried out and recommendation made on algorithms that can be used for data storage on such a system.

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LIST OF ABBREVIATIONS

API	–	Application programmers interface
BMA	–	Bit-map-assisted
B-MAC	–	Berkeley Medium Access Protocol
CF	–	Compact flash
COTS	–	Common off the shelf
CPU	–	Central processing unit
CSMA	–	Carrier sense multiple access
CTS	–	Clear to send
EEPROM	–	Electrically Erasable Programmable Read-Only Memory
FAMA	–	Floor acquisition multiple access
FAT	–	File allocation table
FIFO	–	First-in-first-out
GAMA	–	Group allocation multiple access
GPRS	–	General packet radio service
GPS	–	Global positioning system
GUI	–	Graphical user interface
IC	–	Integrated circuit
IR	–	Infra-red
LAN	–	Local area network
LEACH	–	Low Energy Adaptive Clustering Hierarchy
LED	–	Light emitting diode
LMAC	–	Lightweight Medium Access Protocol
LPL	–	Low power listening
MAC	–	Medium/Media Access Control
MEMS	–	Micro-Electro-Mechanical Systems
MMC	–	Multimedia memory card
MMU	–	Memory management unit
OS	–	Operating system
PCB	–	Printed circuit board

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LIST OF ABBREVIATIONS

PDA	–	Personal digital assistant
PEDAMACS	–	Power efficient and delay aware medium access protocol sensor networks
PPC	–	Packets-per-cycle
RF	–	Radio frequency
ROM	–	Read only memory
RTS	–	Ready to send
Rx	–	Receiver/Reception
SD	–	Secure Digital
S-MAC	–	Sensor Medium Access Protocol
S-MAC/AL	–	Sensor MAC with adaptive listening
SPI	–	Serial peripheral interface
SRAM	–	Static random access memory
TDMA	–	Time division multiple access
T-MAC	–	Timeout Medium Access Protocol
TOSSIM	–	TinyOS simulator
Tx	–	Transmitter/Transmission
WSN	–	Wireless sensor network

