PROCEEDINGS OF SPIE

Broadband Access Communication Technologies III

Benjamin B. Dingel Raj Jain Katsutoshi Tsukamoto Editors

28–29 January 2009 San Jose, California, United States

Sponsored and Published by SPIE

Volume 7234

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Broadband Access Communication Technologies III*, edited by Benjamin B. Dingel, Raj Jain, Katsutoshi Tsukamoto, Proceedings of SPIE Vol. 7234 (SPIE, Bellingham, WA, 2009) Article CID Number.

ISSN 0277-786X ISBN 9780819474803

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445 SPIE.org

Copyright © 2009, Society of Photo-Optical Instrumentation Engineers

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/09/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.



Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

v vii	Conference Committee Introduction
	KEYNOTE SESSION
7234 02	Convergence of broadband optical and wireless access networks [7234-01] GK. Chang, Georgia Institute of Technology (United States); Z. Jia, Telcordia Technologies (United States); HC. Chien, A. Chowdhury, YT. Hsueh, Georgia Institute of Technology (United States); J. Yu, NEC Labs. America (United States)
	EMERGING FREE-SPACE OPTICS- AND WIRELESS-BASED BROADBAND ACCESS TECHNOLOGIES
7234 04	Research and development of a next-generation free-space optical communication system (Invited Paper) [7234-03] K. Wakamori, K. Kazaura, M. Matsumoto, Waseda Univ. (Japan)
7234 06	Proposal of dynamic subcarrier selection technique using CSMA/CA for cognitive wireless mesh networks (Invited Paper) [7234-05] S. Miyamoto, Y. Goda, S. Sampei, Osaka Univ. (Japan)
	ADVANCED FITH TECHNOLOGIES: PON ARCHITECTURES AND PASSIVE COMPONENTS
7234 07	Emerging radio-over-fiber technologies and networks: challenges and issues (Invited Paper) [7234-21] J. E. Mitchell, Univ. College London (United Kingdom)
7234 08	Broadband access technology for passive optical network (Invited Paper) [7234-06] S. Chi, Yuan Ze Univ. (Taiwan) and National Chiao Tung Univ. (Taiwan); CH. Yeh, Industrial Technology Research Institute (Taiwan); CW. Chow, National Chiao Tung Univ. (Taiwan)
7234 09	PON ring architectures for truly shared LAN capability and dynamic bandwidth allocation for fiber wireless (FiWi) applications [7234-07] N. Madamopoulos, B. Pathak, City College of CUNY (United States); N. Antoniades, The College of Staten Island, CUNY (United States); M. A. Ummy, New York City College of Technology (United States)
7234 0A	Bidirectional WDM-RoF system for simultaneous 1.25Gb/s wired/wireless transmission using multi optical carrier suppression in FP LD [7234-08] HS. Kim, T. T. Pham, YY. Won, SK. Han, Yonsei Univ. (Korea, Republic of)
7234 OB	Bend-insensitive optical fibers for FTTH applications (Invited Paper) [7234-09] MJ. Li, Corning, Inc. (United States)

7234 OC	C Advanced integrated WDM system for POF communication [7234-10] M. Haupt, U. H. P. Fischer, Harz Univ. of Applied Studies and Research (Germany)				
	ADVANCED FITH TECHNOLOGIES: 100GE TECHNIQUES AND ACTIVE COMPONENTS				
7234 OD	Advances and challenges in vector modulation technologies (Invited Paper) [7234-11] T. Kawanishi, T. Sakamoto, A. Chiba, National Institute of Information and Communicati Technology (Japan)				
7234 OE	Super-linear modulator with extended bandwidth capability for broadband access applications [7234-12] A. Prescod, City College of CUNY (United States) and Corning, Inc. (United States); B. B. Dingel, Nasfine Photonics, Inc. (United States); N. Madamopoulos, Corning, Inc. (United States)				
7234 OF	Linearity enhancement of uncooled DFB laser diode using opto-electronic predistortion method for radio-over-fiber systems [7234-13] TK. Lee, YT. Moon, YW. Choi, Chung-Ang Univ. (Korea, Republic of)				
7234 OG	1-µm- band transmission by use of a wavelength tunable quantum-dot laser over a hole-assisted fiber [7234-14] R. Katouf, N. Yamamoto, K. Akahane, T. Kawanishi, National Institute of Information and Communications Technology (Japan); H. Sotobayashi, National Institute of Information and Communications Technology (Japan) and Aoyama Gakuin Univ. (Japan)				
7234 OH	Optical clock recovery [7234-15] Z. Chen, H. Sun, S. Ma, N. K. Dutta, Univ. of Connecticut (United States) POSTER SESSION				
7234 01	The need for a single cleaning standard for OEM and OSP fiber optic connections [7234-16] E. J. Forrest, Jr., P. Blair, ITW Chemtronics (United States)				
7234 OJ	1.25-Gb/s millimeter-wave band wired/wireless radio-over-fiber system based on RSOA using an injection-locked FP-laser [7234-17] YY. Won, HS. Kim, SK. Han, Yonsei Univ. (Korea, Republic of)				
7234 OL	RoFSO channel modeling considering time-correlation of scintillation and its application to performance evaluation of WLAN signal transmission [7234-19] KH. Kim, H. Onodera, T. Higashino, T. Nakamura, Y. Aburakawa, K. Tsukamoto, S. Komaki, Osaka Univ. (Japan); K. Wakamori, T. Suzuki, K. Kazaura, M. S. Alam, K. Takahashi, K. Ohmae, T. Satou, M. Matsumoto, Waseda Univ. (Japan)				
7234 OM	Efficient resource allocation scheme for visible-light communication system [7234-20] WC. Kim, CS. Bae, DH. Cho, KAIST (Korea, Republic of); HS. Shin, D. K. Jung, Y. J. Oh, Samsung Electronics Co. (Korea, Republic of)				
	Author Index				

Conference Committee

Symposium Chair

James G. Grote, Air Force Research Laboratory (United States)

Symposium Cochair

E. Fred Schubert, Rensselaer Polytechnic Institute (United States)

Program Track Chair

Benjamin B. Dingel, Nasfine Photonics, Inc. (United States)

Conference Chairs

Benjamin B. Dingel, Nasfine Photonics, Inc. (United States) **Raj Jain**, Washington University in St. Louis (United States) **Katsutoshi Tsukamoto**, Osaka University (Japan)

Program Committee

Arjan Durresi, Indiana University-Purdue University Indianapolis (United States)

David W. Faulkner, British Telecom Research Laboratories (United Kingdom)

Mahbub Hassan, University of New South Wales (Australia)

Mohsen Kavehrad, The Pennsylvania State University (United States)

Rangaraj Madabhushi, Madabhushi Consultants, LLC (United States)

Nicholas Madamopoulos, City College, CUNY (United States)

Dalma Novak, Pharad, LLC (United States)

Jean-Charles Point, JCP-Consult (France)

Ken-ichi Sato, Nagoya University (Japan)

Peter Van Daele, Universiteit Gent (Belgium)

Jeroen S. Wellen, Lucent Technologies (Netherlands)

Session Chairs

1 Keynote Session

Benjamin B. Dingel, Nasfine Photonics, Inc. (United States)

2 Emerging Free-Space Optics- and Wireless-based Broadband Access Technologies

Raj Jain, Washington University in St. Louis (United States) **Tsukamoto Katsutoshi**, Osaka University (Japan)

3 Advanced FTTH Technologies: PON Architectures and Passive Components

Tsukamoto Katsutoshi, Osaka University (Japan) **Benjamin B. Dingel**, Nasfine Photonics, Inc. (United States)

4 Advanced FTTH Technologies: 100GE Techniques and Active Components

Benjamin B. Dingel, Nasfine Photonics, Inc. (United States) **Raj Jain**, Washington University in St. Louis (United States)

Introduction

It is our pleasure to welcome all of you to Photonics West 2009's conference on Broadband Access Communication Technologies III. Our move from Optics East to Photonics West brings renewed spirit and focus on exciting developments in broadband access technologies to wider audiences in the photonics and optics industries. This year we have assembled high quality technical papers from Europe, Asia, and North America. This will provide coherent coverage on the latest technologies in broadband access.

The purpose of this conference is to promote discussions and disseminations of design, development, and performance of various types of broadband access communication technologies. This includes platform technologies such as optical fiber-based, radio-over-fiber-based, photonics-based, satellite-based, free-space-based, and mobile wireless-based. We have invited a number of well-known speakers to present the current and future trends of these broadband access technologies.

Finally, we strongly appreciate the speakers and authors of the contributed and invited papers, the technical program committee members, and the session chairs for helping with the sessions. We also thank the SPIE staff for their help in processing the submissions and organizing the conference. The success of this conference is strongly due them.

Thank you for joining us at the Broadband Access Communication Technologies III conference.

Benjamin B. Dingel Raj Jain Katsutoshi Tsukamoto