



universal personal communications

Shinsuke Hara  
Ramjee Prasad

**MULTICARRIER  
TECHNIQUES  
FOR 4G MOBILE  
COMMUNICATIONS**

# Multicarrier Techniques for 4G Mobile Communications

---

**The Artech House Universal Personal  
Communications Series**

Ramjee Prasad, Series Editor

*CDMA for Wireless Personal Communications*, Ramjee Prasad

*IP/ATM Mobile Satellite Networks*, John Farserotu and Ramjee Prasad

*Multicarrier Techniques for 4G Mobile Communications*, Shinsuke Hara  
and Ramjee Prasad

*OFDM for Wireless Multimedia Communications*, Richard van Nee and  
Ramjee Prasad

*Radio over Fiber Technologies for Mobile Communications Networks*,  
Hamed Al-Raweshidy and Shozo Komaki, editors

*Simulation and Software Radio for Mobile Communications*,  
Hiroshi Harada and Ramjee Prasad

*TDD-CDMA for Wireless Communications*, Riaz Esmailzadeh and  
Masao Nakagawa

*Technology Trends in Wireless Communications*, Ramjee Prasad and  
Marina Ruggieri

*Third Generation Mobile Communication Systems*, Ramjee Prasad,  
Werner Mohr, and Walter Konhäuser, editors

*Towards a Global 3G System: Advanced Mobile Communications in Europe*,  
*Volume 1*, Ramjee Prasad, editor

*Towards a Global 3G System: Advanced Mobile Communications in Europe*,  
*Volume 2*, Ramjee Prasad, editor

*Universal Wireless Personal Communications*, Ramjee Prasad

*WCDMA: Towards IP Mobility and Mobile Internet*, Tero Ojanperä and  
Ramjee Prasad, editors

*Wideband CDMA for Third Generation Mobile Communications*,  
Tero Ojanperä and Ramjee Prasad, editors

*Wireless IP and Building the Mobile Internet*, Sudhir Dixit and  
Ramjee Prasad, editors

*WLAN Systems and Wireless IP for Next Generation Communications*,  
Neeli Prasad and Anand Prasad, editors

*WLANs and WPANs towards 4G Wireless*, Ramjee Prasad and Luis Muñoz

# Multicarrier Techniques for 4G Mobile Communications

Shinsuke Hara  
Ramjee Prasad



Artech House  
Boston • London  
[www.artechhouse.com](http://www.artechhouse.com)

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

Hara, Shinsuke.

Multicarrier techniques for 4G mobile communications / Shinsuke Hara, Ramjee Prasad.

p. cm. — (Artech House universal personal communications series)

Includes bibliographical references and index.

ISBN 1-58053-482-1 (alk. paper)

1. Universal Mobile Telecommunications System. 2. Carrier waves.

I. Prasad, Ramjee. II. Title. III. Series.

TK5103.4883.H37 2003

621.382—dc21

2003048095

**British Library Cataloguing in Publication Data**

Hara, Shinsuke

Multicarrier techniques for 4G mobile communications. — (Artech House universal personal communications series)

1. Mobile communication systems

I. Title II. Prasad, Ramjee

621.3'8456

ISBN 1-58053-482-1

**Cover design by Igor Valdman**

© 2003 Shinsuke Hara and Ramjee Prasad.

All rights reserved.

All rights reserved. Printed and bound in the United States of America. No part of this book may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing from the publisher.

All terms mentioned in this book that are known to be trademarks or service marks have been appropriately capitalized. Artech House cannot attest to the accuracy of this information. Use of a term in this book should not be regarded as affecting the validity of any trademark or service mark.

International Standard Book Number: 1-58053-482-1

Library of Congress Catalog Card Number: 2003048095

10 9 8 7 6 5 4 3 2 1

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.