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**PROTOCOL DESIGN FOR
REAL TIME MULTIMEDIA COMMUNICATION
OVER HIGH-SPEED WIRELESS NETWORKS**

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ABSTRACT

The growth of interactive multimedia (IMM) applications is one of the major driving forces behind the swift evolution of next-generation wireless networks where the traffic is expected to be varying and widely diversified. The amalgamation of multimedia applications on high-speed wireless networks is somewhat a natural evolution. Wireless local area network (WLAN) was initially developed to carry non-real time data. Since this type of traffic is bursty in nature, the channel access schemes were based on contention. However real time traffic (e.g. voice, video and other IMM applications) are different from this traditional data traffic as they have stringent constraints on quality of service (QoS) metrics like delay, jitter and throughput. Employing contention free channel access schemes that are implemented on the point coordination function (PCF), as opposed to the numerous works on the contending access schemes, is the plausible and intuitive approach to accommodate these innate requirements. Published researches show that works have been done on improving the distributed coordination function (DCF) to handle IMM traffic. Since the WLAN traffic today is a mix of both, it is only natural to utilize both, DCF and PCF, in a balanced manner to leverage the inherent strengths of each of them. We saw a scope in this technique and develop a scheme that combines both contention and non-contention based phases to handle heterogeneous traffic in WLAN. Standard access scheme, like 802.11e, improves DCF functionality by trying to emulate the functions of PCF. Researchers have made a multitude of improvements on 802.11e to reduce the costs of implementing the scheme on WLAN. We explore improving the PCF, instead, as this is more stable and implementations would be less costly. The initial part of this research investigates the effectiveness of the point coordination function (PCF) for carrying interactive multimedia traffic in WLAN. The performance statistics of IMM traffic were gathered and analyzed. Our results showed that PCF-based setup for IMM traffic is most suitable for high load scenarios. We confirmed that there is a scope in improving IMM transmissions on WLAN by using the PCF. This is supported by published researches on PCF related schemes in carrying IMM traffic on WLAN. Further investigations, via simulations, revealed that partitioning the superframe (SF) duration according to the need of the IMM traffic has considerable impact on the QoS of the WLAN. A theoretical model has been developed to model the two phases, i.e., PCF and DCF, of WLAN medium access control (MAC). With this model an optimum value of the contention free period (CFP) was calculated to meet the QoS requirement of IMM traffic being transmitted. Treating IMM traffic as data traffic or equating both IMM and non-IMM together could compromise a fair treatment that should be given to these QoS sensitive traffic. A self-adaptive scheme, called MAC with Dynamic Superframe Selection (MDSS) scheme, generates an optimum SF configuration

according to the QoS requirements of traversing IMM traffic. That particular scheme is shown to provide a more efficient transmission on WLAN. MDSS maximizes the utilization of CFP while providing fairness to contention period (CP). The performance of MDSS is compared to that of 802.11e, which is taken as the benchmark for comparison. Jitter and delay result for MDSS is relatively lower while throughput is higher. This confirms that MDSS is capable of making significant improvement to the standard access scheme.

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ABSTRACT

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CONTENTS

LIST OF PUBLICATIONS

LIST OF ABBREVIATIONS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 INTRODUCTION.....	1
1.1. WIRELESS LOCAL AREA NETWORKS.....	1
1.2. SCOPE OF THE STUDY.....	4
1.3. CONTRIBUTIONS.....	5
1.4. ORGANISATION OF THE THESIS.....	7
CHAPTER 2 QOS IN MULTIMEDIA NETWORKS.....	9
2.1. WLAN STANDARD AND OSI NETWORK PROTOCOL STACK.....	10
2.2. MEDIUM ACCESS CONTROL (MAC).....	11
2.3. PERFORMANCE REQUIREMENTS.....	15
2.4. CROSS-LAYER DESIGN CONCEPT.....	19
CHAPTER 3 REVIEW OF RELATED WORK.....	21
3.1. WLAN MAC IMPROVEMENTS.....	22
3.2. IEEE 802.11E.....	24
3.3. CENTRALIZED CONTENTION FREE FUNCTION WITH PCF.....	33
3.4. POLLING AND SCHEDULING.....	37
CHAPTER 4 MODELLING AND SIMULATION OF THE PCF.....	47
4.1. FUNDAMENTALS OF PCF AND POLLING.....	47
4.2. DISCRETE-EVENT SIMULATION.....	49
4.3. THE OPNET SIMULATION SOFTWARE.....	50
4.4. PCF AND POLLING MECHANISMS IN OPNET.....	53
4.5. PERFORMANCE MEASUREMENT METRICS.....	58
4.6. SUMMARY OF SIMULATION MODELS.....	60
CHAPTER 5 THE MAC WITH DYNAMIC SUPERFRAME SELECTION SCHEME.....	61
5.1. INTRODUCTION.....	61
5.2. CFP AND SF DURATION VARIATION.....	62
5.3. PCF VS. DCF IN MIXED TRAFFIC.....	62
5.4. IMPACT OF THE SIZE OF CFP.....	65
5.5. SIMULATION RESULTS.....	66
5.5.1. VARYING CFP (20MSEC SF).....	66
5.5.2. VARYING SF WITH CFP FIXED AT 50% OF SF.....	70
5.5.3. VARYING IMM (FIXED SF 20 MSEC AND CFP 10 MSEC).....	74
5.6. CFP SELECTION USING LOOK-UP TABLE.....	77
5.7. VALIDATION OF SIMULATION MODELS.....	84
CHAPTER 6 ANALYTICAL MODEL OF MDSS.....	87
6.1. CFP AND CP OPTIMIZATION.....	87
6.2. ANALYTICAL MODEL.....	89
6.3. A MODEL OF THE MDSS.....	91
6.4. ALGORITHM COMPLEXITY.....	94
6.5. COMPARISON OF OPTIMIZATION MODELS.....	95
6.6. SIMULATION MODEL AND RESULTS.....	97

CHAPTER 7 IMPLEMENTATION OF MDSS	104
7.1. VARIATION OF THE MODELS	104
7.2. MODELS WITH FIXED NUMBER OF NON-IMM AND INCREASING NUMBER OF IMM NODES	105
7.2.1 RESULTS OF SIMULATION MODEL	106
7.3. MODELS WITH FIXED NUMBER OF NON-IMM AND IMM NODES.....	108
7.3.1 RESULTS OF SIMULATION MODEL	109
7.4. HOMOGENEOUS WLAN SETUP WITH ONLY NON-IMM NODES	111
7.4.1 RESULTS OF SIMULATION MODEL	112
7.5. HOMOGENEOUS WLAN SETUP WITH ONLY IMM NODES	113
7.5.1 RESULTS OF SIMULATION MODEL	114
7.6. SUMMARY OF THE RESULTS	116
CHAPTER 8 CONCLUSIONS AND DIRECTIONS FOR FUTURE WORKS.....	117
8.1. RESEARCH CONTRIBUTIONS	117
8.2. DIRECTIONS FOR FUTURE WORKS	120
REFERENCES	123
APPENDIX A PSEUDOCODE OF THE <i>wlan_mac</i> PROCESS MODEL IN OPNET	
APPENDIX B SNAP SHOTS OF OPNET CONFIGURATION MENUS FOR SIMULATION OF THE MDSS SCHEME	

LIST OF PUBLICATIONS

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LIST OF ABBREVIATIONS

AC – Access Categories
ACK – Acknowledgment
AID – Association Identifiers
AP – Access Point
ARQ – Automatic Repeat Request
BER – Bit Error Rate
BSS – Basic Service Set
CBR – Constant Bit Rate
CFP – Contention-Free Period
CFPri – CFP Repetition Interval
CODEC – Compressor/Decompressor
CP – Contention Period
CSMA – Carrier Sense Multiple Access
CSMA/CA – CSMA with Collision Avoidance
CW – Contention Window
DCF – Distributed Coordination Function
DCF/CD – Distributed Coordination Function with Collision Detection
DES – Discrete-Event Simulation
DIFS – DCF Interframe Space
DRR – Deficit RR
DS – Distribution System
DTIM – Delivery Traffic Indication Message
EBA – Early Backoff Announcement
EDCA – Enhanced Distributed Channel Access
EIFS – Extended Interframe Space
FQ – Fair Queuing
GHz – Gigahertz
HCCA – HCF Controlled Channel Access
HCF – Hybrid Coordination Function
HTML – Hypertext Markup Language
IEEE – The Institute of Electrical and Electronics Engineers
IFS – Interframe Space

IMM – Interactive Multimedia
IP – Internet Protocol
ITU – International Telecommunication Union
Kbps – Kilobits per second
MAC – Medium Access Control
Mbps – Megabits per second
MDSS – MAC with Dynamic Superframe Selection
MPEG – Moving Pictures Expert Group
MPLS – Multiprotocol Label Switching
MSDU – MAC Service Data Unit
Msec – Milliseconds
MWN – Multimedia Wireless Network
NAV – Network Allocation Vector
NIC – Network Interface Card
nRT – non Real Time
OPNET – Optimized Network Engineering Tool
OSI – Open Systems Interconnection
PC – Point Coordinator
PCF – Point Coordination Function
PCM – Pulse-Code Modulation
PER – Packet Error Rate
PHY – Physical (Layer)
PIFS – PCF Interframe Space
QoS – Quality of Service
RF – Radio Frequency
RR – Round-Robin
RT – Real Time
Sec – Seconds
SF – Superframe
SIFS – Short Interframe Space
STA – Workstation
TCP – Transmission Control Protocol
TCP/IP – TCP/Internet Protocol
TS-MP – Two-step Multipolling

TXOP – Transmission Opportunity

UBR – Unspecified Bit Rate

VBR – Variable Bit Rate

WFQ – Weighted FQ

WLAN – Wireless Local Area Network

WRR – Weighted RR

LIST OF TABLES

1. Table 1-1 Statistics of research on WLAN from IEEE Explore.....	2
2. Table 2-1 Performance targets for IMM applications	18
3. Table 4-1 Performance targets for IMM applications	60
4. Table 6-1 Constants for Optimization Function	93
5. Table 6-2 Feasible Starting Points.....	94
6. Table 6-3 Haines Optimization Results	95
7. Table 6-4 Li Optimization Results	96
8. Table 6-5 Proposed Optimization Results	96
9. Table 6-6 System Parameters	99
10. Table 6-7 Comparison Table for Schemes – 10 Non-IMM & 10 IMM Nodes	102
11. Table 7-1 Comparison Table for Schemes – 10 Non-IMM And 14 IMM Nodes	116
12. Table 7-2 Comparison Table for Schemes – 10 non-IMM and 0 IMM Nodes	116
13. Table 7-3 Comparison Table for Schemes – 0 non-IMM and 10 IMM Nodes	116

LIST OF FIGURES

1. Figure 2-1 MAC Frame Format	12
2. Figure 2-2 DCF and PCF in MAC layer	13
3. Figure 2-3 Diagrammatic Representation of the Access Mechanisms Showing Interframe Spaces	13
4. Figure 2-4 Cross-layer Protocol Design Concept Showing Dynamic Exchange of Information Between Layers.....	20
5. Figure 3-1 Wireless MAC Protocol Technology Basic Functional Blocks	23
6. Figure 3-2 Channel Access in IEEE 802.11 MAC Layer	25
7. Figure 3-3 Channel access in IEEE 802.11e MAC layer	26
8. Figure 3-4 Graph Indicating Number of Publications for Polling and Scheduling in WLANs	35
9. Figure 3-5 Segments of Superframe	36
10. Figure 3-6 Round-Robin Scheduling of a Polling List.....	37
11. Figure 4-1 Typical Superframe Configuration.....	47
12. Figure 4-2 OPNET WLAN Protocol Features	51
13. Figure 4-3 OPNET WLAN Node Module	52
14. Figure 4-4 OPNET WLAN Model for Infrastructured Network	53
15. Figure 4-5 OPNET Access Point (AP) Attributes.....	54
16. Figure 4-6 OPNET <i>wlan_mac</i> Process Model	55
17. Figure 4-7 OPNET Polling Process Diagram	56
18. Figure 4-8 An Example of OPNET Polling List	57
19. Figure 4-9 An Example of OPNET Polling Code.....	57
20. Figure 4-10 OPNET DES Statistics	59
21. Figure 5-1 Experimental Setup of Infrastructured WLAN	62
22. Figure 5-2 Average Packet Delay for 20 Nodes Operating Under PCF and DCF.....	63
23. Figure 5-3 Average Jitter for 20 Nodes Operating Under PCF and DCF	64
24. Figure 5-4 Average Throughput for 20 nodes Operating Under PCF and DCF	64
25. Figure 5-5 Delay as a Result of Varying CFP.....	67
26. Figure 5-6 Jitter as a Result of Varying CFP	67
27. Figure 5-7 Throughput as a Result of Varying CFP	68
28. Figure 5-8 Average Delay as a Result of Varying CFP	68
29. Figure 5-9 Average Jitter as a Result of Varying CFP.....	69

30. Figure 5-10 Average Throughput as Result of Varying CFP.....	69
31. Figure 5-11 Delay as Result of Varying SF Duration.....	71
32. Figure 5-12 Jitter as Result of Varying SF Duration.....	71
33. Figure 5-13 Throughput as Result of Varying SF Duration.....	72
34. Figure 5-14 Average Delay as a Result of Varying SF Duration.....	72
35. Figure 5-15 Average Jitter as a Result of Varying SF Duration	73
36. Figure 5-16 Average Throughput as a Result of Varying SF Duration	73
37. Figure 5-17 Delay as a Result of Varying IMM nodes	74
38. Figure 5-18 Jitter as a Result of Varying IMM nodes.....	75
39. Figure 5-19 Throughput as a Result of Varying IMM nodes.....	75
40. Figure 5-20 Average Delay as a Result of Varying IMM nodes.....	76
41. Figure 5-21 Average Jitter as a Result of Varying IMM nodes	76
42. Figure 5-22 Average Throughput as a Result of Varying IMM nodes	77
43. Figure 5-23 Simulation Setup to Model Dynamic PCF Scheme.....	78
44. Figure 5-24 Delay Statistics as a Result of Default SF Configuration.....	79
45. Figure 5-25 Delay Statistics as a Result of Dynamic SF Configuration	79
46. Figure 5-26 Average Delay Trend for Dynamic and Default SF Configuration.....	80
47. Figure 5-27 Jitter Statistics as a Result of Default SF Configuration	80
48. Figure 5-28 Jitter Statistics as a Result of Dynamic SF Configuration.....	81
49. Figure 5-29 Average Jitter Trend for Dynamic and Default SF Configuration	81
50. Figure 5-30 Throughput Statistics as a Result of Default SF Configuration	82
51. Figure 5-31 Throughput Statistics as a Result of Dynamic SF Configuration.....	82
52. Figure 5-32 Average Throughput Trend for Dynamic and Default SF Configuration	83
53. Figure 5-33 Typical Rate of Video Traffic Sent to the WLAN	85
54. Figure 6-1 Diagram of SF Partitioning into CFP and CP.....	88
55. Figure 6-2 SF model showing wastages in CFP and CP	90
56. Figure 6-3 Network Setup in OPNET for Performance Study of MDSS.....	97
57. Figure 6-4 Video Conferencing Node Parameters	98
58. Figure 6-5 Voice Node Parameters	98
59. Figure 6-6 Jitter Statistics as a Result of Implementing Various Schemes.....	100
60. Figure 6-7 Delay Statistics as a Result of Implementing Various Schemes	101
61. Figure 6-8 Throughput Statistics as a Result of Implementing Various Schemes.....	102
62. Figure 7-1 IMM and non-IMM scenario setup in WLAN	105
63. Figure 7-2 Delay Statistics as a Result of Increasing Number of IMM Nodes.....	106

64.	Figure 7-3	Jitter Statistics as a Result of Increasing Number of IMM Nodes	107
65.	Figure 7-4	Throughput Statistics as a Result of Increasing Number of IMM Nodes.....	108
66.	Figure 7-5	Delay Statistics as a Result of 14 IMM Nodes.....	109
67.	Figure 7-6	Jitter Statistics as a Result of 14 IMM Nodes	110
68.	Figure 7-7	Throughput Statistics as a Result of 14 IMM Nodes.....	111
69.	Figure 7-8	Delay Statistics as a Result of 0 IMM Nodes.....	112
70.	Figure 7-9	Throughput Statistics as a Result of 0 IMM Nodes.....	113
71.	Figure 7-10	Jitter Statistics as a Result of Exclusively 10 IMM Nodes.....	114
72.	Figure 7-11	Delay Statistics as a Result of Exclusively 10 IMM Nodes	114
73.	Figure 7-12	Throughput Statistics as a Result of Exclusively 10 IMM Nodes.....	115