

Title : AN INVESTIGATION INTO THE ROLE OF X.25
IN A LOCAL AREA DATA NETWORK

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ABSTRACT

Large geographically distributed data communication networks have been in existence for a number of years and indeed internationally agreed standards have been established for their use. The standard access protocol to public packet-switched networks is X.25 and a wide range of hardware and software support for X.25 is now available from most large computer manufacturers.

It is with these activities as a backcloth that a proliferation of local area networks have come into being during the past few years. Until very recently, however, the lack of any form of standards for use with these networks has meant that these differ considerably one from another. One of the primary aims of this thesis, therefore, has been to investigate the role the X.25 standard used for wide area networks might have in a local area context.

The topology proposed in this thesis is a hybrid network which is comprised of a high-level Packet Switching Exchange which adheres to the X.25 standard and this then supports the possibly wide range of other network resources. Typically these will include large mainframe and minicomputers, communities of unintelligent terminals, other smaller subnetworks and probably a connection to one or more public data networks.

The hardware and software design of a microprocessor-based modular packet switch is presented which is suitable for use with such a network topology. It is comprised of a variable number of Link Access Units each controlling a number of full-duplex serial links. These are interconnected by means of a high-speed parallel bus to which is also connected an Exchange Management Unit to provide performance monitoring and diagnostic functions.

The thesis is structured into eight chapters. Chapter 1 traces the evolution of computer communications networks to achieve resource sharing and the importance of the use of packet switching techniques. The role of layered architectures and communication protocols leading to the standardization of the X.25 protocol is presented and this is followed in Chapter 2 by a review of some of the alternative local area network architectures currently in use. Their topological organizations and the different media access control structures and protocols are described.

Chapter 3 discusses the X.25 protocol, its layered design and the set of functions provided by each layer. The more controversial aspects of the protocol are interpreted and analysed as well as the different control mechanisms used by each level and the possible implementation alternatives and interlevel relationships.

Chapter 4 summarizes the design aims of the modular Packet Switching Exchange and describes its hardware design. The exchange is comprised of a number of Link Access Units and an Exchange Management Unit which are interconnected by means of a high speed Interchannel Unit.

Chapter 5 describes the use of the X.25 protocol in connection with the exchange topology and its implementation. The flow and congestion control mechanisms utilized are discussed. An end-to-end virtual circuit flow control is combined with a network access flow control, the latter using an Input Buffer Limit scheme based on a structured buffer pool. The internal protocol devised for the interunit communications subsystem is presented and this includes the internal channel assignment

scheme and various recovery mechanisms. Finally, the interlevel signalling is discussed and solutions are proposed to handle possible failures within each level.

Chapter 6 discusses the software organization of the exchange. This includes the identification of the main processing tasks, their forms of communication and the implementation of the scheduling algorithm to achieve concurrency. The Buffer and Timer Managers are then described and the processing structure of each protocol level is detailed by means of event/state tables. Finally the laboratory facilities used to develop and test the exchange hardware and software are presented.

Chapter 7 describes the Exchange Management Unit and the set of functions implemented to provide performance monitoring and diagnostic facilities. The performance figures of the exchange are also assessed by means of an analytical model. Useful results are established concerning the exchange stability and its throughput and delay profile.

Chapter 8 discusses further topics that should be considered in order to overcome some of the exchange limitations and to improve its potential usefulness; namely the use of broadband techniques and the provision of additional components (PAD's, gateways, etc). The use of a single Link Access Unit to control several serial links is also proposed thus constituting an inexpensive and self-contained packet switch. Finally, some conclusions are presented, stressing in particular the importance of current efforts of standardization within local area networks and how they should be integrated into a broader perspective to achieve wider network compatibility and system interconnection.

The work described in this thesis has been the subject of

two technical papers and a copy of each of these is included in an appendix at the end of the thesis.