

---

# TELECOMMUNICATIONS AND DATA COMMUNICATIONS HANDBOOK

---

**RAY HORAK**  
The Context Corporation  
Mt. Vernon, WA 98273



WILEY-INTERSCIENCE  
A JOHN WILEY & SONS, INC., PUBLICATION

CISCO SYSTEMS, INC. v. FOCAL IP, LLC

Copyright © 2007 by Ray Horak. All rights reserved.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey  
Published simultaneously in Canada

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers MA 01923, 978-750-8400, fax 978-750-4470, or on the web at [www.copyright.com](http://www.copyright.com). Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, 201-748-6011, fax 201-748-6008, or online at <http://www.wiley.com/go/permission>.

**Limit of Liability/Disclaimer of Warranty:** While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor author shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

For general information on our other products and services or for technical support, please contact our Customer Care Department within the United States at 877-762-2974, outside the United States at 317-572-3993 or fax 317-572-4002.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic formats. For more information about Wiley products, visit our web site at [www.wiley.com](http://www.wiley.com).

Wiley Bicentennial Logo: Richard J. Pacifico

*Library of Congress Cataloging-in-Publication Data:*

Horak, Ray.  
Telecommunications and data communications handbook/Ray Horak.  
p. cm.  
Includes index.  
ISBN 978-0-470-39607-0  
1. Telecommunication—Handbooks, manuals, etc. 2. Digital communications—Handbooks, manuals, etc. I. Title.  
TK5101 .H6655  
621.382—dc22

2006032496

Printed in Mexico

10 9 8 7 6 5 4 3

CISCO SYSTEMS, INC. v. FOCAL IP, LLC

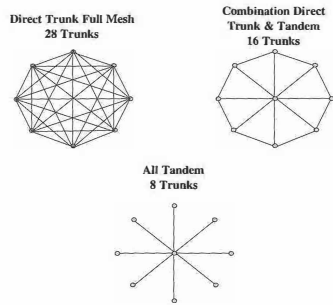


Figure 5.1 Network configurations: direct trunk full mesh, all tandem, and combination direct trunk and tandem.

exit. They also are known as *Class 5 offices*, the lowest of the five classes in the switching hierarchy, and *edge offices*, as they are at the very edges of the service provider's network. Manufacturers of COs include Lucent Technologies (SESS), which previously was AT&T; Nortel (DMS), which previously was Northern Telecom; Siemens (EWSD); and Ericsson (AXE).

**5.3.1.3.2 Tandem Switches** Tandem switches are network switches that serve in partnership with lesser switches, linking them together. In other words, tandem switches serve no end users directly; rather, they serve to interconnect lesser switches. At the lowest level, tandem switches serve to link together CO switches over dedicated interoffice trunks. This approach can be used to form a fully interconnected and toll-free metropolitan calling area, for example. There are a number of basic network topologies, including full mesh, full tandem, and a combination tandem and direct trunk plan.

- **Full Mesh:** If all COs are interconnected through direct trunking in a full-mesh network topology, a large number of trunks and trunk groups are required, as calculated by the formula

$$X = \frac{n(n-1)}{2}$$

where  $n$  is the number of nodes to be interconnected. If there are eight nodes, as illustrated in Figure 5.1, the number of trunks required is calculated as

$$28 = \frac{8(8-1)}{2}$$