



**BIO- INSPIRED CHAMELEON TECHNIQUE IN
MAC PROTOCOL FOR ENERGY EFFICIENT
WIRELESS SENSOR NETWORKS**

by

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In the Name of Allah, The Most Beneficent, and The Most Merciful: “My Lord, enable me to be grateful for your favor which you have bestowed upon me and upon my parents and to do righteousness of which you approve. And admit me by your mercy into [the ranks of] your righteous servants. (An-Naml: 19) ”.

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LIST OF ABBREVIATIONS

AC-MAC	Adaptive coordinated sensor MAC
AEE-MAC	Adaptive Energy Efficient MAC
B-MAC	Berkeley-MAC
BPS-MAC	Back-off Preamble Sequential-MAC
BS	Base Station
CA-MAC	Channel access MAC
CCA	Clear Channel Assessment
CC-MAC	Correlation-based Collaborative MAC
CF	Control Factor
CH	Cluster Head
CLUDDA	Clustered diffusion with dynamic data aggregation
C-MAC	Classifier MAC
CM	Chameleon Mechanism
CM-BMAC	Chameleon mechanism -Berkeley MAC
CSMA	Carrier Sense Multiple Access
CSMA-MPS	Carrier Sense Multiple Access- Minimum Preamble Sampling
CR	Crossover Factor
DDH-MAC	Dynamic De-Centralized Hybrid
DEA	Differential evolution algorithm
DOE	Design Of Experiments
DPS-MAC	Dual Preamble Sampling MAC
DTA-MAC	Dynamic Traffic-Adaptive MAC Protocol

E-MAC	Event MAC
EA-A LPL	Energy Aware Adaptive low power Listening
E2-MAC	Energy-Efficient Medium Access
EB-MAC	Enhanced B-MAC
ELA-MAC	Energy Latency Aware MAC
EQ-MAC	Energy Efficient QoS MAC
FF	Fitness Function
GCCC	Global Common Control Channel
G-MAC	Gateway MAC
HY-MAC	Hybrid MAC
IPS-MAC	Information Preamble Sampling
LEACH	Low Energy Adaptive Cluster Hierarchy
LA-MAC	Low Latency Asynchronous MAC
LPL	Low Power Listening
L-MAC	Lightweight Medium Access Protocol
LWOF	Light-Weight Opportunistic Forwarding
MAC	Medium Access Control
Max-MAC	Maximally traffic adaptive MAC protocol
MC-MAC	Multi-channel MAC protocols
MCM	MTDE control Message
MH-MAC	Multi- Mode Hybrid
MFP	Micro Frame Preamble
ML-MAC	Multi-Layer MAC
MQ-MAC	Multi Constrained QoS Aware MAC
MTDE	Merge Taguchi Differential Evolution

N-MAC	Network MAC
OVs	Optimum Values
PE-MAC	Power Efficient MAC
PEGASIS	Power Efficient Data Gathering Protocol For Sensor Information System
PEDAP-PA	Power Efficient Data Gathering Protocol For Sensor Information System With Power Aware
PDR	Packet Delivery Ratio
PF1	Partial of Farm1
PF2	Partial of Farm2
PSO	Particle swarm optimization
PRIMA	Priority Based MAC protocol
PS	Packet Size
PSO	Particle Swarm Optimization
PT	Pause time
QoS	Quality of Service
REQ/REP	Request/ Reply
RIX-MAC	Receiver-Initiated X-MAC
RTS/CTS	Request to Send / Clear to Send
S-MAC	Sensor MAC
SA-MAC	Spectrum Agile Medium Access Control Protocol
SCP-MAC	Scheduling Channel Polling MAC
S/N	Signal – to – Noise
SNs	Sensor Nodes
ST	Simulation Time
STEM	Spare Topology and Energy Management

TAH-MAC	Time Adaptive Hybrid MAC
TAS-MAC	Traffic- Adaptive Synchronous MAC protocol
TATD-MAC	Traffic-Adaptive Time Division multiple access control
TDMA	Time Division Multiple Access
TDMA-CSMA	Time division multiple access- Carrier Sense Multiple Access
TDMA-FDMA	Time division multiple access- frequency division multiple access
TF-MAC	Time Frequency MAC
TG	Traffic Generation
TM	Taguchi Method
TRAW-MAC	Traffic Aware MAC
TOA	Taguchi Orthogonal Array
RA-MAC	Transmission Scheduling scheme-Aggregation MAC
WPAN	Wireless Personal Area Network
WSN	Wireless Sensor Network

Teknik Chameleon Bio-Inspired di Protokol Mac untuk Kecekapan Tenaga Rangkaian Sensor Tanap Wayar

ABSTRAK

Aplikasi Rangkaian Sensor Tanpa Wayar (WSN) telah semakin menarik minat para penyelidik untuk dibangunkan dan diterokai. Komponen WSN adalah terdiri daripada nod sensor yang disambungkan dengan teknologi tanpa wayar bagi membentuk rangkaian. Terbaru, penggunaan teknologi cekap tenaga adalah merupakan salah satu cabaran yang sangat signifikan dalam pembangunan WSN. Oleh itu, dalam aspek pemuliharaan penjimatan tenaga pada WSN topik yang telah mendapat perhatian penyelidik sejak kebelakangan ini adalah rekabentuk tenaga pada protocol MAC di mana penggunaan tenaga menekankan kesan mekanisme protokol dalam prestasi WSN. Sejak kebelakangan ini, analisis protokol MAC serta kesannya terhadap prestasi rangkaian dengan senario rangkaian yang berbeza telah mendapat tempat dikalangan penyelidik serta meningkatkan kefahaman yang menyeluruh berkenaan keperluan dan matlamat dalam merekabentuk protocol MAC. Selanjutnya, tinjauan kajian menunjukkan terdapat banyak rekabentuk protokol MAC yang dicadangkan adalah untuk menangani keperluan WSN ini. Walau bagaimanapun, cadangan mekanisme protokol MAC yang dicadangkan dalam kebanyakan tinjauan kajian adalah hanya terhad kepada senario satu rangkaian WSN tunggal sahaja. Tetapi kebanyakan masalah pada rangkaian WSN adalah pada node sensor yang menghadapi masalah seperti kegagalan fungsi, penambahan nod, penyusutan tenaga dan pergerakan yang mana telah membawa kepada senario yang sangat berbeza. Ciri-ciri tingkah laku node WSN tersebut telah menghasilkan keperluan bagi mekanisme MAC untuk menangani keperluan lebih dari satu senario rangkaian yang mana masalah ini kurang diberi perhatian dalam tinjauan kajian berkaitan. Sehubungan dengan ini, tesis ini mencadangkan agar mekanisme Chameleon pada protocol MAC dapat menangani perubahan topologi di WSN. Dalam mekanisme yang dicadangkan telah mentakrifkan prestasi protokol Berkeley-MAC (B-MAC) bagi senario rangkaian yang berbeza sebagai masalah pengoptimuman objektif tunggal dan berbilang-objektif. Bagi masalah objektif tunggal diselesaikan dengan kaedah Taguchi, sementara bagi masalah pengoptimuman multi-objektif diselesaikan dengan menggunakan kaedah algoritma evolusi pembezaan. Mekanisme protokol yang dikemukakan ini adalah digabungkan dengan Berkeley-MAC. Hasil simulasi meluas ditunjukkan dengan membandingkan prestasi mekanisme Berkeley-MAC yang dioptimumkan dan tidak dioptimumkan. Mekanisme ini dinilai di bawah perubahan nombor nod, masa simulasi, penjanaan lalu lintas, dan kepanjangan mesej untuk dua topologi rangkaian; sebahagian senario daripada ladang 1 dan ladang 2. Keputusan menunjukkan bahawa mekanisme Chameleon yang dicadangkan untuk B-MAC meningkatkan prestasi pelbagai senario WSN dari segi nisbah penghantaran paket, throughput, kelewatan akhir ke akhir, dan meminimumkan penggunaan kuasa. Mekanisme pengoptimuman objektif tunggal (teknik Taguchi) mengurangkan penggunaan kuasa sebanyak 42%; keterlambatan akhir ke akhir sebanyak 33%; dan meningkatkan PDR sebanyak 52%; dan throughput sebanyak 40%. Mekanisme pengoptimuman multi-objektif (algoritma evolusi pembezaan) mengurangkan penggunaan kuasa sebanyak 42%; keterlambatan akhir ke akhir sebanyak 33%; dan meningkatkan PDR sebanyak 52%; dan throughput sebanyak 40%. Selain itu, analisis prestasi protokol B-MAC untuk senario WSN yang berbeza menunjukkan perbezaan prestasi. Ini menyokong hipotesis bahawa topologi rangkaian mempunyai kesan terhadap prestasi protokol B-MAC. Tesis ini menyimpulkan bahawa pengoptimuman protokol B-MAC adalah perlu untuk meningkatkan prestasi WSN. Pengoptimuman objektif tunggal

menghasilkan peningkatan yang besar untuk protokol B-MAC. Walau bagaimanapun, ia tidak dapat meningkatkan lebih daripada satu persembahan secara serentak. Di sisi lain, mekanisme pengoptimuman multi-objektif dianggap sebagai penyelesaian untuk mengurangkan penggunaan kuasa tanpa mempengaruhi prestasi protokol WSN B-MAC.

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