

IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS

IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS (TWC) contains high-quality technical manuscripts on advances in the state of the art of wireless communications. Both theoretical contributions (including new techniques, concepts, and analyses) and practical contributions (including system experiments, prototypes, and new applications) are encouraged. Tutorial expositions of permanent reference value are also welcome. For membership and subscription information and pricing, please visit www.ieee.org/membership-catalog.

IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS

Editorial Board

TWC Home Page URL: <http://www.comsoc.org/twc>

M. ZORZI, *Director, Journals and Location*
Univ. of Padova

JUNSHAN ZHANG, *Editor-in-Chief*
Dept. of ECE
Univ. of California Davis
Davis, CA 95616

JOSEPH MILIZZO, *Assistant Publisher*
IEEE Communications Society
New York, NY 10016

NEELES MEHTA, *Chair*
Indian Inst. of Sci., Bangalore

ERIK G. LARSSON
Linköping Univ.

MATTHEW VALENTI
West Virginia University, USA

SUMEI SUN
Inst. Infocomm Res., Singapore

STEERING COMMITTEE

EXECUTIVE EDITORIAL COMMITTEE

WOLFGANG GERSTACKER,
Friedrich-Alexander University
Erlangen-Nürnberg, Germany
KAIBIN HUANG,
The University of Hong Kong,
Hong Kong

SOFIE POLLIN,
University of Leuven, Belgium
LUCA SANGUINETTI,
University of Pisa, Italy

CHENGXIANG WANG,
Southeast University, China
LIUQING YANG,
Colorado State University, USA

V. WONG, *Chair*
UBC, Canada
LIN CAI,
Illinois Institute of Technology, USA
HUAIYU DAI,
NC State, USA

ASSOCIATE EDITORS

Antennas, Channel Models, and Location

M. BUEHRER, *Area Editor*
Virginia Polytechnic Inst. and State Univ.

P. CASARI
Univ. of Trento

B. CHALISE
New York Inst. of Technol.

M. DING
Data 61

R. DINIS
FCT UNL

Y. GAO
Univ. of Surrey

J. HAMALAINEN
Aalto Univ.

I. KRKIDIS
Univ. of Cyprus.

N. LEE
POSTECH

Q. LIU
Tongji Univ.

W. NI
CSIRO ICT Centre

Y. SHEN
Tsinghua Univ.

L. SHMIG
RWTH Aachen Univ.

Z. SUN
SUNY Buffalo

Cross-Layer Design and Optimization
T. QUEK, *Area Editor*
Singapore Univ. of Technol. and Design

H. CHEN
The Chinese Univ. of Hong Kong

G. FODOR
Ericsson Research

M. KANEKO
National Institute of Informatics

K. KANSANEN
Norwegian Univ. of Sci. and Technol.

S. KHOSRAVIRAD
Nokia

A. SCHMEINK
RWTH Aachen Univ.

B. SMIDA
Univ. of Illinois at Chicago

R. TANDON
Univ. of Arizona

O. TIRKKONEN
Aalto Univ.

C.-J. WONG
Carnegie Mellon University

K. ZHANG
Univ. of Nebraska-Lincoln

Machine Learning and Artificial Intelligence
S. CUI, *Area Editor*
UC Davis

C. G. BRINTON
Purdue Univ.

Z. CAI
Georgia State Univ.

X. CHEN
Sun Yat-sen Univ.

X. CHENG
George Washington Univ.

E. DE CARVALHO
Aalborg Univ.

A. EL GAMAL
Purdue Univ.

J. GROSS
Royal Inst. of Technol.

D. GUNDUZ
Imperial College London

C. HUANG
Texas A&M

Y. SHU
Microsoft Research Redmond

J. XU
Chinese Univ. of Hong Kong (Shenzhen)

L. YANG
Univ. of Nevada at Reno

Online Content Editor
E. BJÖRNSSON
Linköping Univ.

Z. HAN
Univ. of Houston

M. WIGGER
Telecom ParisTech

Resource Management and Multiple Access

N. KATO, *Area Editor*
Tohoku University

A. S. CACCIAPUOTI
Univ. of Naples

X. CHEN
GEIRINA

K. CHOI
Sungkyunkwan Univ.

K. COHEN
Ben-Gurion Univ. of the Negev,

Y. CUI
Shanghai Jiaotong Univ.

S. DEY
Uppsala Univ.

L. DUAN
Singapore Univ. of Technol. and Design and Eng. Sys. and Design

D. T. HOANG
Univ. of Technol. Sydney

D. (TAO) NIYATO
Nanyang Technol. Univ.

M. PAYARO
CTTC

L.-C. WANG
National Chiao Tung Univ.

L. ZHAO
Ryerson Univ.

H. ZHOU
Nanjing Univ.

Wireless Communication Theory and Systems I
W. ZHANG, *Area Editor*
Univ. of New South Wales

L. BAI
Beihang Univ.

X. CHENG
Peking Univ.

M. DONG
Univ. Ontario Institute of Technol.

S. PRAKRIYA
Indian Inst. of Technol. Delhi

S. MA
Univ. of Macau

M. SHENG
Xidian Univ.

D. SO
Univ. of Manchester

X. TAO
Tsinghua Univ.

W. P. TAY
Nanyang Technol. Univ.

C.-K. WEN
National Sun Yat-sen Univ.

W. ZHANG
Univ. of Sci. and Technol. of China

S. ZHOU
Tsinghua Univ.

Wireless Communication Theory and Systems II
A. LOZANO, *Area Editor*
Universitat Pompeu Fabra

I. BERGEL
Bar-Ilan Univ.

R. BROWN
Worcester Polytechnic Inst.

L. DASILVA
Trinity College, Dublin

G. C. FERRANTE
Ericsson Research, Chalmers

M. GUILLAUD
Huawei Technologies

L. GIUPONNI
Ericsson, Spain

M. CENK GURSOY
Syracuse Univ.

M. JUNTTI
Univ. of Oulu

J. LI
Nanjing Univ. of Sci. and Technol.

V. RAGHAVAN
Qualcomm

S. K. MOHAMMED
Indian Inst. of Technol.

HIEN QUOC NGO
Queen's Univ. Belfast

M. XIAO
Royal Inst. of Technol.

Wireless Communication Theory and Systems III
S. ULUKUS, *Area Editor*
Univ. of Maryland

H. DHILLON
Virginia Tech

R. HU
Utah State Univ.

Y. LIU
Queen Mary Univ. of London

C. MASAOUROS
UCL

O. OZEL
George Washington Univ.

H. PISHTRO-NIK
Univ. of Massachusetts

V. SCIANCALEPORA
NEC Laboratories Europe GmbH

Y. SHI
Shanghai Tech Univ.

K. TOURKI
Huawei Technologies

T. TSIFTSIS
Jinan Univ.

A. VOSOUGH
Univ. of Central Florida

M. WANG
Miami Univ.

J. YANG
Penn State Univ.

Wireless Communication Theory and Systems IV
W. YU, *Area Editor*
Univ. of Toronto

M. CALEFFI
Univ. of Naples Federico II

Q. DUONG,
Queen's Univ., Belfast

G. GERACI
Universitat Pompeu Fabra

A. LIU
Zhejiang Univ.

L. LIU
Hong Kong Polytechnic Univ.

Y.-F. LIU
Chinese Academy of Sci.

D. K. NG
Univ. of New South Wales

J. YUAN
Univ. of New South Wales

X. YUAN
Univ. of Electronic Sci. & Technol. of China

Z. ZHANG
Zhejiang Univ.

Wireless Networking
S. MAO, *Area Editor*
Auburn Univ.

D. BLOUGH
Georgia Tech

X. GONG
Auburn Univ.

P. LI
Case Western Reserve Univ.

J. LIU
Xidian Univ.

K. NAVAIE
Lancaster Univ.

C. POELLABAUER
Florida Int. Univ.

M. C. VURAN
Univ. of Nebraska Lincoln

X. WANG
Fudan Univ.

L. XIE
Univ. North Carolina at Charlotte

K. XUE
USTC

D. YU
Shandong Univ.

H. ZHANG
Iowa State Univ.

Y. ZHENG
The Hong Kong Polytechnic Univ., Hong Kong

H. ZHU
Shanghai Jiaotong Univ.

K. J. RAY LIU, *President & CEO*
SAIFUR RAHMAN, *Director & President-Elect*
JOHN W. WALZ, *Director & Secretary*
MARY ELLEN RANDALL, *Director & Treasurer*
SUSAN "KATHY" LAND, *Past President*

KHALED BEN LETAIEF, *Director & Delegate, Division III—Communications Technology*

IEEE EXECUTIVE STAFF

STEPHEN WELBY, *Executive Director and COO*

DR. CHERIF AMIRAT, *Chief Information Officer*
CHRIS BRANTLEY, *Managing Director, IEEE-USA*
KAREN L. HAWKINS, *Chief Marketing Officer*
STEVEN HEFFNER, *Managing Director, Publications*
DONNA HOURICAN, *Staff Executive, Corporate Activities*

STEPHEN M. PHILLIPS, *Director & Vice President, Educational Activities*
LAWRENCE O. HALL, *Director & Vice President, Publication Services and Products*
DAVID A. KOEHLER, *Director & Vice President, Member and Geographic Activities*
JAMES E. MATTHEWS, *Director & President, Standards Association*
BRUNO MEYER, *Director & Vice President, Technical Activities*
DEBORAH M. COOPER, *Director & President, IEEE-USA*

CCELIA JANKOWSKI, *Managing Director, Member and Geographic Activities*
KONSTANTINOS KARACHALIOS, *Managing Director, IEEE-Standards Association*
JAMIE MOESCH, *Managing Director, Educational Activities*
SOPHIA A. MUIRHEAD, *General Counsel and Chief Compliance Officer*
THOMAS SIEGERT, *Chief Financial Officer*
MARY WARD-CALLAN, *Managing Director, Technical Activities*

IEEE Publishing Operations

Senior Director, Publishing Operations: DAWN MELLEY

Director, Editorial Services: KEVIN LISANKIE Director, Production Services: PETER M. TUOHY

Associate Director, Editorial Services: JEFFREY E. CICHOCKI Associate Director, Information Conversion and Editorial Support: NEELAM KHINVASARA
Senior Manager, Journals Production: KATIE SULLIVAN Journals Production Manager: SHARON M. TURK

IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS (ISSN 1536-1276) is published monthly by the Institute of Elect. and Electronics Engineers, Inc. Responsibility for the contents rests upon the authors and not upon the IEEE, the Society/Council, or its members. IEEE Corporate Office: 3 Park Avenue, 17th Floor, New York, NY 10016. **IEEE Operations Center:** 445 Hoes Lane, Piscataway, NJ 08854. **NJ Telephone:** +1 732 981 0060. **Price/Publication Information:** To order individual copies for members and nonmembers, please email the IEEE Contact Center at contactcenter@ieee.org. (Note: Postage and handling charge not included.) Member and nonmember subscription prices available upon request. **Copyright and Reprint Permissions:** Abstracting is permitted with credit to the source. Libraries are permitted to photocopy for private use of patrons, provided the per-copy fee of \$31.00 is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923. For all other copying, reprint, or republication permission, write to Copyrights and Permissions Department, IEEE Publications Administration, 445 Hoes Lane, Piscataway, NJ 08854. Copyright © 2022 by Institute of Elect. and Electronics Engineers, Inc. All rights reserved. Periodicals postage paid at New York, NY and at additional mailing offices. **Postmaster:** Send address changes to: IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, IEEE, 445 Hoes Lane, Piscataway, NJ 08854. GST Registration No. 125634188. CPC Sales Agreement #40013087. Return undeliverable Canada addresses to: Pitney Bowes IMEX, P.O. Box 4332, Stanton Rd., Toronto, ON M5W 3J4, Canada. IEEE prohibits discrimination, harassment and bullying. For more information visit <http://www.ieee.org/nondiscrimination>. Printed in U.S.A.