WINDOWS TROUBLESHOOTING SERIES

Windows Networking Troubleshooting

Mike Halsey
Joli Ballew

Apress®

Windows Troubleshooting Series

Mike Halsey, MVP
Series Editor

Apress®

Windows Networking Troubleshooting

Mike Halsey
Joli Ballew

Apress®

Windows Networking Troubleshooting

Mike Halsey
Sheffield, South Yorkshire, UK

Joli Ballew
Garland, Texas, USA

ISBN-13 (pbk): 978-1-4842-3221-7
ISBN-13 (electronic): 978-1-4842-3222-4
https://doi.org/10.1007/978-1-4842-3222-4

Library of Congress Control Number: 2017958354

Managing Director: Welmoed Spahr
Editorial Director: Todd Green
Acquisitions Editor: Gwenan Spearing
Development Editor: Laura Berendson
Technical Reviewer: Massimo Nardone
Coordinating Editor: Nancy Chen
Copy Editor: Kim Wimpsett
Compositor: SPi Global
Indexer: SPi Global
Artist: eStudio Calamar

Distributed to the book trade worldwide by Springer Science+Business Media New York, 233 Spring Street, 6th Floor, New York, NY 10013. Phone 1-800-SPRINGER, fax (201) 348-4505, e-mail orders-ny@springer-sbm.com, or visit www.springeronline.com. Apress Media, LLC is a California LLC and the sole member (owner) is Springer Science + Business Media Finance Inc (SSBM Finance Inc). SSBM Finance Inc is a **Delaware** corporation.

For information on translations, please e-mail rights@apress.com, or visit www.apress.com/rights-permissions.

Apress titles may be purchased in bulk for academic, corporate, or promotional use. eBook versions and licenses are also available for most titles. For more information, reference our Print and eBook Bulk Sales web page at www.apress.com/bulk-sales.

Any source code or other supplementary material referenced by the author in this book is available to readers on GitHub via the book's product page, located at www.apress.com/9781484232217. For more detailed information, please visit www.apress.com/source-code.

Printed on acid-free paper

Contents at a Glance

Contents

About the Authors

Mike Halsey was first awarded as a Microsoft Most Valuable Professional (MVP) in 2011. He is the author of more than a dozen Windows books, including *Troubleshooting Windows 7: Inside Out, Troubleshoot and Optimize Windows 8: Inside Out, Windows 10 Troubleshooting*, and *The Windows 10 Accessibility Handbook* from Apress. He is also the author of other books in the Windows Troubleshooting Series. Based in Sheffield, United Kingdom, where he lives with his rescue border collies, Evan and Robbie, he gives many talks on Windows subjects from productivity to security, and he makes how-to and troubleshooting videos under the banner Windows.Do. You can follow him on Facebook and Twitter at `@MikeHalsey`.

Joli Ballew is a Microsoft MVP and Windows expert. She has written almost 60 books, most on Windows technologies. She currently works at Lynda.com authoring and filming training videos; is an adjunct professor of technology at Brookhaven College in Farmers Branch, Texas; and teaches Microsoft certification boot camps at Collin College in Plano, Texas. Joli spends her spare time doing yoga and running and enjoys being with her family.

About the Technical Reviewer

Massimo Nardone has more than 23 years of experience in security, web/mobile development, cloud computing, and IT architecture. His true IT passions are security and Android.

He currently works as the chief information security officer (CISO) for Cargotec Oyj and is a member of the ISACA Finland Chapter board. Over his long career, he has held these positions: project manager, software engineer, research engineer, chief security architect, information security manager, PCI/SCADA auditor, and senior lead IT security/cloud/SCADA architect. In addition, he has been a visiting lecturer and supervisor for exercises at the Networking Laboratory of the Helsinki University of Technology (Aalto University).

Massimo has a master of science degree in computing science from the University of Salerno in Italy, and he holds four international patents (PKI, SIP, SAML, and proxy areas). Besides working on this book, Massimo has reviewed more than 40 IT books for different publishing companies and is the coauthor of *Pro Android Games* (Apress, 2015).

Windows Troubleshooting Series

When something goes wrong with technology, it can seem impossible to diagnose and repair the problem, and harder still to prevent a recurrence. In this series of books, we'll take you inside the workings of your devices and software and teach you how to find and fix the problems using a simple step-by-step approach that helps you understand the cause, the solution, and the tools required.

Series Editor
Mike Halsey, MVP

As a Microsoft Most Valuable Professional (MVP) awardee since 2011, the author of more than a dozen books on Microsoft Windows, and a teacher for many years, Mike Halsey understands the need to convey complex subjects in clear and nonintimidating ways.

He believes that the Windows Troubleshooting Series is a great example of how quality help, support, and tutorials can be delivered to individuals of all technical ability. He hopes you enjoy reading this and many other books in this series, both now and for years to come.

CHAPTER 1

Understanding Networks

Despite the advent of the personal computer revolution in the late 1970s/early 1980s, computer networking can be traced all the way back to the early 1950s, more than 20 years earlier. Perhaps unsurprisingly, it's yet another technology that grew out of the Second World War, with one of the first implementations being the connection of U.S. military radar systems.

The advent of what has come to be known as the Internet can also be traced back before the Advanced Research Projects Agency Network (ARPANET) system in 1969 to an earlier project run by the creators of ARPANET, the Defense Advanced Research Projects Agency (DARPA), in 1962, just four years after the organization's creation. This is an organization that is still developing cutting-edge technologies today.

In fact, the networking of personal computer systems arrived comparatively late, with many businesses still using stand-alone IBM PCs, PC clones, and Apple computers until the widespread adoption of 10Base-type networks from companies such as Novell in the mid-1980s, which sometimes required a specially modified operating system to work. These were typically custom networking solutions operating over coaxial cable (the cable that was also used to connect your television to its antenna).

10Base-type networks could theoretically handle traffic up to 10Mbps, though in reality, cable limitations such as signal leakage and interference frequently dropped this to as little as 4Mbps.

Because coaxial cable is an analog, and not a digital, signal technology, configuration could often be tricky. Parameters such as baud rate (the signal modulation rate in pulses per second), initialization strings, and attention commands (AT) needed to be manually configured on each PC, and different networks would use different configurations.

These days we frequently take networking speeds of 100Gbps for granted (80,000 times faster than the maximum theoretical speed of the original 10Base networks). The digital Ethernet connections we use today were first developed in the 1970s by Xerox, Intel, and the Digital Equipment Corporation, and they helped bring about networking standards in 1983, which grew into the widespread adoption of digital networks after the advent of the Category 5 network cable, which we still use today.

Indeed, the networking we use to connect our PCs and devices to each other, and to the Internet, is still constantly evolving. We've been using Wi-Fi since the late 1990s, though it's gone through many changes and upgrades during this time and has gradually evolved to other networking standards, such as cellular and superfast wireless broadband networks.

M. Halsey and J. Ballew, *Windows Networking Troubleshooting*,
https://doi.org/10.1007/978-1-4842-3222-4_1

The pace of change of networking over the past 50 years has been so pronounced that, just as with other technologies such as displays, processors, and the Internet, it's difficult to accurately predict where it'll be 10 or 20 years from now. We're already seeing wireless connections for displays, and Bluetooth connections for peripherals are commonplace. All of these are networking technologies, and all grew from the work of DARPA in the 1960s.

Fortunately, or perhaps unfortunately depending on how you view these things, the standards for networking are well-established and rarely change, with each new technology ratified by the Institute of Electrical and Electronics Engineers (IEEE) before moving into widespread production. This may hold back our networking potential in years to come, as new standards and technologies will be inevitably required to leverage the full potential of what we'll be using in the future, and ratification can sometimes take time. For now, however, these standards help make networking straightforward and simple to configure and maintain.

My Network Is Bigger Than Your Network!

But, I hear you ask, how does this simplicity explain the fact that my company network is constantly suffering from outages, bottlenecks, and misconfigured devices?

The networking problems we face today are commonly linked to the complexity of the networks we create. If you look at a typical business, there will be tens, hundreds, thousands, or even tens of thousands of PCs connected to one or more servers, switches, and a router. There will also be other network devices in use, including Network Attached Storage (NAS) drives, networked printers, video-conferencing systems, security camera systems, and more besides. On top of this, the company will operate one or more Wi-Fi networks, and to each of these will be connected a PC, laptop, tablet, or smartphone running one of several different types of operating system, each with its own configuration options and remote management challenges. When you throw secure virtual private networks (VPNs) into the mix to allow the workforce to securely tunnel into the company network from home, other offices, or client and public locations over Wi-Fi or mobile broadband, you quickly come to realize just how complex the networks we take for granted today can be.

Expand this into the wider world, and we not only encounter the networks of other companies but those of vast datacenters, national wired and wireless telephony and data systems, and connections to satellites in orbit. All of this requires constant observation and management, so even a company with dedicated network management personnel, of which you may be one, won't be able to solve every problem that occurs. Everything is, quite literally, connected to everything else.

In reality, you're unlikely to be asked to repair a networking problem with a satellite in orbit (though if you are, please send us a photo). It's much more likely that the problem you face will be either local to a PC or single device or confined to a small area. Major outages tend to be easier to diagnose, such as a bulldozer at the construction site next door that has ripped through the main fiber-optic cabling outside, or one of your service providers is itself suffering an outage. So, what are the different types of network systems and hardware you're likely to use and encounter?