

A Guide to Network Processors

Eleventh Edition

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Authors: Bob Wheeler and Jag Bolaria

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[The Definitive Report on Network Processing](#)

NPUs have become a critical ingredient of carrier-equipment designs. These chips are appearing in new designs from leading OEMs spanning many applications from PON OLTs and Node Bs to Carrier-Ethernet switch/routers. This broad adoption has created a merchant market that exceeded \$300 million in 2009, large enough to sustain multiple vendors. Yet many large vendors have abandoned the market, leaving excellent opportunities for more focused vendors.

Access infrastructure is migrating to Ethernet and IP backhaul while data rates for both wireline and wireless networks continue to climb. These factors are driving the need for new access NPUs that are more similar to metro-class NPUs. Meanwhile, metro-class NPUs are scaling to 100Gbps and beyond to support high-density line cards and emerging 40G/100G Ethernet. A "Guide to Network Processors" provides a single comprehensive report covering NPUs spanning data rates from 2Gbps to 100Gbps.

This report covers the vendors and products that address multiple markets using programmable designs including: Broadcom's XGS Core line, LSI's APP and Axxia lines, Wintegra's WinPath, EZchip's NPA and NP lines, Netronome's NFP (Intel IXP derivative), and Xelerated's HX and AX lines. We also cover vendors of FPGA-based chips that compete with NPUs in some designs, including Ethernity and Tpack.

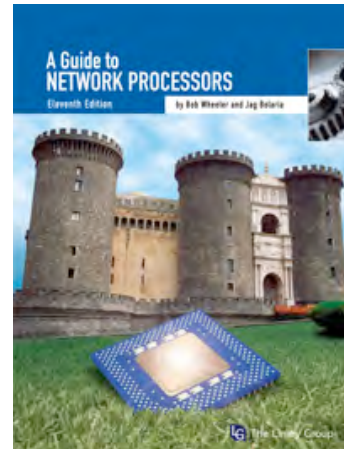
Only The Linley Group follows this market closely enough to give you the complete picture. Which major vendors are in this business for the long haul? Which startups will survive and which will fail? How do the latest products stack up? "A Guide to Network Processors" is the result of years of research that cannot be duplicated. If you are interested in following this strategic standard-product segment, you have located the definitive source.

[Get Facts, Not Fiction](#)

This report cuts through the vendor hype and gives you the solid information you need to understand this market. "A Guide to Network Processors" analyzes each vendor and each product, probes their strengths and weaknesses, then presents key details in a consistent, easy to compare fashion. For those less familiar with this combination of networking and CPU design, the report includes several introductory chapters that define and describe basic concepts and key technologies.

The Linley Group is the most recognized and respected name for technology and market analysis of network processors. Don't be fooled by weak overviews written by market analysts who really don't understand how a network processor works. The "Guide" provides a unique combination of business and technology savvy from the leading analysts in this market. [Bob Wheeler](#) and [Jag Bolaria](#) use their long experience in the networking world to analyze these devices. Together, the two authors ignore the fiction and provide the real story on each NPU vendor and its products.

Don't miss the latest information on this important market, order now.



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

Research. Analyze. Advise

This report is written for:

- Engineers who are designing networking equipment and need to select a network processor (NPU)
- Marketing and engineering staff at companies that sell NPU products who desire competitive information
- Technology professionals who want an introduction to networking and network processors
- Financial analysts who desire a detailed analysis and comparison of NPU companies and their chances of success
- Network architects at carriers and service providers who need to get up to speed on this technology

For further information, contact:

The Linley Group
Phone: 408-281-1947
Fax: 650-745-1490
Email: cs@linleygroup.com
Website: www.linleygroup.com

The following excerpt is from "[*A Guide to Network Processors, Eleventh 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 Network Processors

Eleventh Edition

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By Bob Wheeler and Jag Bolaria



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1-800-413-2881 or 408-281-1947
fax: 650-745-1490
email: cs@linleygroup.com
www.linleygroup.com

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Table of Contents

List of Figures	ix
List of Tables.....	xi
About the Authors	xiii
About the Publisher.....	xv
Preface	xvii
Executive Summary.....	xix
1 Introduction to Carrier Networks	1
Network Types and Topologies	1
Metro-Area Networks (MANs).....	1
Wireline Access	3
Wireless Access	4
Equipment Types.....	4
Metro Platforms	5
Wireline Access Infrastructure	6
Wireless Access Infrastructure	7
2 Carrier-Network Technology	9
Network Layers and the OSI Model.....	9
Layers 3–7	10
Layers 1 and 2	10
Interaction Among Layers	12
Network Protocol Details	13
Ethernet.....	13
PPP	15
ATM	16
Multiprotocol Label Switching (MPLS)	17
Sonet/SDH	18
OTN	19

IP Multicasting.....	20
TDM Emulation	20
Timing Synchronization.....	21
Ethernet OAM and Protection Switching.....	22
HDLC and Frame Relay	22
Carrier Ethernet Services	22
Packet-Processing Pipeline.....	24
Control and Data Planes	24
Parsing	25
Classification.....	25
Forwarding	26
Modification.....	27
Network Paths and Quality of Service.....	27
Traffic Management.....	28
Policing and Shaping.....	29
Congestion Management.....	30
Scheduling.....	30
Hierarchical Traffic Management.....	31
Network and I/O Interfaces	31
MII, XAUI, and Derivatives.....	32
Utopia, POS-PHY, SPI, and Interlaken.....	33
PCI.....	35
RapidIO	35
NPF LA-1.....	35
3 Network Processors.....	37
What Is a Network Processor?.....	37
What Is Not a Network Processor	37
Common Characteristics	38
Microarchitecture Variations	39
Fixed-Function Versus Programmable	40
Network Interfaces.....	41
Memory Interfaces.....	42
Host Interface.....	43
Software Considerations	43
4 Market Size and Trends	45
Market Size and Segmentation	45
Market Share By Vendor	47
Market Forecast.....	48
Market and Technology Trends.....	50
OEM-Proprietary NPUs.....	50
Multicore Processors Versus NPUs	51
FPGAs Versus NPUs	52
Vendor Programming Versus Customer Programming	53
3G and 4G Wireless Backhaul.....	54
Chassis and Board Standards	55

- 5 Broadcom..... 57**
 - Company Background 57
 - Key Features and Performance 58
 - Internal Architecture 59
 - System Design 60
 - Conclusions..... 61

- 6 EZchip 63**
 - Company Background 63
 - Key Features and Performance 64
 - Internal Architecture 66
 - System Design 68
 - Development Tools 71
 - Conclusions..... 71

- 7 LSI..... 73**
 - Company Background 73
 - Key Features and Performance 74
 - Internal Architecture 75
 - System Design 78
 - Development Tools 80
 - Product Roadmap..... 81
 - Conclusions..... 81

- 8 Netronome 83**
 - Company Background 83
 - Key Features and Performance 84
 - Internal Architecture 85
 - System Design 87
 - Development Tools 88
 - Product Roadmap..... 89
 - Conclusions..... 89

- 9 Wintegra 91**
 - Company Background 91
 - Key Features and Performance 92
 - Internal Architecture 94
 - System Design 95

Development Tools	98
Conclusions.....	100
10 Xelerated	101
Company Background	101
Key Features and Performance	102
Internal Architecture	103
System Design	106
Development Tools	107
Conclusions.....	108
11 FPGA Packet Processors	111
Ethernity	111
Company Background.....	111
Key Features and Performance.....	112
Design Details	114
Conclusions.....	115
TPack	116
Company Background.....	116
Product Overview	117
Conclusions.....	119
12 Legacy Vendors.....	121
AppliedMicro (AMCC)	121
Bay Microsystems	123
Exar (Hifn)	124
Intel	125
Lightstorm.....	126
Mindspeed	127
13 Comparing NPUs	131
20Gbps-and-Below NPUs	131
Key Differentiators	135
40Gbps-and-Above NPUs	135
Key Differentiators	139
14 Conclusions.....	141
Vendor Outlook.....	141
EZchip	141
LSI.....	142
Wintegra	143
Xelerated	143

Broadcom	144
Netronome.....	144
Closing Thoughts	145
Appendix: Further Reading.....	147
Index.....	149

List of Figures

Figure 1-1. Generic network architecture	2
Figure 1-2. Wireline access networks	6
Figure 1-3. 3GPP Release 5 IP-based cellular network architecture	8
Figure 2-1. OSI layer traversal example	12
Figure 2-2. Layer 2 protocol stacking within DSL network	13
Figure 2-3. ATM protocol stack	16
Figure 2-4. MPLS encapsulation	17
Figure 2-5. VPLS switch conceptual model	23
Figure 2-6. Control and data planes	24
Figure 2-7. Hierarchical traffic-management example based on TR-059	31
Figure 2-8. Standard line-card interfaces	32
Figure 3-1. Block diagram of a typical NPU	41
Figure 4-1. NPU revenue by application segment, 2009	46
Figure 4-2. NPU revenue by performance segment, 2006–2009	47
Figure 4-3. NPU market share by revenue, 2009	48
Figure 4-4. NPU market forecast, 2009–2014	49
Figure 5-1. Broadcom BCM88025 block diagram	60
Figure 5-2. Broadcom 4×10GbE XGS Core line card	61
Figure 6-1. EZchip NP-4 block diagram	67
Figure 6-2. 100GbE line card using EZchip NP-4	69
Figure 6-3. EZchip GPON OLT line card using NPA-3	70
Figure 7-1. LSI ACP3448 block diagram	77
Figure 7-2. Base-station network interface using LSI APP3300	79
Figure 8-1. Netronome NFP-3240 block diagram	86
Figure 8-2. Netronome NFP-3240 10GbE line card	87

Figure 9-1. Wintegra WinPath3 block diagram	94
Figure 9-2. Wireless-backhaul aggregator based on WinPath3 and UFE	96
Figure 9-3. GPON OLT line card using WinPath3	97
Figure 9-4. 4G wireless base station using WinPath3	98
Figure 10-1. Xelerated HX/AX PISC architecture	104
Figure 10-2. Xelerated HX330 simplified block diagram	105
Figure 10-3. Xelerated 4x10GbE line card with Dune fabric	106
Figure 11-1. Ethernity Carrier Ethernet application.....	115

List of Tables

Table 2-1. OSI reference model	9
Table 2-2. Bandwidths of common interfaces	11
Table 2-3. ITU-T standards for ATM adaptation layers	16
Table 4-1. NPU market share by revenue for 2009	47
Table 5-1. Key parameters for Broadcom NPU and TM devices.....	59
Table 6-1. Key parameters for EZchip NPUs	65
Table 7-1. Key parameters for LSI APP and ACP devices	75
Table 8-1. Key parameters for IXP2855 and NFP-32xx processors	84
Table 9-1. Key parameters for Wintegra WinPath devices	92
Table 9-2. Wintegra protocol and interworking support.....	99
Table 10-1. Key parameters for selected Xelerated NPUs	102
Table 11-1. Key parameters for Ethernity ENET devices.....	112
Table 11-2. Key parameters for TPack TPX devices.....	117
Table 12-1. Legacy NPU vendors and status.....	121
Table 12-2. Key parameters for selected AppliedMicro nP devices	122
Table 12-3. Key parameters for Exar 5NP4G device	125
Table 12-4. Key parameters for Mindspeed TSP3 family.....	128
Table 13-1. Key parameters for 20Gbps-and-below NPUs.....	132
Table 13-2. Key parameters for 40–100Gbps NPUs.....	136
Table 13-3. Sample 4×10GbE line cards.....	138

About the Authors

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.

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 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.

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.

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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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- 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 focused seminars and conferences that analyze products and design strategies in a particular technology segment, providing information that engineers can immediately use to improve their designs. These one- and 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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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
www.linleygroup.com

Preface

What This Report Covers

We define a network processor as a programmable device (i.e., a micro-processor) that is optimized for processing packets. This report covers a variety of network processors that can process packets at 2Gbps or faster. The report includes all announced devices in this category, whether they are shipping or not, except older devices that are not supported for new designs. It also covers FPGA-based products that perform similar tasks in some applications.

This report does not cover general-purpose processors, including multi-core processors, that are not optimized for Layer 2–3 packet processing; these CPUs are covered in our report *A Guide to High-Speed Embedded Processors*. Processors optimized for security applications are covered in our report *A Guide to Security Processors and Accelerators*. This report does not cover fixed-function Carrier Ethernet switch chips; these chips are covered in our report *A Guide to Ethernet Switch and PHY Chips*.

Who Should Read This Report

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

- Engineers who are designing networking equipment and need to select a network processor (NPU)
- Marketing and engineering staff at companies that sell NPU products who desire competitive information
- Technology professionals who want an introduction to networking and network processors
- Financial analysts who desire a detailed analysis and comparison of NPU companies and their chances of success
- Network architects at carriers and service providers 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 networking-design engineers may wish to focus on Chapters 4 through 13; financial

analysts may instead focus on Chapters 1 through 4 and 13 through 14. Those who have read previous editions may wish to start at Chapter 4.

Organization of the Report

The first three chapters provide background information and terminology relating to carrier networks, switches and routers, and network processors (NPUs). They describe metro, wireline-access, and wireless-access networks and associated equipment types. They provide an overview of Ethernet, MPLS, VPN, QoS, and other key technologies. They define terms such as network processor, packet engine, multithreading, data plane, control plane, and wire speed.

Chapter 4 provides quantitative market-size and vendor-share data, our forecast for the merchant-NPU market, and a look at key technology and market trends.

Chapters 5 through 10 provide a detailed look at the leading network-processor vendors and their current NPU products. Companies covered include Broadcom, EZchip, LSI, Netronome, Wintegra, and Xelerated. For each vendor, the report provides a company overview, strategic analysis, a detailed technology description, implementation examples, a roadmap of future products where available, key announced customers, and overall conclusions.

Chapter 11 covers Ethernity and TPack, which are vendors of packet processors implemented using FPGAs. Chapter 12 provides abbreviated coverage of NPU vendors that have discontinued ongoing development or withdrawn their product from the market.

Chapters 13 and 14 conclude the report with a detailed comparison of the NPUs and vendors discussed in the previous chapters. Chapter 13 groups the NPUs into categories and provides technical specifications and comparisons within each group. Chapter 14 provides a forward-looking view of the market, summarizing the outlook for each NPU vendor and providing our closing thoughts.

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

Acknowledgments

The authors wish to thank the numerous people at Broadcom, EZchip, LSI, Netronome, Wintegra, Xelerated, and other companies who supplied information on their products and reviewed sections of the report. These reviewers helped ensure the highest possible technical accuracy.

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Executive Summary

Network processors are replacing ASICs and fixed-function chips in a variety of carrier equipment, including services routers, Carrier Ethernet switch/routers (CESRs), optical-transport platforms, and broadband- and wireless-infrastructure equipment. As such, the network processor (NPU) has emerged as a strategic component of new system designs. Merchant-NPU vendors have announced design wins at every top-tier OEM, even those that have internal NPU and/or ASIC designs.

Fueled by new design wins reaching production, merchant-NPU revenue grew 73% between 2005 and 2009. Products shipping in 2009 divided into three performance categories: sub-2.5Gbps NPUs, OC-48/4xGbE NPUs, and 10Gbps-and-above NPUs. The 10Gbps-and-above category is the fastest growing, whereas the legacy OC-48 class is shrinking.

According to our research, Intel was the NPU market-share leader in 2009 by a wide margin. But Intel is developing no future IXP products; instead, it has provided startup Netronome Systems with a license to develop IXP derivatives. In late 2009, Netronome sampled its first such NPUs: the NFP-32xx family.

LSI maintained the second ranking, thanks to growing shipments of its APP NPUs (formerly from Agere). The company is shipping third-generation NPUs for wireless-infrastructure and wireline-access designs. LSI also offers complete data-plane software for key applications. In February 2010, the company sampled the first chips in its new line of Axxia communication processors (abbreviated as ACP). Combining multiple Power CPUs with data-plane technology from the APP line, the ACP devices represent a hybrid of a multicore processor and an NPU. LSI also offers complementary framer/mapper devices for Sonet/TDM and DSPs for wireless-infrastructure applications.

EZchip ranked third in 2009 and is growing, thanks to its focus on the 10Gbps-and-above category. The company is shipping multiple product generations including the NP-3, a 30Gbps chip combining a customer-programmable NPU, traffic manager, and Ethernet MACs. EZchip worked with Marvell to supply a semicustom version of this chip to Cisco. During 2009, EZchip introduced the new NPA line, which targets access applications. In early 2010, EZchip sampled the NP-4, which is the industry's first merchant 100Gbps NPU.

Whereas EZchip focuses on high-end NPUs, Wintegra focuses on access designs. The small company is a leading vendor of access NPUs because of its flexible architecture and complete data-plane software. Through specific hardware configurations and software bundles, Wintegra offers specific products targeting broadband, wireless, and Carrier Ethernet applications. The company is shipping second-generation devices and sampled its 10Gbps+ WinPath3 third-generation NPUs in 4Q09.

Xelerated is a startup shipping a 40Gbps NPU optimized for high-density Ethernet designs. The company's X11 offers deterministic performance combined with customer programmability, but the current chip lacks traffic management. Like Wintegra, Xelerated supplies complete data-plane code for its primary target applications. Based on a common third-generation architecture, Xelerated's new HX and AX families are due to sample in 2Q10. The HX line will scale NPU performance to 100Gbps and will offer a traffic manager; the AX line will target fiber access with a hybrid NPU and Ethernet-switch-on-a-chip design.

Targeting modular Carrier Ethernet switch/router designs, Broadcom offers its XGS Core chip set, which includes a 40Gbps NPU, traffic manager, and switch fabric. After initially supplying only production (binary) NPU code, the company now allows customers to modify and develop NPU software. In addition to the programmable NPU, Broadcom offers configurable Carrier Ethernet switch chips in its popular StrataXGS line. For chassis-switch designs, Broadcom stands out with the most-complete system solutions.

Because FPGAs are using leading-edge processes and are becoming ever more capable, two small vendors are offering FPGA-based packet processors as alternatives to software-programmable NPUs. Ethernity found initial success in broadband designs, whereas TPack is focused on optical transport and also supplies framer/mapper designs. In addition to Intel, a number of other vendors continue to ship NPUs but have no ongoing development. These legacy vendors include AppliedMicro (AMCC), Exar (which acquired Hifn), and Mindspeed.

After a pause in 2009, we see the NPU market growing in 2010 and expect growth to continue through 2014. This growth will be driven principally by additional displacement of OEMs' in-house NPUs and ASICs. Following years of vendor consolidation, most of the remaining active NPU vendors are now profitable and well positioned for future growth.