A Network Engineer's Travelogue Deploying Domain Solutions

Juniper Networks Warrior

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Peter Southwick

Juniper Networks Warrior

In this practical book, Juniper Networks consulting senior network engineer, Peter Southwick, offers unique first person field studies on designing, configuring, and troubleshooting new systems that are changing the networking world. Each chapter-long "travelogue" follows a team of Juniper Networks warriors as they solve specific problems with emerging network platform architectures.

In these case studies, Southwick and his fellow warriors analyze a client's particular situation, arrive at an architectural solution, and work through the deployment details. For anyone who operates, installs, designs, or works in IT, this book provides an intimate and entertaining look at what's changing and why.

Among the case studies, you'll discover how:

- A service provider protected customers from malicious traffic with Juniper Networks IDP systems
- SRX5800s improved connectivity and security in a data center
- Ethernet WAN technology was chosen as a storage solution, rather than a proprietary design on dark fiber
- An enterprise severed communications between different departments to comply with government personal credit card standards
- Core network and edge devices helped a power company serve local customers and ISPs in the data services market
- A hosting company migrated its core, data center, edge, and access domains to a state-of-the-art network

"In this uniquely written book, you will get a detailed view of life in the data center, the edge, the core, and the office of the customer's CIO."

—Steve Fazio
CEO, TorreyPoint

Peter Southwick, a senior network engineer at TorreyPoint, provides professional services support and training. He is a JNCI, and holds JNCIE-M #473 and other Juniper certifications in routing and security. Peter is co-author of *Junos Enterprise Routing, Second Edition* (O'Reilly), *JNCIE-SP Exam Workbook* (Proteus Press), and *Telecommunications: A Beginner's Guide* (McGraw Hill).

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JUNIPER NETWORKS

US $59.99 CAN $62.99
ISBN: 978-1-449-31663-1

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by Peter Southwick

Printed in the United States of America.

Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472.

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Editors: Mike Loukides and Meghan Blanchette
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Cover Designer: Karen Montgomery
Interior Designer: David Futato
Illustrator: Kara Ebrahim & Rebecca Demarest

November 2012: First Edition

Revision History for the First Edition:

2012-11-09 First release

See *http://oreilly.com/catalog/errata.csp?isbn=9781449316631* for release details.

ISBN: 978-1-449-31663-1

[LSI]

This book is dedicated to the real warriors of this world who keep us free and sometimes die in the process. We salute and honor you.

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Preface

The network has changed a lot recently, with 10 years' worth of developments packed into just 2 or 3. Those changes have been in specific network domains. The industry has grown out of the "just put another rack in" approach, because putting another rack in does not necessarily equate to gaining more bandwidth or more services or more security. Patching your limping network with a new box *will give you a faster limping network*.

The rise of systemic networking has in turn given rise to the Juniper Networks warrior. While it's not a given that they know more than or are better than other vendors' professional installers, Juniper Networks warriors think in terms of network platforms and how the entire architecture works for the client. They think in terms of extra capacity in the near future and long-term scalability for the client. They also think in terms of domains: the needs for the service provider edge are different than those of a campus or branch network, but both might use the MX480. For a Juniper Networks warrior, the deployment adapts to the domain rather than the domain bending to accommodate what the deployment can't do.

An explosion of system-wide architectures and network deployments has occurred in the past five years, and I have seen it happen firsthand as a professional services networking engineer (and trainer). I am one of many, and I have encountered both warriors who are umpteen times smarter than I, and others who I have had to drag along by the scruff of the neck. Our numbers are growing.

This book presents a series of network engineer's travelogues that I hope will entertain and illuminate—they show specific configurations in this new world, where a systemic approach is actually cheaper, easier, and better than squeezing in another rack.

More specifically, I hope these chapter-length travelogues will show our warriors' ability to think on our feet, because no two networks are the same even if they fall in the same domain. A common warrior's morning lament is "OMG, how are we going to fix that!?"

But then we put on our shoes and walk into the meeting room and figure it out somehow. And we do it every day, every week, at almost every deployment. As the saying goes, *sometimes you get the bear and sometimes the bear gets you*. Thankfully, the bear does not win very often, and we're still here, gettin' the bear.

In most engagements, the equipment has been ordered, the sales deal is done, the media has over hyped the issues, everyone wants new networking power, the deadline is looming, and the politics of the client are, well, very visible. You fly in like a smoking gun, meet with a half dozen other warriors—some you know, some you don't—and you are expected to perform like a well-oiled machine for the next week or month, cooped up together, sleeping and eating like a band of foot soldiers. What you do has to be flawless, meticulous, speedy, and mindful of the whims of the client.

As the world favors these platform architectures more and more, the network warrior must perform on a systemic stage. Hats off to you, my fellow network warriors. It's showtime!

What Is the New Network Platform Architecture?

Once upon a time, it used to be just the service provider (SP) and the local area network (LAN). Then it went to SP and enterprise. Then campus and branch, WLAN, and edge joined in. Then the data center, and now user devices by the billion, with each having more communication power than any computer a decade ago. This evolution is a good thing. It means the domains of the world's networks are adapting to the needs of their entities, and they are organizing themselves by how they operate and the services they need to offer to their users. Putting another router on the rack because its cheap ain't going to cut it, because you'll eventually need more warriors and more warrior time to fix the cheap patch.

This book endorses Juniper's *New Network Platform Architecture* approach, if only because I have been installing it for years under different names, and it works. This approach is at the heart of each chapter's deployment. Any warrior worth his salt should be giddy to see such an emphasis on this platform and what that future offers.

This book darts around the domains in a random fashion because their order is not important, but I call them out at the beginning of each new chapter. This book is about network engineers and the problems and challenges they face when they deploy networks to help people communicate and share. Layer 8 of the OSI model of networking, or *politics*, is alluded to in several chapters, but I try to avoid going into gory detail about the political battles witnessed during the deployments (most warriors would rather be confronted by a downed network than two clients giving them separate and contrasting instructions—the network they can fix, while the other problems just seem to fester).

How to Use This Book

Let's look at some specifics on how this book can help you. Every network deployment is different, like trees, like snowflakes, like people. You have to have an open mind, use open standards, and be as meticulous as a warrior. My fellow warriors will enjoy these chapters as pure networking travelogues: they might remind you of that build-out in the Midwest during the Great Blizzard, or those crazy people at University X. For others, who are aspiring to be warriors, or perhaps are part of the warriors' sales and support teams, you need to know the process that happens onsite to make it all work. Upon reflection, however, I think that the people who actually spend the money and buy new networking equipment may benefit the most from this book. The warrior tribe sent to your location can work wonders if you listen and participate.

Different readers will use this book for different reasons, so each might use a different part of each chapter for their purposes. Each chapter starts off with an analysis of the client's situation and how the power of the Juniper Networks domains concept can be harnessed to improve that situation. In this portion of the chapter, the trade-offs are weighed, the requirements are outlined, and the solution's architecture is shown. The second part of each chapter gets into the nuts and bolts of how the solution was crafted. I realize that many concepts are used in most engagements, so some of the details might be skipped. But for the most part, the configuration snippets are all usable as presented. Most chapters end with the steps used by the tribe to install, migrate, or activate the client's network. If you are reading this to understand what devices we use in what environments and why, you might want to skip the gory details. If you are reading this as a means to solve your client's issues, you might skip the political section. All in all, there are many ways to use this book; my hope is that whatever your goals, you find it helpful and enjoyable.

I assume a certain level of networking knowledge on the reader's part. The less you know about the following concepts, the more each chapter will get fuzzy just when it gets down to warrior-dom:

The OSI model
: The Open Systems Interconnection (OSI) model defines seven different layers of technology: the physical, data link, network, transport, session, presentation, and application layers. This model allows network engineers and network vendors to easily discuss different technologies and apply them to specific OSI levels, and allows engineers to divide the overall problem of getting one application to talk to another into discrete parts and more manageable sections. Each level has certain attributes that describe it, and each level interacts with its neighboring levels in a very well-defined manner. Knowledge of the layers above Layer 7 is not mandatory, but understanding that interoperability is not always about electrons and photons will help.

Switches
: These devices operate at Layer 2 of the OSI model and use logical local addressing to move frames across a network. Devices in this category include Ethernet in all its variations, virtual LANs (VLANs), aggregate switches, and redundant switches.

Routers
: These devices operate at Layer 3 of the OSI model and connect IP subnets to each other. Routers move packets across a network in a hop-by-hop fashion.

Ethernet
: These broadcast domains connect multiple hosts together on a common infrastructure. Hosts communicate with each other using Layer 2 media access control (MAC) addresses.

IP addressing and subnetting
: Hosts using IP to communicate with each other use 32-bit addresses. Humans often use a dotted decimal format to represent these addresses. This address notation includes a network portion and a host portion, which is normally displayed as 192.168.1.1/24.

TCP and UDP
: These Layer 4 protocols define methods for communicating between hosts. The Transmission Control Protocol (TCP) provides for connection-oriented communications, whereas the User Datagram Protocol (UDP) uses a connectionless paradigm. Other benefits of using TCP include flow control, windowing/buffering, and explicit acknowledgments.

ICMP
: Network engineers use this protocol to troubleshoot and operate a network, as it is the core protocol used (on some platforms) by the *ping* and *traceroute* programs. In addition, the Internet Control Message Protocol (ICMP) is used to send error and other messages between hosts in an IP-based network.

Junos CLI
: The command-line interface (CLI) used by Juniper Networks routers is the primary method for configuring, managing, and troubleshooting the routers. Junos documentation covers the CLI in detail, and it is freely available on the Juniper Networks website. The Juniper Day One Library offers free PDF books that explore the Junos CLI step by step.

What's in This Book?

The unique advantage of Juniper Networks warriors is that they tend to think in terms of complete systems rather than adding on boxes here and there. It's a different switch you must throw in your head, but soon after, you'll start thinking in terms of network domains.

Here's what we warriors were up to at the deployments covered in this book:

Chapter 1
: This New England engagement looks at a branch office domain implementation using Juniper Networks J-series and MX routers connecting to a provider-provisioned Layer 3 virtual private network (L3VPN). The client's requirements included alternate paths survivability and class of service guarantees for traffic.

Chapter 2
: Most service providers are seeing the need to protect their customers from malicious traffic and attacks. The security of customers is the pervasive thread across all domains. This chapter looks at the tasks and capabilities used to ensure that Juniper Networks intrusion detection and prevention (IDP) systems are kept in optimal operating condition to assure that security.

Chapter 3
: The data center domain is the home for low-latency switches and high-availability servers. With the critical nature of the data in these data centers, securing the communications is as important as getting it to the destination, and in some cases more so. This chapter looks at the deployment of SRX5800s in the heart of a data center—not only improving connectivity at low latency, but also securing that information.

Chapter 4
: This Alaska-based engagement takes a new look at the WAN domain: an existing routed network of M-series and MX routers is reused to offer Ethernet services in the far north. For the readers that have not looked at Ethernet as a WAN technology, this chapter offers a deep dive into the frames, packets, and MTUs of this new entry into an old domain. It was a lesson for me, so I present it to you.

Chapter 5
: The Internet edge domain can be a single router or a multitude of firewalls and security apparatus. In this engagement the multitude was replaced by the singular. This chapter details the migration of a fully distributed Internet egress system to a manageable SRX-based design.

Chapter 6
: This chapter looks at an engagement that took place in my home state of Vermont. This service provider engagement offered a chance to work in the core domain and the edge domain, standing up new services for a traditional telephone company.

Chapter 7
: This Eastern Seaboard engagement took on the government compliance guidelines for personal credit card information and the securing of the same. Oh, how I love regulations: the client needed to assure that different departments of the same enterprise could not talk to one another, so as to comply with the government standards. We used SRXs to secure communications to provide compliance.

Chapter 8
: This chapter takes a different look at the WAN domain. This New Jersey engagement allowed a customer to realize operating expenditure savings by using an Ethernet WAN technology for a storage solution rather than a proprietary design on dark fiber.

Chapter 9
: This engagement was based on the shores of the mighty Mississippi, where a power company was entering into the data services market. The use of MXs allowed the provider to deploy a core network as well as edge devices to serve both local customers and ISPs in the area.

Chapter 10
: Most of the engagements presented in this book are based on the new Juniper Networks platforms, but not all engagements are based solely on these products. In this engagement, Netscreen-based firewalls were used to meet the requirements of a distributed network in New England. It looks at a secure and survivable core domain.

Chapter 11
: The last chapter is a look at a Northeast hosting company that was migrating its core, data center, edge, and access domains into the current decade. This engagement explores the options, the trade-offs, and the migration to a state-of-the-art network.

A Note About This Book

This book is created from my notes and files on various clients over the past four years. The chapters have been sanitized to protect the clients and their networks. All addressing, AS numbers, and locations are made up. The configurations are functional but do not match the actual client devices. In some cases, the chapter is a mashup of multiple engagements.

Conventions Used in This Book

The following typographical conventions are used in this book:

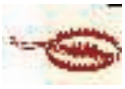
Italic
: Indicates new terms, URLs, email addresses, filenames, file extensions, pathnames, directories, commands, options, switches, variables, attributes, and Unix utilities

`Constant width`
: Indicates the contents of files and the output from commands

`Constant width bold`
: Shows commands and other text that should be typed literally by the user, as well as important lines of code

`Constant width italic`
: Shows text that should be replaced with user-supplied values

This icon signifies a tip, suggestion, or general note.



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Acknowledgments

I alone put pen to paper and recorded these engagements, but I realize that I am a member of a very close-knit tribe. As such, I cannot take credit for all the thoughts, the knowledge, or the total experience that this book represents. There are many groups and individuals that I have to acknowledge as contributors to this endeavor.

First, the tribe. I would like to acknowledge, with great praise and as much fanfare as this single paragraph can raise, all the members and professionals of the global tribe of networking warriors. I am honored to be a part of your profession and the world's network deployment, and all that it means to our society and our diverse cultures.

During my engagements over the past years I have met and worked with many warriors. They are all a part of this book, and without an acknowledgment to them this book would not be complete. Because of reasons involving lawyers, I cannot identify each of these warriors by name and company. It will have to suffice to give thanks to Curtis, Corey, Adam, Eddie, John, Steve, Bill, Cliff, and Joe. Each of you may recognize an idea or a concept that we talked about when I was working with you.

Since we are network engineers, we do fall into the stereotypes of that group. All of this book's editorial cleanup, formatting, and graphical conformity has been performed by people not listed as authors or technical reviewers. It is they who deserve the accolades. I acknowledge them as the true wizards and warriors of the written word: I am grateful to Mike Loukides, Senior O'Reilly Editor, and Meghan Blanchette, Editor, who never let my sporadic schedule and warrior life worry them. Their technical expertise and attention to detail made this book better. I would also like to thank Rachel Head for her copyediting, and Kara Ebrahim and Rebecca Demarest for their artwork; their contributions have made this a better experience for you, the reader.

Patrick Ames has been the guiding light for this project. Thank you for your ideas, editorial help, patience, and eagle eye for detail. Your persistence and enthusiasm have made this project both possible and enjoyable. You gambled on a wild idea that has come to fruition. From the initial phone calls to the final edits, you have been the there as the shining beacon showing the way to the home port. Thank you!

I would like to acknowledge the contributions of Juniper Networks in general, for the assistance provided on various fronts.

I also want to acknowledge my fellow warriors of TorreyPoint and Proteus Networks. You have taught me more than any class or seminar—your passion for the technology and dedication to the customer are goals that we all strive for.

When I was last published, I gave thanks to my family for allowing me to create the book. I was new to this writing stuff and at that point, the thanks seemed a little narrow minded. I am forever grateful to my family for allowing me to continue with this vocation (yes, it is!). They welcome me home with open arms week after week, put up with missed

meets, parties, and holidays, and allow me to spend evenings at home playing in my lab. To say that this book would not have been possible without their support would be an understatement; this book would not have been conceivable without them. You are my inspiration and my reason. Michele, Gabby, and Tori, thank you for being my family, friends, and partners in all that I do.

CHAPTER 1
An Enterprise VPN

This book describes the jobs that I and other networking engineers have performed on client networks over the past few years. We are considered *network warriors* because of the way that we attack networking challenges and solve issues for our clients. Network warriors come from different backgrounds, including service provider routing, security, and the enterprise. They are experts on many different types of equipment: Cisco, Checkpoint, and Extreme, to name a few. A warrior may be a member of the client's networking staff, drafted in for a period of time to be part of the solution, but more often than not, the warriors are transient engineers brought into the client's location.

This book offers a glimpse into the workings of a Juniper Networks warrior. We work in tribes, groups of aligned warriors working with a client toward a set of common goals. Typically technical, commonly political, and almost always economical, these goals are our guides and our measures of success.

To help you get the picture, a quote from the 1970 movie *M*A*S*H* is just about right for us network warriors: "We are the Pros from Dover and we figure to crack this kid's chest and get off to the golf course before it gets dark." Well, not really, but the sentiment is there. We are here to get the job done!

Over the past four years, I have been privileged to team with talented network engineers in a large number of engagements, using a tribal approach to problem solving and design implementation. It is a treat to witness when multiple network warriors put their heads together for a client. But alas, in some cases it's not possible to muster a team, either due to financial constraints, complexity, or timing, and the "tribe" for the engagement ends up being just you. Such was the case for the first domain we'll look at in this book, deploying a corporate VPN.

While I used Juniper Networks design resources for this engagement, there were no other technical team members actively engaged, and I resigned myself to do this job as a tribe of one (although with backup support only a phone call away—don't you just love the promise of JTAC if needed?).

The project came to Proteus Networks (my employer) from a small value added reseller (VAR) based in New England. "We just sold a half-dozen small Juniper Networks routers and the buyers need some help getting up and running." I thrive on such a detailed statement of work. After a phone call to the VAR, and a couple of calls to the customer, I was able to determine the requirements for this lonely engagement.

Company Profile

The company is an enterprise with five locations in the Eastern US (Figure 1-1). The headquarters are located in Hartford, CT (BDL). This location houses the management offices, the accounting and HR departments, the primary data center, and warehouse facilities. A backup data center is located in the Nashville, TN (BNA) area in a leased facility. There are three other warehouses scattered down the Eastern Seaboard, with the southernmost being in Florida.

The company has a CEO who is a techie (he was a Coast Guard radio technician, the kind that can make a radio with nothing more than a soldering iron and a handful of sand). He has kept up with developments in CRM (customer relationship management), inventory control, and web sales. He has grown his company to be a leader in his industry segment by being able to predict when his customers are going to need his product, often before the customers themselves know it.

Network

Prior to the upgrade, the company was running on an Internet-based wide area network. All sites were connected to the Internet and had IPSec tunnels back to the headquarters, creating a virtual private network. The sites have DSL Internet connections from the local ISPs. Each location has a simple LAN/firewall network using static routes to send traffic to the Internet or the main location. At the main location, a series of static routes parse the traffic to its destinations.

In 2010, the company created a disaster recovery and business continuity site in Nashville. The original connectivity between the primary servers in Hartford and the backups in Nashville was a private line service running at 1.5 Mbps.