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Ain Shams University

Faculty of Engineering

Electronics & Communication Engineering Department

Improving the Fairness of

Distributed Queue Dual Bus (DQDB) Network

A Thesis
Submitted in partial fulfillment of the requirements
for the degree of Master of Science in Electrical Engineering

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Abstract

This thesis is concerned with the study of improving the fairness of Distributed Queue Dual Bus (DQDB) network. The Distributed Queue Dual Bus (DQDB) protocol is selected by the IEEE 802.6 working group as the preferred access method for Metropolitan Area Network (MAN). However, many studies have reported that large propagation delay to transmission time ratios (high bit rates, large networks) can cause a certain degree of unfairness in access delay which depends on the stations position with respect to the head of bus station (slot generator).

More importantly, this unfairness behavior, which depends on the size of the subnetwork, can degenerate into a deadlock (hogging) situation where one station can monopolize almost all the available bandwidth. The distribution of bandwidth during an overload period is a function of the initial network conditions and is in that sense unpredictable. This problem was first illustrated in [16,17] with a number of hogging scenarios. In these scenarios, one node can take and keep almost 100% of the bus bandwidth regardless of other nodes demands, given that it has a head start.

To solve this problem, an enhancement to the DQDB protocol, the Bandwidth Balancing Mechanism [19], was proposed and adapted by the IEEE 802.6 working group. This scheme limits the maximum bandwidth available to each node in order to leave a portion of bandwidth unused. This unused bandwidth permits the congestion to relax and allows equal sharing of the available bandwidth to be attained eventually. Unfortunately, further studies [22] found that the Bandwidth Balancing Mechanism is ineffective with multiple priorities.

We study the fundamental reasons of this unpredictable behavior by means of the bandwidth distribution equations of DQDB with BWB in overload conditions and we provides graph model which meets these criterion of DQDB with BWB and validate the steady state of the DQDB(BWB) network under heavy load conditions with different initial conditions (i.e., the bandwidth of the network is equally distributed among the all active nodes) by using simulator.

The thesis consists of six chapters, a conclusion, and a comprehensive list of references. After the introduction, which provides the brief description of the thesis.

Chapter 1 is presented to initiate the reader to take a brief history about the computer networks.

Chapter two, explains the Topology, and the performance of the QPSX (Queued Packet and Synchronous Switch) that is the first version of DQDB has been provided for a public Metropolitan Area Network.

Chapter three, introduces more details about the Architecture of DQDB Network i.e., Dual Bus Structures and Looped Bus Structure and explains also the interaction between Data Link Layer (DQDB layer) with the Physical Layer in the MAN Network.

In forth Chapter, the DQDB Protocol and its performance under overload traffic conditions is presented, also the original DQDB access mechanism for a synchronous traffic is reviewed with more details and the unfairness problem is clearly analyzed by using analytical analysis [17].

Chapter five, presents the concept of Bandwidth Balancing (BWB) mechanism, and the implementation of BWB mechanism using the modified DQDB method, also the " Graph Model " which is based on the space-time diagram, for the case of two active (overloaded) nodes in the network, which completely specifies the nodal throughputs.

In chapter six, the simulation results are obtained for various possible scenarios in the case of two active nodes in the network, and these results satisfied the analysis of modified DQDB under steady state condition by using space time diagram for the two station case (heavy loaded) with three different initial conditions. The graph model and the simulator results illustrated clearily the transition of the DQDB with BWB network from transient state to the steady state under different initial conditions and network parameters.

There is one Appendix at the end of the thesis containing the listing of the simulator program.

Acronyms

ACF	Access Control Field
ANSI	American National Standards Institute
AU	Access Unit
BAsize	Buffer Allocation size
BEtag	Beginning-End tag
BIF	Bus Identification Field
BOM	Beginning Of Message
BWBM	BandWidth Balancing Mechanism
BWB_CNTR	BandWidth Balancing CounNTeR
BWB_MOD	BandWidth Balancing MODulus
CC	Configuration Control (function)
CCITT	the International Telegraph and Telephone Consultative Committee
CD	CountDown (counter)
CIB	CRC32 Indicator Bit
COM	Continuation Of Message
CRC	Cycle Redundancy Check
DA	Destination Address
DMPDU	Derived MAC Protocol Data Unit
DQ	Distributed Queue
DQDB	Distributed Queue Dual Bus
DQSM	Distributed Queue State Machine

DSG	Default Slot Generator
EOM	End Of Message
ETS	External Timing Source
HCS	(segment) Header Check Sequence
HEL	Header Extension Length
HOB	Head Of Bus
HOB_A	Head Of Bus A
HOB_B	Head Of Bus B
IMPDU	Initial MAC Protocol Data Unit
ISDN	Integrated Service Digital Network
ISDU	Integrated Service Data Unit
ISO	International Organization for Standardization
LAN	Local Area Network
LLC	Logical Link Control
MAC	Medium Access Control
MAN	Metropolitan Area Network
Mb/s	Megabit per second
MID	Message IDentifier
MSAP	MAC Service Access Unit
MSDU	MAC Service Data Unit
OSI	Open System Interconnection
PA	Pre-Arbitrated
PDU	Protocol Data Unit
Ph-SAP	Physical layer Service Access Point
PI	Protocol Identification
QA	Queued Arbitrated
REQ	REQuest
RQ	ReQuest (counter)
SA	Source Address

SAP	Service Access Unit
SSM	Single Segment Message
VCI	Virtual Channel Identifier

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Chapter 1: Local and Metropolitan Area Networks