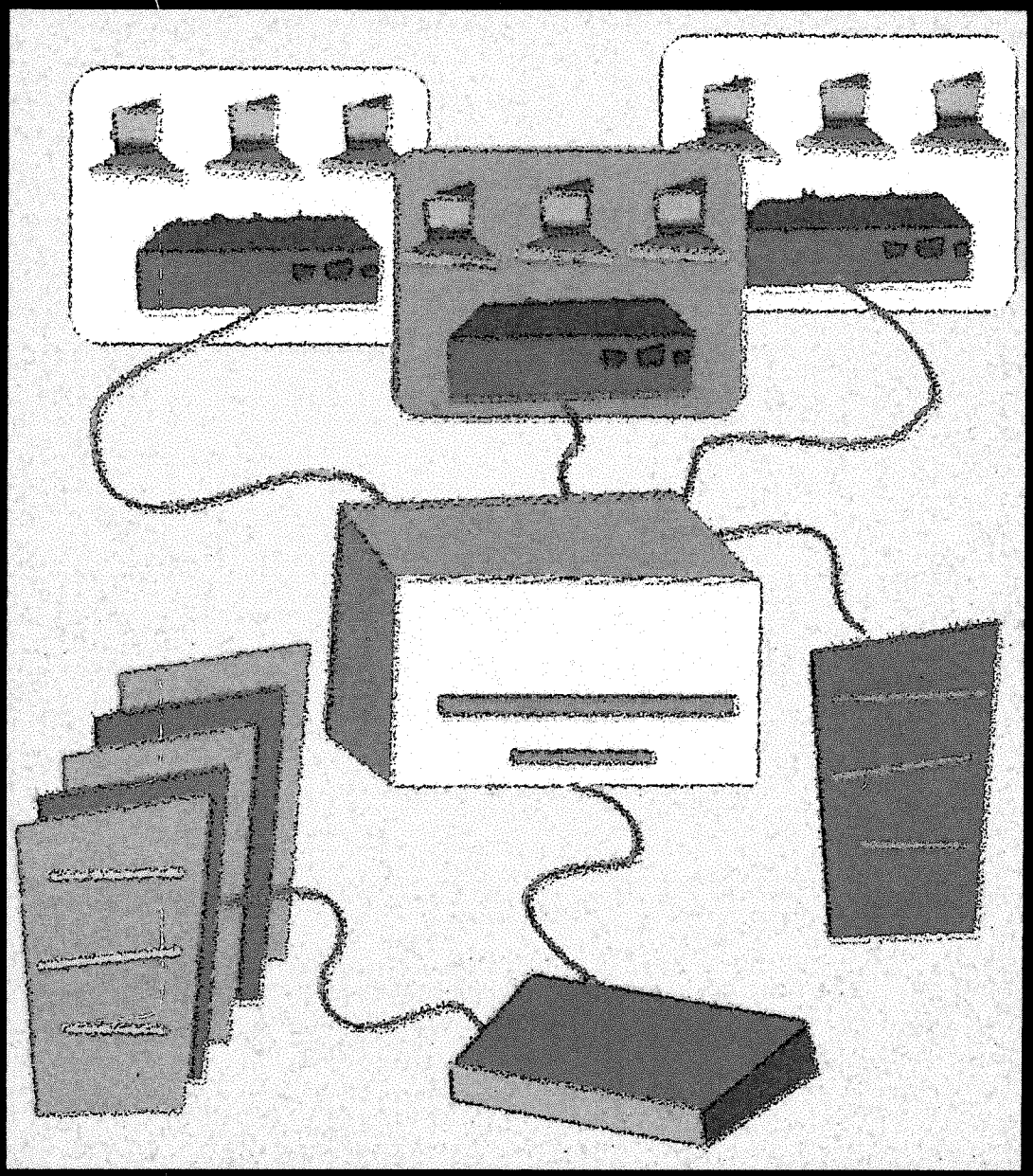
TECHNOLOGY AND APPLICATIONS FOR HIGH-SPEED LANS

GIGABIT ETHERNET



RICH SEIFERT

Gigabit Ethernet

Technology and Applications for High-Speed LANs

Rich Seifert

Addison-Wesley
An imprint of Addison Wesley Longman, Inc.
Reading, Massachusetts • Harlow, England • Menlo Park, California
Berkeley, California • Don Mills, Ontario • Sydney • Bonn
Amsterdam • Tokyo • Mexico City

Library of Congress Cataloging-in-Publication Data

Seifert, Rich, 1952–
Gigabit Ethernet: technology and applications for high-speed LANs / Rich Seifert.
p. cm.
Includes bibliographical references and index.
ISBN 0-201-18553-9
1. Ethernet (Local area network system) I. Title.
TK5105.8.E83S45 1998
621.39'81—dc21 98–9357
CIP

Text printed on recycled and acid-free paper.
ISBN 0201185539

configuration would have to be done on *every device in the network* (possibly thousands), the likelihood that everything would work properly is quite low.

The need for Auto-Negotiation can easily be seen from the computer installer's perspective. You have a device with an RJ-45 connector on the back, labeled "LAN." The device could operate at 10 Mb/s or 100 Mb/s or both, could be capable of half-duplex operation or full-duplex operation or both, and may have other features, all of which are invisible. There is a jack on the wall with an RJ-45 connector, similarly labeled "LAN." It is connected to a hub in a wiring closet that is at the end of the hall, and probably locked. The hub similarly could support some combination of data rates and duplex operation. How does the installer decide which mode(s) of operation should be configured on this computer?

Auto-Negotiation allows the computer and the hub to determine each others' capabilities and set themselves to the "highest common denominator"—the highest set of capabilities that both support.

8.2 Auto-Negotiation on UTP Systems

In theory, the problem of multiple, incompatible configurations on common media and connectors exists for both UTP and optical-fiber systems. Even before Gigabit Ethernet, there were incompatible, standards-compliant Ethernet systems using optical fibers (for example, 10BASE-FL/FP/FB and 100BASE-FX). However, optical-fiber Ethernet was still a relatively small part of the total market, being primarily deployed in controlled, backbone environments. Thus manual configuration was considered acceptable, since the number of systems was within the realm of human management.

The vast majority of Ethernet systems are now deployed using unshielded twisted-pair wiring. The problem of proper configuration in desktop LANs was the primary focus for the designers of Auto-Negotiation.

8.2.1 Auto-Negotiation Development

The Auto-Negotiation mechanism in wide use today was developed during 1993–95 and standardized as part of the Fast Ethernet project in IEEE 802.3 [IEEE95, Clause 28]. It was based on a system developed by National Semiconductor Corp., called *Nway*. Nway was originally developed for use with isoEthernet [IEEE94a], a system pioneered by National Semiconductor that

allowed a UTP/RJ-45 connection to carry a standard 10 Mb/s Ethernet signal, plus a 6 MHz isochronous channel (hence, the "iso" part of isoEthernet). This allowed the integration of voice and video services (using the isochronous channel) with conventional LAN data over the same wires. Nway negotiation allowed isoEthernet devices to determine the capabilities of the partner at the other end of the UTP link and to enable the isochronous services only when they could be supported.

isoEthernet was a commercial failure. Even though it achieved IEEE standardization, it never gained much market acceptance. However, the Auto-Negotiation system derived from Nway has found commercial life in most new Ethernet systems.

8.2.2 Auto-Negotiation Scope

By the time Auto-Negotiation was being developed, there was already a wide range of incompatible options within the scope of Ethernet systems using RJ-45 connectors. In particular, Auto-Negotiation had to deal with the following:

- 10 Mb/s-only, 100 Mb/s-only, and dual 10/100 Mb/s-capable devices
- Within the 100BASE-T family (at least in theory), two possible signaling schemes (-TX, -T4)
- A large installed base of 10BASE-T devices that did not have any Auto-Negotiation capability
- A smaller number of prestandard 100 Mb/s Ethernet devices that did not have Auto-Negotiation capability

Later, additional signaling options (100BASE-T2) and flow control support were added to the Auto-Negotiation capabilities.[5]

8.2.3 Auto-Negotiation Principles

Auto-Negotiation incorporates the following concepts.

- **Auto-Negotiation operates over a single, point-to-point link.** Typically, the negotiation occurs between a station and a hub, as depicted in Figure 8–1.[6] The characteristics of the devices at each end of the link are the

5. While in theory it is important to allow the negotiation of different signaling methods for a given data rate (for example, 100BASE-TX, -T4, and -T2), in practice the use of anything except 100BASE-TX has been so minimal that it is not really an issue.

6. In the simple case of a two-station LAN, the negotiation would be station-to-station.

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.