

## A Guide to Ethernet Switch and PHY Chips

### Seventh Edition

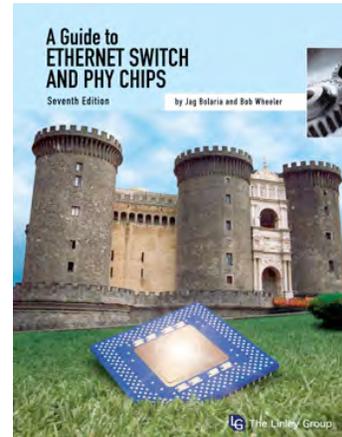
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### Evaluating and Comparing the Latest Ethernet Switches and PHY Chips

The Ethernet market is marked by technology transitions which often result in large shifts in vendor share. In Ethernet switches, 10 Gigabit Ethernet (10GbE) shipments are growing quickly, with Broadcom, Marvell, and Fulcrum competing to establish a leadership position. These vendors are increasing port counts and reducing power dissipation. Broadcom and Marvell are also the leaders for Gigabit Ethernet switch chips. The market for 10GbE PHY chips is even more competitive, with several vendors vying to establish an early leadership position. In some cases, large vendors have acquired startups to fill holes, while at the same time, PHY vendors continue to raise new funding.

With the adoption of 10GbE in servers within the data center, it is necessary to have aggregation switches that support higher data rates. IEEE working groups are busy developing specifications for 40GbE and 100GbE. We expect these specifications to be adopted in the data center as well as in telecommunication applications. The leading vendors have already sampled Switch and PHY products that support 40GbE—and more are expected to follow.

Ethernet is riding its success from LAN to access and metro markets with service providers migrating from circuit switched networks to Carrier Ethernet. Instead of competing directly with the established vendors, new players such as Xelerated and Ethernity are entering with Carrier Ethernet products. The combination of new investment and a large number of suppliers is serving to make the Ethernet switch and PHY market increasingly competitive. "A Guide to Ethernet Switch and PHY Chips" breaks this market into five key segments:

- GbE switch chips
- 10GbE switch chips
- Carrier-Ethernet switches
- 10GbE PHYs for copper and optical media
- 10GbE (KR) backplane transceivers

Unlike typical market research, this report provides technology analysis and head-to-head product comparisons. Which chips will win designs and why? How will these vendors be positioned as GbE and 10GbE continue to grow? Only The Linley Group's unique technology analysis can provide this forward-looking view.

The Linley Group, 355 Chesley Avenue, Mountain View, California 94040

***Research. Analyze. Advise***

### We Sort Out the Technology and the Key Vendors

"A Guide to Ethernet Switch and PHY Chips" begins with an extensive overview of this growing market. The report provides tutorials that help you decipher the myriad of acronyms and Ethernet standards. We explore the target markets and applications for GbE silicon, followed by an explanation of the common attributes of these products.

Following these introductory chapters, the report delivers a complete chapter on five major vendors that offer products in multiple segments: Broadcom, Marvell, Realtek, Vitesse, and Xelerated. Each major-vendor chapter includes company background information, full details of announced products, a discussion of the vendor's roadmap where available, and our conclusions about the vendor and its products. Then, for each product segment, we include a chapter covering other vendors and a chapter comparing the products in the segment.

Product segment chapters include coverage of switch chips and PHY chips. We cover switch chips from Centec, Dune, Ethernity, Fujitsu, Fulcrum, and Tpack. For PHY products, we cover optical transceivers from NetLogic, AppliedMicro, ClariPhy, Phyworks, and Inphi, as well as Ethernet backplane transceivers from these vendors. We also provide coverage of 10Gbps Ethernet-over-copper chips from Aquantia, Plato Networks, Solarflare, and Teranetics, and provide the landscape of vendors that have yet to announce products. Finally, we offer our outlook for the leading vendors in each segment and for the overall market.

### Make Informed Decisions

As the leading vendor of technology analysis for networking silicon, The Linley Group has the expertise to deliver a comprehensive look at the full range of chips designed for GbE/10GbE applications. Senior analysts Jag Bolaria and Bob Wheeler use their broad experience to deliver the deep technical analysis and strategic information you need to make informed business decisions.

Whether you are looking for the right Ethernet chip for your application or seeking to partner with or invest in a chip vendor, this report will cut your research time and save you money. Make the intelligent decision, [order](#) "A Guide to Ethernet Switch and PHY Chips" today.

### This report is written for:

- Engineers designing Ethernet switch products or systems that embed an Ethernet controller or switch
- Marketing and engineering staff at companies that sell related chips who need more information on Ethernet chips
- Technology professionals who wish an introduction to Ethernet chips
- Financial analysts who desire a detailed analysis and comparison of GbE, 10GbE, and switch-fabric semiconductor companies and their chances of success
- Press and public-relations professionals who need to get up to speed on this technology

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# **A Guide to Ethernet Switch and PHY Chips**

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## About the Authors

### **Jag Bolaria**



Jag Bolaria is a senior analyst at The Linley Group. During more than 20 years in the communications and PC semiconductor industries, he defined and launched products that shipped more than 100 million units. Coauthor of *A Guide to Ethernet Switch and PHY Chips*, *A Guide to FPGAs for Communications*, and *A Guide to Network Processors*, he has spoken at many industry events—including Network Systems Design Conference, Northcon, Wescon, and Min/Micro—and has written several application notes as well as articles for *EDN* and other magazines. His extensive industry experience includes senior roles in both marketing and engineering.

Before joining The Linley Group, Jag was the director of network systems and validation for Intel's Ethernet components. He joined this group as the director of marketing, responsible for strategic, product, and technical marketing. In this role, he worked directly with major customers, including Cisco, Lucent, Nortel, D-Link, and Hewlett-Packard.

Prior to that, Jag was in Intel's PC division. As director of marketing for chipsets, he led the development of product plans, design wins, and customer support for Pentium and P6 chipsets, working with all major PC suppliers worldwide.

Before these positions, Jag worked in Intel's communications group in technical marketing, product marketing, strategic marketing, and marketing management roles. He had worldwide product management responsibility for codecs/filters, modems, ISDN components, and LAN devices. During that time, he worked with engineers at AT&T, Fujitsu, IBM, NEC, Nortel/BNR, Rolm, and Siemens, among others.

Jag started his career as an R&D engineer with Standard Telecom Labs (STL), then the research arm of ITT in the U.K. During his three-year tenure with STL, he developed hardware and software for the prototype ISDN switches and LAN ring architectures over optical fiber. Jag earned a bachelor of science degree in electronics, with honors, from the University of Salford in the U.K.

## **Bob Wheeler**



Bob Wheeler is The Linley Group's senior analyst for networking silicon. He has more than 20 years of experience in the PC, networking, and semiconductor industries. An industry analyst and consultant since 1997, he has served clients such as 3Com, AMD, ESS Technology, and Merrill Lynch. Coauthor of *A Guide to Network Processors*, *A Guide to Security Processors and Accelerators*, and *A Guide to 10G Ethernet Adapters and Controller Chips*, he has spoken at industry conferences that include WinHEC, Embedded Processor Forum, and Network System Design Conference.

Before 1997, Bob was division marketing manager for the Network Products Division of AMD. He was responsible for marketing local-area network (LAN) products, including Ethernet and wireless LAN controllers and transceivers. Strategic customers included Cisco, Compaq, HP, 3Com, and many other PC and networking OEMs. During his four-year tenure at AMD, Bob's roles included strategic marketing, product marketing, and technical marketing positions.

Before joining AMD, Bob was head of operations for Way To Go, a technology startup. The company launched an appliance and service for wireless traffic information in the San Francisco Bay Area. Bob was responsible for taking the product from proof-of-concept prototypes to production, including field-testing, contract manufacturing, and establishing the traffic-operations center. This challenging role built on his experience as engineering manager at Sysgen, a manufacturer of PC peripheral products. At Sysgen, Bob was responsible for developing one of the first client/server tape-backup systems for local-area networks.

Bob spent the early part of his career as a software engineer, including seven years at microcomputer pioneer North Star Computers. While working for North Star in the mid-1980s, he was responsible for one of the first ports of Novell NetWare to an OEM platform. In the early 1980s, he worked as an independent consultant at the U.C. Berkeley School of Business, serving as a microcomputer programmer.

# About the Publisher

## ***The Linley Group***

The Linley Group is the leading vendor of technology analysis on networking, communications, mobile and wireless semiconductors, providing a unique combination of technical expertise and market knowledge. We help clients understand the market for these devices, their product requirements, the choices available, and which ones are best for a particular application.

### **Technology Reports**

For clients desiring off-the-shelf assistance, we offer standard reports on specific topics. These in-depth reports provide an overview of a particular market segment, including market size and share, key trends, and expected developments. The reports then analyze all available products, highlighting their strengths and weaknesses. Readers find our reports particularly useful when they are selecting a vendor or partner.

Our reports are written by our own expert analysts. Technical accuracy is very high, as each vendor provides information about its products and reviews our presentation of those products. We add our analysis and insight, comparing and contrasting the various offerings and indicating the applications for which they are best suited. To ensure that our opinions are objective and unbiased, The Linley Group does not accept stock or retainers from the companies we cover. Our reports are used by more than 200 companies, including leading equipment makers, chip makers, software vendors, and investment firms.

Our reports cover Ethernet chips, network processors, communications processors, embedded processors, security processors, and high-speed interconnect as well as processors and connectivity chips for mobile and wireless devices. Additional titles are in development. We offer our reports in paper and PDF formats. Multiple paper copies and multiuser PDF licenses are available at significant discounts.

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The Linley Group offers customized consulting services for clients that need help with a specific issue. The Linley Group has served a variety of

clients, including Altera, AppliedMicro, AMD, Bay Microsystems, Brocade, Cavium, Cortina, Cypress, Exar/Hifn, EZchip, Fulcrum, Freescale/Motorola, Gennum, HP, IBM, IDT, Intel, LSI/Agere, Marvell, Mindspeed, MIPS, NetLogic, Raytheon, Sony, Symantec, Synopsys/Virage Logic/ARC, Wintegra, Xelerated, Xilinx, Crosslink Capital, Piper Jaffray, and Ziff Brothers Investments. Typical consulting projects include the following:

- Helping established semiconductor vendors with competitive analysis, messaging, and positioning for upcoming product launches
- Working with young companies to help direct their initial product definitions to best differentiate themselves from potential future competitors
- Assisting equipment vendors to identify the core silicon most appropriate for their application
- Providing valuable insights and technical due diligence to investment firms evaluating whether to invest in a semiconductor company

Our analysts start with a deep understanding of the key technologies in these markets, ignoring the hype and finding the features that make a difference. But we also understand that market success is based on business strategy as much as on technical excellence, and our recommendations are always steeped in the realities of the marketplace. We understand the dynamics of startups and established corporations alike and can shape our message to apply to the client's situation.

### Events

The Linley Group presents conferences that analyze products and design strategies in a particular technology segment, providing information that engineers can immediately use to improve their designs. These two-day events feature in-depth technical presentations from our own analysts as well as leading technologists from the industry. Thousands of people have already attended.

Please check our web site for a list of upcoming dates, topics, and locations. The web site also offers the proceedings (slides) from past events free of charge.

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# Preface

## ***What This Report Covers***

Our coverage includes commercially available chips for high-volume Gigabit Ethernet (GbE), 10 Gigabit Ethernet (10GbE), and 40 Gigabit Ethernet (40GbE) designs. We cover local-area network (LAN) components and Carrier Ethernet devices for use in access, metro-area (MAN), and wide-area (WAN) networks. We consider GbE PHYs to be mature products and have excluded them from this year's coverage. We do not cover custom chips (ASICs) designed by or for a specific OEM, as these devices are not available to other customers as merchant products.

This report covers GbE, 10GbE, and 40GbE switch chips but not Fast Ethernet (FE) switch chips with GbE uplinks. For Carrier Ethernet applications, we cover switch chips, most of which run at GbE data rates. For PHY products, we cover 10Gbps serdes devices used in optical modules and on line cards. We also cover 10GBase-LRM PHYs, which are designed to compensate for electrical dispersion (EDC). For 10G Ethernet over copper (10GBase-T), we cover the leading PHYs. For 40G Ethernet, we cover retimers used on line cards to connect a MAC/switch and the optical module. This report also covers switch fabrics, which are typically used in highly scalable systems.

## ***Who Should Read This Report***

This report is designed to meet the needs of a variety of readers:

- Engineers designing Ethernet switch products or systems that embed an Ethernet controller or switch
- Marketing and engineering staff at companies that sell related chips who need more information on Ethernet chips
- Technology professionals who want an introduction to Ethernet chips
- Financial analysts who desire a detailed analysis and comparison of GbE, 10GbE, and switch-fabric semiconductor companies and their chances of success
- Press and public-relations professionals who need to get up to speed on this technology

As described below, the report is structured to allow different readers to skip certain sections as needed. For example, experienced communications engineers may wish to focus on the vendor and comparison chapters; financial analysts may instead focus on the tutorial, introduction, comparisons, and conclusions chapters.

## ***Organization of the Report***

The first two chapters provide a tutorial and overall introduction to networking and Ethernet technology. Chapter 1 provides background information on LANs, data centers, Carrier Ethernet, and related equipment; Chapter 2 focuses on the details of Ethernet technology. The appendix provides pointers to additional sources of tutorial information. Readers who are familiar with Ethernet may wish to skim or skip these chapters.

Chapter 3 provides background and terminology for high-speed interconnect technology and system design. Chapter 4 defines and describes the major types of GbE and 10GbE silicon, setting the stage for later chapters that study individual products. Chapter 5 provides a look at current technology and market trends. Chapter 6 provides quantitative data on vendor share and market forecasts by product segment.

Chapters 7 through 11 cover the five vendors—AppliedMicro, Broadcom, Fulcrum, Marvell, and Vitesse—that have a major presence in multiple GbE and 10GbE segments. For each vendor, the report provides a company overview, strategic analysis, detailed product descriptions, design examples, a roadmap of future products where available, and overall conclusions.

Chapter 12 covers GbE and 10GbE switch chips from Centec, Ethernity, QLogic, Realtek, and Xelerated. Chapter 13 covers 10GbE PHY products from Aquantia, ClariPhy, Cortina, Maxim, NetLogic, PLX Technology, and Solarflare.

Chapter 14 compares Ethernet switch products in selected segments, including 10GbE switches, switch fabrics, and multiple GbE switch types. It also compares Ethernet PHY products in selected segments, including 10GBase-SR serdes, 10GBase-LRM products, and 10GBase-T PHYs. Chapter 15 concludes the report with our high-level analysis of the market and presents our outlook for the leading vendors.

## ***Acknowledgments***

The authors wish to thank the numerous people at the many vendors covered in this report who supplied information on their products and reviewed sections of the report. These reviewers helped ensure the highest possible technical accuracy.

Thanks go to our copy editor, Jeffrey Clark, for keeping our grammar straight, to our technical editor, Linley Gwennap, and to Eileen Schmidt, who assisted with production.

# Executive Summary

This report examines Ethernet switch chips and PHY chips for a range of applications. For switch chips, we look at high-volume Gigabit Ethernet (GbE) switches for enterprise and small and medium-size businesses (SMBs), data-center switches, and Carrier Ethernet switches. For PHY chips, we look at 10G Ethernet (10GbE) optical and backplane PHYs, 10GBase-T (copper) PHYs, and 40G/100G Ethernet physical-layer products.

The overall Ethernet market continues to grow, driven by an increasing number of clients and increasing traffic. After the global slowdown of early 2009, Ethernet shipments increased, and we estimate the market for Ethernet components will exceed \$2.8 billion in 2010. We project this market to continue growing and exceed \$3.3 billion by 2013. This report details the switch- and PHY-port shipments at different data rates to 2014.

In 2010, GbE port shipments exceeded Fast Ethernet shipments for the first time. As the GbE market matures, the leading vendors are focusing on enabling low-cost systems that dissipate little power. Broadcom and Marvell are the established leaders, while Vitesse and Realtek are looking to increase their small market share. Each of these vendors is taking a different approach to enable low cost and low power. This report examines these differences as well as the market share of these vendors.

Although GbE provides the vast majority of switch-chip revenue, 10GbE is growing rapidly thanks to designs in data centers and aggregation equipment. Within the data center, the convergence of storage and communications represents an inflection point that vendors can use to increase market share. Cisco, Brocade, and HP/3Com are already shipping data-center switches that support Ethernet, Fibre Channel (FC), and FC over Ethernet (FCoE). The first silicon vendor to successfully integrate these technologies will be a big winner. In 2010, QLogic joined leading competitors Broadcom, Fulcrum, and Marvell. The report looks at the products and strategies of each of these players.

Carrier Ethernet (CE) represents another growth area for vendors of Ethernet chips. The requirements of Ethernet switches for carrier systems differ from those of enterprise switches. Even among CE applications, products for access systems have requirements that differ from those for edge systems. In addition to Broadcom and Marvell, AppliedMicro, Centec, Ethernity, Vitesse, and Xelerated offer CE-specific chips. Some of

these vendors are enhancing their existing enterprise-focused switch chips to meet CE requirements. Some are developing Layer 2 switches, while others are developing Layer 3 switches. Some vendors offer configurable switches, whereas others offer programmable switches.

For the physical layer, vendors are moving to quad optical PHY chips, which can also be adapted for backplane and SFP+ direct-attach applications. Broadcom, Cortina, NetLogic, and Vitesse continue to duke it out for PHY market share. The market for standalone 10GBase-SR optical PHYs, however, could be limited by the integration of 10Gbps serdes in 10GbE switches. Among this group of vendors, only Broadcom is shipping a PHY for 10GBase-T, which supports 10GbE over copper wiring. AppliedMicro, which sells optical PHYs, plans to sample a 10GBase-T PHY before the end of 2010.

The market for 10GBase-T has been slow to develop, leading to consolidation. In the past year, PLX Technology acquired volume-leader Tera-netics, and NetLogic picked up the assets of Plato Networks. Aquantia is best positioned to lead in this market, and Solarflare has compelling technology. A noticeable late starter is Marvell, which may have a strategy to jump ahead.

For 40GbE and 100GbE, the physical-layer standards are in place, enabling a small volume of shipments in 2010. Marvell and Broadcom have integrated 40GbE ports into their switch chips, and switch vendors such as Extreme Networks have designed 40GbE uplinks into their top-of-rack (ToR) switches. NetLogic, Cortina, and Broadcom were the first vendors to sample PHYs that support 40GbE and 100GbE interfaces. This report looks at shipments in 2010 and projects them to 2014.

Overall, the Ethernet market is characterized by flux, ranging from the transition from Fast Ethernet to low-cost GbE switches, fabric convergence in the data center, adoption of Ethernet by carriers, 40nm 10GBase-T PHYs, and 40GbE/100GbE products. Each of these changes brings about uncertainty in implementation for the system designer and opportunity for the silicon vendor that gets it right first.