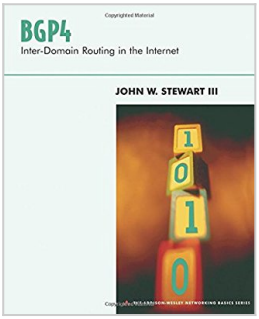

BGP4: Inter-Domain Routing in the Internet

By John W. Stewart III

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BGP4: Inter-Domain Routing in the Internet provides a practical introduction to the TCP/IP protocol suite and to routing in general. This concise guide describes the BGP protocol in clear terms and explains messages and rules for processing information through the protocol. In addition to illustrating low-level details of the protocol, the author examines the conceptual way that BGP works in practical networks, the way that BGP4 interacts with other parts of a network, and other details important to its operation. This book also covers the many extensions that have been made to the original specification to increase the protocol's usability and scope of operation. In addition, this book offers a revealing look into how large ISPs work with BGP4, including a discussion on aggregation, filtering transit customers, and public interconnect points. Numerous real-world examples throughout the book demonstrate concepts and techniques for high-level configurations.

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Editorial Review

Amazon.com Review
Since its introduction in 1993, the Border Gateway Protocol (BGP) has been used extensively to allow network routers to optimize the transmission of Internet Protocol (IP) packets across the Internet. As Internet Service Providers (ISPs) and corporations seek to make their network infrastructures faster and more reliable, more administrators need to get acquainted with BGP (now in version 4). John Stewart's *BGP4: Inter-Domain Routing on the Internet* provides a short, authoritative guide to how Internet routing works generally, along with the specifics of the BGP4 protocol.

Early sections introduce the IP protocol, the foundation of the Internet, including a concise description of IP header structure. Routing basics are also discussed, including External Gateway Protocols (EGPs) and Interior Gateway Protocols (IGPs). The book presents protocols used to determine routing efficiency, including distance-vector and linking-state routing protocols.

Next, Stewart covers the Bridging Control Protocol (BGP) itself and includes discussion of BCP sessions and the message types used to send routing information between routers in BGP. A particular strength of this text is that it explains networking infrastructure with clear examples of hypothetical configurations for your ISP or organization, all using BGP. The author explains both single homing and multihoming (both with a single ISP and multiple ISPs) and explains the strategies that BGP uses to filter routing information efficiently. The book closes with new extensions to BGP, including the notion of BGP *communities*.

This handy introduction to one of the most important--and slightly mysterious--Internet protocols is a must for any networking professional who deals with Internet routing. *--Richard Dragan*

From the Inside Flap

This book is about Border Gateway Protocol Version 4 (BGP4). At the time of this writing, BGP4, the latest version of BGP, has been deployed extensively on routers within the Internet. BGP is a routing protocol for the Internet Protocol (IP). A routing protocol is defined by a set of message formats for describing the reachability and preference for network addresses along with rules for processing information learned through these messages. The role played by routing protocols in networks is to ensure that information can be sent between computers connected to the network. For example, an individual dialing into the Internet from home probably wants to access information, make a purchase, or communicate with friends or colleagues. These resources may be far away from the user's computer, and it is the routing protocols that are responsible for making sure that information can be exchanged between the user and the resources.

BGP is an inter-domain routing protocol. The Internet is a collection of many thousands of networks--from the largest backbones to the smallest dial-up providers and from multinational corporations to an individual dentist's office. Routing protocols are run completely internally to each of these networks as well as between a network and its neighbor. Inter-domain routing protocols such as BGP are the glue that ties the various networks together to make sure that a user of one network can reach a resource no matter where it connects to the network.

The number of people who either need or want to know about BGP has increased dramatically in the past few years, for two reasons. First, the growth in the number of Internet service providers has been explosive in the recent past. Second, many companies depend on the Internet for mission-critical exchange of information or for revenue stream either through Internet sales or through the sale of advertising space on

Web pages. Such organizations often need to understand and use BGP either because of their sheer size or as a way of maximizing the efficiency or reliability of their Internet connection(s).

This book presents a practical introduction to BGP and is structured so that it can serve as a reference for people who need to use BGP. Chapter 1 gives an introduction to the TCP/IP protocol suite and to routing in general. Chapter 2 describes the protocol itself, including the messages and the rules for processing information learned through the protocol. Chapter 3 describes how BGP is used and explains the operational details that are important to know to use BGP. Chapter 4 describes the major extensions that have been made to the original specification to increase the protocol's usability, stability, and scope of operation.

The intended audience is people who have a solid understanding of general computing and at least a cursory familiarity with networks. The background presented in Chapter 1 is as brief as possible, although it attempts to give enough information so that someone who is not an expert in IP can understand the operational details of BGP as well as the reasons for some of the design choices. For readers who are curious about either TCP/IP in general, routing in general, or some particular area of BGP, the Appendix lists a number of references for further reading. Acknowledgments

This is a short book, but it created more than its fair share of stress in my life for several months. Trying to tackle the project of writing a book for the first time shortly after moving across the country, starting a new job with a Bay Area networking start-up, and starting a new relationship certainly presented some challenges. Given this set of challenges, there are a number of people I need to thank for helping me start and, more important, finish the project.

First, I should thank Mary Hart (nee Harrington) of Addison Wesley Longman, Inc., who is responsible for the overall project. She was patient, persistent, and, amazingly, pleasant in her periodic requests for status updates.

Next, I should thank John Fuller of Addison Wesley's production department. He was extremely professional and reliable in seeing the book through to publication.

Next, I should thank Allison Mankin of the University of Southern California's Information Sciences Institute. Allison was my boss for a year and suggested to Mary Hart that she check with me to see whether I had an interest in writing a book on BGP. Allison has been a friend to me in many ways for most of my career, and I appreciate everything she has done for me.

Next, I should thank my professional friends and colleagues. It is certainly they, and not I, who are responsible for my knowing enough about BGP to write this book. My jobs at the Corporation for National Research Initiatives, MCI, USC/ISI, and now Juniper Networks, along with my associated involvement in the IETF, have given me a chance to meet and learn from some incredibly talented people. It's impossible to list everyone, but some of the people I'd like to mention are Roy Alcala, Tony Bates, Scott Bradner, Vint Cerf, Ravi Chandra, Enke Chen, Bruce Cole, Dennis Ferguson, Scott Huddle, Joe Lawrence, Tony Li, Allison Mankin, Yakov Rekhter, John Scoggin, Rob Sparre, and Paul Traina.

Next, I should thank the people who reviewed both the proposal for this book and an early draft of the full manuscript. Their comments were helpful and insightful and definitely improved the final product. Many thanks to Jeffrey Burgan (@Home Network), Joe Furgerson (Juniper Networks), Gerald L. Hopkins (Bell Atlantic), Barry Margolin, Robert Minnear, and Yakov Rekhter (Cisco Systems).

Finally, I should thank my family. My mother, father, and sister were very supportive, albeit from 3,000 miles away. My partner, Tim Houston, struck an unbelievable balance of encouraging me to keep working while simultaneously being a pleasant distraction. He dealt with my being absent for quite a while, and I

really appreciate his patience. --John W. Stewart III
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San Francisco

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From the Back Cover

BGP4 (Border Gateway Protocol version 4) is the de facto standard inter-domain routing protocol deployed in the Internet today. As the means by which Internet destinations are communicated between subscribers and service providers, BGP4 provides a critical function for Internet operations. Whether you are associated with an Internet service provider or are a system administrator at an organization whose business depends heavily on the Internet, a background in BGP4 is essential.

BGP4: Inter-Domain Routing in the Internet provides a practical introduction to the TCP/IP protocol suite and to routing in general. This concise guide describes the BGP protocol in clear terms and explains messages and rules for processing information through the protocol. In addition to illustrating low-level details of the protocol, the author examines the conceptual way that BGP works in practical networks, the way that BGP4 interacts with other parts of a network, and other details important to its operation. This book also covers the many extensions that have been made to the original specification to increase the protocols' usability and scope of operation.

Specifically, you will find coverage of such key topics as:

- IP base protocol, including the packet formats, addressing and routing, and other protocol rules
- Autonomous systems and the distinction between IGPs and EGPs
- Distance Vector versus Link State Routing Protocols
- CIDR and how it relates to BGP4
- Operational details essential to using BGP
- BGP message types, path attributes, and the route selection process
- Singly homed and multihomed subscribers
- BGP interaction with IGP
- Internal BGP scaling
- TCP MD5 authentication
- Other extensions to the protocol

In addition, this book offers a revealing look into how large ISPs work with BGP4, including a discussion on aggregation, filtering transit customers, and public interconnect points. Numerous real-world examples throughout the book demonstrate concepts and implementation techniques.

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Users Review

From reader reviews:

Jeffrey Osburn:

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