THE LOCAL AREA NETWORK REFERENCE GUIDE

BIS Applied Systems
with Mackintosh International

THE LOCAL AREA NETWORK REFERENCE GUIDE

BIS APPLIED SYSTEMS
WITH MACKINTOSH INTERNATIONAL

Tom Brooks, Editor

PRENTICE-HALL, INC., Englewood Cliffs, New Jersey 07632

Library of Congress Cataloging in Publication Data

The Local area network reference guide.

"Tom Brooks, guide editor"—Editor's pref.
Includes index.
1. Local area networks (Computer networks)
I. Brooks, Tom (date) II. BIS Applied
Systems. III. Mackintosh International.
TK5105.7.L63 1985 001.64'404 84-24838
ISBN 0-13-539586-0

Editorial/production supervision and
interior design: *Catherine Doherty*
Cover design: *Edsal Enterprises*
Manufacturing buyer: *Gordon Osbourne*

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

ISBN 0-13-539586-0 01

PRENTICE-HALL INTERNATIONAL, INC., *London*
PRENTICE-HALL OF AUSTRALIA PTY. LIMITED, *Sydney*
EDITORA PRENTICE-HALL DO BRASIL, LTDA., *Rio de Janeiro*
PRENTICE-HALL OF CANADA INC., *Toronto*
PRENTICE-HALL HISPANOAMERICANA, *S.A., Mexico*
PRENTICE-HALL OF INDIA PRIVATE LIMITED, *New Delhi*
PRENTICE-HALL OF JAPAN, INC., *Tokyo*
PRENTICE-HALL OF SOUTHEAST ASIA PTE. LTD., *Singapore*
WHITEHALL BOOKS LIMITED, *Wellington, New Zealand*

THE
LOCAL AREA NETWORK
REFERENCE GUIDE

Editor's Preface

The concept of a Reference Guide to Local Area Networks designed for management and others working in the information systems field emerged through an opportunity to study reports produced by various colleagues within the BIS group of companies. Principal among these was a study undertaken by Mackintosh International and subscribed to by most of the major manufacturers that do, or could, operate in the local network products field. That work of scholarship contained many sections that are very relevant to the information technology user, and the Mackintosh report forms the backbone of this guide.

In 1983, BIS-Pedder published its tenth annual census of installed computer systems in the United Kingdom. The annual census has evolved in line with the computing industry and now covers mini- and microcomputers, PABX systems, electronic office products, and local area networks. The market trends identified by BIS-Pedder gave a good understanding of user influences and contributed to user trend statements in many parts of this guide.

The Training Division of BIS Applied Systems was early in the field of developing local area network training courses for computer management. From this activity a clear pattern emerged of the questions that information systems management initially ask about LANs and the questions they ask when their knowledge expands. This input has influenced the structure and format of the guide as well as the content.

The contributors to the guide include Mackintosh International: John Godfrey and Gerry Clare; BIS-Pedder: Derek Pedder and Ken Steadman; and BIS Applied Systems: Gerry Roff, Steve Landles, and Tom Brooks.

This guide refers from time to time to existing products and their features. However, it was recognized that in a period of rapid development, it is important not to be tied too closely to products available. The guide therefore also discusses features and issues that will emerge with products currently under development. The guide is thus expected to have a vital shelf life of several years and to be a most useful addition to the library of every computing and information systems department.

Tom Brooks
Editor

THE
LOCAL AREA NETWORK
REFERENCE GUIDE

Contents

Part 1

USER NEEDS

This part of the guide provides an introduction to local area networks (LANs) and is essential background reading prior to the study of the other three parts.

- Chapter 1 discusses some terminology that is not always precisely used in discussing local networks. The standard interpretation of some key terms used in this guide is established.
- Chapter 2 discusses the major application areas that local networks can help to address. It briefly reviews current solutions that address these application areas and identifies the potential interest in future solutions.
- Chapter 3 examines general user requirements and explores the financial justification for local networks and some purchasing considerations. The implications of the need to provide for network evolution and growth are discussed.
- Chapter 4 examines the characteristics and implications of the traffic types associated with different LAN application areas.

1

Clarification of Terms

1.1 WHAT IS "LOCAL"?

1.1.1 Sites and Establishments

This guide is concerned with applications for and solutions to problems concerning communications in a single site. This includes communications with the outside world, which require transportation between locations within the site and the external network.

- By the term *site,* we mean a relatively well-defined and restricted geographic area which might be a small part of a single building (e.g., within a multitenanted office block) or as large as an airport or university campus.

We also freely use the term *establishment* as almost synonymous with *site.*

- Strictly, *establishment* can be defined as a single-addressed location, typically bounded by the public highway or other establishments.
- A *site* may be identical to an establishment (e.g., a hospital). A site may also contain multiple, separably identifiable establishments.
  - For example, an airport is a site that contains establishments belonging to many different organizations: airlines, freight companies, catering companies, etc.
  - "Intra-establishment communications" may be more restricted in some instances than "on-site communications."
  - Correspondingly, an on-site network may coexist, and possibly interconnect, with another on-site network.

There is confusion in the use of "local" in "local network" and "local area network" in that these terms have come to apply to a much more restricted geographical area than those included in "local telephone area" or the local area served by a CATV system.

- In this guide we define the word *local,* as used in the terms "local network" and "local area network," as explicitly referring to a single site.
- Thus we explicitly allow for the possibility of a single local area network serving more than one establishment on the same site.
- We believe this to be a necessary definition, for there is no essential difference between a network that serves, for example, the common needs of different companies within an airport complex, and the different departments contained within a university campus.

This definition leads immediately to the possibility that a local area network may be used by different companies.

- Several LAN definitions (notably that of the IEEE) attempt to reserve LAN usage to a single organization. While this will frequently be the case, there will also be important instances where a LAN will be operated for the initial benefit of multiple organizations.
  - We may also expect future multitenanted office blocks to be provided with LAN facilities as a general utility, managed by a single services organization for the benefit of all tenants.

While it is desirable for the term *local* to imply some definite geographic restriction, it is unnecessary to set a maximum distance.

- Identifying "local" with a single site is an adequate restriction.
  - Few sites have dimensions such that the maximum distance between any two points within the site exceeds a few kilometers.
  - Whether we set a limit at 2 kilometers or 5 kilometers is quite arbitrary and unhelpful.
- LANs intended for use on a university campus must be capable of spanning maximum distances of several kilometers; LAN extension within an office complex is unlikely to involve distances much greater than 1 kilometer.

The phrases "local network" and "local area network" are often used interchangeably.

- In this guide *local network* tends to refer to a service that happens to be available within a local area; *local area network* refers to something specifically designed for that purpose.

1.1.2 Internal and External Communication

A local area network may provide facilities for wholly internal communications, within a site, but may also permit access to external networks.

- If a LAN is intended purely for internal communications (i.e., communications solely within a site), it can be quite independent of the characteristics of external networks.

- A LAN that allows users to access an external network must have the capability to be interfaced to that external network, via an appropriate "gateway" facility, and must also provide a means by which the internal user can address the external network and the subscribers connected to the external network.
- External networks may include the public switched telephone network, public data network, or private networks.

1.2 LANs AND PABXs

Although the term "local area network" has come into rather recent use, neither the concept nor its realization is new.

- For example, broadband, coaxial cable-based systems have been installed for at least a decade for applications such as factory management.
  - •• Such networks have accommodated a mixture of traffic types and terminal equipment.

Within this guide the term "local area network" encompasses both switched and nonswitched network types.

- There is no fundamental difference between a PABX-based internal network, a front-end processor–based internal data network, and, for example, an Ethernet type of terminal data network, insofar as all are designed for on-site communications.
  - •• Of course, methods of control, protocols, traffic routing to the destinations, etc., may differ.
- We can differentiate between switched LANs that may involve PABXs or special-purpose data switches and nonswitched "bus-multiplexed" LANs, whether baseband or broadband.

1.3 DEFINITION OF KEY TECHNICAL TERMS

To avoid possible confusion in the reading of this guide, a brief listing is given below of what is meant by some of the more common terms employed. This listing covers performance terminology, general carrier descriptions, and some comments on traffic. Other terms are introduced where appropriate in the body of the guide or are defined in the glossary.

- Technical terms are often loosely used and, without prior definition, ambiguity may arise.

1.3.1 Data Rates and Bit Rates

The following terms will be used to distinguish between the various data rates that may be present in a LAN and the bit rates used by the LAN for carrying data.

- Data rate. The number of useful bits per second. This is only meaningful for messages defined as being digital data. Several data rates are relevant to defining a system's performance:

- •• Total system data rate, which is the sum of the useful data rates of all the simultaneous paths through the system. For some systems, a PABX with data capability, for example, the total system data rate greatly exceeds the data rate on any cable, whereas for others, for example, Ethernet, the cable data rate is identical to the total system data rate.
- •• Cable device data rate, which is the rate at which data can be transferred by the cable. For a multiple-wire bus it is the sum of the useful part of the bit rates of each wire.
- •• Connected device data rate, which is the rate at which a connected device can send data into the system. The instantaneous value of this is the one normally quoted in discussions of system performance. The average data rate may be much lower, because the system limits the duration of any transmission.

- When considering data rates it is necessary to distinguish between the data rate taking place in the system and the rate at which the system can transfer the user's data. This is because some of the system's data-carrying capability is used up by the system itself. Typically, data rate is used by the system for system control, such as addressing, and some transmissions are wasted. To differentiate between the data rates in the system and user data rates, the following terms will be used:
  - •• Effective (or useful) total system data rate. That part of the total system data rate available for carrying users' data. In some systems nearly all the data rate is effective, whereas in others as much as three-quarters of the total data rate is not available for users' data.
  - •• Effective (or useful) cable data rate and effective (or useful) connected device data rate. These are the parts of the cable data rate and connected device data rate available for carrying users' data.

It is usual for manufacturers to publish the bit rates and not the data rates of their systems. The relationship between these bit rates and the system data rates is dependent on the construction of the particular system. In general, data rates are lower than the bit rates and may be very much lower. This is because some of the bits are not used to carry data, but for other functions, such as synchronization or acknowledgment.

- The average bit rate may or may not be equal to the instantaneous bit rate. They are equal only in systems where the cable is continuously carrying bits.

1.3.2 *Channels, Circuits, Connections, Messages, and Traffic*

In most parts of this guide the word *circuit* is used with its normal electrical/electronic engineering meaning. In the sections discussing the communications facilities offered by the system, it is used with the meaning currently common in writings on telecommunications.

- A circuit (telecom) is a facility offered by a communications system for carrying a communication from one attached device to another. Examples of particular circuits are the following:
  - •• A voice circuit is a facility for carrying a voice signal from an originated attached device to a recipient attached device.

- A duplex circuit can carry signals in both directions. But if it cannot do this simultaneously it is half duplex. A simplex circuit is unidirectional.
- A real-time circuit is one that carries the signal immediately, whereas a non-real-time circuit may temporarily store the signal in transit.
- A packet circuit is a facility for transferring data packets from a source to a destination. It is an example of a non-real-time circuit.
- A virtual circuit is a special type of packet circuit that partially emulates a real-time circuit.

A channel is a one-way path through the system with defined performance. A channel is not a circuit; it is a facility in the system that can be used to supply a circuit.

- A voice channel is one capable of carrying voice (usually 300 Hz to 3.4 kHz) from a system input to an output. For a voice dialogue, two channels are needed.
- Video channels—also one-way—must be further defined in terms of the type of video, for example, TV, slow scan, and high resolution.
- In the case of data channels the data rate offered is a necessary parameter.

Transmissions over the network may serve a variety of functions; hence general terms are needed to avoid the need for specifying the type of transmission where it is not relevant.

- Message. A transmission made for any purpose and of any form. This term will be used wherever the exact nature of transmission is unimportant. For example
  - A packet of character-coded data sent to a data base will be referred to as a message.
  - Each direction of a telephone dialogue will be referred to as a message.
- The word *traffic* will be used for all the messages simultaneously passed (regardless of what sort of messages they may be). Examples of how this term is used are the following:
  - Total system traffic. All the messages passed between all the attached devices on all the cables at some given time. This term is used without regard for whether the messages are digital or analog or whether they are voice, video, data, or otherwise.
  - Data traffic. All the data messages passed by the system at a given time.
  - Traffic level or traffic volume is used where emphasis is placed on the quantity of traffic.