

## **A Guide to Backplane Switch Chips** Fifth Edition

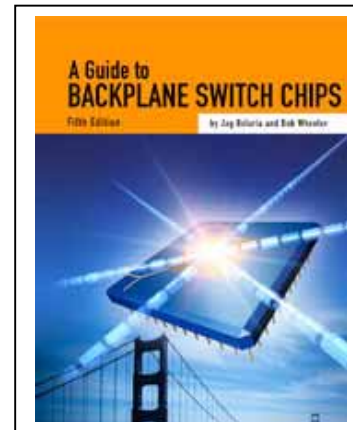
*formerly "A Guide to Switch Fabrics"*

**PUBLISHED AUGUST 2006**

**Authors:** Jag Bolaria and Bob Wheeler

**Price: \$2,995 (single copy)**  
(Price includes 1 PDF and 1 printed copy)

**Pages:** 150



### **An In-Depth Look at Backplane Switches**

Market research firms are forecasting strong growth for data center applications, which include blade servers and storage networking equipment. This projected growth is fueling new switching solutions for the data center. Backplane switch requirements vary between networking and data center applications. Additionally, backplane switches for networking application have traditionally been proprietary ASICs, leaving little room for merchant vendors. In contrast, OEMs of data center equipment want standard and converged solutions for the backplane. Consequently several vendors are developing backplane switches specifically for data center applications.

"A Guide to Backplane Switch Chips" provides extensive coverage of processors for backplane switches and fabrics. Traditional switch-fabrics target primarily networking applications, while new backplane switching chips target data center applications. The report provides coverage of switch components from Fulcrum Microsystems, StarGen, Fujitsu, and NextIO. This edition includes new products from Enigma, PMC-Sierra, and Mercury Computer. Also covered are proprietary switches, RapidIO switches, ASI switches as well as Ethernet switches for the backplane. In addition, the report delivers background on data center equipment—such as blade servers and Ethernet over the backplane.

"A Guide to Backplane Switch Chips" brings you up to date on the traditional fabric vendors and their products, including the latest information on acquisitions and consolidations. It also delivers competitive analysis for different types of switches and fabrics.

### **Get the Facts Fast**

"A Guide to Backplane Switch Chips" is your ultimate guide for this dynamic market. The report covers switch and fabric requirements, features, architectures, and trends. Following these invaluable introductory sections is complete coverage of who's doing what, from the market leaders to the latest startups.

The report delivers in-depth analysis of each vendor and each product, explores the strengths and weaknesses and presents key details in a consistent, easy to compare fashion. Particular attention is paid to features, performance, architecture, system design, and vendor roadmaps along with our own analysis and conclusions. The report also provides market growth trends and forecasts of the available business opportunities.



### Make Informed Decisions

This report doesn't simply recycle vendors' words and diagrams; every word is written by senior analysts Jag Bolaria and Bob Wheeler bringing you the same deep analysis and technology savvy as in other reports from The Linley Group.

Whether you are looking for the right backplane switch chip for your application or seeking to partner with or invest in a backplane switch company, this report will cut your research time and save you money. Make the smart decision. Order "A Guide to Backplane Switch Chips" today.

### This report is written for:

- Engineers who are designing networking equipment and need to select a backplane switch chip.
- Marketing and engineering staff at companies that sell backplane switching solutions who desire competitive information.
- Technology professionals who wish an introduction to backplane switch architectures and technologies.
- Financial analysts and investment professionals who desire a detailed analysis of these vendors and their chances of success.
- Press and public relations professionals who need to get up to speed on these new technologies.

### For further information, contact:

The Linley Group  
Phone: 408-281-1947  
Fax: 650-745-1490  
Email: [cs@linleygroup.com](mailto:cs@linleygroup.com)  
Website: [www.linleygroup.com](http://www.linleygroup.com)

---

The following excerpt is from "***A Guide Backplane Switch Chips, Fifth Edition.***"

This PDF contains the complete table of contents, list of figures, list of tables, preface, and executive summary. The full report may be purchased from The Linley Group.

# **A Guide to Backplane Switch Chips**

(formerly “A Guide to Switch Fabrics”)

**Fifth Edition**

Published August 2006

By Jag Bolaria and Bob Wheeler



The Linley Group

Published by The Linley Group  
355 Chesley Avenue  
Mountain View, California 94040  
1-800-413-2881 or 408-281-1947  
fax: 650-745-1490  
email: [cs@linleygroup.com](mailto:cs@linleygroup.com)  
[www.linleygroup.com](http://www.linleygroup.com)

Copyright © 2006 The Linley Group, Inc.  
All rights reserved.  
Printed in the United States of America.

No part of this report may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without prior written permission from the publisher.

This report contains and analyzes information from publicly available sources and from industry contacts. Although we make considerable effort to ensure the accuracy of the information contained in this report, we are not responsible for any errors or omissions contained herein.

No warranties are made, expressed or implied, with regard to the contents of this report. The publisher shall not be liable for any damages, direct or indirect, resulting from the use of this report.

Trademark names are used throughout this report in an editorial fashion and are not denoted with a trademark symbol. These trademarks are the property of their respective owners.

Cover by Binger Catalog Marketing

# Table of Contents

List of Figures .....	ix
List of Tables .....	xi
About the Authors .....	xiii
About the Publisher .....	xv
Preface.....	xvii
Executive Summary .....	xix
<b>1 Applications .....</b>	<b>1</b>
<b>Metro Equipment .....</b>	<b>3</b>
Edge Routers and Multiservice Switches .....	3
Metro-Ethernet Switches.....	4
Multiservice Provisioning Platforms .....	4
<b>Access Equipment.....</b>	<b>5</b>
DSL Access Multiplexers (DSLAM) .....	5
Cable Infrastructure Equipment .....	5
Cellular Infrastructure .....	6
<b>Enterprise Equipment .....</b>	<b>6</b>
Workgroup Switches.....	7
Modular Switches .....	8
<b>Data-Center Equipment .....</b>	<b>8</b>
SAN and NAS .....	9
Blade Servers .....	9
Security Appliances .....	10
<b>2 Equipment Design.....</b>	<b>11</b>
<b>Router Architecture.....</b>	<b>11</b>
<b>Blade-Server Architecture .....</b>	<b>13</b>
<b>Backplane Switching Requirements.....</b>	<b>15</b>

<b>Quality of Service (QoS)</b> .....	<b>16</b>
RSVP.....	18
DiffServ .....	19
<b>ATCA</b> .....	<b>19</b>
<b>Advanced Switching Interconnect (ASI)</b> .....	<b>21</b>
<b>RapidIO</b> .....	<b>23</b>
Background.....	23
Technology Overview.....	25
<b>Backplane Switched Ethernet</b> .....	<b>29</b>
<b>System Interfaces</b> .....	<b>30</b>
Utopia, POS-PHY, and SPI.....	30
CSIX-L1 and NPF Streaming Interface .....	30
XAUI and XGMII .....	31
<b>Backplane Characteristics</b> .....	<b>32</b>
<b>Design Tradeoffs</b> .....	<b>33</b>
<b>3 Backplane Switching Technology</b> .....	<b>35</b>
<b>Types of Backplane Switches</b> .....	<b>35</b>
<b>Switch-Fabric Architecture</b> .....	<b>36</b>
Shaping .....	37
Congestion Management .....	38
Queuing.....	38
Scheduling and Flow Control .....	40
Switching.....	42
<b>Measuring Performance</b> .....	<b>44</b>
Benchmarks .....	45
<b>4 Trends and Market Outlook</b> .....	<b>47</b>
<b>Technology Trends</b> .....	<b>47</b>
Scaling Performance .....	47
Architecture Variations .....	48
Interfaces .....	49
Backplane Design and Fault Tolerance .....	50
Integration .....	51
Fabric Protocols.....	51
<b>Target Markets</b> .....	<b>52</b>
WAN/MAN Equipment.....	52
Access Equipment.....	52
Enterprise Equipment.....	53
SAN .....	53
Blade Servers .....	53
<b>Market Size and Outlook</b> .....	<b>54</b>
Market Share .....	55
Market Forecast.....	55

<b>5</b>	<b>AMCC</b> .....	<b>57</b>
	<b>Company Background</b> .....	<b>57</b>
	<b>Key Features and Performance</b> .....	<b>58</b>
	PRS Line .....	58
	<b>Internal Architecture</b> .....	<b>60</b>
	PRS-80G .....	60
	<b>System Design</b> .....	<b>62</b>
	PRS .....	62
	<b>Roadmap</b> .....	<b>65</b>
	<b>Conclusions</b> .....	<b>66</b>
<b>6</b>	<b>Broadcom</b> .....	<b>67</b>
	<b>Company Background</b> .....	<b>67</b>
	<b>Key Features and Performance</b> .....	<b>68</b>
	HiBeam .....	68
	BCM56800 .....	69
	<b>Internal Architecture (HiBeam)</b> .....	<b>71</b>
	<b>System Design (HiBeam)</b> .....	<b>73</b>
	<b>Conclusions</b> .....	<b>75</b>
<b>7</b>	<b>Dune</b> .....	<b>77</b>
	<b>Company Background</b> .....	<b>77</b>
	<b>Key Features and Performance</b> .....	<b>77</b>
	<b>Internal Architecture</b> .....	<b>78</b>
	<b>System Design</b> .....	<b>80</b>
	<b>Conclusions</b> .....	<b>81</b>
<b>8</b>	<b>Fujitsu</b> .....	<b>83</b>
	<b>Company Background</b> .....	<b>83</b>
	<b>Key Features and Performance</b> .....	<b>84</b>
	<b>Conclusions</b> .....	<b>87</b>
<b>9</b>	<b>Fulcrum</b> .....	<b>89</b>
	<b>Company Background</b> .....	<b>89</b>
	<b>Key Features and Performance</b> .....	<b>90</b>
	<b>Internal Architecture</b> .....	<b>91</b>
	<b>System Design</b> .....	<b>93</b>
	<b>Conclusions</b> .....	<b>95</b>

<b>10 PMC-Sierra</b> .....	<b>97</b>
Company Background .....	97
Key Features and Performance .....	97
Internal Architecture .....	98
System Design .....	100
Conclusions.....	101
<b>11 Tundra</b> .....	<b>103</b>
Company Background .....	103
Key Products and Features.....	104
Design Details .....	105
Conclusions.....	107
<b>12 Other Switch Vendors</b> .....	<b>109</b>
<b>Enigma</b> .....	<b>111</b>
Company Background.....	111
Key Features.....	111
Conclusions .....	113
<b>Erlang</b> .....	<b>114</b>
Company Background.....	114
Key Features and Performance .....	115
Internal Architecture .....	116
System Design.....	117
Conclusions .....	118
<b>IDT</b> .....	<b>118</b>
Conclusions .....	120
<b>Marvell</b> .....	<b>120</b>
<b>Mercury Computer</b> .....	<b>121</b>
Company Background.....	121
Products .....	122
Conclusions .....	124
<b>NextIO</b> .....	<b>124</b>
<b>StarGen</b> .....	<b>125</b>
<b>TeraChip</b> .....	<b>126</b>
Company Background.....	126
Key Features and Performance .....	126
Conclusions .....	128
<b>Vitesse</b> .....	<b>128</b>
Company Background.....	128
Key Features and Performance .....	129
Conclusions .....	130
<b>Xyratex</b> .....	<b>130</b>

- 13 Comparing Backplane Switches..... 133**
  - Interconnect Technologies and Applications .....134**
  - Proprietary Switch Fabrics.....136**
    - System Configurations .....138
    - Key Differentiators .....140
  - Standard Fabrics .....141**
    - Backplane Ethernet Switch Chips.....141
    - RapidIO Switch Chips .....143
  
- 14 Conclusions ..... 145**
  - Market Overview .....145**
  - Proprietary Fabrics.....147**
    - Dune Networks .....147
    - Broadcom.....148
    - AMCC.....148
    - Rest of the Vendors.....148
  - Standard Fabrics .....149**
    - RapidIO .....149
    - Ethernet.....150
    - Other Standards .....151
  - Closing Thoughts .....151**
  
- Appendix: Further Reading..... 153**
  
- Index ..... 155**

# List of Figures

Figure 1-1. Generic network architecture.....	1
Figure 1-2. 3GPP Release 5 IP multimedia network architecture.....	6
Figure 1-3. Typical LAN architecture.....	7
Figure 2-1. System architecture and interfaces.....	12
Figure 2-2. Current blade-server architecture.....	13
Figure 2-3. Converged blade-server design.....	14
Figure 2-4. RSVP host and router implementation.....	18
Figure 2-5. Logical diagrams of dual-star (left) and mesh topologies.....	19
Figure 2-6. Interconnect examples using RapidIO.....	25
Figure 2-7. RapidIO three-layer model.....	26
Figure 3-1. Switch-fabric architecture and chip partitioning.....	37
Figure 3-2. Three-stage Clos architecture.....	43
Figure 3-3. Fabric latency versus load for generic fabric.....	44
Figure 4-1. Fabric-market revenue share by vendor for 2004 and 2005.....	54
Figure 5-1. AMCC PRS product-line evolution.....	59
Figure 5-2. AMCC PRS-80G internal architecture.....	61
Figure 5-3. AMCC C192X internal architecture.....	62
Figure 5-4. AMCC PRS-Q80G system design.....	63
Figure 5-5. AMCC PRS-5G latency versus load.....	65
Figure 6-1. Broadcom HiBeam packet fabric.....	71
Figure 6-2. Broadcom HiBeam system design.....	73
Figure 8-1. Fujitsu's MB8AAQ3020 block diagram.....	84
Figure 8-2. Fujitsu's 3020 in an ATCA system.....	86
Figure 9-1. Fulcrum FocalPoint internal architecture.....	91
Figure 9-2. Fulcrum FM2224 in a mesh configuration.....	93

Figure 9-3. Fulcrum FN2224 in a blade server .....	94
Figure 10-1. PMC-Sierra's RSE-160 architecture.....	99
Figure 10-3. PMC-Sierra RSE-160 system design for an ATCA chassis.....	100
Figure 11-1. Tundra Tsi578 architecture.....	105
Figure 11-2. Media gateway using the Tundra Serial RapidIO switches.....	106
Figure 12-1. Enigma HybriCore fabric in a 640Gbps configuration. ....	112
Figure 12-2. Erlang Xe system design. ....	117
Figure 12-3. Mercury MC432 system design. ....	123

# List of Tables

Table 2-1. ATCA specifications .....	20
Table 5-1. AMCC PRS product details.....	60
Table 5-2. AMCC PRS configurations and component count.....	63
Table 5-3. AMCC PRS multidevice configurations .....	64
Table 6-1. HiBeam configurations and component count .....	74
Table 7-1. Dune Sand configurations and component count .....	80
Table 8-1. Key parameters for Fujitsu 10GbE switch chip .....	86
Table 11-1. Tundra products for Serial RapidIO switching.....	104
Table 12-1. Switch-fabric vendors and product status .....	110
Table 12-2. Enigma's fabric interface components (FIC).....	111
Table 12-3. Erlang Xe configurations and component counts .....	118
Table 12-4. TeraChip's TCI devices.....	127
Table 12-5. Vitesse GigaStream product details .....	130
Table 13-1. Comparison of standard fabric interconnects.....	134
Table 13-2. Comparison of 10Gbps fabrics from established vendors.....	137
Table 13-3. Comparison of 16x10Gbps fabric configurations.....	139
Table 13-4. Comparison of backplane Ethernet switch chips .....	142
Table 13-5. Comparison of serial RapidIO switch chips.....	143

## 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 has defined and launched products that have shipped more than 100 million units. Coauthor of *A Guide to Switch Fabrics*, *A Guide to Next-Generation Broadband Interface Chips*, and *A Guide to High-Speed Interconnect*, he has spoken at several industry conferences—including Network Systems Design Conference, Wescon, Northcon, 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 chip sets, he led the development of product plans, design wins, and customer support for Pentium and P6 chip sets, 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 Next-Generation Wireless*, and *A Guide to Gigabit Ethernet Silicon*, he has spoken at industry conferences that include WinHEC, Embedded Processor Forum, and Network Processors 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, and consumer-electronics 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 network processors, communications processors, hand-set processors, embedded processors, security processors, voice processors, switch fabrics, high-speed interconnect, wireless chip sets, and Ethernet chips. 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.

### **Consulting Services**

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 Agere, Altera, AMCC, Cavium, Cypress, Hifn, HP, IBM, IDT, Intel, Motorola/Freescale, Wintegra, Xelerated, Xilinx, Crosslink Capital, U.S. Bancorp Piper Jaffray, and Ziff Brothers Investments. Typical consulting projects include the following:

- Working with a startup to help direct its initial product definition to best differentiate it from potential future competitors
- Helping an established semiconductor vendor with messaging and positioning for an upcoming product launch
- Assisting an equipment vendor to select key components that are most appropriate for its application
- Providing valuable insights and technical due diligence to an investment group 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.

### Seminars

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

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

### For More Information

Subscribe to *Linley Wire*, our free email newsletter, and get our analysis of recent semiconductor news and events in networking and communications. To subscribe, visit our web site, [www.linleygroup.com](http://www.linleygroup.com); there you will find more information on The Linley Group, its products, and its services. You can also contact us directly, as shown below.

The Linley Group  
355 Chesley Avenue  
Mountain View, California 94040

1-800-413-2881 or 408-281-1947  
fax: 650-745-1490

email: [cs@linleygroup.com](mailto:cs@linleygroup.com)  
[www.linleygroup.com](http://www.linleygroup.com)

# Preface

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

We define a backplane switch as a chip set capable of switching traffic over the backplane. It may switch one type of traffic, such as Ethernet, or may be a multiservice switch capable of switching IP packets, ATM cells, and, in some cases, TDM circuits. These products support high-speed serial backplanes for use in modular equipment.

This report covers Ethernet switch chips, ASI switch chips, RapidIO switch chips, and proprietary fabrics. These switch chips are used in wide-area networks, metro networks, blade servers, storage networks, and wireless infrastructure. Depending on the application, the port rates can be Gigabit Ethernet, 10G Ethernet, OC-48, or greater.

This report does not cover TDM-only fabrics (cross-connects), InfiniBand fabrics, Ethernet workgroup switches, or PCI fan-out switches.

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

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

- Engineers who are designing switches, routers, or blade servers that need to select a backplane switch
- Marketing and engineering staff at companies that sell backplane switches who desire competitive information
- Technology professionals who wish an introduction to backplane-switch architectures and technology
- Financial analysts and investment professionals who desire a detailed analysis of backplane switch vendors and their chances of success
- Press and public relations professionals who need to get up to speed on this new technology

As described below, the report is structured to allow different readers to skip certain sections, as needed. For example, experienced networking-design engineers may wish to focus on Chapters 3 through 13; financial analysts may instead focus on Chapters 1 through 4 and on 13 and 14.

## **Organization of the Report**

Chapters 1 and 2 provide background information and terminology about networks, routers, data centers, and backplane-switch requirements. They describe equipment such as edge routers, core routers, blade servers, IP DSLAMs, base stations, and LAN backbone switches. They provide an overview of switch and router design, backplane design, and design tradeoffs.

Chapter 3 discusses the types of backplane switches, architecture, and switch-fabric performance. The architecture section discusses the key issues in switch design, serving as a useful tutorial and reference for any reader not intimately familiar with this subject.

Chapter 4 provides a look at current technology trends, covering issues such as architecture choices, line-card interfaces, and backplane technology. This chapter also covers the target markets for backplane switches and our outlook for the market as a whole.

Chapters 5 through 11 provide a detailed look at each of the leading backplane-switch vendors and their current products. AMCC, Broadcom, Dune, Fulcrum, Fujitsu, PMC-Sierra, and Tundra are covered. For each vendor, the report provides a company overview, strategic analysis, detailed technology description, implementation example, design-win data, and overall conclusions.

Chapter 12 covers other backplane switch vendors. The report provides an overview of each company and analyzes announced product information, if any.

Chapters 13 and 14 conclude the report with a detailed comparison of the switch fabrics and vendors discussed in the preceding chapters. Chapter 13 groups the backplane switches into categories and compares technical specifications within each group. Chapter 14 provides a higher-level analysis of the market, summarizing the strengths and weaknesses of each vendor and selecting those that are likely to come out ahead.

The index allows readers to quickly locate definitions of important terms and acronyms. The appendix provides pointers to additional sources of information.

## **Acknowledgments**

The authors wish to thank the numerous people at AMCC, Broadcom, Dune, Enigma, Erlang, Fujitsu, Fulcrum, IDT, PMC-Sierra, StarGen, Tera-Chip, Tundra, Vitesse, Xyratex, and other companies 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 ever-vigilant copy editor, Ellen Clements, for keeping our grammar straight, to Linley Gwennap for sharpening the analysis, and to Eileen Schmidt, who assisted with production.

## Executive Summary

Backplane switches move data between blades or line cards in networking and computing systems. The applications for backplane switches include blade servers, networking routers, SAN switches, wireless infrastructure, and embedded systems. These applications have different requirements, and in some cases these requirements vary within an application. As a result, multiple switch products are needed to meet the requirements of the range of applications. Furthermore, multiple standards—including ASI, Ethernet, RapidIO, and InfiniBand—have been developed for various switching applications.

Bandwidth demand continues to rise, driving the need for more ports and more backplane switches. Although there is a large market for backplane switches, most of it is captive to internal ASICs. Networking applications drove most of the traditional backplane switch market. Blade servers are a new application that should drive future switching demand. Compared with the existing backplane switch market, the blade server market is more likely to use merchant silicon. As the industry converges on standard backplane switches, networking OEMs should move toward merchant silicon as well.

This report looks at proprietary fabrics and standard switching silicon. In 2005, the revenue for merchant proprietary fabrics grew slowly. As a result, several vendors of proprietary fabrics abandoned this market in 2004 and 2005. For example, fabrics are no longer a focus at IDT, Vitesse, and Mindspeed. TeraChip and Erlang have not released any update in the past year and each vendor is struggling to survive. Although AMCC continues to lead on revenue, the company has significantly reduced its development team and does not plan to revise the PRS architecture. Bucking the trend, Broadcom acquired Sandburst and intends to market its HiBeam chip set.

Among the remaining vendors of proprietary fabrics, Dune and Broadcom offer the leading proven solutions. Each vendor won several designs over the course of the year. Dune has benefited from its partnership with Marvell, which promotes Dune's fabric as an extension to its Presteria line. The former Sandburst solution should get a similar boost now that Broadcom is promoting it.

In 2005, startup Enigma disclosed plans to offer a proprietary fabric. The startup offers a high-capacity switch along with the ability to switch

packets in their native format. Compared with most of the current fabrics that switch cells, Enigma's switch eliminates segmentation and reassembly overhead. These advantages should help it gain wins, but mainly at the high end of the market.

Wary of supplier lock-ins, OEMs are looking at standard fabrics to provide a reliable supply line from multiple suppliers. RapidIO is supported by some DSPs from TI and Analog Devices as well some of Freescale's PowerQuicc processors. Tundra was the first supplier of RapidIO switches and remains the leader. It was also first to validate its switch against processors from TI and Freescale. In 2006, Tundra faces new competition from Mercury, IDT, and PMC-Sierra. Mercury now offers its internally developed 80Gbps switch as a standard product. IDT entered the market with the first RapidIO switch that integrates a preprocessor to offload DSPs on a line card. PMC-Sierra sampled the first 160Gbps RapidIO switch. OEMs have many choices from which to select a RapidIO switch that best matches their system requirements.

After building some momentum in 2004, the ASI standard has since lost its support. Xyratex, Intel, IDT, and Vitesse stopped development of ASI programs. StarGen, the sole remaining champion for ASI, was forced to withdraw its ASI switch due to a lack of funding. We do not expect ASI to be relevant for future backplane designs.

The low cost of Ethernet makes it an attractive option as a backplane switch for communication and computing applications. Gigabit Ethernet is a popular choice for systems with less than 25Gbps of bandwidth, and 10G Ethernet supports backplanes with bandwidth of 200Gbps or more. Ethernet, however, has technical limitations that prevent its broad deployment as a fabric. Several industry groups are looking to address these limitations and improve Ethernet for backplane switching.

Fujitsu was the early market leader with a 10G Ethernet switch chip. In 2006, Broadcom leap-frogged Fujitsu by offering a 20-port 10GbE switch. Fulcrum's 24-port Ethernet switch is the largest-capacity Ethernet switch. Additionally, Fulcrum has developed innovative techniques for offering terabits of bandwidth in a nonblocking configuration. With several design wins under its belt, Fulcrum is leading the way for Ethernet deployment in computing and communication applications.