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PREFACE

In 1968 the Advanced Research Projects Agency (ARPA) of the U.S. Department of Defense began implementation of a computer-communication network which permits the interconnection of heterogeneous computers at geographically distributed centres throughout the United States. This network has come to be known as the ARPANET and has grown from the initial four node configuration in 1969 to almost forty nodes (including satellite nodes in Hawaii, Norway, and London) in late 1973. The major goal of ARPANET is to achieve resource sharing among the network users. The resources to be shared include not only programs, but also unique facilities such as the powerful ILLIAC IV computer and large global weather data bases that are economically feasible when widely shared.

The ARPANET employs a distributed store-and-forward packet-switching approach that is much better suited for computer-communications networks than the more conventional circuit-switching approach. Reasons favouring packet switching include lower cost, higher capacity, greater reliability and minimal delay. All of these factors are discussed in these Proceedings.

Since the initial ARPA experiment and success, a number of packet-switched networks have been planned and designed and some are well on their way towards fully operational status. These networks include: COST-11 being developed by a multinational European effort, which when completed in 1975, would link together major computer science centres in England, France, Switzerland, and Italy; CYCLADES, a French network linking centres in Paris, Rennes, Toulouse and Grenoble, planned for initial operation in early 1974; the Experimental Packet Switching System (EPSS) of the British Post Office which has reached the advanced design stage, and which when completed will represent the first major packet-switched service offered by a common carrier; and SITA, a fully operational, special purpose network for European airlines, developed and operated by Societe Internationale de Telecommunications Aeronautique.

With so many diverse networks being designed, we, the organizers of the Institute, felt that it was important to bring together most of the networks groups for the purpose of learning each other's design approaches and philosophies and to evaluate each other's methods to determine their advantages and drawbacks. Thus the programme of the Institute focussed upon the major problem areas in the design and operation of these networks. Topics included: Software and Hardware Design, Analytical Techniques, Network Design, Satellite Transmission, Economic Considerations, and Descriptions of Existing and Planned Networks.

Topological Design Considerations in Computer Communication Networks

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INTRODUCTION

In designing a computer-communication network, a large number of constraints must be considered so as to produce a reasonable network topology. Time delays, throughputs, cost, and reliability are some of the major factors connected with producing an optimum design. Each of these factors encompasses a large amount of detailed analysis which must be completed in order to check a network design.

Since network design is such a complex task, it is important to provide the designer with simple criteria for evaluation. Such criteria permit the network designer to develop an intuitive feeling for his designs, and to be aware of the effects of modifications on its parameters.

This paper uses a linear graph model of computer-communications networks to establish a lower bound on delay and vulnerability[1] for such networks. The networks which are analyzed have the property that their graphs are regular. The lower bound on delay is characterized by measuring the average minimum path length in these regular graphs. The vulnerability of these same networks is shown to be equal to the valence of one

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