THE TOPOLOGY, ALGORITHMS AND ANALYSIS OF A SYNCHRONOUS OPTICAL HYPERGRAPH ARCHITECTURE

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THESIS

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Electrical Engineering
in the Graduate College of the
University of Illinois at Urbana-Champaign, 1987

Urbana, Illinois

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

THE GRADUATE COLLEGE

MAY 1987

WE HEREBY RECOMMEND THAT THE THESIS BY

YORAM OFEK

ENTITLED THE TOPOLOGY, ALGORITHMS AND ANALYSIS OF A SYNCHRONOUS OPTICAL HYPERGRAPH ARCHITECTURE

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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O-517

THE TOPOLOGY, ALGORITHMS AND ANALYSIS OF A SYNCHRONOUS OPTICAL HYPERGRAPH ARCHITECTURE

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One of the main challenges in computer engineering today is the question of how to connect a large number of computing nodes, which are distributed over a large area, into one integrated system. The functions performed by the system are varied from electronic mail, distributed file servers to parallel processing, and real–time data communication (e.g., voice and video).

The research, presented in thesis, involves a bottom–up design of a fiber optic hypergraph network. The network is constructed of nets, which are passive optical stars, and constitute a multiple access medium. The topology and the high bandwidth ($>$1 gigabit/second) enable the construction of a low–dimension, synchronous, hypergraph network. The system maintains a global event synchronization with total ordering and uniformly integrates various functions by using distributed algorithms. It will be shown how voice and data are integrated on the system and how time stamps are used for implementing concurrency control algorithms (e.g., mutual exclusion). These algorithms are designed for a real–time operation in a very high bandwidth.

The following new ideas were incorporated:

- a new family of *conservative codes*, for preserving time integrity and decoding, without a phase–locked loop
- a hierarchical interface to one gigabit/second serial link
- a protocol for periodic exchange of state and time information, which enables the implementation of a hybrid multiple–access control scheme, and the integration of other

network control functions

- an algorithm for maintaining global event synchronization and total event ordering
- a scheme for integrating voice and data by constructing virtual multiplexers and demultiplexers
- an *isolate and skip* mechanism for graceful degradation of the network performance
- a partial hypergraph as a centralized switch

DEDICATION

To Barbara, and Our Children

Tidhar, Gidon, and Daphna

ACKNOWLEDGEMENTS

This work was influenced by many people, their thoughts, and their work, which in turn stimulated my own ideas. I would like to thank my advisor Professor Michael Faiman for his fruitful advice and complete support. I thank my thesis committee: Professors J. Liu, E. Davidson, W. Kubitz and P. Banerjee. I also thank Phil McKinley and Rajagopalan for interesting discussions on the optical hypergraph.

I thank the librarians in the Engineering Library for their assistance and advice during my graduate studies. The computer services in the Department of Computer Science facilitated a very effective environment for research; I would like to thank everyone involved in this operation.

I would like to thank my wife Barbara for her invaluable assistance. Finally, I thank my parents, Yehudith and Yaacov, from whom I acquired the art of critical reading and the love for books.

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