local communication systems: LAN and PBX

edited by
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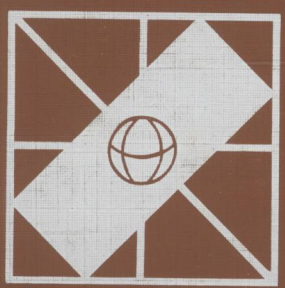

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1986

8763432

LOCAL COMMUNICATION SYSTEMS: LAN and PBX

Proceedings of the IFIP TC 6/WG 6.4 International In-Depth Symposium on Local Communication Systems: LAN and PBX
Toulouse, France, 26-28 November, 1986

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1987

NORTH-HOLLAND
AMSTERDAM · NEW YORK · OXFORD · TOKYO

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ISBN: 0 444 70134 6

Published by:

ELSEVIER SCIENCE PUBLISHERS B.V.
P.O. Box 1991
1000 BZ Amsterdam
The Netherlands

Sole distributors for the U.S.A. and Canada:

ELSEVIER SCIENCE PUBLISHING COMPANY, INC.
52 Vanderbilt Avenue
New York, N.Y. 10017
U.S.A.

Library of Congress Cataloging-in-Publication Data

IFIP TC 6/WG 6.4 International In-Depth Symposium on
Local Communication Systems, LAN and PBX (1986 :
Toulouse, France)
Local communication systems, LAN and PBX.

"Sponsored by the International Federation for
Information Processing (IFIP) "--
1. Local area networks (Computer networks)--Congresses.
2. Telephone--Private branch exchanges--Congresses.
I. Cabanel, J. P. (Jean-Pierre) II. Pujolle, G.,
1949- . III. Danthine, A. IV. International Federa-
tion for Information Processing. V. Title.
TK5105.7.I35 1986 004.6'8 86-24144
ISBN 0-444-70134-6 (U.S.)

PRINTED IN THE NETHERLANDS

8763432

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IFIP TC 6/WG 6.4 International In-Depth Symposium on
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sponsored by the
International Federation for Information Processing (IFIP)

co-sponsored by
Association Française pour la Cybernétique Economique et Technique (AFCET)
Centre National de la Recherche Scientifique (CNRS-C3)
Institut National de Recherche en Informatique et en Automatique (INRIA)
Ecole Nationale Supérieure des Télécommunications (ENST)
Ministère de l'Education Nationale (DCRI)
TELIC-ALCATEL, BULL, IBM, THOMSON-CSF Telephone

organized by
IFIP TC 6, Working Group 6.4 (Local Computer Networks)
Laboratoire Langages et Systèmes Informatiques
Université Paul Sabatier / ENSEEIHT (Toulouse)

The Symposium was held under the auspices of the
Municipality of Toulouse
Regional Administration

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PREFACE

In August 1980, the IFIP Working Group 6.4 International Workshop on Local Networks for Computers Communication held in Zurich brought together active researchers, engineers and systems designers working on aspects of this new technology for the purposes of technical information exchange.

In April 1982, in Florence, the IFIP TC 6, International Symposium on Local Computer Networks was attended by 500 people and, in the preface, the organizers were asking the question "What is required before LANs reach wide commercial acceptance?".

Even if all the conditions foreseen in 1982 are not fulfilled in 1986, this question is not relevant anymore. No "thinktank" company will claim today, as in 1981, that Ethernet will be forgotten in two years.

So many things happened in the last four years that a random enumeration of a few important events is the only way to measure the pace of LAN development : standardization of the 802.X serie, chip-set for all major MACs, deep involvement of DEC and IBM in the LANs, emergence of the ISDN concept, wide acceptance of personal computer by professional users, etc.

The OSI Reference Model, based at the origin on the connection-oriented model, has been able to integrate the connectionless LANs and is now widely supported not only by all manufacturers but also by users oriented groups which, with MAP and TOP, try to make a reality of multi-vendors systems.

A question the organizing committee of this 86 Toulouse Symposium wanted to see discussed was "Which LAN and PBX in 1990?". This question will be addressed not only by some of the papers but also by the panel session whose participants are coming from six countries.

The analysis of the program shows a wide scope of addressed problems with two focal subjects : the performance evaluation and the architecture oriented problems with a particular emphasis on the interconnections.

The truly international character of this symposium is reflected by the origin of the papers coming from outside France : six from USA, six from Japan and nine from seven European countries.

This very strong program is the result of the tremendous efforts of the Chairmen of the organizing committee, Professors Jean-Pierre CABANEL and Guy PUJOLLE. The support they got from an outstanding group of industrial companies guarantees that this symposium will be a forum between the industry, the academic world and the users.

A last word of thanks to the referees who did an outstanding job in order to build a program reflecting today's state of the art.

I personally hope that this Symposium will mark the revival of the activities of IFIP WG 6.4.

International Workshops such as Zurich or Kent on Ring Technology Local Area Networks held in September 1983 are needed to exchange ideas between specialists, and International Symposia such as Florence or Toulouse provide essential forums to the research community and the industry for the benefits of the users.

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INVITED PAPER

LOCAL COMMUNICATION SYSTEMS: LAN and PBX
J.P. Cabanel, G. Pujolle and A. Danthine (editors)
Elsevier Science Publishers B.V. (North-Holland)
© IFIP, 1987

The State of Local Area Network Standardization

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In the last ten years that local area network standardization has been going on, it has become clear that there will not be a single network standard. Instead, a number of local area networks have been standardized to date. Each of these different networks is being used for a particular application, such as factory and office automation, process control, aircraft control, etc. Several other local area network standards are now in the preparation process. The existence of multiple LAN standards will not hinder the interconnection of computer devices because standards at higher protocol layers are emerging for the interconnection of diverse local area networks with each other and with wide area networks.

1. HISTORY OF LAN STANDARDS

One of the earliest Local Area Network, LAN, public standards activities began in the process control industry in about 1975. At that time, computers were becoming less expensive and the control of a refinery, chemical plant, or power-generating station could be distributed throughout the facility. A standard way was needed to interconnect the computers and the different types of process equipment into systems. This standard was to be called PROWAY, PROcess control dataWAY, and was being formulated under the auspices of the International Electrotechnical Commission, IEC, Technical Committee 65. The term LAN had not been invented yet.

The work to standardize LANs for less stringent environments than process control began in 1980 with the establishment of the Institute of Electrical and Electronic Engineers, IEEE, Project 802. The goal of the 802 Committee was to provide the specifications for a LAN in enough detail so that equipment made to these specifications by different manufacturers would be interoperable in systems.

The scope of the 802 Committee was limited to the two lower layers of protocol and to networks only in the 1 to 20 Mbit/second range. This restriction was based on the desire to take on a task that was possible to accomplish in a reasonable amount of time and to provide specifications such that the semiconductor chips needed for economical implementation of the standard LAN would all be functionally equivalent.

Since membership in IEEE committees is open to anyone, the 802 Committee was composed of people with many different interests in LANs. In order to provide some direction to the group and to be able to evaluate technical proposals for the standard, an attempt was made to define the functional requirements for a standard LAN. One of the first functional requirements was that the LAN should provide peer-to-peer communication among the stations on the LAN. This requirement eliminated the use of PBXs as candidates for the standard, and focused the efforts of the 802 Committee on shared-medium networks.

Beyond some basic requirements, the 802 Committee did not come up with functional requirements that could be used to readily distinguish which of the proposals for the standard LAN was better than another. It seems that there are no universal measures as to what constitutes a "good" LAN. Coupled with the lack of firm requirements was the phenomenon that there were at least as many proposals for the standard LAN as there were doctoral degrees that had been granted in the field of data communications in the last 10 years. Everyone seemed to know intuitively that one particular idea of a LAN was better then anything anyone else had ever proposed, but no one knew how to define what "better" meant nor how to communicate that notion to anyone else.

To compound the problems further, three companies, DEC, Intel and Xerox, banded together and announced in June of 1980 that they had the "standard" LAN, Ethernet. Work was going on in 802 at that time on a CSMA/CD network that was Ethernet-like, but different. Considerable lively discussion ensued as to which standard would eventually be the standard, the standard proclaimed in the marketplace or the one defined by industry consensus.

The situation was clarified when the European Computer Manufacturers Association, ECMA, announced that their standard for a CSMA/CD LAN was going to take a mid-way position between the Ethernet and the IEEE versions of the networks. This decision served to consolidate the CSMA/CD efforts. The IEEE Committee established a close liaison with ECMA and moved its technical position toward the ECMA standard. The Ethernet proponents came out with a specification for Ethernet 2 which is close to the ECMA standard.

While the definition of the CSMA/CD LAN standard was consolidating, there were many people who did not feel comfortable with the notion of a random medium access protocol. These people wanted a deterministic network in which the access time for a station to be able to transmit on the shared medium could be finite and calculable. The medium access technology for the deterministic network was to be a token-passing protocol. The initial approach envisaged was a token passing on a bus. A short time later, however, the 802 participants who worked for IBM made it known that they favored a token ring approach. Needless to say, many other people in the 802 Committee who worked for other computer companies suddenly became very interested in the token passing ring.

At this point it became obvious that no single LAN technology was going to be the single standard for LANs. To keep the people interested in different LAN technologies out of each other's way, the 802 Committee was reorganized in 1983 into semi-independent working groups. Each working group would produce a separate LAN standard in a family of standards.

The family resemblance in the standards would be maintained by having a common overall architecture, a common link layer protocol, and common protocol features such as addressing and the frame check sequence. The organization of the 802 standards family as it has emerged is shown in Figure 1.

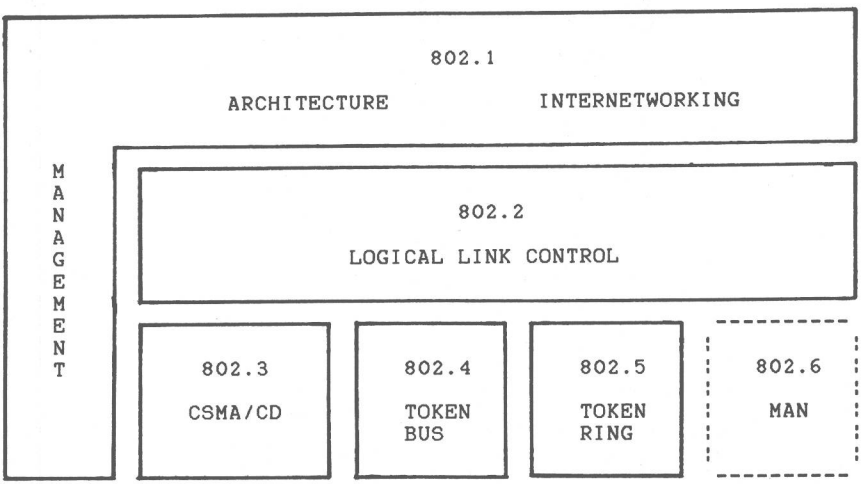

Figure 1 Organization of IEEE 802 LAN Standards

2. PRESENT STATUS OF IEEE 802 STANDARDS

To date, three media and medium-access technologies have been defined that are now IEEE standards and are well on their way to becoming ISO standards. These are the IEEE Std.802.3 for CSMA/CD networks, the IEEE Std. 802.4 for token Passing Busses, and IEEE Std. 802.5 Token Ring standard. Within these standards there are some variants. The IEEE Std 802.3 defines two types of baseband media and a broadband medium. Within IEEE Std. 802.4 Token bus standard there is a baseband called Carrier-band and a broadband version.

The unifying standard is the IEEE Std. 802.2 Logical Link Control which is used with all three of the media and medium-access standards. The IEEE Std. 802.2 defines three types of link protocols: unacknowledged, acknowledged on a frame-by-frame basis and a connection-oriented protocol much like HDLC.

The standard shown in the dotted lines is the Metropolitan Area Network standard that is being formulated at this writing. It will be a fiber-optic slotted ring operating at about 40 Mbits per second and is designed to carry real-time voice. It too will work with the 802.2 Logical Link Control standard.

The ISO equivalents to the IEEE standards are numbered 8802/X.

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