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The information in this program is as of 18 January 2023.

In an effort to support sustainability and Go Green Initiatives, OFC will not be printing update sheets. Please consult the Conference App for the latest changes.

Technical Registrants: Download digest papers by visiting ofcconference.org and clicking on the “Download Digest Papers” on the home page.
  Recorded presentations are available from the same page by clicking “View Presentations.”

OFC® and Optical Fiber Communication Conference® are registered trademarks of Optica (formerly OSA).
# Conference Schedule at a Glance

<table>
<thead>
<tr>
<th>Event</th>
<th>Sunday 05 March</th>
<th>Monday 06 March</th>
<th>Tuesday 07 March</th>
<th>Wednesday 08 March</th>
<th>Thursday 09 March</th>
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<tbody>
<tr>
<td>Registration</td>
<td>07:30–19:00</td>
<td>07:30–17:30</td>
<td>07:00–18:00</td>
<td>07:30–17:00</td>
<td>07:30–15:00</td>
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<tr>
<td>Programming</td>
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<tr>
<td>Short Courses</td>
<td>08:30–17:00</td>
<td>08:30–17:30</td>
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<tr>
<td>Workshops</td>
<td>13:00–18:30</td>
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<tr>
<td>Hack Your Research! Tools and Tricks for Today’s Telecommunications Techies</td>
<td>19:00–21:00</td>
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<tr>
<td>Technical Sessions</td>
<td>08:00–18:30</td>
<td>14:00–18:30</td>
<td>08:00–18:30</td>
<td>08:00–16:00</td>
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<tr>
<td>Symposium: Quantum Information and Optical Communication Networks: Emerging Research Areas, Challenges and Opportunities</td>
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<td>14:00–18:30</td>
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<tr>
<td>Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities</td>
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<td>14:00–18:30</td>
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<tr>
<td>Symposium: Beyond the Hype of Network Analytics: Use Cases, Feasibility and Barriers</td>
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<td>14:00–18:30</td>
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<tr>
<td>Special Session: Ultra-Stable Frequency Sources and their Future Applications in Telecom</td>
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<td>08:00–10:00</td>
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<tr>
<td>Special Session: High Performance Networks for Future Data Center and Computing Applications</td>
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<td>10:30–12:30</td>
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<tr>
<td>Special Session: Photonics for Visible Wavelengths</td>
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<td>08:00–16:00</td>
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<tr>
<td>Open Networking Summit: Top to Bottom: Practical Approaches to Openness, Disaggregation, and Reaggregation in Optical Communication</td>
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<td>16:30–18:30</td>
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<tr>
<td>Demo Zone</td>
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<td>14:00–16:15</td>
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<tr>
<td>Rump Session: Is the Silicon Photonics Platform about to be Standardized, Diversified or Supplanted?</td>
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<td>19:30–21:30</td>
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<tr>
<td>Poster Sessions</td>
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<td>10:30–12:30</td>
<td>10:30–12:30</td>
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<tr>
<td>Postdeadline Papers</td>
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<td>Exhibition and Show Floor Activities</td>
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<tr>
<td>Unopposed Exhibit-Only Time</td>
<td>10:00–17:00</td>
<td>(10:00–14:00)</td>
<td>10:00–17:00</td>
<td>(12:30–14:00)</td>
<td>10:00–16:00</td>
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<tr>
<td>Network Operator Summit - Expo Theater I</td>
<td>10:15–14:30</td>
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<tr>
<td>Data Center Summit – Expo Theater II Sponsored by Amphenol</td>
<td>12:00–15:45</td>
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<tr>
<td>Special Events</td>
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<tr>
<td>Optical Transmission Systems – Design and Simulation Workshop (Presented by the Optica Foundation &amp; VPIphotronics)</td>
<td>13:00–18:00</td>
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<tr>
<td>OFC Mentor/Mentee Meet-Up</td>
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<tr>
<td>The Journal Review Process: All You Need to Know!</td>
<td>12:00–13:00</td>
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<tr>
<td>Birds of a Feather: Designing and Operating the Next Generation Optical Photonic Networks</td>
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<td>14:00–15:30</td>
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<tr>
<td>Photonics Society of Chinese Heritage Workshop &amp; Networking Social</td>
<td>16:30–18:30</td>
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<td>17:00–19:30</td>
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<tr>
<td>Student Party</td>
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<td>19:00–21:00</td>
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<tr>
<td>Plenary Session</td>
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<td>08:00–10:00</td>
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<tr>
<td>Conversation with the Plenary Speakers</td>
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<td>10:15–10:45</td>
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<tr>
<td>Optical Communications Technical Group Poster Pitch Competition</td>
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<td>11:00–12:00</td>
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<tr>
<td>Awards Ceremony and Luncheon Supported by Corning</td>
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<td>12:00–14:00</td>
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<tr>
<td>Conference Reception</td>
<td>18:30–20:00</td>
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<tr>
<td>International Women’s Day Breakfast</td>
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<td>07:00–08:30</td>
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<tr>
<td>The Art of Writing the Perfect OFC Paper</td>
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<td>10:30–12:00</td>
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<tr>
<td>Rise and Shine Fun Run/Walk</td>
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<td>06:00–07:00</td>
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</table>
OFC thanks the following corporate sponsors for their generous support:

- ACACIA Communications, Inc. (now part of Cisco)
- acphotonics
- Amphenol
- ci
ea
- CISCO
- CORNING
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- HYC
  HYC CO., LTD
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- MARVELL
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  CELEBRATING 25 YEARS
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- Sanwa Technologies
- SENKO
  Advanced Components
- sheetak
- SUMITOMO ELECTRIC LIGHTWAVE
- SYNOPSYS
- US CONEC

OFC thanks the following media partners:

- Fibre Systems
- LIGHTWAVE
-PHOTONICS MEDIA
  photonics.com
- PHYSICS TODAY
General Information

Customer Service and Conference Information
Convention Center Lobby

Please visit the Customer Service and Conference Information desk to get information on:
- Parking
- Coat and Baggage Check
- Restaurant Information
- General Conference Information
- Lost and Found (for after-hours Lost and Found, please go to the OFC Security Office located in Show Office D. Look for the security sign).

Exhibition
Exhibit Halls B-G

Schedule plenty of time to roam the Exhibition, visit with the hundreds of companies represented and see the latest products and technologies.

Exhibition Hours

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
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<tr>
<td>Tuesday, 07 March</td>
<td>10:00–17:00</td>
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Event Policies and Terms/Code of Conduct

All guests, attendees, speakers, and exhibitors are subject to the Event Policies and Terms, including the Code of Conduct. The full text is available at ofcconference.org/eventpolicies. Conference management reserves the right to take any and all appropriate actions to enforce the Code of Conduct, up to and including ejection from the conference individuals who fail to comply with the policy.

First Aid Station
Box Office E

A first aid station will be operated according to the schedule below. In addition, information regarding local medical facilities will be available.

First Aid Station Hours

<table>
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<th>Day</th>
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<td>Sunday, 05 March</td>
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Emergencies - Contact Security Command Center on house phone at ext. 5911 or call +1 619.525.5911.

Media Center
Rooms 4, 5A and 5B

The Media Center consists of a Media Room, 5A, and semi-private space for one-on-one interviews and/or briefings with media and analysts. The media room is restricted to registered media/analysts holding a Media badge.

Media Center Hours

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Career Zone
Exhibit Hall B1

Looking for a job? Or interested in exploring career options? The Career Zone connects employers and skilled job seekers from all areas of optical communications. Conference attendees are encouraged to visit the Career Zone and be prepared to discuss your future with representatives from the industry's leading companies.

Job Seekers
Meet Participating Companies

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<th>Day</th>
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<td>Thursday, 09 March</td>
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Register Online at ofcconference.org/careerzone or visit the Career Zone to:
- Search job postings freely
- Post your résumés online confidentially
- Network and schedule interviews with employers/recruiters

Employers

Didn’t sign up for the onsite Career Zone? It’s not too late.

Participate online at ofcconference.org/careerzone to:
- Post jobs online
- Review résumés before, during or after the conference
- Create alerts to inform you of newly submitted résumés and openings

For more information, call +1 888.491.8833 or email careercenter@ofcconference.org.
OFC Conference App
Manage your conference experience by downloading the OFC Conference App to your smartphone or tablet. Download the conference app one of three ways:

1. Search for ‘OFC Conference’ in the Google Play or Apple App stores.
2. Go to ofcconference.org/app
3. Scan the QR code

Schedule
Search for conference presentations by day, topic, speaker or program type. Plan your schedule by setting bookmarks on programs of interest. Technical attendees can access technical papers within session descriptions.

Exhibit Hall
Search for exhibitors in alphabetical order and set bookmark reminders to stop by booths. Tap on the map icon within a description, and you’ll find locations on the Exhibit Hall map. View a daily schedule of all activities occurring on the show floor.

Technical Digest Papers
Full technical registrants can navigate directly to the technical papers right from the OFC Conference App. Locate the session or talk in “Event Schedule” and click on the “Download PDF” link that appears in the description. IMPORTANT: You will need to log in with your registration email and password to access the technical papers. Access is limited to Full Conference attendees only.

Join the Conversation!
Get the latest updates from OFC via Twitter at @OFCConference. Use the hashtag #OFC23 and join in the conversation today!

Registration
Lobby D
Sponsored by

<table>
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<tr>
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<td>Thursday, 09 March</td>
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Speaker Ready Room
Room 11
All speakers and presiders are required to report to the Speaker Ready Room at least 1 hour before their sessions begin. Computers will be available to review uploaded slides.

Speaker Ready Room Hours*

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<tr>
<td>Sunday, 05 March</td>
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<td>Thursday, 09 March</td>
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*Market Watch and Network Operator Summit speakers should go directly to Exhibit Hall C in Expo Theater I (#5335) to upload their presentations.

Wireless Internet Access
OFC is pleased to provide free wireless Internet service throughout San Diego Convention Center for all attendees and exhibitors. The wireless internet can be used for checking email, downloading the Conference App, and downloading the OFC Technical Papers, etc.

- SSID: OFC
- Password: OFC2023

OFC Management advises you to write your name on all of your conference materials (Conference Program, Buyers’ Guide, and Short Course Notes). There is a cost for replacements.
Make Our Community Your Community!

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The IEEE Communications Society (IEEE ComSoc) is a global network of 30,000+ engineers, practitioners and academics working together to advance communications technology for the betterment of humanity.

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- Top-notch Training and Continuing Education Resources
- Exciting Volunteer Opportunities

Stop by the ComSoc Booth #2939
Visit www.comsoc.org/membership for more information or to join.

*IEEE half-year membership dues pricing begins March 1. Professional members use promo code OFCJOIN23 before March 31 to join ComSoc free.

IEEE COMSOC TRAINING OPTIONS

We offer high-quality communications technology training by world-class industry experts. Courses are taught live, online and cover a wider range of topics from optical to 5G. Members receive discounts on all courses.

Discounts are also available for group purchases of 8 or more course seats. Plus, you can arrange for customized training to match the unique needs of your team. Contact Tara McNally at t.mcnally@comsoc.org to learn more.

Visit www.comsoc.org/training to view the full course schedule and join our email list to receive alerts for upcoming courses.
## Short Course Schedule

### Sunday, 05 March 2023

**08:30–12:30 (UTC - 08:00)**

**SC105: Modulation Formats and Receiver Concepts for Optical Transmission Systems**
Peter Winzer, Nubis Communications, USA; Vivian Chen, Nokia Bell Labs, USA

**SC203: 400 Gb/s and Beyond Optical Communication Systems, Design and Design Trade-offs**
Ezra Ip, NEC Labs, USA; Chongjin Xie, Alibaba Group, USA

**SC208: Optical Fiber Design for Telecommunications and Specialty Applications**
David J. DiGiovanni, OFS Labs, USA

**SC328: Standards for High-Speed Optical Networking**
Tom Huber, Nokia, USA

**SC395: Modeling and Simulation of Optical Transmitter and Receiver Components for Coherent Communications**
Harald Rohde, Nokia, Germany; Howard Wang, Nokia, USA

**SC432: Hands on: Silicon Photonics Component Design & Fabrication**
Lukas Chrostowski, University of British Columbia, Canada

**SC443: Optical Amplifiers: From Fundamental Principles to Technology Trends**
Peter Andreksen, Chalmers University of Technology, Sweden; Michael Vasilyev, University of Texas, Arlington, USA

**SC461: High-capacity Data Center Interconnects for Cloud-scale Networking**
Dirk van den Borne, Juniper Networks, Germany; Sander L. Jansen, ADVA Optical Networking, Germany; Mark Filer, Google, USA

**SC463: Optical Transport SDN: Architectures, Applications, and Actual Implementations**
Achim Autenrieth, ADVA Optical Networking SE, Germany; Jörg-Peter Elbers, ADVA Optical Networking SE, Germany

**SC469: Hands-on: Laboratory Automation and Control Using Python (Beginner)**
Jochen Schröder, Chalmers University of Technology, Sweden; Binbin Guan, Microsoft, USA; Roland Ryf, Nokia Bell Labs, USA

**SC470: Secure Optical Communications**
Andrew Shields, Toshiba Research Labs, UK; Helmut Grießner, ADVA Optical Networking, Germany

**09:00–12:00 (UTC - 08:00)**

**SC177: High-speed Semiconductor Lasers and Modulators**
John Bowers, University of California, Santa Barbara, USA

**SC216: An Introduction to Optical Network Design and Planning**
George Rouskas, North Carolina State University, USA

**SC369: Test and Measurement for Signals with Complex Optical Modulation**
Fabio Pittala and Michael Koenigsmann, Keysight, Germany

**SC433: Introduction to Photodetectors and Optical Receivers**
Andreas Beling, University of Virginia, USA

**SC448: Evolving Software Defined Optical Network: Architecture and Design Principles**
Ramon Casellas, CTTC, Spain

**SC452: FPGA Prototyping for Optical Subsystems**
Noriaki Kaneda, nEye systems Inc, USA; Robert Elschner, Fraunhofer HHI, Germany

**SC453A: Hands-on: Fiber Optic Handling, Measurements, and Component Testing**
Steve Baldo, Seikoh Giken, USA; Chris Heisler, OptoTest Corporation, USA; Steve Lane and Julien MAILLE, Data-Pixel, France

**SC469: Hands-on: Laboratory Automation and Control Using Python (Beginner)**
Jochen Schröder, Chalmers University of Technology, Sweden; Binbin Guan, Microsoft, USA; Roland Ryf, Nokia Bell Labs, USA

**SC470: Secure Optical Communications**
Andrew Shields, Toshiba Research Labs, UK; Helmut Grießner, ADVA Optical Networking, Germany

### Monday, 06 March 2023

**08:30–12:30 (UTC - 08:00)**

**SC102: WDM in Long-haul Transmission Systems**
Neal S. Bergano, Retired, USA

**SC160: Microwave Photonics**
Jose Capmany, Polytechnic University of Valencia, Spain

**SC341: Sub-carrier Modulation and Superchannels for Terabit-class DWDM Transceivers**
Sander L. Jansen, ADVA Optical Networking, Germany; Dirk van den Borne, Juniper Networks, Germany

**SC369: Test and Measurement for Signals with Complex Optical Modulation**
Fabio Pittala and Michael Koenigsmann, Keysight, Germany

**SC433: Introduction to Photodetectors and Optical Receivers**
Andreas Beling, University of Virginia, USA

**SC448: Evolving Software Defined Optical Network: Architecture and Design Principles**
Ramon Casellas, CTTC, Spain

**SC452: FPGA Prototyping for Optical Subsystems**
Noriaki Kaneda, nEye systems Inc, USA; Robert Elschner, Fraunhofer HHI, Germany

**SC453A: Hands-on: Fiber Optic Handling, Measurements, and Component Testing**
Steve Baldo, Seikoh Giken, USA; Chris Heisler, OptoTest Corporation, USA; Steve Lane and Julien MAILLE, Data-Pixel, France
SC454: Hands on: Silicon Photonics Design - Circuits
Wim Bogaerts, University of Ghent, Belgium

SC472: Hands-on: Controlling and Monitoring Optical Network Equipment
Ricard Vilalta, CTTC, Spain

SC473: Photonic Switching Systems
David Neilson, Nokia Bell Labs, USA; Benjamin Lee, NVIDIA, USA

SC483: Machine Learning in Optical Networks
Massimo Tornatore, Politecnico di Milano, Italy; Darko Zibar, DTU FOTONIK, Denmark

SC487: Hands-On: Laboratory Automation and Control using Python (Advanced)
Jochen Schröder, Chalmers University of Technology, Sweden; Nicolas Fontaine, Nokia Bell Labs, USA; Binbin Guan, Microsoft USA

SC488: Space Division Multiplexing for Optical Communication Systems and Networks
Roland Ryf, Nokia Bell Labs, USA

SC459: Multimode Photonic Devices, Characterization and Applications
Nicolas Fontaine, Nokia Bell Labs, USA

SC485: Advanced Fiber Access Networks
Jun Shan Wey and Rajesh Yadav, Verizon, USA

13:30–17:30 (UTC - 08:00)

SC261: ROADM Technologies and Network Applications
Thomas Strasser, Molex, USA

SC325: Highly Integrated Monolithic Photonic Integrated Circuits
Chris Doerr, Doerr Consulting, LLC, USA

SC327: Modeling and Design of Long-haul Fiber-Optic Communication Systems
René-Jean Essiambre, Nokia Bell Labs, USA

SC347: Reliability and Qualification of Fiber-Optic Components, Modules and Equipment
David R. Maack, David Maack Consulting, USA

SC393: Digital Signal Processing for Coherent Optical Transceivers
Chris Fludger, Infinera, Germany

SC431: Photonic Technologies in the Datacenter
Clint Schow, University of California, USA

SC451: Optical Fiber Sensors
Alexis Mendez, MCH Engineering USA; William Shroyer, SageRider, Inc., USA

SC453B: Hands-on: Fiber Optic Handling, Measurements, and Component Testing
Steve Baldo, Seikoh Giken, USA, Chris Heisler, OptoTest Corporation, USA, Steve Lane and Julien Maille, Data-Pixel, France
This workshop will explore the various aspects of introducing smart pluggable optics to new network architectures. In Part I, we will focus on use cases for integrated IP over DWDM versus traditional layered IP and transport solutions. In Part II, we will discuss the control and management challenges of an integrated IP over DWDM network architecture.

**Speakers:**
- Heidi Adams, Nokia, Canada
- Ian Alderide, Ciena, USA
- Oscar Gonzalez de Dios, Telefonica, Spain
- Steven Hand, Infinera, USA
- Tad Hofmeister, Google, USA
- Maxim Kuschnerov, Huawei, Germany
- Qingyun (Wendell) Liu, Verizon, USA
- Tim Pennell, Juniper Networks, USA
- Glenn Wellbrock, Verizon, USA

**S1B: Quantum Dots – The Resurrection?**

**Room: 6D**

Organizers: Hai-Feng Liu, HG Genuine Optics Tech Co., Ltd., China; Martin Schell, Fraunhofer HHI, Germany; Tomoyuki Akiyama, Fujitsu, Japan

After more than 30 years of research and more than ten years since the first field deployments, quantum dot (QD) based lasers and semiconductor optical amplifiers (SOAs) have recently begun generating strong interest. QDs offer unique properties and additional degrees of freedom in design compared to traditional quantum wells. They are being explored for use in various applications and monolithic integration into silicon photonics manufacturing platforms. Is this resurgence based on the improved quality of the quantum dots or fundamentally new properties? Is isolator-free on-chip silicon integration the “killer app”? Is this success transferable back to III/V substrates like InP or GaAs? Where further can quantum dots go in performance? Will CdSe, ZSe, or other colloidal quantum dots play a role?

**Speakers:**
- Namyong Anh, Los Alamos National Laboratory, USA
- Yasuhiro Arakawa, Tokyo University, Japan
- Alexey Kovsh, Alfalume, USA
- Alan Y Liu, Quintessent, USA
- Huiyun Liu, University College London, UK
- Martin Moehrle, Fraunhofer HHI, Germany
- Johann Peter Reithmaier, University of Kassel, Germany
- Stephan Reitzenstein, Technical University of Berlin, Germany
- Mitsuru Sugawara, QD Laser, Japan
- Maksym Sych, Aegig, UK
requirements for latency are needed. But what data rate do we need for 5G, 20 Gb/s per user? Do we need a peak rate over 100 Gb/s by 2030 for 6G?

We will consider energy efficiency, low carbon emission networks, and resilient networks (lifeline, battery, etc.) for future access. Optical networks are also expected to assist with societal requirements (fire assistance, sensors for agriculture, water level monitoring, climate, etc.) to support the Sustainable Development Goals (SDGs) by the United Nations.

To enable all the emerging use cases for optical access, a cost-effective symmetrical data rate of 100 Gb/s and beyond will be needed. In addition, new optical access standards, and what comes after the 25G and 50G-PON standards? Topics for discussion include IM/DD versus coherent, introduction of flexibility, and point-to-point versus point-to-multipoint architectures. Will optical access standards move forward for all types of architectures? Will cost-effective coherent access be feasible?

Speakers:
Pham Tien Dat, NICT, Japan
Saifuddin Faruk, University of Cambridge, UK
Roberto Gaudino, Politecnico di Torino, Italy
Ed Harstead, Nokia, Germany
Paulo Monteiro, University of Averio, Portugal
Derek Nesset, Huawei, Germany
Kazuki Tanaka, KDDI Labs, Japan
JunShan Wey, Verison, USA

S1D: Will Optics Have a Role to Play in Scaling Out Future Quantum Computing Architectures? (Part 1)
Room: 6F

Organizers: Mekena Metcalf, Lawrence Berkley, USA; Eleni Diamanti, Universite Pierre et Marie Curie, France; Daniel Kilper, Trinity College Dublin, Ireland; Fotini Karinou, Microsoft Research Ltd, UK

Scaling quantum computing architectures is trending towards interconnected quantum processing units. For several platforms that require increasingly larger dilution refrigerators, communication between the modular quantum chips based on electrical/RF connections is a limitation due to the limited thermal load capacity the refrigerator can support. Other platforms expected to operate at higher temperatures would eventually face similar challenges. Optical interconnects are a potential answer to this scaling challenge to enable multi-chip communication. Such topologies would require the conversion of qubits to optical wavelengths for some platforms and, more generally, transmission over a networked quantum computing architecture, i.e., notionally a “quantum data center.”

Further, control of quantum computers necessitates a hybrid computing framework with both classical and quantum resources. In the first session, this workshop will encapsulate industry strategies for scaling quantum computing for various qubit technologies with classical control frameworks. The secondary session will cover the technologies and challenges facing quantum interconnects.

Session 1: This session will give an overview of different technologies/platforms the industry is pursuing to build a scalable quantum computing architecture. The Speakers will present their chosen technology, their vision toward a scalable computing platform, the challenges and the role of optics in their roadmap.

Session 2: This session will focus on different material platforms and devices as building blocks to enable various essential quantum system functionalities and their integration and packaging aspects to address system challenges induced by cryogenic environments.

Speakers:
Mercedes Gimeon-Segovia, VP System Architecture, PsiQuantum, USA
Jungsang Kim, Co-Founder and Chief Technology Officer, IonQ Inc., USA
Jason Orcutt, Principal Research Scientist, IBM Quantum, USA
Richard Rouse, Microsoft, USA

S1E: Is It Really Game Over for the Quest to Approach Fiber Capacity Limits?
Room: 7AB

Organizers: Gabriele Liga, Eindhoven University of Technology, Netherlands; David Millar, Infinera, USA; Sergejs Makovejs, Corning, USA

After a decade of intense research and animated discussions around new approaches to increase the spectral efficiency (SE) of single-mode optical fiber transmission systems, we now see a significant slowdown in achievable SE gains as improvements become more challenging and costly. Therefore, the question of improving system SE appears to be beyond the scope of just modern improvements for the first time in many years. As a result, the balance between optical transmission power, SE gains, and investment cost needed to develop more advanced solutions is ever so harder to strike. Yet, no one knows with absolute certainty how much fiber capacity gain can be achieved in the coming years and with what level of implementation complexity.

This workshop will address a fundamental question: is it still worth trying to squeeze more SE out of optical fiber transmission systems? And if not, what are the most attractive alternative options to keep up with the current network capacity demand? Other questions to discuss in this workshop will include the following:

• Increasing number of spatial paths (more fibers per cables, new fiber designs, etc.) is promising, but is it the only way forward?
• Is it worth realizing the remaining SE gains, and which tools should we use? Are ultra-wide bandwidth solutions also valid contenders?
• What is the practical limit on bit-rate per wavelength (1.6Tb/s, 3.2Tb/s, etc.)? Are there any options to overcome this limit?
• Pluggable transceivers have somewhat reduced performance with significantly reduced power and size. Will they enable the next wave of capacity growth throughout the network?
whether such a stand exists, and if so, where is the last stand where the parallel optics solve all the problems and Coherent makes no sense. The question is whether such a stand exists, and if so, where is the eventual boundary between IM-DD and Coherent? The boundary can be characterized by various metrics like data rate, distance, power consumption and transceiver cost, and may be closely related to the application drivers. This workshop will discuss such boundaries and address typical questions like:

- Will Coherent Lite find its position in the competition between IM-DD and Coherent?
- Is there a practical technique for an all-analog coherent system to avoid the ADC and DSP?
- Will there be a common and interoperable implementation for Coherent like 400ZR for shorter-distance applications, or will the solutions be diversified?
- Will the local oscillator wavelength management kill the application of Coherent to ultra-short-reach uncooled applications?
- Is it worth sending a remote light through a separate link for self-homodyne coherent detection?
- Can coherent access really meet the end users’ stringent power/cost limit, and if so, how far are we away from that?

This workshop will invite speakers from academia, system and module vendors, datacenter and access operators to provide a diversity of perspectives.

Speakers:

Hector Andrade, Univ. of California, Santa Barbara, USA
Matt Sysak, Ayar Labs, USA
Tao Gui, Huawei, China
Zhensheng Jia, Cable Labs, USA
Hong Liu, Google, USA
Radha Nagarajan, Marvell, USA
Fabienne Saliou, Orange Labs, France
Seb J. Savory, University of Cambridge, UK
Yawei Yin, Microsoft, USA
Hongbing Zhang, Cisco, USA

S1F: Where are the Boundaries Between IM-DD and Coherent?

Room: 8

Organizers: Clint Schow, Univ. of California, Santa Barbara, USA; Di Che, Nokia Bell Labs, USA; Sam Palermo, Texas A&M University, USA; Paola Parolari, Politecnico di Milano, Italy

Despite the continuous debate between IM-DD and Coherent, it is an irrefutable trend that Coherent has gradually encroached the market share of IM-DD. The extensive deployment of 400ZR over the past few years has marked a big success of Coherent to single-span transmissions like metro/datacenter interconnects. Currently, academia and industry are actively developing next-generation coherent solutions targeting even shorter distances such as <10km datacenter intra-connects and optical access networks. Besides the advances of DSP/Photonic integration, a hotly pursued pathway to accelerate the expansion of Coherent is Coherent Lite, aiming to simplify or even remove the power-hungry DSP by using lower symbol rate, simpler modulation format, and specially designed analog electronic or optical subsystems.

Though the coherent camp has the ambition to rule the world, the IM-DD camp believes they’ll hold their last stand where the parallel optics solve all the problems and Coherent makes no sense. The question is whether such a stand exists, and if so, where is the

Sunday, 06 March, 16:00–18:30

S2A: Revolutionary vs. Evolutionary SDM Fibers: Extra Gain at Extra Complexity

Room: 6C

Organizers: Tetsuya Hayashi, Sumitomo Electric Industries Ltd., Japan; Inna Kozmina, Corning, USA; Pierre Sillard, Prysmian Group, France; Benyuan Zhu, OFS Laboratories, USA

Rising network traffic, driven by consumer bandwidth demand, creates a capacity challenge for networks of all types. The search for scalable capacity has become a driving force in network systems. Space Division Multiplexing (SDM) is a viable approach as it increases the relative core density in a given system. In data center applications, it could solve practical installation problems of very large fiber counts in data center interconnect (DCI) links. In a submarine, it offers a path towards 1-5 Pbps/subsea cable capacity. The latter presents the ultimate challenge due to high-reliability requirements and power-limited cable designs on top of the high-capacity transmission. The debate will therefore focus on which technology will emerge to meet challenging 5 Pbps cable capacity targets in a submarine. Scalability, ecosystem readiness, compatibility with incumbent systems, and mechanical robustness are among the factors to be addressed for two leading solutions: multicore (MCF) and reduced geometry (Cladding or Coating) fibers.

Speakers:

Mattia Cantono, Google, USA
Olivier Courtois, Alcatel Submarine Networks, France
Hans Damgaard, OFS, Denmark
Lidia Galdino, Corning, UK
Stephen Grubb, Meta, USA
Takemi Hasegawa, Sumitomo Electric, Japan
Takanori Inoue, Sumitomo Electric, Japan
Benyuan Zhu, OFS Laboratories, USA
Hans Damgaard, OFS, Denmark

Room: 6C
S2B: Will Machine Learning be the Killer Application for Optical Networks in Data Centres
Room: 6D

Organizers: Georgios Zervas, University College London, UK; Hitesh Ballani, Microsoft, USA; Manya Ghobhadi, MIT, USA

Machine learning models increase x10 every 18 months. Custom processors (TPUs, NPUs, xPUs) used for ML tasks support significantly higher I/O bandwidth compared to CPUs. However, the scalability and training time significantly depends on network performance. Current electronic multi-layer networks, due to over-subscription and large network diameter, lead to significant overheads and could limit the scale and efficiency of the system and ML applications. This workshop will explore methods used to scale models (data/model/hybrid parallelism) across hundreds and thousands of processing units, discuss existing network solutions and explore the potential and challenges of optical networks. Both current and future technologies will be presented and explored. Some of the questions that we aim to answer include but are not limited to include:

- Can electronic packet switching and traditional pluggable transceivers sustain the performance and power consumption demanded by the rapid growth of ML models?
- What are the requirements for broad adoption of fast all-optical switching and networking?
- Will optical networks change how we design distributed deep learning training systems and processes?

Part 1. Session on methods and current systems to support large-scale ML models.
Part 2. Potential and challenges of optical networks for ML systems.

Speakers:
Larry Dennison, NVIDIA, USA
Alessandro Ottino, University College London, UK
Josh Shalf, Lawrence Berkley National Laboratory, USA
Sergey Shumarayev, Intel Corporation, USA

S2C: Perennial Bandwidth at Home: LiFi or FiWi?
Room: 6E

Organizers: Bernhard Schrenk, Austrian Institute of Technology, Austria; Edouard Tangdiongga, Eindhoven University of Technology, Netherlands; Chi-Wai Chow, National Chiao Tung University, Taiwan

With access to fiber broadband, the user experience is strongly linked to home network performance. Towards this direction, Fiber-to-the-Room (FTTR) is now being investigated as a perennial deep-fiber infrastructure within ITU-T SG15 and ETSI F5G. FTTR poses a lot of questions concerning its opportunities. It also positions wireless in-house access in a new context: FTTR as an extender for WiFi6 promises Gbps connectivity in a quasi-interference-free environment, with considerable potential for wireless bandwidth upgrades when moving to (sub-)mm-wave technology readily maturing through Beyond-5G efforts. Will FiWi deployment within the premises cannibalize efforts to make LiFi a commodity? Are there still unmet requirements that can only be addressed through LiFi? Will LiFi co-exist or rather cease to exist? The workshop aims to address these pressing questions by bringing together speakers from academia and industry to discuss the deployment aspects of future home networks backed by FTTR technology and the roles of light- and radio-based wireless access.

Speakers:
Benjamin Azoulay, Oledcomm, France
Rene Bonk, Nokia Bell Labs, Germany
Philippe Chanclou, Orange Labs, France
Steve Hranilovic, McMaster University, Canada
Anthony Ng’oma, Corning, USA
Nikola Serafimovski, pureLiFi, UK

S2D: Will Optics Have a Role to Play in Scaling Out Future Quantum Computing Architectures? (Part 2)
Room: 6F

Organizers: Mekena Metcalf, Lawrence Berkley, USA; Eleni Diamanti, Universite Pierre et Marie Curie, France; Daniel Kilper, Trinity College Dublin, Ireland; Fotini Karinou, Microsoft Research Ltd, UK

Scaling quantum computing architectures is trending towards interconnected quantum processing units. For several platforms that require increasingly larger dilution refrigerators, communication between the modular quantum chips based on electrical/RF connections is a limitation due to the limited thermal load capacity the refrigerator can support. Other platforms expected to operate at higher temperatures would eventually face similar challenges. Optical interconnects are a potential answer to this scaling challenge to enable multi-chip communication. Such topologies would require the conversion of qubits to optical wavelengths for some platforms and, more generally, transmission over a networked quantum computing architecture, i.e., notionally a “quantum data center.”

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Session 1: This session will give an overview of different technologies/platforms the industry is pursuing to build a scalable quantum computing architecture. The Speakers will present their chosen technology, their vision toward a scalable computing platform, the challenges and the role of optics in their roadmap.

Session 2: This session will focus on different material platforms and devices as building blocks to enable various essential quantum system functionalities and their integration and packaging aspects to address system challenges induced by cryogenic environments.
tuning of OISLs at extremely high orbital speeds, the communication, the pointing-and-acquisition-ity. The workshop will discuss the gigabit-per-second future applications based on space optical links a real-

Several challenges need to be overcome to make services leveraging space networks at a global scale. Securely quantum devices to provide groundbreaking communications. Satellite-based quantum commu-

tion in space is becoming increasingly important to space. Long-distance, high-data-rate communication in space is becoming increasingly important to support science data transfer, telemetry, remote monitoring, and Internet connectivity. As a result, there is a trend in space communication to transition from radio frequency-based links to links using optical beams. Key motivations are an unregulated spectrum, smaller size/weight, lower power consumption per bit, larger bandwidth, and significantly smaller beam diffraction, resulting in much smaller link loss and, thus, higher capacity. The promising OWC applications in space will include Low Earth Orbit satellite constellations and High-Altitude Platform Stations with Optical Inter-Satellite Links (OISLs), inter-satellite mesh networks, low latency networking, and integration of satellites and 5G-and-beyond. In addition, quantum technologies attract great interest for their potential applications in computing, sensing, and communications. Satellite-based quantum communications are interesting in this context for linking securely quantum devices to provide groundbreaking services leveraging space networks at a global scale. Several challenges need to be overcome to make future applications based on space optical links a reality. The workshop will discuss the gigabit-per-second speed communication, the pointing-and-acquisition-tuning of OISLs at extremely high orbital speeds, the dynamic network routing, and the economic viability for OWC in space as well as the novel and secure space network concept based on optical technologies for satellite quantum information networks.

Speakers:

Guray Acar, European Space Agency, Netherlands
Mohammed-Slim Alouini, KAUST, Saudi Arabia
Baris Erkmen, Hedron, USA
Bryan S. Robinson, MIT Lincoln Lab, USA
Mathias van den Bossche, Thales Alenia Space, France
Juan Yin, University of Science and Technology of China, China

S2E: Does Optics Have a Role in Space?
Room: 7AB
Organizers: Morio Toyoshima, National Institute of Information & Comm Tech, Japan; Murat Yuksel, University of Central Florida, USA; Eleni Diamanti, Universite Pierre et Marie Curie, France

Optical Wireless Communication (OWC), also called free-space optical communication, has recently evolved in many significant ways and is now employed in a wide range of applications extending to space. Long-distance, high-data-rate communication in space is becoming increasingly important to support science data transfer, telemetry, remote monitoring, and Internet connectivity. As a result, there is a trend in space communication to transition from radio frequency-based links to links using optical beams. Key motivations are an unregulated spectrum, smaller size/weight, lower power consumption per bit, larger bandwidth, and significantly smaller beam diffraction, resulting in much smaller link loss and, thus, higher capacity. The promising OWC applications in space will include Low Earth Orbit satellite constellations and High-Altitude Platform Stations with Optical Inter-Satellite Links (OISLs), inter-satellite mesh networks, low latency networking, and integration of satellites and 5G-and-beyond. In addition, quantum technologies attract great interest for their potential applications in computing, sensing, and communications. Satellite-based quantum communications are interesting in this context for linking securely quantum devices to provide groundbreaking services leveraging space networks at a global scale. Several challenges need to be overcome to make future applications based on space optical links a reality. The workshop will discuss the gigabit-per-second speed communication, the pointing-and-acquisition-tuning of OISLs at extremely high orbital speeds, the dynamic network routing, and the economic viability for OWC in space as well as the novel and secure space network concept based on optical technologies for satellite quantum information networks.

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Mathias van den Bossche, Thales Alenia Space, France
Juan Yin, University of Science and Technology of China, China

S2F: Slow and Wide Versus Fast and Narrow: How Do We Make our Datacenters Green?
Room: 8
Organizers: Trey Greer, NVIDIA, USA; Norm Swenson, Norman Swenson Consulting, USA; Xian Zhou, University of Science & Technology Beijing, China

There are different approaches to improving energy efficiency in and between data centers. We can con-
tinue to press toward higher baud rates and higher bits per symbol or use multiplexing techniques over optical wavelength, subcarrier frequency, and spatial/ fiber cores at lower baud rates. Which approach results in the best efficiency in terms of overall power consumption for the end-to-end system? It should include the power consumption of electrical inter-
connect, light generation, detection, amplification, signal processing, SERDES, and FEC. This workshop will address this topic in two sessions, within the data center (chip to chip) and between data centers.

Short Reach, <100 meters
The first session will deal with short-reach intercon-
nect within a rack or between racks. Energy per bit is vital in these short optical interconnects.

• In the context of the bandwidth needed for 100 Tbps switches, where is the sweet spot in the battle between high channel bit rates vs. high fiber counts and channels per fiber?

• In lieu of higher channel data rates, what’s the best way to increase the number of channels per fiber core or fiber cores around the host ASIC?

• On the host ASIC side, can we save power with the wider and slower electrical interfaces made possible with co-packaged optics?

Long Reach, up to 10km
The second session will look at communications between data centers.

• Which technologies and multiplexing techni-
ques promise the most energy efficiency to achieve these distances? Is it intensity modula-
tion/direct detection on multiple lanes, coherent subcarrier multiplexing, simplified coherent, or something else?

• What’s the role of DSP in a power-efficient trans-
sponder? Does DSP actually result in net power savings?

• What key technologies must be demonstrated to realize these energy-efficient techniques in practical product offerings?

Speakers:

Keren Bergmen, Columbia University, USA
Arash Farhood, Marvell, USA
Joe Kahn, Stanford University, USA
Dan Kuchta, IBM, USA
Di Liang, Alibaba, USA
Karl Muth, Broadcom, USA
Sunil Priyadarshi, Intel, USA
Dave Welch, Infinera, USA
Hack Your Research! Tools and Tricks for Today’s Telecommunications Techies (formerly Lab Automation Hackathon)
Sunday, 05 March, 19:00–21:00
Room: 17
Organizers: Henrique Buglia, University College London, UK; Marco Eppenberger, PsiQuantum, USA; Menno van den Hout, Eindhoven University of Technology, Netherlands; Vincent van Vliet, Eindhoven University of Technology, Netherlands
Advisory Committee: Nicolas Fontaine, Nokia Bell Labs, USA; Binbin Guan, Microsoft, USA; Roland Ryf, Nokia Bell Labs, USA; Jochen Schroeder, Chalmers University of Technology, Sweden
Come and learn the most powerful techniques expert researchers and professionals use to enhance productivity and make life easier. Join us and take this chance to upgrade your work methods and discuss while enjoying lots of food and drinks in an informal, relaxed, and fun way.

Our everyday research is most fun and productive when we concentrate on creative problem-solving. Good news: tools are available for almost all other tasks to make your engineering life easier. Many software packages written by the large community allow you to quickly and easily automate menial tasks, build graphical user interfaces, visualize data, and much more! This event aims to bring awareness of these packages by hosting multiple interactive demos of mostly free and open-source software built in easy-to-learn languages such as Python. The demos are set up around informal discussion tables with plenty of time for inspiring discussion and questions, alternated with lighting talks and videos showing the usage of these tools.

This event is an opportunity to learn how to tap into and use the available public resources and learn about the newest tools developed by Ph.D. students and researchers alike. From students to highly experienced experts, everybody is welcome to learn and share ways to boost their research. Benefit and learn from the trial-and-error of others and get a kickstart in productivity!

Symposia
Three symposia are scheduled for OFC 2023. Please refer to the abstract section or Conference App for full details.

Quantum Information and Optical Communication Networks: Emerging Research Areas, Challenges and Opportunities
Monday, 06 March, 14:00–18:30
Room: 1AB
Organizers: Eleni Diamanti, CNRS, France; Fotini Karinou, Microsoft Research, UK; Dan Kilper, University of Dublin Trinity College, Ireland; Fabian Laudenbach, Xanadu Quantum Computing, Canada; Rui Lin, Chalmers, Sweden; Michael Vasilyev, University of Texas, USA; Rui Wang, University of Bristol, UK
Recent advances in quantum technologies are enabling new functionality in communication networks. Quantum key management system support is available as a feature on commercial optical transmission systems and quantum random number generators are attracting attention for use in a variety of applications. At the same time, research is accelerating on the development of networked quantum computing to both scale existing platforms and to provide internet-like capabilities, perhaps to form a quantum internet. In addition to QKD-related applications, a new body of activity is developing around entanglement distribution and routing. A race is on to develop a scalable and commercially viable quantum repeater for distributing entanglement and performing teleportation over long distances. Quantum sensor networks promise nonclassical sensitivity enhancements. All these developments open up a wide range of potential new research areas in optical devices, communications and networks, spanning both the near and long term.

Key questions that this symposium will address include:
- What are other applications of quantum networking beyond QKD?

This symposium will explore these questions and others in regard to emerging research areas with a focus on optical communication technologies. The first session will provide high level overviews of broad areas with introductory or survey level talks followed by a panel discussion. The second session will breakdown specific areas in shorter talks, concluded with a panel discussion.

Session I: Emerging Research Areas in Quantum for Optical Communications
This session will provide broad overviews of key emerging research areas, including topics such as quantum enhanced security technologies in optical transmission systems, wavelength conversion and quantum computer/memory interfaces, quantum repeater network architectures for multi-partite entanglement distribution and teleportation, and quantum sensor networks and distributed quantum applications. The panel will discuss the current state of the art and the key research challenges.
Session I: Photonics and Sustainability

The role of photonics, and education, reduce inequality, and eliminate strategies that close the digital divide, improve health and other deprivations must go hand-in-hand with urgent call for action by all countries. Ending poverty and into the future. Core to this agenda are 17 and prosperity, for the planet and its people, now

The United Nation’s 2030 Agenda for Sustainable Development, for the planet and its people, now and into the future. Core to this agenda are 17 Sustainable Development Goals (SDGs) that form an urgent call for action by all countries. Ending poverty and other deprivations must go hand-in-hand with strategies that close the digital divide, improve health and education, reduce inequality, and eliminate greenhouse gas emissions. The role of photonics, e.g., when deployed around a smart city framework and in rural underserved communities, is crucial to meeting the UN SDGs in a timely manner. However, even with its critical role as the digital backbone of society, the infrastructure itself can become a significant sustainability burden. It is thus imperative that future optical communication systems and networks are integrated in the society ensuring environmental sustainability as they evolve.

This OFC 2023 symposium, as the first in a series of OFC symposia on this topic, will specifically aim to: (a) reflect on the smartcity predictions made by OFCity 2015 competition teams towards sustainability, and (b) discuss related recent R&D efforts and future opportunities towards achieving SDGs from data center network operators, telecom network operators, system and technology providers, and academia. Through the discussions, we aim to highlight crucial next steps for the OFC Community to focus on the next years.

Speakers
Kasandra Plyay, Council for Scientific and Industrial Research (CSIR), South Africa
Marco Ruffini; University of Dublin Trinity College, Ireland
Yosuke Aragane, NTT, Japan
Marcus Brunner, Huawei Technologies, China
Naveena Genay, Orange Labs, France
Thomas Karagiannis, Microsoft Research Cambridge, UK
James (Dezhi) Zhang, China Telecom Corp Ltd, China

Beyond the Hype of Network Analytics: Use Cases, Feasibility, and Barriers

Wednesday, 08 March, 14:00–18:30

Organizers: Fotini Karinou, Microsoft, UK; Yuanqiu Luo, Futurewei Technologies; Albert Rafel, British Telecommunications, UK; Luca Valcarenghi, Scuola Superiore Sant Anna de Pisa, Italy; Elaine Wong, University of Melbourne, Australia

The United Nation’s 2030 Agenda for Sustainable Development is a shared blueprint for global peace and prosperity, for the planet and its people, now and into the future. Core to this agenda are 17 Sustainable Development Goals (SDGs) that form an urgent call for action by all countries. Ending poverty and other deprivations must go hand-in-hand with strategies that close the digital divide, improve health and education, reduce inequality, and eliminate greenhouse gas emissions. The role of photonics, e.g., when deployed around a smart city framework and in rural underserved communities, is crucial to meeting the UN SDGs in a timely manner. However, even with its critical role as the digital backbone of society, the infrastructure itself can become a significant sustainability burden. It is thus imperative that future optical communication systems and networks are integrated in the society ensuring environmental sustainability as they evolve.

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Special Programming

OFC 2023 • 05–09 March 2023
Panels
Ten panels are scheduled for OFC 2023. Please refer to the abstract section for full descriptions.

Towards Standardized PIC Testing: Challenges & Roadmaps
Date: Monday, 06 March, 08:00–10:00
Room: 7AB
Organizers: Patrick Lo, Advanced Micro Foundry, Singapore; Ashkan Seyedi, NVIDIA, USA; Wei Shi, Université Laval, Canada

Virtualization in Optical Networks: A Reality Check
Date: Monday, 06 March, 08:00–10:00
Room: 6C
Organizers: Ricardo Martinez, CTTC, Spain; Jamie Gaudette, Microsoft, USA; Annachiara Pagano, Telecom Italia, Italy

Connectivity for Beyond 5G: How Can Wireline and Wireless Optical Access Live Up to the Mobile Expectations?
Date: Monday, 06 March, 10:30–12:30
Room: 7AB
Organizers: Jim Zou, ADVA, Germany; Albert Rafel, BT, UK; Baris Erkmen, HEDRON, USA; Frank Chang, Source Photonics, USA; Ke Wang, RMIT, Australia

Optical Fiber Sensing: Technology and Emerging Applications
Date: Monday, 06 March, 14:00–18:30
Room: 7AB
Organizers: Raja Ahmad, Cisco Systems, USA; Ting Wang, NEC, USA; Georg Rademacher, NICT, Japan; Mikael Mazur, Nokia Bell Labs, USA

1.6Tb/s+ Intra-DC Networks
Date: Monday, 06 March, 16:30–18:30
Room: 6C
Organizers: Stephan Pachnicke, Christian-Albrechts Universität zu Kiel, Germany; James Chien, Marvell Technology Inc., USA; Juthika Basak, Nokia, USA

LiDAR Systems and Technologies with Integrated Photonics
Date: Tuesday, 07 March, 14:00–16:00
Room: 7AB
Organizers: Long Chen, Cisco, USA; Sylvie Menez, SCINtIL Photonics, France; Milos Popovic, Boston University, USA; Shilong Pan, Nanjing Univ Aeronautics & Astronautics, China

Advanced Packaging Technologies for Optical Modules
Date: Wednesday, 08 March, 08:00–10:00
Room: 6C
Organizers: Omer Khayam, Google, USA; Joris Van Campenhout, IMEC, Belgium; Juthika Basak, Nokia, USA; Molly Piels, Juniper Networks, USA

How Can We Start to Consistently and Quantitively Account for End-to-End Power Consumption, Beginning with a Focus on 100 Meter Datacenter Links?
Date: Thursday, 09 March, 08:00–10:00
Room: 7AB
Organizers: Trey Greer, NVIDIA, USA; Clint Schow, Univ. of California, Santa Barbara, USA

Promises, Prospects and Challenges of VCSELs for Data Center Interconnects, Free-Space Communications, and Sensing
Date: Thursday, 09 March, 08:00–10:00
Room: 6C
Organizers: Connie Chang-Hasnain, Berxel Photonics, China; Hai-Feng Liu, HG Genuine, China; Jim Lott, Technical University Berlin, Germany; Fotini Karinou, Microsoft Research Ltd, UK

Roadmap for Photonic AI Accelerators
Date: Thursday, 09 March, 14:00–16:00
Room: 7AB
Organizers: Volker Sorger, George Washington University, USA; Nikos Pleros, Aristotle University of Thessaloniki, Greece; Xian Xiao, Hewlett Packard Labs, USA; Glenn Bartolini, Coherent Corp, USA

Special Sessions
Ultra-Stable Frequency Sources and their Future Applications in Telecom
Monday, 06 March, 08:00–10:00
Room: 7AB
Organizers: Dan Blumenthal, University of California, Santa Barbara, USA; Nick Fontaine, Nokia Bell Labs, USA; Radan Slavik, University of Southampton, UK

Optical fiber communications have resulted in commodity technologies benefiting other disciplines, including optical fiber and other components. Now, the outcomes of these other disciplines, in turn, can benefit fiber communications. An important example is time and frequency metrology and the development of the Optical Frequency Combs used to transfer signals over optical fibers (e.g., to compare national clocks at different National Metrology Institutes). Other examples include self-referenced ultra-stable optical and microwave signals for atomic clocks, ultra-narrow-linewidth frequency stabilized lasers, and quantum computing and sensing technologies. These technologies are now finding importance and application that feedback to fiber communications with optical networks needing more accurate time and frequency (e.g., for emerging 5G, distributed database synchronization), and using the existing telecom data carrying fiber base as a distributed precision sensor providing additional services such as Earthquake detection.

The Objective of the Special Session is to bring together researchers from the distinct disciplines of fiber communications, environmental sensing, precision metrology and spectroscopy, atomic clocks and stabilized lasers, and quantum sensing to bridge communications between these different areas and explore common research grounds and solutions. For example, measurement sensitivity using undersea cables is greatly improved using sources with high frequency and phase stability developed by the metrology community. We aim to promote an understanding of the requirements of ultrastable frequency sources in telecom, including portability and the benefits of photonic integration, and to discuss the current state-of-the-art performance. Further, we hope to develop connections in the telecom community that has access to terrestrial and transoceanic fibers with...
those who develop state-of-the-art photonic sources and precision optical techniques with those who have expertise in environmental sensing and precision frequency and phase transfer. Finally, we aim to understand how emerging telecom fields, such as quantum systems, could benefit from precision frequency metrology and atomic timing developments. The session will also touch upon frequency references in applications such as space communications, wireless communications, atmospheric sensing, time transfer, geodetic sensing, and synchronization of large-scale experiments.

Speakers
Christopher Hilweg, Universitat Wien, Austria
Giuseppe Marra, National Physical Laboratory, UK
Frank Quinlan, National Inst. of Standards & Technology, USA
Mark Saffman, University of Wisconsin, USA

High Performance Networks for Future Data Center and Computing Applications
Monday, 06 March, 10:30–12:30
Room: 1AB
Organizers: Fotini Karinou, Microsoft, UK; Laurent Schaeres, IBM TJ Watson Research Center, USA; Chongjin Xie, Alibaba, USA

Data center workloads are continuously growing due to various emerging applications calling for higher bandwidth, lower latency, and more power-efficient networks. Machine Learning (ML) workloads, in particular, grow exponentially in size every year, and training them requires clusters of thousands of interconnected accelerators with Tbps-scale I/O bandwidth per node today. This new hardware needed to serve emerging applications will require innovation in designing and building networks that can scale AI supercomputers without exploding the overall power consumption and cost. This session will discuss emerging trends, including, for example, (1) composable systems with disaggregated resources (GPUs, CPUs, storage/memory) being co-located as a pool that is accessed via a local network and (2) reconfigurable network topologies to provision bandwidth on demand. It will focus on the challenges and opportunities for photonics and will try to address some of the following questions:

- Will optics penetrate composable systems or the accelerator-to-accelerator space?
- Reconfigurable network topologies - what role will they play?
- Ethernet: will it continue to be the driving design paradigm in the AI era?
- CXL or proprietary interconnects: what protocol will dominate the chip-scale fabrics?

Speakers
Rui Wang, Google LLC, USA
Manya Ghobadi, Massachusetts Institute of Technology, USA
Larry Dennison, NVIDIA, USA
Binzhang Fu, Alibaba Cloud, China
Ram Huggahalli, Microsoft Azure, USA

Photonics for Visible Wavelengths
Wednesday, 08 March, 08:00–16:00
Room: 2
Organizers: Cheryl Agaskar, MIT Lincoln Lab, USA; Chi-Wai Chow, National Yang Ming Chiao Tung University, Taiwan; Fotini Karinou, Microsoft Research Ltd, UK
David Marpaung, University of Twente, Netherlands

Visible wavelengths are getting increasing attention due to their usefulness for communication, quantum, and sensing applications. In communication, blue-green wavelengths can be used for underwater comm, while LiFi systems can work across the visible spectrum. Visible wavelengths are often necessary when probing physical systems, such as the neutral atoms or ions used in quantum computing, optical clocks, color centers used in quantum sensors, or biological systems such as medical or chemical sensors. Visible light can also be useful for lidar and atmospheric sensing. Finally, nonlinear photonics and frequency combs often involve visible wavelengths.

This special session will begin by covering mature current applications and what systems, if any, are used in the field. It will then cover the state of the art of visible light devices such as lasers, detectors, and fibers, as well as foundry processes and packaging needs. This session will address the maturity of the available technologies and whether current or anticipated future performance is acceptable for application needs. And lastly, the session will also attempt to highlight the most significant outstanding needs in this emerging field.

Session I is scheduled from 08:00–10:00
Session II is scheduled from 14:00–16:00

Speakers
Brian Corbett, Tyndall National Institute, Ireland
Michael Geiselmnn, LIGENTEC, Switzerland
Douwe Geuzebroek, LionIX, Netherlands
Harald Haas, University of Strathclyde, UK
Hao-Chung Kuo, National Yang Ming Chiao Tung University, Taiwan
William Loh, MIT Lincoln Lab, USA
Boon Ooi, King Abdullah Univ. of Science & Technology, Saudi Arabia
Joyce Poon, Max-Planck-Institut für Mikrostrukturphysik, Germany
Todd Stievater, U.S. Naval Research Laboratory, USA
Jeremy Witzens, RWTH Aachen University, Germany

Demo Zone
Monday, 06 March, 14:00–16:15
Room: 6A
Organizers: Ben Puttnam, National Institute of Information and Communications Technology (NICT), Japan; Marco Ruffini, University of Dublin Trinity College, Ireland

Committee: Fatima Gunning, Tyndall National Institute, Ireland; Ezra Ip, NEC Laboratories America Inc., USA; Jelena Pesic, Nokia Bell Labs, France; Raul Muñoz, CTTC, Spain; Dora Van Veen, Nokia Bell Labs, USA

The Demo Zone features live demonstrations of research projects and proof-of-concept implementations in the space of optical communication devices, systems, and networks.

Please refer to the abstract section for full descriptions.
Rump Session: Is the Silicon Photonics Platform about to be Standardized, Diversified or Supplanted?
Tuesday, 07 March, 19:30–21:30
Room: 6F
Moderator: Daniel Kuchta, IBM TJ Watson Research Center, USA; Co-Moderator: Michael Hochberg, Luminous Computing, USA

As the required raw single wavelength data transmission rates now exceed 200 Gbps, the use of the all-Silicon transmitter is threatened by a coven of materials: Thin Film Lithium Niobate, Organic Polymers, Barium Titanate, Plasmonic metals, and of course, InP. Will Silicon Photonics follow the course of integrated circuits and bifurcate into the equivalent of CMOS (pure Si) and Bipolar (Si, SiGe, and everything else) variants? Can pure Si Silicon Photonics maintain commercial dominance? Or will InP finally take over? This year’s rump session will bring together industry provocateurs representing these three competing views and pit them against each other and the audience in an arena containing beer and live lions (the VCSEL community)!

Open Networking Summit: Top to Bottom: Practical Approaches to Openness, Disaggregation, and Reaggregation in Optical Communication
Wednesday, 08 March, 16:30–18:30
Room: 8
Organizers: Yawei Yin, Microsoft, USA; Jim Zou, ADVA, Germany; Dan Pitt, Palo Alto Innovation Advisors, USA

As we look at the success of the “Open” and “Disaggregated” systems in data centers, it is not difficult to draw a few fundamental conclusions: #1, servers came easiest because of standardized processing units, whether it’s x86-based CPU, GPU, or Arm processors, running in Linux-based white-box servers, which have become the norm for even the branded server vendors; #2, the standard interfaces that can connect servers together, i.e., the Ethernet-based NIC card and the BGP/TCP/IP protocol stack that enable the communication, and the appearance of Linux-based white-box switches have not yet resulted in their proliferation beyond the hyperscale realm because of the strength of incumbent brands and the challenges of integrating and supporting disaggregated components, and #3, the optical links, while disaggregated to the pluggable level with standardized interfaces, cannot match the density and scale of the computing world. Moreover, DSP algorithms are still being treated as “secret sauce,” and advanced modulation schema is not connecting different light sources together. Finally, silicon photonics and III-V semiconductors remain silos not amenable to the integration density required for a wide-open market in co-packaged optics and the eye-popping applications in consumer, health, and civic technologies. In this session, we will paint a “coherent” portrait of advancing openness, manageable disaggregation, and heterogeneous integration and reaggregation in optical communication. We will look at the progress in open-source network operating systems, open-source coherent optical light sources, industry standards in DSP algorithms, and manufacturable heterogeneous-integration technologies. Join us to hear from and debate with the experts leading these innovations.

Speakers
Óscar González de Dios, Telefónica I+D, Spain
Stephan Neidlinger, ADVA, Germany
Guohan Lu, Microsoft, USA
David Gomez, X-Celeprint, USA
Tino Jaeger, X-FAB, Germany

Postdeadline Paper Presentations
Thursday, 09 March, 16:30–18:30
Rooms: 6C, 6D, 6E, 6F

Discover the best and most cutting-edge research in optical communications. The OFC 2023 Technical Program Committee has accepted a limited number of Postdeadline Papers for oral presentation. The purpose of Postdeadline Papers is to give participants the opportunity to hear new and significant material in rapidly advancing areas. Only those papers judged to be truly excellent and compelling in their timeliness were accepted.

Lists of accepted papers with their presentation times will be posted throughout the convention center, in the OFC Conference App and online on Tuesday, 07 March.

Special Events

Optical Transmission Systems – Design and Simulation Workshop (Presented by the Optica Foundation & VPIphotonics)

Sunday, 05 March, 13:00–18:00
Room: 31A (Limited Registration. RSVP required to trooney@optica.org)

This workshop will show you how to conceptualize and evaluate optical transmission systems from a communication engineer’s perspective by using professional simulation software. You will learn how to efficiently simulate optical transmission systems and automate the design and analysis of new technologies using VPIphotonics Design Suite. We will investigate transmission systems scenarios for applications ranging from data center interconnects to high-capacity core network links to optical satellite communication links. We will explore general system design concepts, demonstrate how to investigate the impact of performance-limiting effects, and assess how to mitigate or compensate for them.

Topics include:

- Professional simulation software design environment
- Intensity-modulated direct detection systems
- Digital coherent systems
- Free-space optical systems

This workshop targets students and early-career professionals who want to learn how to utilize a professional simulation and design environment for their engineering and research tasks in optical transmission systems. Basic knowledge of technologies, concepts, and methodologies of the various transmission systems is helpful.

This workshop includes a 4-hour session of lectures, guided labs, and independent work with 1-on-1 support. Attendees will be provided access to the software in a cloud-based environment using their own private laptops.

Registration is limited to 35 seats to provide attendees with direct access to our team of experts, so reserve your seat today by contacting trooney@optica.org.

OFC Mentor/Mentee Meet-Up

Monday, 06 March, 12:00–13:00
Room: 17 (Separate registration required. See ofcconference.org/special-events/ for details.)

Are you new to OFC, perhaps a student, a young professional, or even an experienced researcher, but have never been to OFC? Or are you looking for some advice in navigating through your research goals and ambition?

Join us at our mentor match event, where you can meet photonics experts and mentors who may advise you on how to steer through the conference, introduce you to people in the field, share some of their experiences, and find someone who shares a unique talent with you.

The Journal Review Process: All You Need to Know!

Monday, 06 March, 14:00–15:30
Room: 14B

Journal publications are critical for our industry. They are where new results, ideas and demonstrations are reported, after which they are permanently stored and made available for others to use in their own research and design work. This body of knowledge has been built up for the optical industry over many decades. This event will provide a behind-the-scenes look into the journal publications process and allow attendees with the opportunity to ask questions and interact with Editors and Reviewers of some of the highest impact factor Journals in the field of optical communications and networking. It will follow the trail of what happens once a new research paper is submitted to an IEEE or Optica journal.

The event will consist of informative presentations followed by roundtable discussions, hosted by people involved in the review and publication process, willing to answer questions and engage with you. Most importantly, for those interested to learn more, this event will provide guidance on how to get involved in the review process of the most prestigious journal publications in the field of optical telecommunications.

Welcome Address
Andrew Lord, Editor-in-Chief, Journal of Optical Communications and Networking, Sr. Manager of Optical Networks Research, BT, UK; Gabriella Bosco, Editor-in-Chief at IEEE/Optica Journal of Lightwave Technology, Full Professor at Politecnico di Torino, Italy

Overview of the Review Process
Kelly Cohen, Sr. Publisher, Optica Publishing Group, USA

Why be a Reviewer?
Peter Winzer, Former Editor-in-Chief Journal of Lightwave Technology, Founder, Nubis Communications, USA

Are Journals Really Just for Academia?
Sorin Tibuleac, JLT Associate Editor, Director, ADVA Optical Networking, USA

Birds of a Feather: Designing and Operating the Next Generation Optical Photonic Networks

Monday, 06 March, 16:30–18:30
Room: 14B

Starting in 2023, OFCnet brings a new opportunity to the exhibition to demonstrate products, concepts, solutions, research, and architectures in a live high-speed optical network connected to the leading research and education networks worldwide. This increased focus on designing and building the next generations of Optical Networks will expand exposure to connectivity, emerging technologies, Quantum Computer networks, programmability, and network software applications for big data applications.
In this BOF, we propose a workshop series that solicits papers and demonstrator reports on all aspects of building networks out of components and using those networks for the whole range of commodities to extreme applications. Furthermore, we will solicit input on possible challenges for demonstrating novel new architectures, technologies, and implementations.

**Student Party**
Monday, 06 March, 19:00–21:00  
*Location: The Loft, Petco Park*

New to OFC, the Student Party is an opportunity for students to meet and network in a fun and relaxed environment. Please be sure to bring a form of ID with you to the event.

**Conversation with the Plenary Speakers**
Tuesday, 07 March, 10:15–10:45  
*Theater III, Exhibit Hall*

Join OFC General Chairs Ramon Castelles, Chris Cole and Ming-Jun Li for a conversation with Plenary Speakers, Patricia Obo-Nai, Jayshree Ullal and Wendell Weeks.

**Optical Communications Technical Group Poster Pitch Competition**
Tuesday, 07 March, 11:00–12:00  
*Room 3*

You are invited to join the Optica Technical Group on Optical Communications for this fun and interactive session. Students and early career professionals will be sharing their latest research with us through short talks and videos. You will then have the chance to vote for the best poster pitch and network with colleagues over refreshments. Please RSVP at https://forms.gle/ngK4UCFK7729QqU1A to let us know you will be attending.

**Conference Reception**
Tuesday, 07 March, 18:30–20:00  
*Ballroom 20*

Enjoy food and drinks with your friends and colleagues during the conference reception. Tickets for this event are included with all full conference registrations. Additional tickets may be purchased at Registration for USD 85.

**International Women’s Day Breakfast**
Wednesday, 08 March, 07:00–08:30  
*Room: 20A (Limited registration. See ofcconference.org/special-events/ for details.)*

The 2023 United Nation International Women’s Day theme is “DigitALL: Innovation and Technology for Gender Equity.” In support of this, Program Chairs Fotini Karinou, Microsoft Research Ltd, United Kingdom & Elaine Wong, Univ. of Melbourne, Australia, invite you to join them Wednesday, 08 March at 07:00 for breakfast followed by a panel discussion to recognize and celebrate the contributions of women in optical fiber communications.

Panelists will discuss their personal career path and the women who have inspired them and explore the role women have played in innovation and in driving positive transformation in science, technology and engineering. Our panel will comprise thought leaders and innovators in science, engineering and technology.

**The Art of Writing the Perfect OFC Paper**
Wednesday, 08 March, 10:30–12:00  
*Room: 14B*

Organizers: Georg Rademacher, National Inst. of Information & Comm Tech, Japan; Paolo Monti, Chalmers University of Technology, Sweden

Join OFC committee members, journal editors, and distinguished researchers for an interactive workshop on how to write a highly-scored OFC paper. We will discuss the qualities of great OFC submissions and the common reasons why papers are rejected from OFC. The workshop will kick off with a few short talks followed by smaller breakout/brainstorming sessions and end with some time for networking.

**IEEE/Optica Publishing Group Journal of Lightwave Technology 40th Anniversary Luncheon**
Wednesday, 08 March, 17:00–19:30  
*Room: 15AB*

Organizers: China International Optoelectronic Expo (CIOE), Infostone, and Optica

**Data Center Technology at the Crossroads**
Wednesday, 08 March, 17:00–19:30  
*Room: 15AB*

Organizers: China International Optoelectronic Expo (CIOE), Infostone, and Optica

Data center technology is entering a time of great change. After many years of headlong growth, the impetus for continued rapid progress is even stronger, but there are now also unprecedented new options for direction. This workshop will explore a few of the most impactful roadmap choices the industry will have to make in the next three to five years, such as data center coherent, direct-drive optics, CPO/NPO/Chiplet, and Thin-film Lithium Niobate.

All are welcome to hear a select panel of industry experts present and answer questions on this year’s hot topic. Networking dinner offsite will follow the event.

**Rise and Shine Morning Run/Walk**
Thursday, 09 March, 06:00–07:00  
Hilton Bayfront, (Bottom of San Diego Convention Center stairs, front entrance)

Meet up for an early morning three-mile run or walk with fellow colleagues.
Harnessing Digitalization for Effective Social Change
Patricia Obo-Nai, Chief Executive Officer, Vodafone, Ghana

Digitalization is a potent driver of progress in the modern world, particularly in Africa. The increased use of mobile phones has given it the momentum it needs across Africa. However, much more work is required. This talk will touch on what needs to be done to ensure that everyone, especially the most vulnerable, reaps the benefits of the global digital movement.

Patricia Obo-Nai is an experienced leader in Ghana’s telecommunications industry. She was named CEO of Vodafone Ghana in April 2019, making her the first Ghanaian to hold that position in the country’s 10 years of business.

Obo-Nai has a Bachelor of Science in Electrical and Electronic Engineering from Kwame Nkrumah University of Science and Technology (KNUST), an Executive MBA in Project Management from the University of Ghana Business School, and executive education from the Kellogg School of Management, London Business School, and INSEAD in France.

She is passionate about the future of young people and women in the digital age and is a vigorous advocate for STEM. She has advocated for youth and women on a variety of local and international platforms, including the UN General Assembly panel sessions.

The Road to Petascale Cloud Networking
Jayshree V. Ullal, President and Chief Executive Officer, Arista Networks, USA

As the future application demands and compute performance evolve, the network needs to adapt for exponential growth in traffic, connecting tens of thousands of processors with Petahertz bandwidth. As a pioneer in cloud networking, Arista has become synonymous with elastic scaling and programmable provisioning delivering modern data-driven platforms.

Arista believes Moore’s law is alive and will enable next-generation 100-Terabit switching and multi-terabit optics. A networking and Silicon Valley veteran, Jayshree Ullal will discuss the trends, evolution, and impact of petascale and AI-driven networking technologies ahead.

Jayshree V. Ullal

As President and CEO of Arista for over a decade, Ullal is responsible for Arista’s business and thought leadership in cloud networking. She led the company to historic and successful IPO in June 2014 from zero to a multibillion-dollar business. Formerly Ullal was Senior Vice President at Cisco, responsible for a $10B business in datacenter, switching and services. With more than 30 years of networking experience, she is the recipient of numerous awards including E&Y’s “Entrepreneur of the Year” in 2015, Barron’s “World’s Best CEOs” in 2018 and one of Fortune’s “Top 20 Business persons” in 2019.

Ullal holds a B.S. in Engineering (Electrical) and an M.S. degree in engineering management. She is a recipient of the SFSU and SCU Distinguished Alumni Awards in 2013 and 2016.

Capacity to Transform
Wendell P. Weeks, Chairman and Chief Executive Officer, Corning Incorporated, USA

Corning’s Chairman and CEO, Wendell Weeks, will highlight the industry’s growth drivers and breakthrough innovations in product and process, and the importance of connecting the unconnected with glass thinner than a human hair. Mr. Weeks will also share how optical fiber, invented more than 50 years ago, is contributing to greener solutions – benefiting our shared and more sustainable future.

Wendell P. Weeks has served as Corning’s chief executive officer since 2005 and as chairman of its board since 2007. He has been a member of the company’s board of directors since 2000.

Weeks joined Corning in 1983, working in finance, before holding roles in business development, commercial, and general management.

In 1996, he became vice president and general manager of Corning’s optical fiber business. In 2001, he was named president of the company’s Optical Communications division, leading through dynamic market growth and the subsequent challenges of the telecommunications crash. Weeks became Corning’s president and chief operating officer in 2002, helping oversee Corning’s restructuring and return to profitability.

As CEO, he has played an instrumental role in several life-changing innovations, including the development of Corning® Gorilla® Glass. He has earned 33 U.S. patents.

Weeks is a graduate of Lehigh University and earned a Master of Business Administration from Harvard University as a Baker Scholar. He serves on the board of directors at Amazon.com Inc. and on the board of trustees for the Corning Museum of Glass and the Institute for Advanced Study. He is a member of the Liveris Academy Honorary Board.
OFC and Co-Sponsor Awards and Honors

Awards Ceremony and Luncheon
Tuesday, 07 March, 12:00–14:00
Ballroom 20A

Supported by CORNING
Join conference co-sponsors Optica (formerly OSA), IEEE Photonics Society, and IEEE Communications Society for a special luncheon to recognize award and honor recipients from each society. The event is open to all ticket-holders, but seating is limited. Tickets can be purchased for USD 45 at registration.

The following awards and recognitions will be presented at the Awards Ceremony and Luncheon.

2023 John Tyndall Award
First presented in 1987, this award recognizes outstanding contributions in any area of optical-fiber technology that have met the test of time and been of proven benefit to science, technology, or society. It is jointly presented by Optica and the IEEE Photonics Society and is funded by Corning, Incorporated.

Congratulations to this year’s recipient, Ming-Jun Li, Corning Incorporated, USA

Optica 2023 Fellows
Recognizes Optica members who have served with distinction in the advancement of optics and photonics through distinguished contributions to education, research, engineering, business leadership, and society.

Congratulations to the following Fellows:
Kazi Abedin, CACI International, Inc., USA
Anjali Agarwal, CACI | Technology Innovation and Labs, USA
Antonella Bogoni, Sant’Anna School/CNIT, Italy
Xi (Vivian) Chen, Nokia Bell Labs, USA
John D. Downie, Corning Incorporated, USA
Masayuki Fujita, Osaka University, Japan
Gordon Keeler, Defense Advanced Research Projects Agency, USA

IEEE Photonics Society 2023 Fellows
A distinction reserved for select IEEE members who have achieved extraordinary accomplishments. Fellows have contributed importantly to the advancement or application of engineering, science, and technology, bringing the realization of significant value to society.

Congratulations to the following Fellows:
Fabrizio Forghieri, Cisco Photonics, Italy
Magnus Karlsson, Chalmers University of Technology, Sweden
Christina M Lim, University of Melbourne, Australia
Yoshiaki Nakano, The University of Tokyo, Japan
Boon S Ooi, King Abdullah University of Science and Technology, Saudi Arabia
Ping Shum, Southern University of Science and Technology Shenzhen Guangdong, China

IEEE Communications Society 2023 Fellows
Recognizes the extraordinary contributions and accomplishments of IEEE members. Fellows are honored for their outstanding technical, educational, and leadership achievements.

Congratulations to the following Fellows:
Andrew Lord, BT Group, UK
Perry Ping Shum, Southern University of Science and Technology Shenzhen Guangdong, China

IEEE/Optica Journal of Lightwave Technology Best Paper Award
Recognizes the top cited original papers published in JLT in 2020, as determined by a variety of citation metrics and databases. It is presented by the JLT Coordinating and Steering Committees.

Copies of the winning papers will be available at OFC and will be made open access in the IEEE Xplore Digital Library.

Congratulations to the authors of the following paper:
800G DSP ASIC Design Using Probabilistic Shaping and Digital Sub-Carrier Multiplexing by Han Sun1, Mehdi Torbatian1, Mehdi Karimi1, Robert Maher2, Sandy Thomson1, Mohsen Tehran1, Yuliang Gao1, Ales Kumpara1, George Soliman1, Aditya Kakkar1, Mohammad Osman1, Ziad A. El-Sahn1, Clayton Doggart1, Weikun Hou1, Shailesh Sutarwala1, Yuejian Wu1, Mohammad Reza Chitgarha2, Vikrant Lal3, Huan-Shang Tsai2, Scott Corzine2, Jianing Zhang2, John Osenbach3, Sanketh Buggaveeti3, Zulfikar Morbi4, Miguel Iglesias Olmedo5, Irene Leung6, Xin Xu7, Parmijit Sarna8, Vince Dominici2, Steve Sanders2, Mehrdad Ziai8, Antonio Napoli1, Bernhard Spinnler4, Kuang-Tsan Wu1, Parthiban Kandappan5, 1Infinera Canada Inc., Ottawa, Canada; 2Infinera Corp., Sunnyvale, USA; 3Infinera Corp., Allentown, USA; 4Infinera Corp., Munich, Germany

IEEE Photonics Award
Established in 2002, the award is presented for, but not limited to: light-generation, transmission, deflection, amplification and detection, and the optical/electro-optical componentry and instrumentation used to accomplish these functions. Recipients are selected by the Technical Field Awards Council of the IEEE Awards Board.

Congratulations to this year’s recipient, Roel Baets, Ghent University - IMEC, Belgium
Wiley-IEEE Press Professional Book Award
Recognizes the authors of an outstanding monograph or professional book published by Wiley-IEEE Press during a three-year window prior to the year of the nomination. Books must cover a field relevant to the IEEE.

Congratulations to this year’s recipients,
*VCSEL Industry: Communication and Sensing* by Babu Dayal Padullaparthi, VQuanta Private Limited, India; Jim Tatum, *Dallas Quantum Devices*, USA; Kenichi Iga, *Tokyo Institute of Technology*, Japan

Jane M. Simmons Memorial Speakership
Established in 2021 in honor of Jane M. Simmons’ high impact contributions to optical network architecture, design, and planning, the speakership recognizes an invited speaker at OFC. The recognition is endowed by the Simmons Family. The OFC community is encouraged to contribute to the fund by visiting optica.org/donate.

Congratulations to this year’s recipient,
Hong Liu, Google, USA

The Corning Outstanding Student Paper Competition
Endowed through the Optica Foundation by Corning Incorporated, the paper competition recognizes innovation, research excellence, and presentation abilities in optical communications. All students submitting their papers during the regular “call for papers” process for OFC are eligible for the competition. Finalists present their work to the OFC Program and General Chairs in a private session before the conference.

Congratulations to this year’s finalists:
Leonard Budd, ORC, UK
Benjamin Crockett, INRS, Canada
Keren Liu, Chalmers University of Technology, Sweden
George Giamougiannis, Aristotleio Panepistimio Thessalonikis, Greece
Kyousuke Nakada, Kagawa University, Japan
Christos Pappas, Aristotle University of Thessaloniki, Greece
Apostolos Tsakyridis, Aristotle University of Thessaloniki, Greece

The Corning Women in Optical Communications Scholarship
Endowed through the Optica Foundation by Corning Incorporated, these scholarships recognize three outstanding women graduate students studying optical communications and networking.

Congratulations to this year’s recipients:
Hannah Tomio, Massachusetts Institute of Technology, USA
Xiaohui Xu, Purdue University, USA
Wenting Yi, University College London, UK

The Tingye Li Innovation Prize
Presented to an early career professional who has demonstrated innovative research, the prize honors the global impact Tingye Li had on the field of optics and photonics. It is administered by the Optica Foundation, and endowed by Alliance Fiber Optic Products, Inc., AT&T, Optica, IEEE Photonics Society, IEEE Communications Society, Thorlabs, Inc, the Li Family, and supporters of the Tingye Li Memorial Fund.

Congratulations to this year’s recipient, Benjamin Crockett, Institut National de la Recherche Scientifique (INRS), Canada
Activities on the Show Floor

The OFC 2023 Exhibition is the perfect place to build and maintain professional contacts and broaden your knowledge about the companies that lead our industry in product development and technological advances. Hundreds of exhibits showcase the entire continuum of the supply chain – from communication systems and equipment to network design and integration tools and components and devices. In addition, three exhibit hall theaters feature presentations by experts from major global brands and key industry organizations. Get high-level perspectives on hot topics like intra and inter data center connectivity, infrastructure, access networks, optical systems and components and standards and industry updates.

Exhibition

Exhibit Halls B-G

Exhibit Hall Regulations

- All bags are subject to search.
- Neither photography nor videotaping is permitted in the exhibit hall without the express written consent of OFC 2023 Show Management. Non-compliance may result in the surrendering of film and removal from the hall.
- Children under 18 are not permitted in the exhibit hall during set-up and teardown.
- Children 12 and under must be accompanied by an adult at all times.
- Strollers are not allowed on the show floor at any time.
- Soliciting in the aisles or in any public spaces is not permitted.
- Distribution of literature is limited to exhibitors and must be done from within the confines of their booths.
- Smoking is not permitted inside the San Diego Convention Center. You are welcome to step outside the Convention Center to smoke in designated smoking areas only, but please be considerate of others when you do.
- Alcohol is not permitted in the exhibit hall during set-up and tear-down.

Exhibit Hall Coffee Breaks

The exhibit floor is the perfect place to build and maintain professional contacts, and these breaks provide ideal networking opportunities. Complimentary coffee will be served in the exhibit hall at these times:

<table>
<thead>
<tr>
<th>Time</th>
<th>Exhibit</th>
<th>Coffee Breaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, 07 March</td>
<td>10:00–17:00</td>
<td>10:00–10:30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16:00–16:30</td>
</tr>
<tr>
<td>Wednesday, 08 March</td>
<td>10:00–17:00</td>
<td>10:00–10:30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16:00–16:30</td>
</tr>
<tr>
<td>Thursday, 09 March</td>
<td>10:00–16:00</td>
<td>10:00–10:30</td>
</tr>
</tbody>
</table>

Sponsoring Society Exhibits

Exhibit Hall F

Catch up on the latest product and service offerings of the OFC sponsoring societies by visiting their booth or member lounge located in the back of Exhibit Hall F. IEEE is the world’s largest technical professional organization dedicated to advancing technology for the benefit of humanity. Optica is the leading professional association in optics and photonics, home to accomplished science, engineering, and business leaders from all over the world.

Suzanne R. Nagel Lounge

Booth 2839

Named in honor of the first woman chair of OFC the Suzanne R. Nagel lounge is a dedicated, networking space offering attendees the opportunity to meet colleagues, explore new business opportunities and have complimentary expert headshots taken. Attendees can participate in small professional development sessions throughout the week focused on topics ranging from résumé writing to navigating the industry with confidence.

Lounge Hours

<table>
<thead>
<tr>
<th>Time</th>
<th>Exhibit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, 07 March</td>
<td>10:00–17:00</td>
</tr>
<tr>
<td>Wednesday, 08 March</td>
<td>10:00–17:00</td>
</tr>
<tr>
<td>Thursday, 09 March</td>
<td>10:00–16:00</td>
</tr>
</tbody>
</table>

Exhibit Hall Coffee Break Station

Booth 4717

Please refer to your OFC Buyers’ Guide and Addendum for more details on the exhibition and other activities on the show floor, including participating company information, a map of the exhibit hall and specific presentation schedules for many of the programs. Check the OFC Conference App for regular updates to show floor programming.
Market Watch
This three-day series of panel discussions engages the latest application topics and business issues in the field of optical communications. Presentations and panel sessions feature esteemed guest speakers from industry, research and the investment community. The program will be located on the exhibit floor. Attendees can easily attend the sessions and tour the exhibit hall. Audience members are encouraged to participate in the question and answer segments that follow the presentations.

Market Watch and Theater I Schedule

<table>
<thead>
<tr>
<th>Tuesday, 07 March</th>
<th>Wednesday, 08 March</th>
<th>Thursday, 09 March</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:30–12:00</td>
<td>Panel I: State of the Industry</td>
<td>10:30–12:00 Panel V: Perspectives on the Future of ROADDM Technologies and Architectures for Next-Gen Networks</td>
</tr>
<tr>
<td>14:00–15:30</td>
<td>Panel III: 800G / 128GBaud Pluggable Coherent - Key Technologies and Applications</td>
<td>14:00–14:30 Cisco Sponsored Session</td>
</tr>
<tr>
<td>15:45–16:45</td>
<td>COBO: Design Considerations of Optical Connectivity in a Co-Packaged or On-Board Optics Switch</td>
<td>14:45–15:45 3D Sensing in High Volume Consumer and Automotive Applications</td>
</tr>
</tbody>
</table>

Network Operator Summit
This dynamic program presents the inside perspective from service providers and network operators—their issues, drivers, and how their requirements may impact the future of the industry. Everyone in the supply chain, from equipment manufacturers to components, will want to hear what's next in meeting the needs of all network operators.

Network Operator Summit Schedule

<table>
<thead>
<tr>
<th>Wednesday, 08 March</th>
<th>Thursday, 09 March</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15–10:45</td>
<td>Network Operator Summit: Keynote Andreas Gladisch, Vice-President, Deutsche Telekom AG, Germany</td>
</tr>
<tr>
<td>11:00–12:30</td>
<td>Panel I: What's the Value of Optical Network Automation and How Can Optics Help</td>
</tr>
<tr>
<td>13:00–14:30</td>
<td>Panel II: Brownfield Application in Legacy Networks</td>
</tr>
</tbody>
</table>

2023 Show Floor Program Chair
Scott Wilkinson, Cignal AI, USA

Expo Theater II Programming, Exhibit Hall E

Data Center Summit
This program focuses on next generation optical technologies for intra and/or inter data center connectivity. It discusses evolving data center requirements for technologies, equipment, applications and deployment scenarios in hyperscale and enterprise.

Theater II Schedule

<table>
<thead>
<tr>
<th>Tuesday, 07 March</th>
<th>Wednesday, 08 March</th>
<th>Thursday, 09 March</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:45–11:45</td>
<td>OCP: Optics in Future AI Systems: Interconnects, Switching and Processing</td>
<td>12:00–12:30 Data Center Summit: Keynote Chongjin Xi, Senior Director, Chief Communication Scientist, Alibaba Group, USA</td>
</tr>
<tr>
<td>12:00–12:30</td>
<td>Data Center Summit: More than a Clos: Future Datacenter Network Architectures and the Role of Optics</td>
<td>12:30–14:00 Data Center Summit Panel I: Open Line Systems – Can We Shape “Disaggregation” in One Direction?</td>
</tr>
<tr>
<td>12:30–14:00</td>
<td>14:15–15:45 Data Center Summit Panel II:</td>
<td>16:00–17:00 Amphenol Sponsored Session</td>
</tr>
</tbody>
</table>

Please refer to your OFC Buyers’ Guide and Addendum for more details on the exhibition and other activities on the show floor, including participating company information, a map of the exhibit hall and specific presentation schedules for many of the programs. Check the OFC Conference App for regular updates to show floor programming.
**Show Floor**

Please refer to your OFC Buyers’ Guide and Addendum for more details on the exhibition and other activities on the show floor, including participating company information, a map of the exhibit hall and specific presentation schedules for many of the programs. Check the OFC Conference App for regular updates to show floor programming.

---

**Wednesday, 08 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:30–11:30</td>
<td><strong>Ethernet Alliance:</strong> Ethernet in Telecom: The Rise of ZR and ZR+ for Metro (and Beyond?)</td>
</tr>
<tr>
<td>11:45–12:45</td>
<td><strong>OpenZR+:</strong> OpenZR+ MSA - New Developments and Next Steps</td>
</tr>
<tr>
<td>13:00–14:00</td>
<td><strong>OIF:</strong> Defining 800ZR and 800L; An OIF Update</td>
</tr>
<tr>
<td>14:15–15:15</td>
<td><strong>FBA:</strong> The State of Fiber in America</td>
</tr>
<tr>
<td>15:30–16:30</td>
<td><strong>Broadband Forum:</strong> Technologies and Focus to Add Value to the Goal of a Single Multi-Access Optical PON Network</td>
</tr>
</tbody>
</table>

**Thursday, 09 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00–12:00</td>
<td><strong>AIM Photonics</strong> and the Next PIC Generation</td>
</tr>
<tr>
<td>12:15–13:15</td>
<td><strong>OIF:</strong> Enabling Next Generation Co-Packaging Solutions</td>
</tr>
<tr>
<td>13:00–14:30</td>
<td><strong>IPEC:</strong> IPEC Overview of Optoelectronic Technology and Industry Standards in the Cloud Era</td>
</tr>
<tr>
<td>14:45–15:45</td>
<td><strong>FSG Update:</strong> The Second Release of Use Cases and Demonstrations</td>
</tr>
</tbody>
</table>

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**Expo Theater III Programming, Exhibit Hall F**

**Schedule**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tuesday, 07 March</strong></td>
<td></td>
</tr>
<tr>
<td>10:15–10:45</td>
<td>Conversation with the Plenary Speakers</td>
</tr>
<tr>
<td>11:00–12:00</td>
<td><strong>ITU-T SG15:</strong> Standards Update with the Latest on 5G Transport, Higher Speed PON, SDM, OTN Technologies and Interoperable Optical Interfaces</td>
</tr>
<tr>
<td>12:15–12:45</td>
<td>How Innovations in Coherent Optical Engines Can Deliver Substantial Value to Telecom Networks Presented by Infinera</td>
</tr>
</tbody>
</table>

**Wednesday, 08 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15–10:45</td>
<td><strong>SWK Series:</strong> Next Generation Connectivity Presented by Sumitomo Electric Lightwave</td>
</tr>
<tr>
<td>11:00–11:30</td>
<td><strong>OFCnet Quantum Network - Coexistence, Transporting Entanglements</strong></td>
</tr>
</tbody>
</table>

**Thursday, 09 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15–10:45</td>
<td><strong>QXP Innovative Silicon-based Midex Materials for Photonic Integration</strong> Presented by QXP Technologies Inc.</td>
</tr>
<tr>
<td>11:00–11:30</td>
<td><strong>OFCnet Emerging Technologies</strong></td>
</tr>
<tr>
<td>13:30—15:00</td>
<td><strong>MOPA:</strong> Mobile Optics (MOPA) for the 6G Era</td>
</tr>
</tbody>
</table>

**Schedules:**

- **11:40–12:10:** **OFCnet High Performing Networks Demonstrations**
- **13:00–13:30:** **OFCnet Backstage Pass:** Highlighting the Unsung Heroes of Optical Connectivity
- **13:45–14:45:** **OpenROADM:** Open ROADM MSA Updates and Demonstration
- **15:00–15:30:** Bringing Order to Chaos – OIF – Part 1 Presented by OIF
- **15:30–16:00:** Bringing Order to Chaos – OIF – Part 2 Presented by OIF
OFCnet, Booth 5917

Starting in 2023, OFCnet brings a new opportunity to the exhibition to demonstrate products, concepts, solutions, research, and architectures in a live high-speed optical network connected to leading research and education networks worldwide. This increased focus on designing and building the next generation of Optical Networks will enable OFCnet to bring emerging technologies, Quantum Computer networks, programmability, and network software applications for big data applications to the forefront of the industry.

OFCnet Committee

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C. Randy Giles, Optica, USA, Chair
Gwen Amice, EXFO, Canada
Sana Bellamine, CENIC, USA
Dave Brown, Nokia, USA
Cees de Laat, University of Amsterdam, Netherlands
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Maurizio Gazzola, Cisco, USA
Eve Griliches, Cisco, USA
Scott Kohlert, Ciena, Canada
Reza Nejabati, University of Bristol, UK
Kevin Quire, UETN, USA
Tunde Sanda, CENIC, USA
Jim Stewart, UETN, USA
Sergey Ten, Corning, USA
Chris Tracy, Esnet, USA
Carl Williams, CJW Quantum Consulting, USA
Rodney Wilson, Ciena, Canada

Live demonstrations from the following organizations and companies will be connected through OFCnet. Please refer to the Buyers’ Guide for more details.

- ADVA
- Ciena
- ESnet
- Ethernet Alliance
- ID Quantique
- NuCrypt
- Qunnect
- Qubitekk
- Northwestern University - ICAIR
- NTT Labs
- Nokia
- NEC
- OIF
- SDSC
- University of Amsterdam
- University of Bristol
- UCSD
- UTD
- Verizon

OFCnet is supported by:

- CENIC
- Ciena
- Corning
- ESnet
- EXFO
- Huber+Suhner
- Lumien
- VIAVI

Poster Presentations
Exhibit Hall B1

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Session</th>
<th>Location</th>
<th>In-Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday, 08 March</td>
<td>10:30–12:30</td>
<td>W2A</td>
<td>Posters Session I, In-Person</td>
<td></td>
</tr>
<tr>
<td>Thursday, 09 March</td>
<td>10:30–12:30</td>
<td>Th2A</td>
<td>Posters Session III, In-Person</td>
<td></td>
</tr>
</tbody>
</table>

Poster presentations are an integral part of the technical program and offer an opportunity for lively discussion between the poster presenters and attendees.

Beverages and light snacks are served during poster sessions. More information about the posters can be found in the abstract section of this program book.
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Chris Cole, Coherent Corp., USA
Ming-Jun Li, Corning Inc., USA

Program Chairs
Nick Fontaine, Nokia Bell Labs, USA
Fotini Karinou, Microsoft Research Ltd, UK
Elaine Wong, University of Melbourne, Australia

Subcommittees

Track D: Devices, Components, and Fibers

D1: Advanced Prototyping, Packaging and Integration
Long Chen, Cisco Systems, USA, Subcommittee Chair
Juthika Basak, Nokia Corp., USA Long Frank Chang, Source Photonics, USA
Fred Kish, North Carolina State Univ., USA
Sylvie Menezo, SCINTIL Photonics, France
Sam Palermo, Texas A&M Univ., USA
Joris Van Campenhout, IMEC, Belgium
Xi Xiao, Wuhan Research Inst. of Post & Telecom, China
Molly Piels, Juniper, USA

D2: Passive Components
Yikai Su, Shanghai Jiao Tong Univ., China, Subcommittee Chair
Glenn Bartolini, Coherent, USA
Stefano Camatelli, Finisar Australia, Australia
Qixang Cheng, Cambridge Research Inst., UK
Lukas Chrostowski, Univ. of British Columbia, Canada
Kazuhiko Ikeda, AIST, Japan
Christi Madsen, Texas A&M Univ., USA
Sagi Mathai, Hewlett Packard Labs, USA
Miloš Popović, Boston Univ., USA
Mengjie Yu, Univ. of Southern California, USA

D3: Active Components
Hai-Feng Liu, HG Genuine, China, Subcommittee Chair
Tomoyuki Akiyama, Fujitsu Laboratories Ltd., Japan
Omer Khayam, Google LLC, USA
Martin Schell, Fraunhofer Institut, Germany
Matthew Sysak, Ayar Labs, USA
Mitsuru Takenaka, Univ. of Tokyo, Japan
Connie Chang-Hasnain, Berxel, China
Askhan Seyedi, NVIDIA, USA
Patrick Lo, AFM, Singapore
Joyce Poon, Max Planck Institute of Microstructure Physics, Germany
Wei Shi, Univ. of Laval, Canada

D4: Fiber and Propagation Physics
Lara Garrett, Subcom, USA, Subcommittee Chair
Peter Andrekson, Chalmers University of Technology, Sweden
Sophie Camille Bres, EPFL, Switzerland
Ivana Gasulla, Universitat Politecnica de Valencia, Spain
Takashi Matsui, NTT Access Service Systems Labs, Japan
Luca Palmieri, Univ. of Padova, Italy
Georg Rademacher, NICT, Japan
Pierre Sillard, Prismian Group, France
Toshiki Taru, Sumitomo Electric Industries Ltd., Japan
Natalie Wheeler, Univ. of Southampton, UK
Aramias Zakharian, Corning, USA
Benyuan Zhu, OFS Laboratories, USA

D5: Fiber Devices, Fiber Lasers and Amplifiers, and Nonlinear Waveguides
Michael Vasilyev, Univ. of Texas at Arlington, USA, Subcommittee Chair
Raja Ahmad, Molex, USA
John Ballato, Clemson Univ., USA
Xiaoyi Bao, Univ. of Ottawa, Canada
Yong-min Jung, Optoelectronics Research Centre (ORC), UK
Xiaoying Li, Tianjin Univ., China
Yosuke Mizuno, Yokohama National Univ., Japan
Sergei P. Nikitin, T8 Sensor, Russia
Chester C.T. Shu, Chinese Univ. of Hong Kong, Hong Kong

Track S: Subsystems and Systems

S1: Datacom Subsystems and Systems
Xiaodan Pang, Kungliga Tekniska Hogskolan Kista, Sweden, Subcommittee Chair
Robert Borkowski, Nokia Bell Labs, USA
Jingchi Cheng, Huazhong Univ. of Science and Technology, China
Trey Greer, NVIDIA, USA
Fumio Koyama, Tokyo Institute of Technology, Japan
Fan Li, Sun Yat-Sen Univ., China
Wenhua Lin, Intel Corp., USA
Clint Schow, Univ. of California, Santa Barbara, USA
Norman Swenson, Collinear Networks, USA
Brian Taylor, Inphi, USA

S2: Transmission Subsystems
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Di Che, Nokia Bell Labs, USA
Hung-Chang (James) Chien, Marvell Technology, USA
John Downie, Corning Inc., USA
Jianjiang Li, Kuaishou Technology, USA
Gabriele Liga, Technical Univ. of Eindhoven, Netherlands
David Millar, Infinera Canada, Canada
Dario Pilori, INRIM, Italy
Laurent Schmalian, Karlsruhe Institute of Technology, Germany
Ke (Desmond) Wang, RMIT Australia, Australia
Jiang Xu, Hong Kong Univ. of Science and Technology, Hong Kong, China
Xian Zhou, Univ. Of Science & Technology Beijing, China

S3: Transmission Systems
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Fatima Gunning, Tyndall National Institute, Ireland
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Toshiaki Koike-Akino, MERL, USA
Sergei Makovejs, Corning Inc., USA
Antonio Mecozzi, Univ. of L’Aquila, Italy
Alexei Pilipetskii, Subcom, USA
Kohki Shibahara, NTU, Japan
Yuta Wakayama, KDDI Research, Inc., Japan
<table>
<thead>
<tr>
<th>Track N: Networks and Services</th>
</tr>
</thead>
</table>
| **N1: Advances in Development of Systems, Networks and Services**
Albert Rafel, British Telecommunications, UK, Subcommittee Chair
Mattia Cantono, Google, USA
Jiajia Chen, Facebook, USA
Frank Effenberger, Futurewei, USA
Bibin Guan, Microsoft, USA
Qian Hui, Nokia Bell Labs, USA
Priyanth Mehta, Ciena Corp., USA
Stephan Pachnicke, Univ. Kiel, Germany
Dirk van den Borne, Juniper, Germany
Ting Wang, NEC-Labs, USA
Tiejun (TJ) Xia, Verizon Communications Inc., USA
Sophie Zhang, China Telecom, China |
| **N2: Optical Networking for Data Center and Computing Applications**
Georgios Zervas, Univ. College London, UK, Subcommittee Chair
Hitesh Ballani, Microsoft Research Ltd., UK
Keren Bergman, Columbia Univ., USA
Nicola Calabretta, Technische Universiteit Eindhoven, Netherlands
Xiaoliang Chen, Sun Yat Sen Univ., China
Odile Liboiron-Ladouceur, McGill Univ., Canada
Nikos Plerios, Aristotle Univ. of Thessaloniki, Greece
Volker Sorger, George Washington University, USA
Xian Xiao, Hewlett Packard Labs, USA
Ben Yoo, Univ. Of California Davis, USA |
| **N3: Architectures and Software-defined Control for Metro and Core Networks**
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Konstantinos (Kostas) Christodouloupolous, Nokia Bell Labs Germany, Germany
Jamie Gaudette, Microsoft, USA
Hasegawa Hiroshi, Nyoja Univ., Japan
Jason Jue, The Univ. of Texas as Dallas, USA
Dan Kilper, Trinity College Dublin, Ireland
Ricardo Martinez, CTTC, Spain
Cristina Rotondi, Politecnico di Torino, Italy
Hidenori Takahashi, KDDI Research, Inc., Japan
Christine Tremblay, École de Technologie Supérieure, Canada
Murat Yuksel, Univ. of Central Florida, USA
Zuqing Zhu, Univ. of Science & Technology of China, China |
| **N4: Optical Access Networks for Fixed and Mobile Services**
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Nan Chi, Fudan Univ., China
Naveena Genay, Orange Labs Network, France
Shin Kaneko, NTT, Japan
Yuanqiu Luo, Futurewei Technologies, USA
Annachiara Pagano, TIM, Italy
Paola Parolari, Politecnico di Milano, Italy
Dora Van Veen, Nokia Bell Labs, USA
Huang Xingang, ZTE, China
Mu Xu, Cable Labs, USA
Lilin Yi, Shanghai Jiao Tong Univ., China
Jim Zou, ADVA, Germany |
| **N5: Market Watch, Network Operator Summit & Data Center Summit (Invited Program Only)**
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Martin Birk, Curbius, USA
Paulina Gomez, Ciena, Canada
Lisa Huff, Omdia, USA
Kentarou Nakamura, Fujitsu, Japan
Art Nichols, Windstream, USA
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**New! Subcommittee**

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Ann von Lehmen, DARPA, USA

IEEE/Photonics Society
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Jörg-Peter Elbers, ADVA Optical Networking SE, Germany
Dalma Novak, Pharad LLC, USA

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Chris Fludger, Infinera, Germany
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Tetsuya Hayashi, Sumitomo Electric Industries Ltd., Japan
Fotini Karinou, Microsoft, UK
Ming-Jun Li, Coming Inc., USA
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Elaine Wong, University of Melbourne, Australia

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### Explanation of Session Codes

<table>
<thead>
<tr>
<th>Session Designation (alphabetically)</th>
<th>Number (Presentation order within the session)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day Of The Week</td>
<td>M1C.4</td>
</tr>
<tr>
<td>S = Sunday</td>
<td></td>
</tr>
<tr>
<td>M=Monday</td>
<td></td>
</tr>
<tr>
<td>T=Tuesday</td>
<td></td>
</tr>
<tr>
<td>W=Wednesday</td>
<td></td>
</tr>
<tr>
<td>Th=Thursday</td>
<td></td>
</tr>
</tbody>
</table>

- **Series Number**
  - 1 = First series of sessions in day
  - 2 = Second series of sessions in day

The first letter of the code denotes the day of the week (Sunday=Sunday, Monday=M, Tuesday=Tu, Wednesday=W, Th=Thursday). The second element indicates the session series in that day (for instance, 1 would denote the first parallel sessions in that day). Each day begins with the letter A in the third element and continues alphabetically through a series of parallel sessions. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded M1C.4 indicates that this paper is being presented on Monday (M) in the first series of sessions (1), and is the third parallel session (C) in that series and the fourth paper (4) presented in that session.

- **Invited** Invited Presentation
- **Tutorial** Tutorial Presentation
- **Record** Record Presentation
- **Top-Scored** Top Scored Paper
## Agenda of Sessions — Sunday, 05 March

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 6C</th>
<th>Room 6D</th>
<th>Room 6E</th>
<th>Room 6F</th>
<th>Room 7AB</th>
<th>Room 8</th>
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<tbody>
<tr>
<td>08:30–12:30</td>
<td></td>
<td>SC105, SC203, SC208, SC328, SC395, SC432, SC443, SC461, SC463, SC469, SC470</td>
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<td>09:00–12:00</td>
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<td>SC177, SC216, SC444</td>
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<td>12:00–13:00</td>
<td>Lunch Break (on own)</td>
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<tr>
<td>13:00–15:30</td>
<td>S1A • Workshop: Smart Pluggable Coherent Optics: Is it the End of Layered IP Over DWDM?</td>
<td>S1B • Workshop: Quantum Dots - The Resurrection?</td>
<td>S1C • Workshop: Is Optical Access in Good Shape for the Future?</td>
<td>S1D • Workshop: Will Optics Have a Role to Play in Scaling out Future Quantum Computing Architectures? I</td>
<td>S1E • Workshop: Is It Really Game Over for the Quest to Approach Fiber Capacity Limits?</td>
<td>S1F • Workshop: Where are the Boundaries Between IM-DD and Coherent?</td>
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<td>13:00–16:00</td>
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<td>SC447, SC512</td>
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<td>13:00–17:00</td>
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<td>SC267, SC384, SC514</td>
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<tr>
<td>13:00–18:00</td>
<td>Optical Transmission Systems - Design and Simulation Workshop, Room 31A</td>
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<td>15:30–16:00</td>
<td>Coffee Break, Upper Level Corridors</td>
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<tr>
<td>16:00–18:30</td>
<td>S2A • Workshop: Revolutionary vs. Evolutionary SDM Fibers: Extra Gain at Extra Complexity?</td>
<td>S2B • Workshop: Will Machine Learning be the Killer Application for Optical Networks in Data Centres?</td>
<td>S2C • Workshop: Perennial Bandwidth at Home: LiFi or FiWi?</td>
<td>S2D • Workshop: Will Optics Have a Role to Play in Scaling Out Future Quantum Computing Architectures? II</td>
<td>S2E • Workshop: Does Optics have a Role in Space?</td>
<td>S2F • Workshop: Slow and Wide Versus Fast and Narrow: How Do We Make our Datacenters Green?</td>
</tr>
<tr>
<td>19:00–21:00</td>
<td>Hack Your Research! Tools and Tricks for Today’s Telecommunications Techies, Room 17</td>
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Short Courses are an excellent training opportunity to learn about new products, cutting-edge technology and vital information at the forefront of communications. They are offered Sunday and Monday and require an additional fee. Go to ofcconference.org/shortcourse for a list of available short courses and the format in which they will be offered.
### Agenda of Sessions — Monday, 06 March

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1AB</th>
<th>Room 2</th>
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<td>07:30–08:00</td>
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<td>Coffee Break, Upper Level Corridors</td>
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<tr>
<td>08:00–10:00</td>
<td>M1A • Special Session: Ultra-Stable Frequency Sources and their Future Applications in Telecom I</td>
<td>M1B • SDM Devices and Amplifiers</td>
<td>M1C • Circulators, Mode Multiplexers, Dispersion Compensators, Ultrasound and Wavemeters</td>
<td>M1D • Panel: Virtualization in Optical Networks: A Reality Check</td>
<td>M1E • Coherent Technologies for Data Centers</td>
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<tr>
<td>10:30–12:30</td>
<td>M2A • Special Session: High Performance Networks of Future Data Center and Computing Applications</td>
<td>M2B • SDM Devices and Systems</td>
<td>M2C • Fiber- and Waveguide-Based Sensors</td>
<td>M2D • High Speed EMLs and DMLs</td>
<td>M2E • Optical Fiber and Device Modelling</td>
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<td>14:00–16:00</td>
<td>M3A • Symposium: Quantum Information and Optical Communication Networks: Emerging Research Areas, Challenges and Opportunities I</td>
<td>M3B • Multi-Core Fiber</td>
<td>M3C • Free Space and Coupling Devices</td>
<td>M3D • RF and THz Signal Generation</td>
<td>M3E • Enabling Technologies for Data Center and HPC</td>
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<td>14:00–16:15</td>
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<tr>
<td>16:30–18:30</td>
<td>M4A • Symposium: Quantum Information and Optical Communication Networks: Emerging Research Areas, Challenges and Opportunities II</td>
<td>M4B • Multi-Mode Fiber</td>
<td>M4C • High Power and Comb Laser Sources</td>
<td>M4D • Panel: 1.6Tb/s+ Intra-DC Networks</td>
<td>M4E • High Bandwidth Density Interconnects for Computing</td>
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**Key to Shading**

- Short Courses

Short Courses are an excellent training opportunity to learn about new products, cutting-edge technology and vital information at the forefront of communications. They are offered Sunday and Monday and require an additional fee. Go to ofcconference.org/shortcourse for a list of available short courses and the format in which they will be offered.
<table>
<thead>
<tr>
<th>Room 6E</th>
<th>Room 6F</th>
<th>Room 7AB</th>
<th>Room 8</th>
<th>Room 9</th>
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<tbody>
<tr>
<td>M1F • Complexity Optimized Coding and DSP for Optical Communications</td>
<td>M1G • Survivability and Security</td>
<td>M1H • Panel: Towards Standardized PIC Testing: Challenges and Roadmaps</td>
<td>M1I • Photonic Integrated QKD (ends at 09:30)</td>
<td>M1J • Optical Signal Processing</td>
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<tr>
<td>SC359, SC450, SC465</td>
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<td>Coffee Break, Upper Level Corridors</td>
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<tr>
<td>OFC Mentor/Mentee Meet-up, Room 17</td>
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<td>Lunch Break (on own)</td>
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<td>The Journal Review Process: All You Need to Know!, Room 14B</td>
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<td>M3F • LIDAR, RADAR and Ranging Systems</td>
<td>M3G • Telemetry and Synchronisation</td>
<td>M3H • Panel: Optical Fiber Sensing: Technology and Emerging Applications Part I</td>
<td>M3I • Monolithic or 3D Electro-Optical Integration</td>
<td>M3J • Accurate Frequency/Time Distribution and Optical Computing</td>
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<td>M3Z • OFC Demo Zone, Room 6A</td>
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<td>Birds of a Feather: Designing and Operating the Next Generation Optical Photonic Networks, Room 14B</td>
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<tr>
<td>M4F • Visible Light Communications and Positioning (ends at 18:15)</td>
<td>M4G • Multi-X Networks</td>
<td>M4H • Panel: Optical Fiber Sensing: Technology and Emerging Applications Part II</td>
<td>M4I • Passive Silicon Photonic Devices</td>
<td>M4J • Photonic Switching Devices</td>
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<td>Student Party, Petco Park</td>
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<td>08:00–10:00</td>
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<td></td>
<td>Tu1A • Plenary Session, Ballroom 20BCD</td>
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<td>10:00–17:00</td>
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<td>Exhibition and Show Floor, Exhibit Hall (concessions available)</td>
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<tr>
<td>10:00–14:00</td>
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<td>Unopposed Exhibit-only Time, Exhibit Hall (coffee service 10:00–10:30)</td>
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<tr>
<td>10:00–16:45</td>
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<td>OFC Career Zone, Exhibit Hall, B2</td>
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<td>11:00–12:00</td>
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<td>Optical Communications Technical Group Poster Pitch Competition, Room 3</td>
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<tr>
<td>12:00–14:00</td>
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<td>OFC and Co-Sponsors Awards Ceremony and Luncheon, Upper Level, Ballroom 20A</td>
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<tr>
<td>14:00–16:00</td>
<td>Tu2A • Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities I</td>
<td>Tu2B • Photonic Devices for Novel Applications</td>
<td>Tu2C • Deployment and Field Trials</td>
<td>Tu2D • Network Planning and Operation</td>
</tr>
<tr>
<td>16:00–16:30</td>
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<td>Coffee Break, Upper Level Corridors and Exhibit Hall</td>
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<tr>
<td>16:30–18:30</td>
<td>Tu3A • Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities II</td>
<td>Tu3B • Photonic Integrated Circuits</td>
<td>Tu3C • New Materials and Technologies</td>
<td>Tu3D • Network Orchestration</td>
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<td>17:15–18:15</td>
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<td>Exhibitor Reception, Center Terrace</td>
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<td>18:30–20:00</td>
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<td>Conference Reception, Upper Level, Ballroom 20BCD</td>
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<td>19:30–21:30</td>
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<td>Rump Session: Is the Silicon Photonics Platform about to be Standardized, Diversified or Supplanted?, Room 6F</td>
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<tr>
<td>Room 7AB</td>
<td>Room 8</td>
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<td>Exhibit Hall Theater I</td>
<td>Exhibit Hall Theater II</td>
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<tr>
<td>Plenary Session Coffee Break, Upper Level, Ballroom 20 Lobby</td>
<td>Tu1A • Plenary Session, Ballroom 20BCD</td>
<td>Tu2I • Panel: LiDAR Systems and Technologies with Integrated Photonics</td>
<td>MW1 • MW Panel I: State of the Industry</td>
<td>SF2 • OCP: Optics in Future AI Systems: Interconnects, Switching and Processing</td>
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<td>Tu2H • Quantum Computing (ends at 15:45)</td>
<td>MW2 • MW Panel II: PAM vs. Coherent for Data Center Connectivity</td>
<td>DC5 • Data Center Summit Keynote: Past Experiences and Future Prospects of Data Center Interconnect Optical Networks</td>
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<td>Tu2J • Radio-Over-Fiber for 5G and Beyond Systems</td>
<td>SF1 • COBO: Design Considerations of Optical Connectivity in a Co-Packaged or On-Board Optics Switch</td>
<td>12:00–12:30</td>
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<td>DCS1 • DCS Panel I: More than a Clos: Future Datacenter Network Architectures and the Role of Optics</td>
<td>12:30–14:00</td>
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<td>DCS2 • DCS Panel II: Open Line Systems</td>
<td>SF3 • ITU-T SG15: Standards Update with the Latest on 5G Transport, Higher Speed PON, SDM, OTN Technologies, and Interoperable Optical Interfaces</td>
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<td>- Can We Shape “Disaggregation” in One Direction?</td>
<td>How Innovations in Coherent Optical Engines Can Deliver Substantial Value to Telecom Networks Presented by Infinera</td>
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<td>Amphenol Sponsored Session</td>
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<td>OFCnet Optical Engineering and Maintenance</td>
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<td>Tu3H • Quantum Interconnect and Hybrid Classical/Quantum Systems</td>
<td>Tu3I • High-Baud Rate Data Center Technologies</td>
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<td>SF4 • IEEE Future Directions: Space-Based Optical Communications and Networking</td>
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<td>Tu3J • W-Band Fiber-Wireless Links</td>
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<td>OFCnet Quantum Key Distribution</td>
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<td>Coffee Break, Upper Level Corridors and Exhibit Hall</td>
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<td>Exhibitor Reception, Center Terrace</td>
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<td>Conference Reception, Upper Level, Ballroom 20BCD</td>
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<td>Rump Session: Is the Silicon Photonics Platform about to be Standardized, Diversified or Supplanted?, Room 6F</td>
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Exhibit Hall Opens 10:00
Exhibit Hall Closes 17:00
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<td>08:00–10:00</td>
<td>W1A • Advanced Photodetectors</td>
<td>W1B • Special Session: Photonics for Visible Wavelengths I</td>
<td>W1C • Fiber Characterization and Fiber Sensing</td>
<td>W1D • Panel: Advanced Packaging Technologies for Optical Modules</td>
<td>W1E • DSP Design and System Modeling</td>
<td>W1F • 5G and Beyond</td>
<td>W1G • Optical Networks for Machine Learning Systems</td>
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<td>IEEE/Optica Publishing Group Journal of Lightwave Technology</td>
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<td>40th Anniversary Luncheon, Upper Level, Ballroom 20A</td>
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<tr>
<td>14:00–16:00</td>
<td>W3A • Symposium: Beyond the Hype of Network Analytics: Use Cases, Feasibility and Barriers I</td>
<td>W3B • Special Session: Photonics for Visible Wavelengths II</td>
<td>W3C • Devices for Quantum Technologies (Joint D5/SCQ)</td>
<td>W3D • Modulators and Transceivers</td>
<td>W3E • Transmission Impairment Mitigation and Compensation Techniques</td>
<td>W3F • Convergent Optical Access for Mobile Connectivity</td>
<td>W3G • Photonic Processing for Computing and ML</td>
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<tr>
<td>16:30–18:30</td>
<td>W4A • Symposium: Beyond the Hype of Network Analytics: Use Cases, Feasibility and Barriers II</td>
<td>W4B • Lasers and CPO</td>
<td>W4C • Advanced Optical Technologies</td>
<td>W4D • Hollow Core Fiber (ends at 18:15)</td>
<td>W4E • Direct Detection and Short Reach Transmission Systems</td>
<td>W4F • Converged Fixed and Mobile Networks</td>
<td>W4G • Machine Learning for Estimation and Forecasting</td>
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<td><strong>International Women's Day Breakfast, Upper Level, Ballroom 20A</strong></td>
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<td><strong>SF5 • Ethernet</strong></td>
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<td><strong>W1H • Optical Performance Monitoring</strong></td>
<td><strong>W1I • Flexible Coherent PON</strong></td>
<td><strong>Operator Summit: Keynote</strong></td>
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<td><strong>Exhibition and Show Floor, Exhibit Hall, (coffee service 10:00–10:30)</strong></td>
<td><strong>W2A • Posters Session I, In-Person, Exhibit Hall B1</strong></td>
<td><strong>NOSK • Network Operator Summit: Keynote</strong></td>
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<td><strong>OFC Career Zone, Exhibit Hall</strong></td>
<td><strong>W2B • Posters Session II, Remote, ePoster Gallery on OFC website</strong></td>
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<td><strong>The Art of Writing the Perfect OFC Paper, Room 14B</strong></td>
<td><strong>Lunch Break (on own; concessions available in Exhibit Hall)</strong></td>
<td><strong>NOS1 • NOS Panel I: What's the Value of Optical Network Automation and How Can Optics Help</strong></td>
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<td><strong>IEEE/Optica Publishing Group Journal of Lightwave Technology</strong></td>
<td><strong>MW4 • MW Panel IV: Performance-Centric Long Haul</strong></td>
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<td><strong>Unopposed Exhibit-only Time, Exhibit Hall</strong></td>
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<td><strong>NOS2 • NOS II: Brownfield Applications in Legacy Networks</strong></td>
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<td><strong>W3H • Coherent Pluggables and Field Trials</strong></td>
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<td><strong>W3I • Enabling Technology for Free Space Optical Communications</strong> (ends at 15:45)</td>
<td><strong>MW5 • MW Panel V: Connectivity</strong></td>
<td><strong>SF6 • OpenZR+: OpenZR+MSA - New Developments and Next Steps</strong></td>
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<td><strong>W3J • Sensing, Devices and OTDR</strong></td>
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<td><strong>Coffee Break, Upper Level Corridors and Exhibit Hall</strong></td>
<td><strong>MW6 • MW Panel VI: Access</strong></td>
<td><strong>SF7 • OIF: Defining 800ZP and 800LR; an OIF Update</strong></td>
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<td><strong>W4H • Transmission Systems and Modelling</strong></td>
<td><strong>W4I • Hybrid Communication/Sensing Systems</strong> (ends at 18:15)</td>
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<td><strong>W4J • Quantum Networks</strong></td>
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<td><strong>MW7 • MW Panel VII: A New Era of Optical Connectivity</strong></td>
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<td><strong>W4K • Quantum Networks</strong></td>
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<td><strong>SF8 • OpenROADM: OpenROADM MSA Updates and Demonstration</strong></td>
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<td><strong>NOS2 • NOS Panel II: Brownfield Applications in Legacy Networks</strong></td>
<td><strong>SF9 • FBA: The State of Fiber in America</strong></td>
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<td><strong>W4L • Quantum Networks</strong></td>
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<td><strong>SF10 • Broadband Forum: Technologies and Focus to Add Value to the Goal of a Single Multi-Access Optical PON Network</strong></td>
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<td><strong>W4N • Quantum Networks</strong></td>
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<td><strong>SWK Series: Next Generation Connectivity</strong></td>
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<td><strong>W4O • Quantum Networks</strong></td>
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<td><strong>W4Q • Quantum Networks</strong></td>
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<td><strong>OFCnet Quantum Network Coexistence, Transporting Entanglements</strong></td>
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<td><strong>W4S • Quantum Networks</strong></td>
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<td><strong>OFCnet High Performing Networks Demonstrations</strong></td>
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<td><strong>W4T • Quantum Networks</strong></td>
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<td><strong>W4U • Quantum Networks</strong></td>
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<td><strong>With Growing Bandwidth Demand Driving Innovative Optical Technologies, What Is the Impact on Network Architectures Today and Tomorrow? Presented by Infinera</strong></td>
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<td><strong>W4V • Quantum Networks</strong></td>
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<td><strong>W4W • Quantum Networks</strong></td>
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<td><strong>OFCnet Backstage Pass: Highlighting the Unsung Heroes of Optical Connectivity</strong></td>
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<td><strong>W4X • Quantum Networks</strong></td>
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<td><strong>Coffee Break, Upper Level Corridors and Exhibit Hall</strong></td>
<td><strong>40th Anniversary Luncheon, Upper Level, Ballroom 20A</strong></td>
<td><strong>Bringing Order to Chaos – OIF – Part 1</strong></td>
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<td><strong>W5A • Optical Performance Monitoring</strong></td>
<td><strong>W5B • Posters Session I, In-Person, Exhibit Hall B1</strong></td>
<td>Presented by OIF 15:00–15:30</td>
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<td><strong>W5C • Fiber Sensing</strong></td>
<td><strong>W5D • Posters Session II, Remote, ePoster Gallery on OFC website</strong></td>
<td><strong>Bringing Order to Chaos – OIF – Part 2</strong></td>
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<td><strong>W5E • Fiber Sensing</strong></td>
<td><strong>Lunch Break (on own; concessions available in Exhibit Hall)</strong></td>
<td>Presented by OIF 15:30–16:00</td>
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<td><strong>W5F • Fiber Sensing</strong></td>
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**Exhibit Hall Opens at 10:00**

**Exhibit Hall Theater II**

**Exhibit Hall Theater III**

**Exhibit Hall Theatre Closes at 17:00**
### Agenda of Sessions — Thursday, 09 March

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1AB</th>
<th>Room 2</th>
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<td>07:30–08:00</td>
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<td>08:00–10:00</td>
<td>Th1A • Novel Photonic Devices and Applications</td>
<td>Th1B • Nonlinear-Optical Amplifiers and Oscillators</td>
<td>Th1D • Data Center Networks and Control</td>
<td>Th1C • Panel: Promises, Prospects and Challenges of VCSELs for Data Center Interconnects, Free-Space Communications, and Sensing</td>
<td>Th1E • Beyond 400G Transmission</td>
<td>Th1F • Machine Learning and Advanced Digital Signal Processing</td>
<td>Th1G • Signal Processing in Next-Generation PON</td>
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<td>13:00–14:00</td>
<td>Personal Branding for Social Media Workshop, OFC Career Zone, Exhibit Hall</td>
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<td>14:00–16:00</td>
<td>Th3A • Novel Enabling Devices</td>
<td>Th3B • Silicon Photonics Devices and Integrated Circuits</td>
<td>Th3C • Doped Fiber Amplifiers</td>
<td>Th3D • Advances in Data Center Switching and Interconnects</td>
<td>Th3E • Modulation Formats</td>
<td>Th3F • Wideband Transmission Systems</td>
<td>Th3G • High Data-Rate Direct Detection in Access (ends at 15:45)</td>
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<td>16:00–16:30</td>
<td>Coffee Break, Upper Level Corridors</td>
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<td>16:30–18:30</td>
<td>Postdeadline Paper Sessions, Room 6C, 6D, 6E, 6F</td>
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<td><strong>Rise and Shine Morning Run/Walk, Hilton Bayfront</strong></td>
<td><strong>Coffee Break, Upper Level Corridors</strong></td>
<td><strong>Th1J • Panel: How Can We Start to Consistently and Quantitatively Account for End-to-End Power Consumption, Beginning with a Focus on 100 Meter Datacenter Links?</strong></td>
<td><strong>MW5 • MW Panel V: Perspectives on the Future of ROADM Technologies and Architectures for Next-Gen Networks 10:30–12:00</strong></td>
<td><strong>SF11 • AIM Photonics and the Next PIC Generation 11:00–12:00</strong></td>
<td><strong>QXP Innovative Silicon-based Midex Materials for Photonic Integration Presented by QXP Technologies Inc. 10:15–10:45</strong></td>
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<td><strong>OFC Career Zone, Exhibit Hall</strong></td>
<td><strong>Unopposed Exhibit-only Time, Exhibit Hall</strong></td>
<td><strong>SF14 • MOPA: Mobile Optics (MOPA) for the 6G Era 13:30–15:00</strong></td>
<td>**OFC Career Zone Job Fair</td>
<td>Resume Critique Workshop</td>
<td>Mock Interviews**</td>
<td><strong>Exhibit Hall Closes at 16:00</strong></td>
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<td><strong>Lunch Break (on own; concessions available in Exhibit Hall)</strong></td>
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<td><strong>personal Branding for Social Media Workshop, OFC Career Zone, Exhibit Hall</strong></td>
<td><strong>Power of Social Media, OFC Career Zone, Exhibit Hall</strong></td>
<td><strong>Th2A • Posters Session III, In-Person, Exhibit Hall B1 Lunch Break (on own; concessions available in Exhibit Hall)</strong></td>
<td><strong>Th2A • Posters Session III, In-Person, Exhibit Hall B1 Lunch Break (on own; concessions available in Exhibit Hall)</strong></td>
<td><strong>Power of Social Media, OFC Career Zone, Exhibit Hall</strong></td>
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<td><strong>personal Branding for Social Media Workshop, OFC Career Zone, Exhibit Hall</strong></td>
<td><strong>Coffee Break, Upper Level Corridors</strong></td>
<td><strong>Th3I • Panel: Roadmap for Photonic AI Accelerators</strong></td>
<td><strong>Th3H • Free Space and Optical Camera Communications (ends at 15:45)</strong></td>
<td><strong>Th3J • Advanced Control in Quantum Systems</strong></td>
<td><strong>Coffee Break, Upper Level Corridors</strong></td>
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<td>Resume Critique Workshop</td>
<td>Mock Interviews**</td>
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**OFC 2023 • 05–09 March 2023**
Monday, 6 March

08:00–10:00  M1A • Special Session: Ultra-Stable Frequency Sources and their Future Applications in Telecom
Presider: Daniel Blumenthal and Nicolas Fontaine; Nokia Bell Labs, USA and Radan Slavík; Univ. of Southampton, UK

M1A.1 • 08:00  Invited
Title to be Announced, Christopher Hilweg1; ‘Universität Wien, Austria. Abstract not available.

M1B • SDM Devices and Amplifiers
Presider: Yi Sun; OFS Fitel LLC, USA

M1B.1 • 08:00  Invited
Scaling Modal Capacity of Fibers by Exploiting Topological Properties of Light, Siddharth Ramachandran1; ‘Boston Univ., USA. We describe the phenomenon and applications of topological confinement, a light transport mechanism distinct from total-internal reflection that has yielded up to 60 modes over a km with in-fiber intermodal crosstalk as low as -45 dB/km.

M1B.2 • 08:30  Invited
Structured Light Generation in Multicore or Multimode Fiber Amplifiers, Di Lin1; ‘Univ. of Southampton, UK. Abstract not available.

08:00–10:00  M1C • Circulators, Mode Multiplexers, Dispersion Compensators, Ultrasound and Wavemeters
Presider: Glenn Bartolini; Coherent Inc, USA

M1C.1 • 08:00  Invited
Polarization-Insensitive Isolators and Circulators on InP Photonics, Kuiping Jiao1; ‘Technische Universität Eindhoven, Netherlands. On-chip isolators and circulators are regarded as the last piece of puzzle for photonic integrated circuits. In this talk, recent successful demonstration of a polarization insensitive design, compatible with the InP laser process, is presented.

M1C.2 • 08:30  Invited
Fully Passive Integrated-Optic Chromatic Dispersion Compensation and its Use to PM4 Signal Compensation, Koichi Takiguchi1; ‘National Institute of Information and Communications Technologies, Japan. We report an integrated-optic chromatic dispersion compensator without any adjustment parts. The compensator comprises two arrayed-waveguide gratings and 100 fixed delay lines and was used to compensate for 80 Gbit/s pulse amplitude modulation signal distortion.

08:00–10:00  M1D • Panel: Virtualization in Optical Networks: A Reality Check
Organizers: Jamie Gaudette, Microsoft, USA; Ricardo Martinez, CTC, Spain; Annachiara Pagano, Telecom Italia, Italy
Speakers: Filippo Cugrini, CNIT, Italy; Oscar González de Dios, Telefonica, Spain; Darren Lohr, Google, USA; Priyanshu Mehta, Ciena, USA; Emilio Riccardi, Telecom Italia, Italy
Description: Over the last few years, telecom operators have consolidated the strategy for achieving cost-effective and flexible vendor-neutral open solutions by disaggregating the optical transport infrastructure. This will permit telecom operators to face the continuous growth of traffic while keeping a similar network cost (e.g., eliminating vendor lock-in). A key enabler to that is the virtualization concept applied in a broad sense to embrace both the control management and data plane.

The complexity for managing and controlling open and disaggregated networks notably increases since multiple providers at the system and component level will come into play. Thus, it is needed to rely on vendor-neutral control solutions (e.g., ONF Open Disaggregated Transport Networks, OpenCOTN) where open and standard APIs enable the SDN controllers configuring multi-vendor network nodes. With respect to the SDN control architectures, an emerging solution revolves around the cloud-native (microservices) technology with the aim to overcome the classic monolithic implementations towards a more agile, flexible, and scalable controllers (e.g., µONOS).

At the data plane, the disaggregation helps eliminating the vendor lock-in where an interesting step on this strategy is the evolution towards open packet optical transport. PROF: project within the Telecom Infra Project, TIP). White boxes decouple the providers of both hardware, based on COTS and open components, from the software, i.e., Network Operating System (e.g., SONIC, Stratum, …). This is enabled by open interfaces with the aim to accelerate the innovation, reduce cost, and increase the flexibility within disaggregated transport networks.

The panel is expected to last 2h (5-6 speakers are expected with 10-15 minute). Speakers from academia, system vendors, telecom operators, and service providers will share their views on the current challenges faced by deploying and operating virtualized optical network infrastructure. In addition, they will address the tradeoffs at play, identify the sweet spots of the expected with 10-15 minute).

08:00–10:00  M1E • Coherent Technologies for Data Centers
Presider: Norman Swenson; Norman Swenson Consulting, USA

M1E.1 • 08:00  Invited
Power Efficient Coherent Detection for Short-Reach System, Hongbin Zhang1; ‘Cisco Systems Inc, USA.
Faster-than-Nyquist QPSK based on symbol-rate DSP can maximize the link loss budget and enable a single laser solution and low-power driver design in 1.6 Tb/s DR4 short-reach systems.

M1E.2 • 08:30  Invited
Self-Coherent Transmission Using Metasurface-Based Stokes-Vector Receiver, Go Somai1, Yoshihiro Nomoto1, Toshimasa Umezawa2, Yuki Yoshida2, Yoshiaki Nakano1, Takuo Tanemura3; ‘School of Engineering, The Univ. of Tokyo, Japan; ‘Central Research Laboratory, Hamamatsu Photonics K.K., Japan; ‘National Inst. of Information and Communications Technologies, Japan.
Stokes-vector receiver with compact metasurface and two-dimensional photodetector array is developed to demonstrate 15-Gbaud 16QAM self-coherent transmission over 25-km single-mode fiber. Surface-normal configuration enables direct coupling to multi-core fibers in the future highly parallelized systems.
M1F • Complexity Optimized Coding and DSP for Optical Communications
Presider: Gabriele Liga; Eindhoven Univ. of Technology (TUe), Netherlands

M1G • Survivability and Security
Presider: Paolo Monti; Chalmers Univ. of Technology, Sweden

M1G.1 • 08:00 Invited
Flexible Survivability in Multi-Band Next-Generation Optical Transport Networks, Antonio Eira1, Andre Souza1, João Pedro1, 1Infinera Corporation, Portugal; 2Instituto de Telecomunicações, Portugal.
We evaluate survivable network design options in the scope of C+L long-haul systems with high baud-rate channels. The analysis shows how design margins required for different failure response levels significantly affect resource and cost efficiency.

M1G.2 • 08:30 P4-Based Telemetry Processing for Fast Soft Failure Recovery in Packet-Optical Networks, Filippo Cugini1, Carlos Natale da Silva1, Davide Scano1, Francesco Paolucci1, Paolo Monti1; 1CNIT, Italy; 2Electrical Engineering, Chalmers Univ. of Technology, Sweden; 3Scuola Superiore Sant’Anna, Italy. A novel framework for n-network P4 processing of distributed telemetry data is presented, enabling effective soft failure detection and recovery strategies enforced in just few microseconds.

M1I • Photonic Integrated QKD
Presider: Cheryl Sorace-Agaskar; MIT Lincoln Laboratory, USA

M1I.1 • 08:00 Invited
A Chip-Based Quantum Access Network Without Trusted Relays, Feihu Xu1, 1Univ. of Science and Technology of China, China. I will report our recent efforts towards the construction of a chip-based quantum access network using the measurement-device-independent protocols. This includes the recent experiments on Si chip-based QKD, high-rate QKD, twin-field QKD and all-photonic quantum repeater.

M1I.2 • 08:30 CV-QKD Receiver Platform Based on a Silicon Photonic Integrated Circuit, Yoann Piétri1, Luis Trigo Mestre1, Eleni Diamanti1, 1CNRS - Sorbonne Université, France; 2ICFO - Institut de Ciències Fotòniques, The Barcelona Inst. of Science and Technology, Spain; 3Université Paris-Saclay, Institut d’Optique Graduate School, CNRS, Laboratoire Charles Fabry, France. We report on the characterization of a SiGe PIC-based receiver along with its usage in a Gaussian-modulated coherent state CV-QKD setup. Excess noise measurements lead to secret key rate estimations of 280 kbits/s at 6.9 km.

M1I.3 • 08:30 Wide-Bandwidth, Enhanced-Quality Wireless Signal Detection With Low-Bandwidth Devices, Mohammad Elsayed1, Jarosh Meyer1, Younus Mandawala1, Karanveer Singh1, Paulomi Mandal1, Evans Baidoo1, Aymar M. Molhrab1, Thomas Schneider1, 1Technische Universität Braunschweig, Germany; 2Optoelectronica, Military Technical college, Egypt. We discuss a new method for detecting high-bandwidth wireless signals with low-bandwidth electronics. We experimentally demonstrated the detection of 24 GBd-QPSK Nyquist data with 4 GHz electronics and a Q-factor enhancement of 2.2 dB. © 2023 The Author(s)

M1J • Optical Signal Processing
Presider: Bill Corcoran; Monash Univ., Australia

M1J.1 • 08:00 Ultra-Wideband Pulse Generation Based on Dispersion-Diversity Multicore Fiber, Mario Ureña Gibrat1, Sergio García Cortijo1, Ivana Gasulla Mestre1, 1Universitat Politécnica de València, Spain. We experimentally demonstrate, for the first time, reconfigurable arbitrary waveform generation using a dispersion-diversity heterogeneous multicore fiber by synthesizing a variety of tunable high-order ultra-wideband pulses (up to 7 samples).

M1J.2 • 08:15 Power Dissipation Bounds for Photonic Analog to Digital Converters, Callum Deakin1, Zhixin Liu1, 1Univ. College London, UK. We present the first power dissipation bounds for a generalised class of photonic analog to digital converters, and estimate achievable power efficiency compared to conventional electronic designs.

M1J.3 • 08:30
Wide-Bandwidth, Enhanced-Quality Wireless Signal Detection With Low-Bandwidth Devices, Mohammad Elsayed1, Jarosh Meyer1, Younus Mandawala1, Karanveer Singh1, Paulomi Mandal1, Evans Baidoo1, Aymar M. Molhrab1, Thomas Schneider1, 1Technische Universität Braunschweig, Germany; 2Optoelectronica, Military Technical college, Egypt. We discuss a new method for detecting high-bandwidth wireless signals with low-bandwidth electronics. We experimentally demonstrated the detection of 24 GBd-QPSK Nyquist data with 4 GHz electronics and a Q-factor enhancement of 2.2 dB. © 2023 The Author(s)
M1A • Special Session: Ultra-Stable Frequency Sources and their Future Applications in Telecom—I—Continued

M1B • SDM Devices and Amplifiers—Continued

M1C • Circulators, Mode Multiplexers, Dispersion Compensators, Ultrasound and Waveformers—Continued

M1D • Panel: Virtualization in Optical Networks: A Reality Check—Continued

M1E • Coherent Technologies for Data Centers—Continued

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**M1A.3 • 09:00** Invited

*Title to be Announced,* Franklyn Quinlan1; 1National Inst of Standards & Technology, USA. Abstract not available.

**M1B.3 • 09:00**

Modal Gain Equalization of Few-Mode Erbium-Doped Fiber Amplifiers Enabled by Mirrored Mode Exchanges, Tao Xu1, Zhiqun Yang1, Yaping Liu1, Jiang Guo1, Rui Zhou1, Xinhuo Xiao1, Weihao Li1, Wei Li1, Cheng Du1, Zhanhua Huang1, Lin Zhang1; 1Tianjin Univ., China; 2Huawei Technologies Co., Ltd., China; 3FiberHome Telecommunication Technologies Co., Ltd., China; 4Peng Cheng Laboratory, China. We propose a six-mode erbium-doped fiber amplifier with significantly reduced differential modal gain (DMG) by mirrored exchanging of the spatial modes for the first time. A DMG of <1.8 dB across the whole C-band is experimentally achieved.

**M1C.3 • 08:45**

Free-Standing, Microscale, Mode-Selective Photonic Lantern Supported by a Truss Structure, Yoav Dana1, Dan Marom1; 1Rehovot Univ. of Jerusalem, Israel. We design, fabricate and characterize a three-mode selective photonic lantern using 3D waveguides made of photopolymer core and air-cladding. Although the waveguides exhibit high index contrast, crosstalk between mode groups measures below -10dB.

**M1C.4 • 09:00**

Fabrication-Tolerant, 2-Mode, 4λ Multiplexer Based on Si Waveguides for Beyond Tbit/s Optical Ethernet, Takeshi Fujisawa1, Kunimasa Saiochi1; 1Hokkaido Univ., Japan. A fabrication-tolerant, 2-mode, 4λ multiplexer is proposed for beyond Tbit/s optical Ethernet system. Various techniques for strengthening fabrication tolerance are introduced, and a proof-of-concept device is fabricated for Si-photonics platform.

**M1C.5 • 09:15**

Athermal Silicon Photonic Wavemeter With Wide Temperature Range, Brian Stern1, Kwangwoong Kim1, Harry Gans1, David Batdul1; 1Nokia Bell Labs, USA; 2III-V Lab (a joint lab of Nokia Bell Labs, Thales & CEA-LETI), France. We demonstrate a silicon photonic wavemeter with high accuracy for broadband measurements over a large temperature range of 20-60°C. The integrated wavemeter reaches a mean error of 11 pm over an 80 nm span.

**M1D.3 • 09:00**

Panel: Virtualization in Optical Networks: A Reality Check—Continued

The panel will consist of two parts, one more related to the disaggregated / white-box data plane aspects and one targeting more service and network control aspects. Finally, the panel will end with a panel discussion where the invited speakers and the audience will discuss the issues highlighted during the various talks.

**M1E.3 • 08:45**

DSP-Free Frequency Stabilized DCI Coherent Fiber Links Operating at 5.4Tbps 15λx90G-16QAM, 330G 72G-32QAM, and 336G 56G-64QAM, Mark W. Harrington1, Grant Brodnik1, Andrei Isichenko1, Kaikai Liu1, Travis Briles2, Scott Papp2; 1University of Colorado, USA; 2Time and Frequency division 688, NIST, USA. We demonstrate a 5.4 Tbps (90G-16QAMx15λ) DSP-free WDM coherent link and compare performance to single-λ 360G 72G-32QAM and 56G-64QAM coherent links over 100m using an integrated coil-resonator-stabilized Brillouin-laser-pumped integrated Kerr-comb.

**M1E.4 • 09:00** Invited

Self-Homodyne Coherent Systems for Short-Reach Optical Interconnects, Ming Tang1; 1Huazhong Univ of Science and Technology, China. Self-homodyne coherent detection scheme is promising for short-reach optical interconnect for its significantly reduced complexity and compatibility with legacy coherent infrastructure without sacrificing spectral efficiency. Solutions towards practical use are presented here with future perspectives.
M1F.3 • 08:45
Packet-Optical Differentiated Survivability Implemented by P4 Slices and GNMI Telemetry. Rossano P. Pirlo1, Kayal S. Mayer1, Dallon S. Arantes1, Dari Mello1, Christian E. Rothenberg1; UNICAMP, Brazil. We demonstrate a packet-optical differentiated survivability mechanism implemented in P4 switches using GNMI telemetry. The controller detects the premium slice interruption and switches it to an alternative path reducing the throughput of the regular slice.

M1F.4 • 09:00
Invited
Enhancement of Network Cloud Ecosystem Resilience With Openness Disaggregation and Cooperation. Sugang Xu1, Kiyo Ishii2, Noboru Yoshikane2, Subhadeep Sahai1, Sifat Ferdous3, Masaki Shirawa2, Yuuke Hirota2, Takeshi Tantani1, Massimo Tomatone1, Yoshinari Awaji1, Shu Namiki2, Biswaranath Mukherjee1; National Inst. of Informatics, Japan; 2NTT Network Innovation Laboratories, Japan; 3KDDI Research, Inc., Japan; 4Politecnico di Milano, Italy. We investigate the problem of enhancing the resilience of future optical network-cloud ecosystems. We introduce new solutions to build disaster-resilient single- and multi-entity network-cloud ecosystems with openness, disaggregation, and cooperation between networks and clouds.

M1G.3 • 08:45
InP-Based CV-QKD PIC Transmitter. Jennifer D. Aldama1, Samael Sarmiento-Hernández2, Sebastian Etcheverry1, Ignacio López Grande1, Luis Trigo Vidarte1, Lorenzo Castellano1, Alberto Hirogasa1, Tobias Beckenherst2, Yoann Pietri3, A. Rhoumi3, Eleni Diamant3, Valerio Puni4; ICFQ-Institut de Ciencies Fotoniques, Spain; 2VLC, Spain; 3Fraunhofer HHI, Germany; 4Sorbonne Université, CNRS, France. An InP-based photonic integrated circuit (PIC) transmitter for pulsed Gaussian-modulated coherent-state (GMCs) CV-QKD protocol is presented and characterized. Results show potential asymptotic secret key rates of 0.4 Mbps at 11 km, and up to 2.3 Mbps in back-to-back configuration.

M1G.4 • 09:00
Invited
Demonstration of Reference Frame Independent Quantum Key Distribution With Integrated Optical Circuits. Kyongchun Lim1, Byung-seok Choi1, Joong-Soon Cho1, Ju Hee Baek1, Minchul Kim1, Kap-Joong Kim1, Chun Ju Youn2; ETRI, Korea (the Republic of). Free-space quantum key distribution usually requires limited space and weight. We implement reference frame independent quantum key distribution protocol with chip-scale integrated optical circuits such as laser diode, variable optical attenuator, and polarization beam combiner.

M1H.3 • 08:45
Polarization-Encoded BB84 QKD Transmitter Sourced by a SiGe Light Emitter. Florian Horz1, Nemjana Vekic1, Philip Walther1, Hannes Hüb1, Bernhard Schrenk1; AIT Austrian Inst. of Technology, Austria; 2Faculty of Physics, Univ. of Vienna, University Wien, Wien, Wien, AT, academic, Austria. We demonstrate a polarization-encoded BB84 transmitter sourced by a SiGe light source and show that such a potentially “all-silicon” QKD scheme can operate well below the OBER threshold at which secret keys can be established.

M1I.4 • 08:45
Invited
Automatic Turbulence Resilience in Self-Coherent Free-Space Optical Communications. Runchou Zhang1, Xinzhou Su2, Hao Song1, Huiben Zhou2, Moshe Tur1, Alan Willner1; 1Univ. of Southern California, USA; 2Tel Aviv Univ., Israel. We review the recently reported self-coherent approaches that can enable resilient free-space optical communications using automatic optoelectronic multi-mode mixing.
M1A • Special Session: Ultra-Stable Frequency Sources and their Future Applications in Telecom I—Continued

M1A.4 • 09:30 Invited
Title to be Announced, Mark Saffman1; 1Univ. of Wisconsin-Madison, USA. Abstract not available.

M1B • SDM Devices and Amplifiers—Continued

M1B.5 • 09:30 Invited
Photonic-Lantern-Based MDM Devices, Lars E. Gruner-Nielsen1,2; 1DTU Electro, Tech Univ of Denmark, Denmark; 2Danish Optical Fiber Innovation, Denmark. Results for air clad photonic lanterns are presented including new results for a 6-mode photonic lantern. Results for cross talk dynamics in a 1.6 km link versus both time and wavelengths are presented.

M1C • Circulators, Mode Multiplexers, Dispersion Compensators, Ultrasounds and Wavemeters—Continued

M1C.6 • 09:30
64-Channel Fiber-Optic Ultrasound Detector Array With High Sensitivity for Photoacoustic Imaging, Anqi Wang1; 1Huazhong Univ. of Science and Technology, China. We present a 64-channel fiber-optic ultrasound detector array with high sensitivity. The sensor can exhibit a NEP of 0.64kPa and a wide bandwidth about 47MHz, which gives a favorable resolution of photoacoustic imaging.

M1D • Panel: Virtualization in Optical Networks: A Reality Check—Continued

M1E • Coherent Technologies for Data Centers—Continued

M1E.5 • 09:30 Top-Scored
A 224 Gbps/λ O-Band Coherent Link for Intra-Data Center Applications, Aaron Maharry1; 1UC Santa Barbara, USA; 2Intel Corporation, USA. We present the first >200 Gbps/λ O-band optical link with integrated transmitter and receiver photonic and electronic ICs. 224 Gbps/λ DP-QPSK transmission is demonstrated below the 3.8×10-3 HD-FEC threshold with 6.8 pJ/bit power consumption.

M1E.6 • 09:45
A 200Gb/s QAM-16 Silicon Photonic Transmitter With 4 Binary-Driven EAMs in an MZI Structure, Arian Hashemi Talkhooncheh1; 1California Inst. of Technology, USA; 2Rockley Photonics Inc., USA. A DAC-less 200Gb/s QAM-16 transmitter in a multi-micron silicon-photonics platform using 4 binary-driven SiGe EAMs in an unbalanced MZI is presented. The transmitter exhibits bit-error rates of 3×10-4 and 2.8×10-4 for square and hexagonal constellations.


09:00–12:00 SC359, SC450, SC465

10:00–10:30 Coffee Break, Upper Level Corridors
M1F.4 • 09:30
Top-Scored
FPGA Implementation of Multi-Layer Machine Learning Equalizer With on-Chip Training, Keren Liu1, Christian Häger2, Erik Borjeson3, Per Larsson-Edefors1; 1Department of Computer Science and Engineering, Chalmers Univ. of Technology, Sweden; 2Department of Electrical Engineering, Chalmers Univ of Technology, Sweden. We design and implement an adaptive machine learning equalizer that alternates multiple linear and nonlinear computational layers on an FPGA. On-chip training via gradient backpropagation is shown to allow for real-time adaptation to time-varying channel impairments.

M1G.5 • 09:30
An Open Line System With Ultra-Fast Protection Switching for Data Center Interconnect, Juan Wang1, Yu Jin1, Chen Zhu1, Feng Gao1, Yongge Cui1, Gang Cheng1, Xu Zhou1; Baidu, China. We present a DCI OLS with 5ms ultra-fast protection switching. By optimizing the DSP traffic rebuild time with a magneto-optic switch, we are able to improve the current ITU standard by an order of magnitude.

M1J.6 • 09:45
Photonic Max-Pooling for Deep Neural Networks Using a Programmable Photonic Platform, Farshid Ashtiani1, Mehmet Berkay On1,2, David Sanchez-Jacome1, Daniel Pérez-López1, S. J. Ben Yoo1, Andrea Blanco-Redondo2; 1Nokia Bell Labs, USA; 2Univ. of California Davis, USA; 2Phonics, Spain. We propose a photonic max-pooling architecture for photonic neural networks which is compatible with integrated photonic platforms. As a proof of concept, we have experimentally demonstrated the max-pooling function on a programmable photonic platform consisting of a hexagonal mesh of Mach-Zehnder interferometers.

M1F.5 • 09:45
Area-Efficient Neural Network CD Equalizer for 4x200Gb/s PAM4 CWDMA Systems, Bo Liu1, Christian Bluemmler1, Stefano Calabrò2, Bing Li1, Ulf Schlömann1; 1Technical Univ. of Munich, Germany; 2Huawei Technologies Dusseldorf GmbH, Germany. We use multi-task learning to train a neural network on datasets of multiple wavelengths to mitigate chromatic dispersion. Shared weights allow logic simplification of multipliers. Flexible biases allow a low BER. Results show the neural network equalizer achieves a similar BER compared with a Volterra equalizer with 71% reduction in hardware area.

M1G.6 • 09:45
Man-in-the-Middle Attacks Through Re-Shaping I-Q Optical Constellations, Marc Ruiz1, Jaume Cornellas1, Luis Velasco1; Universitat Politècnica de Catalunya, Spain. A module to re-shape optical constellations making the optical signal resembles as it has traversed some distance is presented. Armed with this module, Man-in-the-Middle attacks can be performed, which could be undetectable by security systems.

M1F.5 • 09:45
Area-Efficient Neural Network CD Equalizer for 4x200Gb/s PAM4 CWDMA Systems, Bo Liu1, Christian Bluemmler1, Stefano Calabrò2, Bing Li1, Ulf Schlömann1; 1Technical Univ. of Munich, Germany; 2Huawei Technologies Dusseldorf GmbH, Germany. We use multi-task learning to train a neural network on datasets of multiple wavelengths to mitigate chromatic dispersion. Shared weights allow logic simplification of multipliers. Flexible biases allow a low BER. Results show the neural network equalizer achieves a similar BER compared with a Volterra equalizer with 71% reduction in hardware area.

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**Monday, 6 March**

**10:30–12:30**

**Room 1AB**

**M2A • Special Session: High Performance Networks of Future Data Center and Computing Applications**

[Room 2]

**M2B • SDM Devices and Systems**

**Title to be Announced, Rui Wang; Google LLC, USA. Abstract not available.**

**Invited**

**M2B.1 • 10:30**

Performance Requirements for FIFO-Less Multicore Fibre Repeaters in Transatlantic-Class Transmission, Daniel J. Elson1, Yuta Wakayama2, Noboru Yoshikane1, Takehiro Tsutsumi1, KDDI R&D Laboratories, Japan.

**M2B.2 • 11:00**

Top-Scored

10-Spatial-Mode 1300-km Transmission Over 6-LP Graded Index Few-Mode Fiber With 36-m Modal Dispersion, Kohki Shishihara1, Megumi Hoshi1, Yutaka Miyamoto1, NTT Network Innovation Laboratories, Japan. We demonstrate record-long 10-mode-multiplexed transmission over 1300 km with 6-LP few-mode-fiber with modal dispersion coefficient of 157 ps/km. Modal-dispersion-unmanaged link was built by cyclic mode-group permutation, achieving reduction in modal dispersion accumulation by 82%.

**M2C • Fiber- and Waveguide-Based Sensors**

**Invited**

**M2C.1 • 10:30**

Transforming Subsea Optical Cables Into a Giant Network of Environmental Sensors, Giuseppe Marra1, National Physical Laboratory (UK, UK). 70% of the Earth’s surface is water-covered, yet the ocean floor remains mostly unmonitored. We show how ultra-stable interferometry can change this by enabling seafloor cables to be used as arrays of environmental sensors.

**M2C.2 • 11:00**

Top-Scored

High-Sensitivity Acoustic Impedance Sensing Using Forward Stimulated Brillouin Scattering in Highly Nonlinear Fiber, Koenig Zeng1, Jiang Song1, Ming Tang1, Deming Liu1, Huazhong Univ. of Sci. & Tech., China. High-sensitivity acoustic impedance sensing has been demonstrated for the first time by using radial acoustic modes induced forward Brillouin scattering in highly nonlinear fiber. The measurement sensitivity has been improved to be 3.83 MHz/mm².

**M2D • High Speed EMLs and DMLs**

**Invited**

**M2D.1 • 10:30**

Ultrahigh Speed EA-DFB Lasers Beyond 200 Gbps per Lane, Kazuho Naoe1, Lumentum Japan, Inc., Japan. We describe 224 Gbps-PAM4 uncooled operation by EA-DFB. Moreover, 330 Gbps-PAM6 (128-Gbaud PAM6), 384 Gbps-PAM8 (128-Gbaud PAM8) and 420 Gbps-PAM8 (140-Gbaud PAM8) operations by ultrahigh speed EA-DFB are reviewed.

**M2D.2 • 11:00**

Top-Scored

225 Gb/s PAM4 2 km and 10 km Transmission of EMLs With Hybrid Waveguide Structure for 800G & 1.6TE Transceivers, Asami Uchiyama1, Keyan Zeng1, Liang Wang1, Asami Uchiyama1, Keyan Zeng1, Liang Wang1, Photonic Reservoir, Canada. We experimentally demonstrate 10 km transmission of 225 Gb/s PAM4 modulation signal using our developed high-speed EMLs with a hybrid waveguide structure. Clear eye patterns were observed with 5 taps of TDECQ reference equalizer.

**Monday, 6 March**

**10:30–12:30**

**Room 2**

**M2A • Special Session: High Performance Networks of Future Data Center and Computing Applications**

**Room 3**

**Room 6C**

**Room 6D**

**10:30–12:30**

**Room 1AB**

**M2A • Special Session: High Performance Networks of Future Data Center and Computing Applications**

[Room 2]

**M2B • SDM Devices and Systems**

**Title to be Announced, Rui Wang; Google LLC, USA. Abstract not available.**

**Invited**

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Performance Requirements for FIFO-Less Multicore Fibre Repeaters in Transatlantic-Class Transmission, Daniel J. Elson1, Yuta Wakayama2, Noboru Yoshikane1, Takehiro Tsutsumi1, KDDI R&D Laboratories, Japan. We use the extended droop model to evaluate the performance requirements for SDM repeaters in transatlantic systems. The impact of repeater crossstalk on cable capacity is evaluated separately from fibre effects.

**M2B.2 • 11:00**

Top-Scored

10-Spatial-Mode 1300-km Transmission Over 6-LP Graded Index Few-Mode Fiber With 36-m Modal Dispersion, Kohki Shishihara1, Megumi Hoshi1, Yutaka Miyamoto1, NTT Network Innovation Laboratories, Japan. We demonstrate record-long 10-mode-multiplexed transmission over 1300 km with 6-LP few-mode-fiber with modal dispersion coefficient of 157 ps/km. Modal-dispersion-unmanaged link was built by cyclic mode-group permutation, achieving reduction in modal dispersion accumulation by 82%.

**M2C • Fiber- and Waveguide-Based Sensors**

**Invited**

**M2C.1 • 10:30**

Transforming Subsea Optical Cables Into a Giant Network of Environmental Sensors, Giuseppe Marra1, National Physical Laboratory (UK, UK). 70% of the Earth’s surface is water-covered, yet the ocean floor remains mostly unmonitored. We show how ultra-stable interferometry can change this by enabling seafloor cables to be used as arrays of environmental sensors.

**M2C.2 • 11:00**

Top-Scored

High-Sensitivity Acoustic Impedance Sensing Using Forward Stimulated Brillouin Scattering in Highly Nonlinear Fiber, Koenig Zeng1, Jiang Song1, Ming Tang1, Deming Liu1, Huazhong Univ. of Sci. & Tech., China. High-sensitivity acoustic impedance sensing has been demonstrated for the first time by using radial acoustic modes induced forward Brillouin scattering in highly nonlinear fiber. The measurement sensitivity has been improved to be 3.83 MHz/mm².

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**Invited**

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**M2D.2 • 11:00**

Top-Scored

225 Gb/s PAM4 2 km and 10 km Transmission of EMLs With Hybrid Waveguide Structure for 800G & 1.6TE Transceivers, Asami Uchiyama1, Keyan Zeng1, Liang Wang1, Photonic Reservoir, Canada. We experimentally demonstrate 10 km transmission of 225 Gb/s PAM4 modulation signal using our developed high-speed EMLs with a hybrid waveguide structure. Clear eye patterns were observed with 5 taps of TDECQ reference equalizer.

**Monday, 6 March**

**10:30–12:30**

**Room 3**

**M2C • Fiber- and Waveguide-Based Sensors**

**Invited**

**M2C.1 • 10:30**

Transforming Subsea Optical Cables Into a Giant Network of Environmental Sensors, Giuseppe Marra1, National Physical Laboratory (UK, UK). 70% of the Earth’s surface is water-covered, yet the ocean floor remains mostly unmonitored. We show how ultra-stable interferometry can change this by enabling seafloor cables to be used as arrays of environmental sensors.

**M2C.2 • 11:00**

Top-Scored

High-Sensitivity Acoustic Impedance Sensing Using Forward Stimulated Brillouin Scattering in Highly Nonlinear Fiber, Koenig Zeng1, Jiang Song1, Ming Tang1, Deming Liu1, Huazhong Univ. of Sci. & Tech., China. High-sensitivity acoustic impedance sensing has been demonstrated for the first time by using radial acoustic modes induced forward Brillouin scattering in highly nonlinear fiber. The measurement sensitivity has been improved to be 3.83 MHz/mm².

**M2D • High Speed EMLs and DMLs**

**Invited**

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Ultrahigh Speed EA-DFB Lasers Beyond 200 Gbps per Lane, Kazuho Naoe1, Lumentum Japan, Inc., Japan. We describe 224 Gbps-PAM4 uncooled operation by EA-DFB. Moreover, 330 Gbps-PAM6 (128-Gbaud PAM6), 384 Gbps-PAM8 (128-Gbaud PAM8) and 420 Gbps-PAM8 (140-Gbaud PAM8) operations by ultrahigh speed EA-DFB are reviewed.

**M2D.2 • 11:00**

Top-Scored

225 Gb/s PAM4 2 km and 10 km Transmission of EMLs With Hybrid Waveguide Structure for 800G & 1.6TE Transceivers, Asami Uchiyama1, Keyan Zeng1, Liang Wang1, Photonic Reservoir, Canada. We experimentally demonstrate 10 km transmission of 225 Gb/s PAM4 modulation signal using our developed high-speed EMLs with a hybrid waveguide structure. Clear eye patterns were observed with 5 taps of TDECQ reference equalizer.
Room 6E

10:30–12:30
M2F • Machine Learning for System Modeling and Channel Equalization
Presider: Jianqiang Li; Kuaishou Technology, USA

M2F.1 • 10:30
Digital Twins and Measurement-Informed Physical Layer Models, Seb J. Savory1; ‘Univ. of Cambridge, UK. Digital coherent transceivers can monitor the state of an optical network, enabling measurement informed physical layer models. After reviewing the measurement capabilities, we cover physics-based and data-driven models, concluding with the requirements for digital twins.

Room 6F

10:30–12:15
M2G • Data Center Networking and PON Security
Presider: Albert Rafei; British Telecommunications, UK

M2G.1 • 10:30
Invited
Apollo: Large-Scale Deployment of Optical Circuit Switching for Datacenter Networking, Hong Liu1; Google LLC, USA. We describe Apollo, the world’s first large-scale production deployment of optical circuit switches (OCSes) for datacenter networking. We review the underlying hardware technologies including the design of our internally developed OCS and WDM transceivers.

M2G.2 • 11:00
Field Demonstration of Disaggregated Optical Network Consisting of ZR+ and Coherent Channels Using Power Equalization by Switched Gain Equalization Controlled Amplifiers, Sumit Chatterjee1, Anchal1, Eyal Lichtman1; ‘Ribbon Communications, Israel; ‘Airtel, India. We report a field trial of 400G-2R+ QSFP-DD-DCO and ten coherent channels, interoperating with oFEC between two different vendors. We equalize the power by switched gain equalization controlled amplifiers. Field trial is verified by simulations.

Room 7AB

10:30–12:30
M2H • Panel: Connectivity for Beyond 5G: How Can Wireline and Wireless Optical Access Live Up to the Mobile Expectations?
Organizers: Frank Chang, Source Photonics, USA; Baris Ekermen, HERDON, USA; Albert Rafei, BT, UK; Ke Wang, IRIT, Australia; Jim Zou, ADVA, Germany
Speakers: Devin Brinkley, X the Moonshot Factory, USA; Hanne-Stine Hallingby, Telenor, Norway; Xiang Liu, Huawei Technologies, Hong Kong; Junwen Zhang, Fudan University, China

Description: With 5G being commercially deployed and ramped up and witnessing its revolution from 4G, optical access technologies are playing an intrinsic role more than ever before to enable the connectivity between the central office and remote radio units. Looking ahead, both academia and industry have already started investigating the next generation, 6G, in terms of requirements, use cases, enabling technologies, architectures, etc.

Amongst the early research focusing on new radio technologies, it can be foreseen that more wireline and wireless optical access will be adopted, to sustain the even higher throughput and performance demand, less energy consumption, more diverse networking scenarios, just to name a few.

This panel will reveal and discuss new technology trends in the optical domain, ranging from key components to end-to-end system applications, including for instance 5G/100G BOC optics, free-space optical transmission, microwave photonics, WDM-PON, and more. Some of them were already envisioned at the dawn of 5G but too early to be ready, while some of them are purely driven by the solid scaling factor.

The panelists from both academia and industry will share their thoughts and visions.

Room 8

10:30–12:15
M2I • Innovative QKD Systems
Presider: Eleni Diamanti; CNRS, France

M2I.1 • 10:30
Invited
Atomic Clocks Technologies for Twin-Field QKD in Real World, Cesila Civati1, Alice Maida1, Simone Donadello1, Marco Genovese1, Filippo Levi1, Salvatore Virzì1, Alberto Mura1, Mirko Pittaluga1, Zhiang Yuan1, Andrew Shields2, Marco Lucamarni1, Ivo Degiovanni1, Davide Calanca1; INRIM, Italy; ‘Toshiba Europe Ltd, UK; ‘Univ. of York, UK; ‘Beijing Academy of Quantum Information Sciences, China. We integrate atomic clocks technologies, namely narrow-linewidth lasers and phase-coherent distribution of optical signals over fiber, in a Twin-Field Quantum Key Distribution system in a real world fiber network, and discuss possible improvements in key distribution.

M2I.2 • 11:00
High-Rate Continuous-Variable Measurement-Device-Independent Quantum key Distribution, Adnan Hajomer1, Huy Q. Nguyen1, Tobias Gehring1, Andrew Shields2, Marco Lucamarni1, Ivo Degiovanni1; INRIM, Italy; ‘Toshiba Europe Ltd, UK; ‘Univ. of York, UK; ‘Beijing Academy of Quantum Information Sciences, China. We report a field trial of 400G-2R+ QSFP-DD-DCO and ten coherent channels, interoperating with oFEC between two different vendors. We equalize the power by switched gain equalization controlled amplifiers. Field trial is verified by simulations.

Room 9

10:30–12:30
M2J • Optical Computing
Presider: Darko Zibar; Technical Univ. of Denmark, Denmark

M2J.1 • 10:30
Invited
Optical RAM and Optical Cache Memories for Computing, Theonitsa Alexoudi1, Chris Vagionas1, Hanne-Stine Hallingby2; ‘Aristoteliano Panepistimio Thessalonikis, Greece. In this paper, we present the recent progress and achievements of optical RAM technologies expanding from single RAM cells up to fully functional optical cache memory implementations for future Computing architectures.

M2J.2 • 11:00
An Optoelectronic Analog Ising Machine Enabling 2048-Spin and Low-Latency Calculations, Zhihao An1, Zhenghua Li, Zhaodong Deng, Jie Liu, Siyuan Yu1, Sun Yat-sen Univ., China. An optoelectronic analog Ising machine employing FPGA with DAC and ADC modules is experimentally demonstrated. The SpMV algorithm is applied to accomplish two MAX-CUT tasks mapped into 2048-spin Ising networks, taking only 1.6lus per iteration.
M2A • Special Session: High Performance Networks of Future Data Center and Computing Applications—Continued

M2A.3 • 11:10 Invited
Title to be Announced, Larry Dennison1; NVIDIA Corporation, USA. Abstract not available.

M2A.4 • 11:30 Invited
High-Performance Networks for Disaggregated Systems, Binzhang Fu1; Alibaba Cloud, China. Abstract not available.

M2A.5 • 11:50 Invited
Disaggregated Resources/CXL, Ram Huggahalli1; Microsoft Azure, USA. Abstract not available.

M2B • SDM Devices and Systems—Continued

M2B.3 • 11:15 Partial MIMO-Based Mode Division Multiplexing Transmission Over the First Field-Deployed 15-Mode Fiber in Metro Scenario, Alberto Gatto1, Paola Parolari1, Ruben S. Lusi1, Georg Rademacher1, Benjamin J. Putnam2, Robert Emmansch1, Colja Schubert1, Giuseppe Ferri1, Frank Acht1, Pierre Sillard1, Paolo Martelli1, Gianmarco Di Sciuol1, Fabio Grazios1, Andrea Marott1, Antonio Mezzac1, Cristian Antontelli1, Pierpaolo Botti1; Politecnico di Milano - DEIB, Italy; National Inst. of Information and Comm. Technology (NICT), Japan; Fraunhofer Inst. for Telecommunications (HIT), Germany; Prysmian Group, France; Univ. of L’Aquila and CNIT, Italy. We assess mode division multiplexing transmission based on partial MIMO equalization over 6.1 km of the first deployed 15-mode fiber in L'Aquila, Italy. We demonstrate more than 13-Tb/s throughput with reduced receiver DSP resources.

M2B.4 • 11:30 Mode-Group-Division Multiplexing Over a Deployed 15-Mode-Fiber Cable, Lauren Dallachiesa1, Roland Ryf1, Nicolas K. Fontaine1, Mikael Mazur1, Haoshuo Chen1, Pierre Sillard1, Giuseppe Ferri1, Frank Acht1, Andrea Carena2, Antonino Nespoli3, Andrea Marotta1, Antonio Mezzac1, Cristian Antontelli1, Nokia Bell Labs, USA; Prysmian Group, France; Prysmian Group, Italy; Prysmian Group, Netherlands; Politecnico di Torino, Italy; Fondazione LIONS-Leading Innovation & Knowledge for Society, Italy; Univ. of L'Aquila, Italy. We experimentally demonstrate transmission over a subset of up to 4 spatial modes of a deployed 15 mode Graded-index Fiber Cable.

M2B.5 • 11:45 Long-Haul Unidirectional Transmission Over Weakly-Coupled MCF With Distance-Insensitive Inter-Core Skew Spread, Koji Shibahara1, Megumi Hoshi1, Takahiro Matsui1, Takayoshi Mori1, Kauhude Nakajima1, Yuuta Miyamoto1; NTT Network Innovation Laboratories, Japan; NTT Access Network Service Systems Laboratories, Japan. We demonstrate unidirectional 3000-km transmission over homogeneous step-index weakly-coupled multi-core fiber. Distance-insensitive pulse broadening is obtained by inline core-permutation without any fan-in/fan-out device, enabling inter-core-crosstalk cancellation at 3000 km only with 3-ns-processing window in MIMO-OFDM.

M2C • Fiber- and Waveguide-Based Systems—Continued

M2C.3 • 11:15 Sweep-Free Brillouin Optical Correlation Domain Analysis Utilizing Digital Optical Frequency Comb, Huan He1, Shuyan Chen1, Can Zhao1, Zhiquang Zhao1, Songqian Fu1, Ming Tang1; Huazhong Univ. of Science and Technology, China; Gwangju Univ. of Technology, China. We propose and demonstrate a probe sweep-free Brillouin optical correlation domain sensor based on digital optical frequency comb, where acquisitions of Brillouin gain spectrum reach 20 Ksa/s at arbitrary position with 10-cm spatial resolution.

M2C.4 • 11:40 Solid State LI DAR, Toshihiko Baba1; Yokohama National Univ., Japan. Fully nonmechanical solid-state LiDARs are being developed, in particular, on Si photonics platform with OPA, FPA and SLG. They are in the stage of demonstrating real-time LiDAR action. This presentation discusses their perspective.

M2C.5 • 11:50 Tutorial
M2D • High Speed EMLs and DMLs—Continued

M2D.3 • 11:15 Top-Scored
200G per Lane Uncooled CWDWM Hybrid CMBH-Ridge Electroabsorption Modulated Lasers for 2-km Transmission, Prashanth Bhasker1, Sumeeta Arowa1, Alex Robertson1, Tom McCaully1, Adrian Nl1, John Johnman1; Broadcom Inc, USA. We report uncooled (20-70C) hybrid CMBH-Ridge O-band CWDWM EMLs with 60 GHz bandwidth (BW). At 112.5Gb/s PAM4 and 1 Tbps, 4 dB extinction ratio (ER) and greater than 7 dBm output power is demonstrated over temperature.

M2D.4 • 11:30 Top-Scored
225-Gb/s PAM4 Operation Using Lumped-Electrode-Type EA-DFB Laser for 5- and 10-km Transmission With Low TDECQ, Kazuki Nakamura1, Hideaki Asakura1, Syunya Yamauchi1, Takanosu Suzuki1, Yoshihiro Nakai1, Yorimasa Yamaguchi1, Takeo Kageyama1, Masatoishi Mitski1, Kuma Endo1, Kazuhiro Nose1, Lumentum Japan, Inc., Japan. Both 5-km and 10-km transmission was demonstrated under 225-Gb/s PAM4 operation using EA-DFB lasers. We confirmed low TDECQ values of 2.0–3.2 dB for 5 km in the CWDWM range and 10 km at 1293.5 nm.

M2D.5 • 11:45 4 x 200 Gb/s EML-Array With a Single MQW Layer Stack, Michael A. Theurer1, Christoph Kottke1, Ronald Freund1, Felix Ganzer1, Patrick Range1, Martin Moehrl1, Ute Troppenz1, Arane Sigmund1, Martin Schell1; Fraunhofer Heinrich Hertz Inst., Germany; Technical Univ. Berlin, Germany. We demonstrate an EML-array for up to 4x200 Gb/s PAM4 modulation at 45°C. Its single MQW layer stack design allows for low-cost fabrication. The device is optimized for equal performance over four LAN-WDM wavelength channels.

M2E • Optical Fiber and Device Modelling—Continued

M2E.5 • 11:30 Tutorial
M2E.4 • 11:15 Top-Scored
KernNet: Machine Learning to Speed up Exact Nonlinear Variance Computation of Arbitrary Links, Xiaoyan Ye1,2, Amithoseen Ghazisaeidi1; Nokia bell labs France, France; Telecom Paris, France. We introduce a new GoT tool handling arbitrary transmission configurations based on neural networks, accelerating exact models for nonlinear variance: the computation time is reduced by six orders of magnitude while accuracy is not compromised.

M2E.5 • 11:30 Modeling of Nonlinear Distortion in Space-Division Multiplexing, Paolo Serena1; Universita degli Studi di Parma, Italy. We discuss the modeling of nonlinear effects in space-division multiplexing links. We will cover aspects like perturbation theory, the interaction between mode dispersion and the Kerr effect, and Gaussian noise model-based performance predictions.
by using 1×1 convolutions for dimensionality reduction in field reconstruction. This is achieved with a single-mode fiber with ~64% computational-budget sideband 16-QAM signal transmission over 80-km demonstrate a 50-GBaud complex-valued double-

A machine learning approach for improving monitoring in passive optical networks with almost equivalent branches is proposed and experimentally validated. It achieves a high diagnostic accuracy of 98.7% and an event localization error of 0.5m.

An integratable and scalable optoelectronic neuromorphic accelerator based on coherent optical devices is proposed and demonstrated. It can achieve the computing speed for convolutions of 523.27 GOPS and accuracy up to 96.67% for handwritten digit recognition as a neural network.

We demonstrate reconfigurable tanh and ReLU-like nonlinear activation functions for incoherent neuromorphic photonic using a balanced photodiode assembled with a programmable electronic TIA chip. Experimental results up to 10 Gb/s line-rates are presented.

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We perform learning to loosen the constraints and enhance the performance of weak-carrier-assisted phase-retrieval receivers. The applied-dispersion-value can be reduced by 4-times and the complexity by 50% with low sensitivity penalties.

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M2A • Special Session: High Performance Networks of Future Data Center and Computing Applications—Continued

M2B • SDM Devices and Systems—Continued

M2C • Fiber- and Waveguide-Based Sensors—Continued

M2D • High Speed EMLs and DMLs—Continued

M2E • Optical Fiber and Device Modelling—Continued

M2B.6 • 12:00 Invited Impact and Mitigation of Mode-Dependent Gain in Ultra-Long-Haul SDM Systems, Darli Mello¹, Ruby Ospina¹, Hrishkeesh Smirnov¹, Karthik Choutagunta¹, Elaine Chu¹, Joseph Kahn¹; ¹Univ. of Campinas, Brazil; ²Stanford Univ., USA. The effect of mode-dependent gain in ultra-long-haul optical SDM systems with coupled channels is reviewed. Simulation results indicate stringent MDG requirements for future SDM amplifiers. Challenges in MDG estimation are also addressed.

M2D.6 • 12:00 106-Gbps PAM4 Operation at an Extinction Ratio Above 3.5 dB Using a Conventional Buried-Heterostructure Directly Modulated Laser, Kosuke Shinohara¹, Ryosuke Miyagoshi¹, Yosuke Suzuki¹, Ryoko Suzuki¹, Go Sakaino¹, Masaaki Shimada¹, Ken-ichi Matsumoto¹; ¹Mitsubishi Electric Corporation, Japan. 106-Gbps PAM4 operation with an extinction ratio above 3.5 dB and TDECQ values of 1.85 and 3.04 dB was demonstrated using a conventional buried-heterostructure directly modulated laser at temperatures of 25 and 55 °C.

M2D.7 • 12:15 10-km Transmission of 106-Gb/s PAM4 With Directly Modulated DFB Lasers in the CWDM Range, Shuhei Ohno¹, Masaru Onga¹, Takayuki Nakajima¹, Akira Nakashita¹, Noriko Sasada¹, Shinichi Tanaka¹, Ryosuke Nakajima¹, Kazuhiko Naoe¹; ¹Lumentum Japan, Inc., Japan. The 106-Gb/s PAM4 operation of four DMLs in the 1.3 μm CWDM range demonstrated < 2.0 dB TDECQ after 5-km transmission. Clear eye openings and BER below KP4-FEC limit (2.2 × 10⁻⁴) were achieved even after 10-km transmission.
M2F • Machine Learning for System Modeling and Channel Equalization—Continued

M2G • Data Center Networking and PON Security—Continued

M2H • Panel: Connectivity for Beyond 5G: How Can Wireline and Wireless Optical Access Live Up to the Mobile Expectations?—Continued

M2I • Innovative QKD Systems—Continued

M2J • Optical Computing—Continued

12:00 Improving the Bootstrap of Blind Equalizers With Variational Autoencoders, Vincent Lauinger¹, Fred Buchali², Laurent Schmalen¹; 'Karlsruher Inst. of Technology (KIT), Germany; 'Nokia, Germany. We evaluate the start-up of blind equalizers at critical working points, analyze the advantages and obstacles of commonly-used algorithms, and demonstrate how the recently-proposed variational autoencoder (VAE) based equalizers can improve bootstrapping.

12:00 Towards Costless Temperature Monitoring Through PLOAM Information in TDMA PON Networks, Christian Salgado-Cazorla¹, Borja Vidal¹; 'Universitat Politècnica de València, Spain. Derivation of environmental temperature from FTTH networks is investigated. Ranging grants in G.984 allows estimation of average temperatures without additional hardware. This information can be valuable in smart cities and early fire warning systems.

12:00 Secure Unrepeated Fiber Transmission With Quantum Deliberate Signal Randomization on Y00 Protocol, Fumio Futami¹, Ken Tanizawa¹, Kentarou Kato¹, Yuki Kawaguchi², Shin Sato¹; 'Tamagawa Univ., Japan; 'Sumitomo Electric Industries, Ltd., Japan. We demonstrate security-enhanced 10-Gbit/s PSK Y00 cipher transmission with deliberate signal randomization driven by a quantum random number generator in a 362 km ultra-low-loss fiber link without optical amplifiers. High security is achieved at high optical powers.

12:15 Incoherent Fiber-Based Optical Neuromorphic Computing Circuit, Maya Yevnin², Alon Harel², Or Arbel-Asenfli², Zeev Zalevsky³, Eyal Cohen³; 'Bar-Ilan Univ., Israel; 'CogniFiber LTD., Israel. We present novel photonic neuromorphic computing scheme working with incoherent light while capable implementing negative weighting for the neural network and obtaining reliable/accurate computing of the linear multiply-accumulate function necessary for neural networks applications.

M2F.4 • 12:00
Physics-Informed Neural Operator-Based Full Wavefield Back-Propagation for Multi-Span Optical Transmission, Yuchen Song¹, Xiaotian Jiang¹, Xiao Luo¹, Ximeng Zhang¹, Min Zhang¹, Danshi Wang¹; 'Beijing Univ. of Post and Telecomm, China. An unsupervised physics-informed neural operator-based wavefield back-propagation scheme is proposed and used for the full wavefield information reconstruction along the link, nonlinearity compensation (0.46 dB Q-factor gain over 1PSDBP), and fiber parameter identification.

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12:00–13:00  OFC Mentor/Mentee Meet-up, Room 17

12:30–14:00 Lunch Break (on own)

13:30–16:30 SC114, SC217, SC408, SC459, SC485

13:30–17:30 SC261, SC325, SC327, SC347, SC357, SC393, SC431, SC451, SC453B

14:00–15:30 The Journal Review Process: All You Need to Know!, Room 14B
Engineering Challenges for the Emerging Quantum Networks, Prem Kumar; 'Northwestern Univ., USA. Abstract not available.

M3B.1 • 14:00 Unique Bending Loss Properties and Design Consideration for Coupled Multi-Core Fiber, Ryota Imada1, Taju Sakamoto1, Takayoshi Man1, Yusuke Yamada1, Kazushiide Nakajima1; 'NTT Corporation, Japan. We reveal the unique bending angle and coupled core count dependence of bending loss in a coupled multi-core fiber and demonstrate adequate core design conditions can be derived by considering the average bending loss property.

M3B.2 • 14:15 Uncoupled 6-Core Fibers With a Standard 125-μm Cladding, ITU-T G.652 Optical Properties, and Low XT, Kazuonri Murakasa1, Takesha Takagi1, Takaaki Shihikura1, Katshusa Marum2, Hajime Oshio3, Atsushi Mehta4, Karsten Rottwitt5, Toshihiko Moroika6; 'Furukawa Electric Co., Ltd., Japan; 'Furukawa Electric Co., Ltd., Japan; 'Technical Univ. of Denmark, Denmark. We developed ultra-high-density uncoupled 6-core fibers with a standard 125-μm cladding, G.652 properties, and low crosstalk at 100 km of -55 to -39 dB by utilizing a novel air-gap structure, which would potentially give the ultimate high-density.

M3C.1 • 14:00 Low Loss, High Extinction Ratio Fiber to Chip Connection via Laser Fusion for Polarization Maintaining Fibers, Sudham Kumar1, Junsai Naungai1, Jaime Cardenas1; 'Univ. of Rochester, USA. We present a new method for PM-fiber to photonic chip connection via laser fusion. This enables low cost and robust coupling with -1.1 dB loss per facet while maintaining 20dB or greater polarization extinction ratio.

M3C.2 • 14:15 Automatic Setting of Multiple FSO Orthogonal Communication Channels Between Photonic Chips, Seyyedmohammad Seyyedinnavadeh1, Maziar MilaniZaheh1, Francesco Zanetto1, Vittorio Grimaldi1, Chiara De Vita1, Andrea Melloni1, Francesco Morichetti1; 'Politecnico di Milano, Italy; 'National Research Council Canada, Canada; 'Stanford Univ., USA. Multiple orthogonal free-space optical (FSO) communication channels are automatically established between photonic chips hosting programmable integrated processors. All-optical channel demultiplexing is achieved with a crosstalk < -30 dB even after co-propagation though arbitrary mode mixers.

M3D.1 • 14:00 Sub-THz Wireless Transmission Based on Graphene on Silicon Nitride Integrated Photonics, Alberto Montanaro1,2, Giulia Piccinini3,4, Vaidotas Miseikis5,6, Vita Soranno6, Marco Angelo Giambra7, Stefano Sores8, Luca Giorgi1, Antonia D’Errico1, Kenji Watanabe1, Takashi Taniguchi1, Sergio Pezzini4,5, Camilla Coletti1,2, Marco Romagnoli3; 'CNIT, Italy; 'Scuola Superiore Sant’Anna, Italy; 'NEST, Scuola Normale Superiore, Italy. We demonstrate the first wireless transmission based on graphene, using an integrated photonic device enabling up-conversion in the sub-THz range. Our approach opens the perspective to the realization of antenna arrays based on integrated photonics.

M3D.2 • 14:15 Silicon-Based on-Chip Phase-Coded Linearly-Chirped Microwave Waveform Generation, Xu Hong1, Bin Wang1, Xiaofeng Zhang1; 'Beijing Inst. of Technology, China. We propose and design a silicon photonic chip for phase-coded linearly-chirped microwave waveform generation based on opto-electronic oscillator. Using the chip, a phase-coded linearly-chirped microwave waveform with an ultra-large time-bandwidth product of $1.9 \times 10^5$ is experimentally demonstrated.
A Hybrid Solid-State Beam Scanner for FMCW LiDAR Application, Zhaoyang Zhang1, Xufeng Du1, Ziyan Zhou1, Qiaki Huang1, Qiang Zhang1, Tingge Dai1, Hui Yu1, Yuehan Wang1, Janyi Yang1, Zheyang Wang1, Chao Jiang2, Zhejiang Lab, China. We demonstrate a hybrid solid-state beam scanner based on a Si/SiN switching array. Two-dimensional beam steering with a 14.3°×9° field of view and FMCW ranging operation at a distance of 7.4 m are achieved.

An Intelligent Optical Telemetry Architecture, Luis Velasco1, Pol Gonzalez2, Marc Rua2, Universitat Politècnica de Catalunya, Spain. A distributed telemetry system is proposed with agents receiving and analyzing data before sending to a centralized manager. Intelligent data aggregation on optical constellations telemetry largely reduces data rate without introducing significant error.

Ultra-Dense 3D Integrated 5.3 Tb/s/mm² 80 Micro-Disk Modulator Transmitter, Stuart R. Darudin1, Surwoa Lee1, Devesh Khilwani1, Christine Ou2, Anthony Rizzo1, Songli Wang1, Michael Cullen1, Ayosha Mohan1, Keren Bergman1, Columbia Univ., USA; Cornell Univ., USA.A large-scale array of 80 micro-disk modulators is densely bonded to an electronic chip and driven at 10 Gb/s/modulator for an unprecedented 5.3 Tb/s/mm² bandwidth density and 50 T/1 bit energy consumption.

A Hybrid Solid-State Beam Scanner for FMCW LiDAR by Use of Avalanche Photodiode With Cascaded Multiplication Layer, Zohauddin Ahmad1, Sung-Yi Biehs2, José-Juan Pedreño-Manresa1, Universidad de Alcalá, Spain; 2 Fraunhofer ISST, Germany. A 4-D FMCW LiDAR is demonstrated. In comparison to the traditional p-i-n PD in its receiver side, the cascaded M-layers APDs provide a better quality of 4-D images with unprecedented high velocity-sensitivity (5µm/sec) for slow-moving objects.

Telemetry Framework With Data Sovereignty Features, Behnam Shanatz1, Haydar Qarawlus2, Stefan Biets3, José-Juan Pedroña-Manresa1, Pooyan Safavi1, Mihail Balanci3, Ayoub Bouchdoubel1, Hendrik Haller1, Achim Ausseneth1, Johannes Karl Fischer1, Ronald Freund1, Fraunhofer Inst Nachricht Henrich-Hertz, Germany; 2Fraunhofer IST, Germany; 3ADVA Optical Networking, Germany. We propose a novel framework that enables data ecosystem and regulated telemetry streaming in open and disaggregated optical networks. We review its requirements, present its architecture, and discuss two demonstrated use-cases in our testbeds.
M3A • Symposium: Quantum Information and Optical Communication Networks: Emerging Research Areas, Challenges and Opportunities I—Continued

M3A.2 • 14:30 Invited
Building a Dynamic Quantum Network: Use Cases and Challenges From Security to Scalable Quantum Computing, Reza Nejabati, Univ. of Bristol, UK. Abstract not available.

M3B • Multi-Core Fiber—Continued

M3B.3 • 14:30 Invited
MCF Manufacturing, Kazunori Mukasa, Furukawa Electric Co., Ltd., Japan. To actually apply MCFs in the real systems, we still have several challenges to overcome. One of them is the MCF manufacturing technology including measurements and we will describe the current situations and future prospective.

M3C • Free Space and Coupling Devices—Continued

M3C.3 • 14:30 Monolithically Integrated Self-Aligned SIN Edge Coupler With <0.6/0.8 dB TE/TM Insertion Loss, <39 dB Back Reflection and >520 mW High-Power Handling Capability, Yusuke Blan, GLOBALFOUNDRIES, USA. We experimentally demonstrated V-groove-based self-aligned SIN edge coupler (EC) on a monolithic CMOS-SiPh platform. <0.6/0.8 dB TE/TM SMF-EC transmission efficiency, in conjunction with <39 dB back reflection and >520 mW power handling capability were achieved.

M3D • RF and THz Signal Generation—Continued

M3D.3 • 14:30 Invited
Piezo-Optomechanical Technologies for RF and Optical Communications, Matt Eichenfield, Sandia National Laboratories Albuquerque, USA. Abstract not available.

M3E • Enabling Technologies for Data Center and HPC—Continued

M3E.2 • 15:00 Nonlinearity Free Operation of SOA for Use in High-Capacity Co-Packaged Optics, Takayuki Kurosai, Satoshi Suda, Shu Namiki, Takeru Amano, NInst Adv Ind Sci & Tech, Japan. We propose a novel concept to generate high-capacity WDM signals from single source of non-mode-locked multi-wavelength light using SOAs. Using micro-ring modulators in a way to suppress SOA nonlinearity, high-quality PAM4 signals can be generated.
M3F • 14:30
Impact of Laser Phase Noise on Ranging Precision in FMCW LiDAR, Wenting Yi1, Zichuan Zhou1, Zhihong Liu1, Zhiqun Liu1, Palina Bayvel1, Robert I. Killey1, 1Univ. College London, UK. We study the impact of laser phase noise on ranging precision in a frequency-modulated continuous-wave (FMCW) LiDAR system, demonstrating ranging of 384.72 m with ~15 cm precision at 7× intrinsic laser coherence length. 

M3G.3 • 14:45
Data Augmentation to Reduce Computational Complexity of Neural-Network-Based Soft-Failure Cause Identifier, Labo Z Khan1, Pedro J. Freire1, João Pedro1, Nelson Costa1, Antonio Napol1, Nicola Sampolo1, Scuola Superiore SantAnna, Italy; 2Aston University, UK. We investigated data augmentation to train neural networks (NNs) for soft-failure cause identification, demonstrating its impacts on NN complexity. Results indicate up to 68% reduction in the computational complexity of NN for each inference. 

M3G.4 • 15:00
Failure Data Augmentation for Optical Network Equipment Using Time-Series Generative Adversarial Networks, Cheng Xing1, Chuyu Zhang1, Bing Ye1, Dashui Wang1, Yinqiu Jia1, Jin Li1, Min Zhang1, 1State Key Laboratory of Mobile Network and Mobile Multimedia Technology, Shenzhen, 518055, China. We propose a failure data augmentation scheme based on time-series generation adversarial networks with real equipment performance data of optical networks and verify that the augmented failure sample data is similar to real failure data. 

M3J.5 • 15:00
Tutorial
Tradeoffs in the Paths Forward for Advanced Packaging in Photonics, Jon Aday1, Ankor Technology, USA. Advanced semiconductor packaging is currently being used to support products that utilize photonics connections, but as we migrate from a wire bonded solution to flip chip the complexity increases dramatically. The fiber coupling methods will also impact the process flows and package structures that can be implemented. The tradeoffs will be reviewed between the coupling methods and semiconductor packaging options as we migrate from pluggable to co-packaged optics. 

M3J.3 • 15:00
Optical Frequency Transfer Stability of 15-15 at 1 Second Over Correlated Core Pairs in a 40 km 7-Core Fiber Link, Mark W. Harrington1, Nicolas K. Fontaine1, Mikael Mazur1, Daniel J. Blumenthal1; 1UTC, USA, 2Nokia Bell Labs, USA. We demonstrate a 40km stabilized optical frequency transfer system with fractional frequency stability of 1×15 at 1s without single-core bidirectional propagation. Highly correlated cores of a 7-core fiber are used for signal transmission and return, mitigating uncorrelated phase fluctuations found in duplex approaches.

M3G.4 • 14:45
Experimental Demonstration of 0.4-Meter Ranging Through Underwater Scattering With 20-mm Resolution Using z-Dependent Angular Rotation of a Spatially Structured Beam, Hao Song1, Huibin Zhou1, Yuxiang Duan1, Zile Jiang1, Murale Ramakrishnan1, Wing Ko1, Yingning Wang1, Xinzhou Su1, Kaiheng Zou1, Abdulrahman Alhaddad1, Ruoyu Zeng1, Robert Bock2, Moshe Tur1, Alan Willner3, Joao Pedro3, Nelson Costa1, Antonio Napol1, Nicola Sampolo1, Scuola Superiore SantAnna, Italy; 2Aston University, UK. We experimentally demonstrate 0.4-meter underwater optical ranging with a 20-mm resolution through underwater scattering (extinction coefficient γ ∼ 4 m−1) utilizing the z-dependent angular rotation of a spatially structured beam. 

M3F.3 • 14:30
Invited
Coherent LiDAR Technology: Practical Deployment Challenges, Shuren Hu1, 1Vanderbilt Univ., USA. Abstract not available.
M3B • Multi-Core Fiber—Continued

M3C • Free Space and Coupling Devices—Continued

M3D • RF and THz Signal Generation—Continued

M3E • Enabling Technologies for Data Center and HPC—Continued

M3A • Symposium: Quantum Information and Optical Communication Networks: Emerging Research Areas, Challenges and Opportunities—Continued

M3A.4 • 15:30 Invited

Photonic Quantum Computing; Ulrik Andersen,

M3A.5 • 15:15

Characteristics of Over 600-km-Long 4-Core MCF Drawn From a Single Preform, Shotaro Kajikawa1, Tsubasa Saito1, Katsumi Takezawa1, Ken’ya Ichiki1, ’Fujikura Ltd., Japan. This report presents details of the successful production of a 4-core MCF, with 125-μm cladding and a length greater than 600 km. This is the champion data for MCF length drawn from a single preform.

M3A.6 • 15:30 Invited

Optical Link Characteristics and Long-Term Stability of High-Density Multi-Core Fiber Cables Deployed in the Terrestrial Field, Yusuke Yamada1, Takayoshi Moti1, Takashi Matsui1, Masashi Kituchi1, Kazuhide Nakajima1, ’NTT Corporation, Japan. The feasibility of a standard 125-μm-cladding multi-core-fiber-based high-density terrestrial cable is described including long-term stability in an underground facility. The impact of a core-rotating splice on the link loss is also investigated.

M3A.7 • 15:30 Invited

Fan-in/Fan-out for Heterogeneous 19-Core Fibers Based on Metasurfaces With Nonuniform Phase Plates, Yong Wang1, Xutao Wang1, Zhiqun Yang1, Yaping Liu1, Lin Zhang1, Zhanhua Huang1, Tianjin Univ., China; ’Peng Cheng Laboratory, China. We propose a metasurface-based fan-in/fan-out device for heterogeneous 19-core fibers. Our results indicate that an average insertion loss of 0.9 dB and maximum crosstalk of -25.5 dB can be achieved at 1550 nm.

M3A.8 • 15:45

High-Resolution Radiation Characterization for an Uniformly Emitted SiNx Nanophotonic Phased Array, Caiming Sun1, Binghui Li1, Ning Ding1, Aiqiong Zhang1, ’CUHK, Shenzhen, China. With a high-resolution characterization setup, waveguide modes are clearly observed in near-field radiation patterns of SiNx-nano-antennas. This phased array has uniform emission throughout the antenna within a 3dB bandwidth of 120 nm from 785-905 nm.

M3B.4 • 15:30 Invited

Optical Link Characteristics and Long-Term Stability of High-Density Multi-Core Fiber Cables Deployed in the Terrestrial Field, Yusuke Yamada1, Takayoshi Moti1, Takashi Matsui1, Masashi Kituchi1, Kazuhide Nakajima1, ’NTT Corporation, Japan. The feasibility of a standard 125-μm-cladding multi-core-fiber-based high-density terrestrial cable is described including long-term stability in an underground facility. The impact of a core-rotating splice on the link loss is also investigated.

M3B.6 • 15:30 Invited

Optical Link Characteristics and Long-Term Stability of High-Density Multi-Core Fiber Cables Deployed in the Terrestrial Field, Yusuke Yamada1, Takayoshi Moti1, Takashi Matsui1, Masashi Kituchi1, Kazuhide Nakajima1, ’NTT Corporation, Japan. The feasibility of a standard 125-μm-cladding multi-core-fiber-based high-density terrestrial cable is described including long-term stability in an underground facility. The impact of a core-rotating splice on the link loss is also investigated.

M3B.7 • 15:45

Conversion Gain Enhancement of a UTC-PD-Integrated HEMT Photonic Double-Mixer by High-Intensity Optical Subcarrier Signal, Dai Nakajima1, Kazuki Ishihara1, Mitsuki Watanabe1, Tsung-Tse Lin1, Ken-ichi Kasai1, Masato Yoshida1, Tetsuya Suemitsu1, Taichi Osuji1, Akira Satou1, ’RIEC, Tohoku Univ., Japan; ’NIChe, Tohoku University, Japan. We investigate the effectiveness of high-intensity subcarrier signal input to the UTC-PD-integrated HEMT for optical-to-wireless carrier frequency down-conversion and report that the conversion gain increased linearly from -51 dB to -44 dB.
Coherent LiDAR Prototype Based on 2D MEMS Mirror Scanning, Sarah Cwalina, Christoph Kottke, Norman Laske, Volker Jungnickel, Ronald Freund. We present a new coherent LiDAR prototype with two-dimensional micro-electro-mechanical-system scanning and walk-off mitigation capability. We address the linearity challenge of the FMCW transmitter, the scan-capture-synchronization and provide point-clouds of two distinct objects.

Electro-Optical Phase-Locked Loop for Hybrid Integrated External Cavity Laser, Chuxin Liu, Yuyao Guo, Bowen Zhang, Ran Tao, Yi Guo, Tian Zhang, Jian Wang, Jian Wu, Reza Nejabati. Here we present our co-packaged optics. We implement an analog EO-PLL for a III/V-Si$_3$N$_4$ photonic transmitter, the scan-capture-synchronization and demonstrate the advantages of using NLP in encoding.

Optical Network Diagnostics Using Graph Neural Networks and Natural Language Processing, Xiaoxuan Ma, Ahmed Khaled, Zhimu Gou, Bhavin J. Shastri, Volker J. Sorger. We propose an AI-powered network diagnostic strategy including alarm clustering and fault localization with >98% accuracy for up-to 16-degree ROADM and demonstrate the advantages of using NLP in encoding.

Automation of Fast Configuration Error Diagnosis in Optical Transport Networks - Natural Language Processing is All You Need, Cen Wang, Noboru Yoshikane, Daniel J. Elson, Takehiro Tsuritani. We train language models to automate the diagnosis of OTN configuration errors, and the diagnostic accuracy is up to 97.56%. We additionally demonstrate the effectiveness of the models on a real OTN system.

Experimental Demonstration of Integrated Low-Cost High-Precision Timing Solution for Optical Transport Networks Supporting 5G, Ekin Arabul, Romerson Oliveira, Rui Wang, Reza Nejabati, Dimitra E. Simeonidou. We successfully integrated FPGA-based low-cost high-precision timing scheme into an optical transport network solution. 16.2 ps synchronisation precision has been achieved across two devices while network-wise setup can sustain up to 21.2 ps precision.

Tradeoffs in the Paths Forward for Advanced Packaging in Photonics, Jan Aday, Amirak Technology, USA. Advanced semiconductor packaging is currently being used to support products that utilize photonics connections, but as we migrate from a wire bonded solution to flip chip the complexity increases dramatically. The fiber coupling methods will also impact the process flows and package structures that can be implemented. The tradeoffs will be reviewed between the coupling methods and semiconductor packaging options as we migrate from pluggables to co-packaged optics.

Calculating With Phase Opens up the High-Precision and High-Reconfigurability Integrated Photonic Computing, Yaping Wu, Hongxiang Guo, Bowen Zhang, Ran Tao, Yi Guo, Tian Zhang, Jiří Číš, Jian Wu. We propose and experimentally demonstrate a novel phase-based optical computing system integrated with photonic AD/DA converters. Further simulation shows that our system can perform 15-bit arithmetic operations when the SNR is around 34 dB.

Fully Integrated Silicon Photonic Tensor Core for Next-Generation Applications, Nicola Peserico, Xiaowen Ma, Ahmed Khaled, Zhimu Gou, Bhavin J. Shastri, Volker J. Sorger, George Washington Univ., USA; Queens Univ., Canada. Here we present our architecture for Silicon Photonic Tensor Core, capable of responding to the needs of Neural Networks, Augmented and Virtual Reality applications. We present a novel version fully integrated, from lasers to photodetectors.

WDM-Compatible Integrated Photonic Computing Core for Implementing a Neural Network, Zheng Zhuo, Shuang Zheng, Weifeng Zhang, Beijing Inst. of Technology, China. We propose and design an energy-efficient integrated photonic computing core by using a microdisk resonator-assisted Mach-Zehnder interferometer. With the use of the fabricated silicon photonic chip, an optical convolutional neural network for image classification is experimentally demonstrated.
Room 6A

14:00–16:15 M32 • OFC Demo Zone

Presider: Benjamin Putnam; National Inst Info & Comm Tech (NICT), Japan and Marco Ruffini; Univ. of Dublin Trinity College, Ireland

M32.1 Adaptive Geometric Constellation Shaping in a Transmission System With a Real-Time Optimisation Loop, Mindongxia Jermolovicius1, Anastassia Vasilychenko1, Eric Silkeles1; 1Univ. College London, UK. We demonstrate the real-time performance of an adaptive intelligent transceiver, tailoring the constellation shape to the transmission system by iteratively maximising the information throughput, quantified by the GMI.

M32.2 Optical Network Tomography: Demonstration of Anomaly Loss Monitoring and Fiber-Type Identification, Ryu Shinzaki1, Motokiko Eto2, Kazuyuki Tajima1, Kyosuke Sone1, Setsuo Yoshida1, Shosho Oda1, Inwoong Kim1, Olga Yassilev1, Paparo Palacharla1, Takashi Hoshiba1, Fujitsu Limited, Japan; 2Fujitsu Network Communications, inc., USA. We demonstrate optical network tomography software prototype for localization of anomaly loss and fiber-type identification based on the estimated measured waveform data in a multi-span transmission testbed.

M32.3 Demonstration of Data-Sovereign Telemetry Broker for Open and Disaggregated Optical Networks, Heydar Dastghaib1, Carlos Natalino da Silva2, Lluis Palacin2, Carles Andriot2, Rohit Jain2, Kate Banks1, Carlos Andres2, Lorena Vazquez2, Cinta Martin1, Pablo Sensa1, Carlos Caro1, Juan Carlos Cea-Diaz1, Oscar Gonzalez de Dios2, Juan Pedro Fernandez-Falco1, Josep Cuenca1, Aitor Ginebreda1, George Parast2, Marcel Bussmann2, Holger Freitag1, Yves du Pin1, Rui Pimenta1, 1The Univ. of Texas at Dallas, USA; 2Univ. Center of Defense at the Spanish Air Force Academy, Madrid, Spain.

M32.4 Distributed Architecture Supporting Intelligent Optical Measurement Aggregation and Streaming Event Telemetry, Pal Gonzalez1, Ramon Casellas3, Jose-Juan Pedrera-Manresas1, Almudena Cuenka1, Fabien Bretier1, Bebram Sharati1, Johannes Karl Fischer1, Marc Ruiz1, Jaime Camellons1, Lucas Velos1, 1Universitat Politècnica de Catalunya, Spain; 2CTTC, Spain; 3ADVA Germany, Germany; 4Fujitsu Optical Networks, Germany; 5HHI, Germany. A distributed telemetry system integrating optical measurement and event data collection is demonstrated. Measurements of optical spectra from Nokia Bell Labs, of optical transponders from ADVA and SDN controller events from CTC will be showcased.

M32.5 Distribution of Quantum Entanglement Through Fiber With Co-Propagating Classical Data, Daniel Reilly1, Kim Lee1, Joe Mambretti2, Prem Kumar1, 1UNICAMP, Brazil; 2Univ. Center of Defense at the Spanish Air Force Academy, Madrid, Spain.

M32.6 Detection of Abnormal Activities on a SM or MM Fiber, Stefan Karlsson1, Mikael Andersson1, Rui Liu1, Lena Worsnaski1, Paolo Moretti1, FMV, Sweden. Electrical Engineering, Chalmers Univ. of Technol., Sweden; 2MicroFiberOptics AB, Sweden. We demonstrate an asynchronous detection based on polarization signatures by analyzing polarization state changes at the receiver. We identify changes related to the normal operation and the ones caused by eavesdropping.

M32.7 Live Demonstration of ML-Based PON Characterization and Monitoring, Maximilian Brueger1, Jasper Muller1, Sai Kreet Patt1, Sander Janssen2, Jim Zou1, Stephanie Althoff1, Klaus-Tycho Förster1; 1ADVA Optical Networking SE, Germany; 2Technical Univ of Dortmund, Germany. We demonstrate a machine learning-based solution for optical time-domain reflectometry devices which can assist classification and monitoring of reflective events in a passive optical network.

M32.8 Open Disaggregated Optical Network Control With Network Management as Code, Javier Erez1, Huy G. Tien1, Domingo Vercher1, Tung H. Thi1, Andrea Mazzini1, Lahcen Abnina1, Jelena Pesic4, Marina Curtol1, Abdelali El Imadi1, Adlen Ksentini1, Djamel Zeghache1, 1Nokia Bell Labs, France; 2Nokia Bell Labs, USA; 3Nokia, Italy; 4Nokia, France; 5Communication Systems, EURIECON, France. "Network Management as Code is presented to manage the infrastructure and deployment of control functions in a declarative way by aborting GinOps in open disaggregated optical networks. We introduce an Automation Engine that analyzes topology changes to trigger the Continuous Delivery procedure of SDN applications on a micro-service architecture.

M32.9 Slice Grouping for Transport Network Slices Using Hierarchical Multi-Domain SDN Control, Luis Ginebre2, Ricardo Vila1, Juan Carlos Cea-Diaz1, Oscar Gonzalez de Dios2, Juan Pedro Fernandez-Falco1, Jose-Juan Pedrera-Manresas1, Asdrubali Autenrieth1, Mika Siivola1, Nicola Carapellese5, Michele Mirollo1, Adam Atzori1, Daniel King1, Ricardo Martinez1, Ramon Casellas1, 1Nokia Bell Labs, USA; 2Telefónica I+D, Spain; 3Telefónica de Telecomunicaciones de Catalunya (CTTC/CERCA), Spain; 4Electrical Engineering, Chalmers Univ. of Technology, Sweden. We demonstrate a scalable processing of OPM data using ML to detect anomalies in optical services at run time. A distributed multi-layer SDN controller uses the data and the ML assessment results.

M32.10 Demonstration of Packet-Optical Intent-Based Survivability Using Mininet-Optical, Rosana F. Firtho1, Cezar H. Cesla1, Kayol S. Mayer1, Andres F. Portilla1, Dalton S. Arantes1, Dari Mello1, Christian E. Rothenberg1; "UNICAMP, Brazil. We demonstrate packet-optical intent-based networking with survivability intents in a Mininet-Optical testbed. The intent agent negotiates intents with users based on path availability and allocates end-to-end connectivity services.

M32.11 Demonstration of Voice User Interface for Intelligent Network Orchestration, Xiaoran Xu1, Haozhou Chen1, Jesse E. Simpson1, Roland Ryi1, Mikael Mazaud1, Lauren Dalachas1, Nicola K. Fontaine1, David Neilsen1; 1Nokia Bell Labs, USA. We demonstrate a voice user interface for SDN, where natural language processing (NLP) is applied to translate human-spoken language into ONOS northbound API commands, and links network-related questions with numerical reasoning.

M32.12 Demonstration of a Scalable and Efficient Pipeline for ML-Based Optical Monitoring, Carlos Natalino da Silva1, Luis Ginebre2, Ricardo Vila1, Juan Carlos Cea-Diaz1, Oscar Gonzalez de Dios2, Juan Pedro Fernandez-Falco1, Jose-Juan Pedrera-Manresas1, Asdrubali Autenrieth1, Mika Siivola1, Nicola Carapellese5, Michele Mirollo1, Adam Atzori1, Daniel King1, Ricardo Martinez1, Ramon Casellas1, 1Nokia Bell Labs, USA; 2Telefónica I+D, Spain; 3Telefónica de Telecomunicaciones de Catalunya (CTTC/CERCA), Spain; 4Electrical Engineering, Chalmers Univ. of Technology, Sweden. We demonstrate a scalable and efficient pipeline for ML-based optical monitoring. Our framework enables real-time analysis and classification of reflective events in optical transport networks in an open-source network operations platform.

M32.13 Hybrid SDN Orchestration in Multi-Layer Network With SONIC Packet-Optical Nodes and Coherent Pluggables, David Scani1, Juraj Orzit1, Alessio Giorgetti1, Joseph Manuel Martinez1, Andrea Sgamellini1, Emilio Riccardi1, Filippo Cugnin1, Pablo Pavan1; "Scuola Superiore Sant’Anna, Italy; 2University of the Defense at the Spanish Air Force Academy, Spain; 3BIET CNR, Italy; 4Eighth Network Solutions, Spain; 5TIM, Italy; 6CNT, Italy; 7Technical Univ. of Cartagena, Spain. This demo presents a comprehensive framework exploiting the effective cooperation of packet-optical nodes, at the edge of packet and optical domains, managed by the BGP and OSPF protocols and a Hierarchical Control Architecture. The framework enables orchestrated provisioning and self-healing recovery across a multi-layered metro network.

M32.14 Enhancing Cross Layer Monitoring on Open Optical Transport Networks, Nathan A. Ellsworth1, Andrea Fumagalli1, Tanliang Zhang1, Sebastian Tzoa1, Guido Maier1; 1The Univ. of Texas at Dallas, USA; 2Politecnico di Milano, Italy. Continuous monitoring of key network elements is instrumental in intelligent networking. This demo presents an end-to-end monitoring framework for optical transport networks in an open-source network operations platform.

M32.15 Self-Calibrating Transponder Using Intelligent DSP Metrics for Efficient Optical Networks, Bernhard Spinelli1, Junaj Slavok1, Hao Su1, Sharfuddin Syed1, Ashwin Gumaste1, Harald Bock1; 1Infraera Corporation, USA. We demonstrate a self-aware automated transponder system for disaggregated open ROADM-based networks with automation using real-time inputs from a PS-capable 800Gb/s DSP that facilitates in situ measurement of signal performance, for optimal line rate selection.

M32.16 Simultaneous 1008-Channel Control and Measurement for Photonic IC, Muhammad R. Ali1, Ali F. Haq1, Muhammad I. Raffi1, Muhammad I. Raffi1, 1Univ. of Paderborn, Germany. We demonstrate a novel optical receiver for direct-detection of QPSK signals using microring based photonic integrated circuit. The QPSK signal is converted into a PAM7 electrical signal, and demodulated without the need for a local oscillator.

M32.17 Direct-Detection Receiver for QPSK-Modulated Signals, Dagmawi A. Abeleka1, Duomarko T. Meysam1, 1Darmstadt Technische Universitaet, Denmark. We demonstrate a novel optical receiver for direct-detection of QPSK signals utilizing microring based photonic integrated circuit.

M32.18 Optoelectronic Frequency Synthesizer With World-Record Phase Noise, Meyyam Bahmanian1, Christoper Scheyt1, Saeed Fard1; 1Univ. of Paderborn, Germany. We demonstrate an ultra-low phase noise PLL based on MLL. The GEFIL has a phase noise (~150 dBc/Hz 100kHz) for 10GHz carrier frequency. This phase noise is ~20 dB better than state-of-the-art frequency synthesizers.

16:00–16:30 Coffee Break, Upper Level Corridors

16:30–18:30 Birds of a Feather: Designing and Operating the Next Generation Optical Photonic Networks, Room 14B

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Monday, 6 March

Room 1AB

16:30–18:30
M4A • Symposium: Quantum Information and Optical Communication Networks: Emerging Research Areas, Challenges and Opportunities II
Presider: Eleni Diamanti; CNRS, France and Rui Lin; Chalmers Tekniska Högskola, Sweden

M4A.1 • 16:30 • Invited Communication Interfaces to Quantum Memories, Matt Eichenfield1; Univ. of Arizona, USA. Abstract not available.

M4A.2 • 16:45
Definition of Mode Field Diameter for Few-Mode Fibers Based on Stationary Expression of Propagation Constant, Akihisa Nakamura1, Masaharu Ohashi2, Masashi Kikuchi1, Takayoshi Morii, Takayoshi Mori1, Yasuke Yamada1; NTT Corporation, Japan. We derive a novel definition of mode field diameters (MFDs) for few-mode fibers (FMFs) from the wave equation. The MFDs obtained with our definition are useful in evaluating splice losses of each mode in FMFs.

M4B • Multi-Mode Fiber
Presider: Ivana Gasulla Mestre; Universitat Politècnica de València, Spain

M4B.1 • 16:30
A Method for Differential Modal Delay Reduction by Using Curvature of Few-Mode Optical Fiber in High-Density Cable, Masashi Kikuchi1, Takayoshi Mori1, Yasuke Yamada1; NTT Corporation, Japan. We propose a method of controlling the differential modal delay of ZLP-mode graded-index fiber by using the curvature of fiber in high-density cable. The method achieved a 50% reduction in the C-L band.

M4B.2 • 16:45
High Power Uncooled CW-DFB Lasers With High Reliability, Yuanfeng Mao1, Yuanbing Cheng1, Yanbo Yuanfeng Mao1, Yuanbing Cheng1, Yanbo, Tianhai Chang1; 1 Huawei Technologies Co., Ltd., China. We demonstrate L-band and O-band CW-DFB lasers with kink-free, single-mode operation at 1.31 μm.

Room 2

16:30–18:30
M4C • High Power and Comb Laser Sources
Presider: Matthew Sysak; Ayar Labs, USA

M4C.1 • 16:30
Record High Efficiency High-Power Uncooled 1.31 μm CW-DFB Lasers, Mihind Gokhale1, Mark A. Emanuel1, Benjamin Li1; 1 Casela Technologies, USA, USA. We demonstrate record high 75°C power conversion efficiencies of 25% at 100 mW (1mm cavity) and 20% at 200 mW (2mm cavity) for CW-DFB lasers with reliable, kink-free, single-mode operation at 1.31 μm.

M4C.2 • 16:45
High Power Uncooled CW-DFB Lasers With High Reliability, Yuanfeng Mao1, Yuanbing Cheng1, Yanbo Li1, Tianhai Chang1; Huawei Technologies Co., Ltd., China. We demonstrate L-band and O-band CW-DFB lasers with kink-free and stable single mode lasing over 600 mW at 55°C and 200 mW at 85°C, respectively. More than 2000 hours reliable operation at 90°C is achieved.

Room 3

16:30–18:30
M4D • Panel: 1.6Tb/s+ Intra-DC Networks
Organizers: Juthika Basak, Nokia, USA; James Chien, Marvell Technology Inc, USA; Stephen Pachnicke, Christian-Albrechts Universität zu Kiel, Germany
Speakers: Andreas Becktolsheim, Anika Networks, USA; Mark Hembuch, Cisco, USA; Maxim Kuschnierov, Huawei Technologies, Germany; Thomas Liljeborg, Intel Corporation, USA; Radha Nagarajan, Marvell Technology, USA; Xiong Zhou, Google, USA.

Description: The bandwidth demands of hyperscale data center operators have been increasing tremendously over the last years. Consequently, an MSA for 800 Gb/s pluggables has been formed and the IEEE P802.3fd task force for the development of 1.6 Tbps Ethernet has been launched recently. This panel aims to highlight the requirements for next generation 1.6 Tb/s+ systems from the data center operator’s perspective and the expected timelines for deployment. Also, it shall provide clarity on the desired module specifications by discussing recent advances in electronic and photonic integration.

Topics will include the following questions:

- What are the needs of hyperscale data center operators?
- How much parallelism (number of wavelengths, spatial channels) do we need?
- What are ultimate and practical limits of symbol rate?
- What are the needs of hyperscale data center operators as well as chip suppliers sharing their views on next generation intra-data center networks. Interaction between speakers and audience through Q&A is highly encouraged.

Room 4

16:30–18:30
M4E • High Bandwidth Density Interconnects for Computing
Presider: Xiaodan Pang; Kungliga Tekniska Högskolan, Sweden

M4E.1 • 16:30
A 0.4 pJ/bit NRZ Voltage Mode VCSEL Driver for up to 224 Gbit/s SWDM Links, Urs Hecht1, Hélia Oudone1, Nikolay Ledentsov Jr.1, Philippe Scholz1, Patrick Kurr1, Ilya E. Titkov1, Nikolay Ledentsov1, Friedel Gerfers1; TU Berlin, Germany; Vertically Integrated Systems GmbH (VIS), Germany. We present the first true voltage-mode VCSEL driver achieving 60Gbit/s at peak efficiency of 0.36pJ/bit with BER<1e-12 improving the state-of-the-art by a factor of 2. Transmission experiments showcase error-free 56Gbit/s transmission up to 100m fiber. Advanced demonstration enables even 224Gbit/s when using SWDM at a total efficiency of 0.4pJ/bit.

M4E.2 • 16:45
30-Gbps/ch x 4 ch Simultaneous Error-Free Transmission With a Low-Power Transmitter Flip-Chip-Bonded 1.3 μm LD-Array-on-Si, Toshiki Kishi1, Munehiko Nagatani1, Shigeru Kanazawa1, Kota Shikama1, Takuro Fujii1, Hirotsuki Nishi1, Tadashi Minotani1, Norio Sato1, Toru Segawa1, Shunji Matsu1; 1 NTT Device Technology Labs., Japan; 2 Vertically Integrated Systems GmbH, Germany. We present Flip-Chip-Bonded 1.3-μm LD-Array-on-Si, resulting in power efficiency of 1.2 mW/Gbps.

Room 6C

16:30–18:30
M4F • Symposium: Optical Interconnects: Latency, Capacity, Reliability and Cost
Presider: Christian-Albrechts Universität zu Kiel, Germany

M4F.1 • 16:30
Reliability, High Power Uncooled CW-DFB Lasers With High Reliability, Yuanfeng Mao1, Yuanbing Cheng1, Yanbo Li1, Tianhai Chang1; 1 Huawei Technologies Co., Ltd., China. We demonstrate L-band and O-band CW-DFB lasers with kink-free and stable single mode lasing over 600 mW at 55°C and 200 mW at 85°C, respectively. More than 2000 hours reliable operation at 90°C is achieved.

Room 6D

16:30–18:30
M4G • Symposium: Optical Interconnects: Latency, Capacity, Reliability and Cost
Presider: Christian-Albrechts Universität zu Kiel, Germany

M4G.1 • 16:30
Reliability, High Power Uncooled CW-DFB Lasers With High Reliability, Yuanfeng Mao1, Yuanbing Cheng1, Yanbo Li1, Tianhai Chang1; 1 Huawei Technologies Co., Ltd., China. We demonstrate L-band and O-band CW-DFB lasers with kink-free and stable single mode lasing over 600 mW at 55°C and 200 mW at 85°C, respectively. More than 2000 hours reliable operation at 90°C is achieved.
Room 6E

16:30–18:15

M4F • Visible Light Communications and Positioning
Presider: James Lott; Technical Univ. Berlin, Germany

Room 6F

16:30–18:30

M4G • Multi-X Networks
Presider: Yojirō Moriwaka, Nagoya Univ., Japan

Room 7AB

16:30–18:30

M4H • Panel: Optical Fiber Sensing: Technology and Emerging Applications Part II
Organizers: Raja Alam, Cisco Systems, USA; Mikael Mazur, Nokia Bell Labs, USA; Georg Rademacher, NICT, Japan; Ting Wang, NEC Laboratories America, USA
Speakers: Dan Blumenthal, University of California, Santa Barbara, USA; Pierepaolo Boffi, Politecnico di Milano, Italy; Lea Bouffarit, Cornell University, USA; Miguel Gonzalez-Herrera, Universidad de Alcalá, Spain; Leo Hollberg, Stanford University, USA; Paul Oshoindriva, University of Pittsburgh, USA; Charlotte Rowe, Los Alamos National Laboratory, USA; Hiroshi Takahashi, Nippon Telegraph and Telephone Corporation, Japan; Paul Westbrook, OFS Labs, USA
Description: This session focuses on the telecom/network operator perspective of fiber sensing to improve future optical communication systems. The panel, which consists of academia, equipment manufacturers and network operators, aims to further discuss the aspect of how, why and when to implement and use fiber sensing in optical networks.

Room 8

16:30–18:30

M4I • Passive Silicon Photonic Devices
Presider: Sagi Mathai; Hewlett Packard Labs, USA

Room 9

16:30–18:30

M4J • Photonic Switching Devices
Presider: Glenn Bartolini; Coherent Inc, USA

M4F1 • 16:30

25G+ Distance-Adaptive Visible Light Communications Enabled by Entropy Loading, Pedro Loureiro, Fernando Guimarães, Paulo Monteiro, Instituto de Telecomunicações, Portugal. Using probabilistic shaping together with multi-carrier modulation and entropy loading, we experimentally demonstrate a distance-adaptive RGB-VLC system operating with diffused white light and supporting record-high bit rates of 26–46 Gbit/s over 50–200 cm.

M4F2 • 16:45

Capacity Enhancement of VLC by Blue-Green Wavelength Division Multiplexing Using Optical Phased Array, Yuje Di, Calming Sun, Shuyan Chen, Weewei Liu, Yizhan Dai, Binghui Li, Wu Shi, Jing Lin, Yingjie Shao, Jing Xu, Lian-Kuan Shi, Department of Information Engineering, The Chinese Univ. of Hong Kong, Hong Kong, China; Peng Cheng Laboratory, China; Shenzhen Inst. of Artificial Intelligence and Robotics for Society (AIRS), The Chinese Univ. of Hong Kong (CUHK), China; Centre for Applied Photonics Fraunhofer UK Research Ltd, UK; Ocean College, Zhejiang Univ., China. We proposed and experimentally demonstrated the first blue-green OPA-based WDM-VLC systems with narrow channel spacing. A 4.5-Gbit/s transmission with 55% capacity enhancement was achieved by OCT-preceding and simplified third-order Volterra equalization.

M4G1 • 16:30

Experimental Demonstration of Cascadable PPLN-Based Inter-Band Wavelength Converters for Band-Switchable Multi-Band Optical Cross-Connect, Hanako Minami, Kento Hino, Takafumi Fukatani, Masahito Nakagawa, Takehi Seki, Shinpei Shimizu, Takayuki Kobayashi, Takeki Kazama, Koji Ebitu, Kei Watanabe, Takeki Umeaki, Takeki Miyamura, NTT Network Service Systems Laboratories, Japan; NTT Network Innovation Laboratories, Japan; NTT Device Technology Laboratories, Japan; NTT Network Service Systems Laboratories, Japan; NTT Network Innovation Laboratories, Japan; NTT Device Technology Laboratories, Japan.

M4G2 • 16:45

Enabling Multiband Transmission and Programmability in Disaggregated Optical Metro Networks, Lai Nadvai Rezaei, Ramon Casellas, Josep Maria Fabregas, F. Javier Vílchez, Michelà Svaluto Moreolo, CTI Tecnologico de Telecom de Catalunya, Spain. A multi-band (MB) sliceable bandwidth the degradable S-BVT architecture is experimentally assessed over a disaggregated optical metro network. The programmability of the MB-S-BVT is demonstrated by the implementation of an OpenConfig SDN agent.

M4H1 • 16:30

CMOS-Foundry Compatible, Broadband, and Compact Routing of Multimode SOI Waveguides, Asher S. Novick, Kayx Jang, Anthony Rizzo, Aniket E. James, Utsav Dave, Michal Lipson, Keren Bergman, Columbia Univ., USA. We demonstrate a CMOS-foundry compatible, broadband, and compact platform for routing multimode waveguides. Insertion loss of <0.5dB and modal cross-talk of <-15dB are measured for 90° and 180° bends supporting over 200nm of bandwidth.

M4H2 • 16:45

Passive Integrated Athermal (De)Multiplexers on 300 mm Silicon Photonics Wafers, Yun Gao, Andrew Netherton, Ren-Jye Shiue, Columbia Univ., USA; 2Department of Electrical and Computer Engineering, Univ. of California Santa Barbara, USA. We demonstrate passive integrated athermal (de) multiplexers showing near 0 pm/°C wavelength shift over 200nm of bandwidth. Wafer-scale data shows its high fabrication tolerance for next-generation optical transceiver systems.
Room 1AB

M4A • Symposium: Quantum Information and Optical Communication Networks: Emerging Research Areas, Challenges and Opportunities II—Continued

M4A.2 • 17:00 Invited
Multi-User Quantum Communication With Linear Optical Networks, Vladoš Usenko1; 1Palacký Univ. Olomouc, Czechia. Multi-user quantum communication enables distribution of secret keys or quantum resources between multiple users. We will discuss possible realizations using continuous-variable states and linear optical networks, considering realistic channels and devices, and optimizing network topology.

M4A.3 • 17:30 Invited
Quantum Sensor Networks, Saikat Guha1, University of Arizona, USA. Abstract not available.

Room 2

M4B • Multi-Mode Fiber—Continued

M4B.3 • 17:00 Invited
Few-Mode Fibers: Characterizations and Applications, Marianne Bigot1, Maroun Bsaibes1, Laurent Bigot1, Yves Quévremont2, Pierre Sillard3, Prysmian Group, France; 2PHALAM, Université de Lille, France. We report design guidelines and modal loss characterizations (light scattering and extra-loss phenomena) of few-mode fibers that allow optimizing their crosstalk, differential mode group delay and differential mode attenuation for practical applications.

M4B.4 • 17:30 Remote Digital Holographic Characterization of a 75.2 km Few-Mode Fiber Without Reference Wave Transfer, Akira Kawai1, Shimpan Shimizu1, Kohki Shibahara2, Takayuki Kobayashi1, Yutaka Miyamoto1, NTT Network Innovation Laboratories, Japan. We characterized inter-mode-group crosstalk of 75.2-km-long three-mode fiber transmission lines with a digital holography system in which a reference wave is "remotely" generated at the output side by utilizing optical injection locking.

Room 3

M4C • High Power and Comb Laser Sources—Continued

M4C.3 • 17:00 Demonstration of a High-Power and High-Reflection-Tolerance Semiconductor Laser for Co-Packaged Optics, Ning Cheng1, Dechao Ban1, Xuejie Zheng1, Innolight, China. A high-power (>100mW) semiconductor laser is demonstrated with a small far-field divergence of 9.3°x17.6°. Under a -19 dB back-reflection, this laser exhibits little changes in relative intensity noise and almost no power penalty for 53Gb/s PAM4 transmission.

M4C.4 • 17:15 A High-Power, Power-Efficient 1.3-µm SOA-Integrated DFB Laser for CPO Applications, Daisuke Houe1, Konosuke Aayama3, Naoki Fujiwara4, Dasei Shoji1, Harold Kamusi1, 1Sumitomo Electric Industries, LTD., Japan; 2Sumitomo Electric Device Innovations, Inc., Japan. We present a high power 1.3-µm SOA-integrated DFB laser which exhibits a power conversion efficiency of more than 25% with output power of 350 mW up to 45°C. This device also shows an averaged RIN of below -155 dB/Hz.

M4C.5 • 17:30 Fully Integrated III-v-on-Silicon Multi-Port DFB Laser Comb Source for 100 GHz DWDM, Torney Thiessen1, Jason Mak1, Florian Denis-Le Coarer1, Zheng Yong1, Kevin Freiberg1, Maryline Marcheray1, Martin Peyrou1, Laurent Milord1, Joyce Poon2, Christophe Jany4, Sylvie Menezo2, 1Innolight, China. The laser comb source produces approximately 1mW of fiber-coupled power per wavelength per fiber with 2dB power variability across all 32 output channels.

Room 6C

M4D • Panel: 1.6Tb/s+ Intra-DC Networks—Continued

Room 6D

M4E • High Bandwidth Density Interconnects for Computing—Continued

M4E.3 • 17:00 Invited
Optical Communication for Data Centers and HPC, Bill Dally1,2, NVIDIA Corporation, USA; 2Stanford Univ., USA. This talk will discuss the needs of data centers and high-performance computers for optical communication. Issues of bandwidth, bandwidth density, cost, and energy efficiency will be discussed. We will also look at the tradeoff between the number of carriers and bit rate per carrier.

M4E.4 • 17:30
Simultaneous Error-Free Data Modulation With Silicon Microdisks in the Multi-FSR Regime for Scalable DWDM Links, Vignesh Gopal1, Anthony Razo1, Maarten Hattink2, Asher S. Novick1, James Robinson1, Kaveh Hassani1, Tim T. Hoang2, Keren Bergman1, Columbia Univ., USA; Intel Corporation, USA. We demonstrate simultaneous error-free modulation of wavelength channels with spectral separation exceeding the individual microdisk FSR. The channels, re-interleaved onto a single optical output, are demultiplexed using ring filters validating the scalable transceiver architecture.
We propose and demonstrate visible-light communication (VLC) system using a light-diffusion-fiber (LDF) optical system, which allows 360° field-of-view (FOV) non-contact communication. The system is demonstrated in a field-deployed multi-mode fiber network, using OFDM-NOMA, illustrating the flexibilities of optical beam steering and data-rate allocation for multiple users. NOMA), illustrating the flexibilities of optical beam steering and data-rate allocation for multiple users.

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M4A • Symposium: Quantum Information and Optical Communication Networks:
Emerging Research Areas, Challenges and Opportunities II—Continued

M4B • Multi-Mode Fiber—Continued

M4C • High Power and Comb Laser Sources—Continued

M4D • Panel: 1.6Tb/s+ Intra-DC Networks—Continued

M4E • High Bandwidth Density Interconnects for Computing—Continued

M4B.5 • 17:45
55-Spatial-Mode Fiber for Space Division Multiplexing, Pierre Sillard1, Mananne Bigot1, Frank Achten1, Geert Rademacher1, Ruben S. Luis2, Benjamin J. Putnam1, 1Prysmian Group, France; 2NICT, Japan. We report the design and the fabrication of a trench-assisted graded-index-core fiber that supports 55 spatial modes. The fiber is optimized to ensure low macro-bend losses for all the modes, while minimizing the differential-mode-group delays.

M4C.6 • 17:45
100 Gbps/λ Transmission With Quantum Dot O-Band Comb Source Using 50 GBd PAM4/16QAM-OFDM Signals, Lakshmi Narayanan Venkatassubramani1, Haixuan Xu1, Mikhail Buyalo1, Alexey Gubenko1, Yonglin Yu1, Luan Barry1; Dublin City Univ., Ireland; 1Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China; 2InnoLume, Germany. We demonstrate a record high transmission rate of 100 GBd/λ with 50 GBd PAM4 and 16QAM-OFDM signals using a packaged wavelength-tunable InAs/InGaAs quantum dot-based laser comb source for short-reach application. We successfully show the performance is within the standard FEC limits.

M4E.5 • 17:45
A Kind of Low-Modal-Crosstalk Mode DEMUX for Stable DSP-Free IM/DD MDM Transmission, Jian Cai1, Yuyang Gao1, Shaolin Huang1, Jinyu Yu1, Lei Shen1, Lei Zhang1, Changkun Yan1, Liubo Yang2, Ruchun Wang1, Yangqi He1, Zhanglei Chen5, Ju Hao1, 1Peking Univ., China; 2YOFC, China; 3Pengcheng Laboratory, China. A low-modal-crosstalk 4-LP-mode demultiplexer with orthogonal combiner for degenerate mode reception is designed and fabricated by side-polishing processing, based on which DSP-free IM/DD MDM-WDM transmission over 20 km weakly-coupled FMF are experimentally demonstrated.

M4B.6 • 18:00 Invited
Processing and Applications of Semiconductor Core Fibers, Ursula J. Gibson1; Norwegian Univ. of Science and Tech, USA. Optical fibers with semiconducting cores permit transmission of signals from the visible to THz wavelengths, and devices can utilize the large nonlinear coefficients of the core materials. Fabrication, post-processing, properties and devices are reviewed.

M4C.7 • 18:00
Highly Reliable Quantum dot Laser Directly Grown on CMOS Compatible Si (001) Substrate, Xiangjie Zhao1, Xiang Li1, Guanlin Lou1, Ling Sun1, Shiyong Zhang1, Hailong Qi1; Hisilicon Optoelectronics Co. Ltd., China. Highly reliable InAs/GaAs quantum dot laser directly grown on CMOS compatible Si (001) substrate without any predefined pattern or intermediate material. Aging at 85°C 100mA, the laser shows optical power degradation less than 5% after 3000 hours.

M4C.8 • 18:15
Multi Aperture High Power 100G Single Mode 850nm VCSEL for Extended Reach 800G Ethernet, Lukasz Chorchos1,1, Nikolay Ledenstov Jr1, Oleg Makarov1, Vitaly Shchukin1, Vladimir Kalosh1, Jaraslaw P. Turkiewicz1, Nikolay Ledenstov1, Warsaw Univ. of Technology, Poland; 1W Systems GmbH, Germany. The paper presents multi-aperture single mode 850nm VCSEL with optical modulation bandwidth exceeding 30GHz and narrow optical spectrum width enabling long distance high-speed data transmission exceeding 800m over OM4 multi-mode fiber.

M4E.6 • 18:00 Invited
Developments of VCSEL-Based CP0 Transceivers Beyond 1Tbps, Daniel Kuchta1, 1IBM TJ Watson Research Center, USA. This paper covers recent industry developments in VCSEL-based transceivers that are designed for co-packaging on a first level package with ASICs, such as CPUs, GPUs, and data center switches.

19:00–21:00 Student Party, Petco Park
M4F • Visible Light Communications and Positioning—Continued

M4G • Multi-X Networks—Continued

M4H • Panel: Optical Fiber Sensing: Technology and Emerging Applications Part II—Continued

M4I • Passive Silicon Photonic Devices—Continued

M4J • Photonic Switching Devices—Continued

M4F.6 • 17:45 Invited Inbuilding Optical Wireless Positioning Using Time of Flight, Christoph Kottke1, Ziyao Ma1, Sepideh Mohammad Kouhiri1, Volker Jungnickel2; Fraunhofer Inst Nachricht Heinrich-Hertz, Germany. We present a LiFi positioning and communication system based on the ITU-T G.9991 standard. Accuracies as low as 3 cm in x,y,z direction have been achieved, utilising an optimization approach for the LED behavior.

M4G.6 • 17:45 On the Impact of Fault-Induced Power Transients in Wideband Optical Networks, Andre Souza1, Antonio Eira1, Nelson Costa1, Joao Pedro1, Joao Pires1; INFINERA UNIPESSAL LDA, NIF 510533079, Portugal; Instituto de Telecomunicacoes, Instituto Superior Tecnico, Portugal; Instituto Superior Tecnico, Portugal. We study the consequences of power transients caused by link failures and stimulated Raman scattering in multi-band networks. Results show that carefully optimizing transient margins should avoid high capacity reduction and excessive costs.

M4G.7 • 18:00 Top-Scored Single Multicore-Fiber Bidirectional Spatial Channel Network Based on Spatial Cross-Connect and Multicore EDFA Efficiently Accommodating Asymmetric Traffic, Kyousuke Nakada1, Hitoshi Takeshita1, Yuki Kuno1, Yusuke Matsuno1, Itsuki Urashima1, Yutaka Uchida1, Kohei Hosokawa1, Ryoshi Otowa1, Rika Tahara1, Emmanuel Le Taillandier de Gabory1, Yasuki Sakurai1, Ryuchi Sugizaki1, Masahiko Jinno1; Kagawa Univ., Japan. A single multicore-fiber bidirectional spatial channel network that efficiently accommodates asymmetric traffic is proposed and demonstrated using a core-selective-switch-based spatial cross-connect with an M×N wavelength-selective switch and a bidirectional multicore EDFA with reversible optical isolators.

M4G.8 • 18:15 Architecture and Performance Evaluation of Bundled-Path-Routing Multi-Band Optical Networks, Ryuji Munakata1,2, Takuma Kuno1, Yojo Mori1, Shih-Chun Lin3, Motoharu Matsuzawa1, Suresh Subramaniam1, Hiroshi Hasegawa1, Nagoya Univ., Japan; 2North Carolina State Univ., USA; 3Univ. of Electro-communications, Japan. We propose a novel bundled-path-routing node architecture for multi-band optical networks and a network design algorithm based on graph degeneration. Feasibility is demonstrated through experiments on a prototype with 308.8 Tbps throughput.

M4J.5 • 17:45 Performance Verification of 7,424 × 7,424 Optical Switch Offering 1.4 µs Switching Time, Ryosuke Matsumoto1, Ryotaro Konoike1, Hiroyuki Matsuura1, Keiji Suzuki1, Takashi Inoue1, Kazuhiro Ikeda1, Shu Namiki1, Ken-ichi Sato1; National Inst. of Advanced Industria, Japan. We experimentally verify performance of 7,424×7,424 optical switches that offer 1.4-µs switching time. Two key enablers are reported; newly developed polarization-insensitive 64×1 silicon-photonic switches integrated with wavelength-tunable filters, and a fast burst-mode coherent receiver.

M4J.6 • 18:00 Invited Large-Scale High-Speed Photonic Switches Fabricated on Silicon-Based Photonic Platforms, Tao Chu1,2, Nuo Chen1, Weijie Tang1, Tiantian Wu1, Zhejiang Univ., China; Zhejiang Laboratory, China. Large-scale high-speed photonic switches were demonstrated on silicon-on-insulator and thin-film Lithium Niobate platforms, respectively. Ultra-low-loss spot-size converter, gratings coupler, waveguide crossing, and high-speed switch unit are developed, as well as an integrated 128 × 128 switch.

19:00–21:00 Student Party, Petco Park
Tuesday, 7 March
OFC 2023 • 05–09 March 2023
Ballroom 20BCD

07:30–08:00 Plenary Session Coffee Break, Upper Level, Ballroom 20 Lobby

08:00–10:00 Tu1A • Plenary Session
Presider: Ramon Casellas; CTTC, Spain; Christopher Cole; Coherent Corp., USA; Ming-Jun Li; Corning Inc, USA

10:00–17:00 Exhibition and Show Floor, Exhibit Hall (concessions available)

10:00–14:00 Unopposed Exhibit-only Time, Exhibit Hall (coffee service 10:00–10:30)

10:00–16:45 OFC Career Zone, Exhibit Hall, B2
OFC Career Zone Job Fair | Resume Critique Workshop | Mock Interviews

11:00–12:00 Optical Communications Technical Group Poster Pitch Competition, Room 3

12:00–14:00 OFC and Co-Sponsors Awards Ceremony and Luncheon, Upper Level, Ballroom 20A

08:00–10:00 Tu1A • Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities I
Presider: To be announced.

Tu2A.1 • 14:00 Invited
Innovative Optical and Wireless Network (IOWN) for a Sustainable World, Yosuke Aragane; NTT Communications Corporation, Japan. IOWN is a next generation communication and computing infrastructure which enables both high-performance and low-power consumption for the Sustainable Development Goals by IOWN’s capabilities of an all-photonics network and a data-centric infrastructure.

Tu2B.1 • 14:00 Invited
Optoelectronic Components for Communications and Sensing, Julie Eng; II-VI Incorporated, USA. Abstract not available.

Tu2C.1 • 14:00 Optic-electronic Components for Communication, Julie Eng; II-VI Incorporated, USA. Abstract not available.

Tu2D.1 • 14:00 Optimal Line-Rates for IP-Over-DWDM in Metro and Core Networks: Comparison of ZR+ and Xponder Architectures, Ashwin Gumaste, João Pedro, Paul Montanhan, Harald Bock; Infinitera Corporation, USA. With the advent of pluggable ZR/ZR+ and embedded optics at 400Gb/s and beyond, we consider optimal network architectures and line-rates in access, metro and core networks. Simulations across a US-core network are demonstrated.

Tu2E.1 • 14:00 Silicon-Phononic Integrated Circuits With Enhanced Optical Functionality for Data-Center Applications, Christopher R. Doerr; Doerr Consulting, LLC, USA. Abstract not available.

Tu2F.1 • 14:00 Invited
CTC Experiences on Building Computing Power Network, Gefan Zhou; China Telecom Corp Ltd, Beijing Res Inst, China. For the optimum leveraging of distributed computing and network resources in the network for various services, we proposed an advanced architecture of Computing Power Network (CPN) with the development of CPN gateway and transaction platform.
07:30–08:00  Plenary Session Coffee Break, Upper Level, Ballroom 20 Lobby

08:00–10:00  Tu1A  •  Plenary Session
Presider: Ramon Casellas; CTTC, Spain; Christopher Cole; Coherent Corp., USA; Ming-Jun Li; Corning Inc, USA

10:00–17:00  Exhibition and Show Floor, Exhibit Hall (concessions available)

10:00–14:00  Unopposed Exhibit-only Time, Exhibit Hall (coffee service 10:00–10:30)

10:00–16:45  OFC Career Zone, Exhibit Hall, B2
OFC Career Zone Job Fair  |  Resume Critique Workshop  |  Mock Interviews

11:00–12:00  Optical Communications Technical Group Poster Pitch Competition, Room 3

12:00–14:00  OFC and Co-Sponsors Awards Ceremony and Luncheon, Upper Level, Ballroom 20A

Room 6F
14:00–16:00  Tu2G  •  Subsea and Long-Haul Transmission
Presider: Alexei Pilipetskii; SubCom LLC, USA

Tu2G.1  •  14:00  Invited
Promising DSP Techniques to Increase Long Haul Transmission Capacity, Dorian Laverly1, Siddharth Varughese1, Carlo Condo1, Mohamed Osman1, Mehrdi Torbatian1, Yuedong Ke1, Han Sun1; 1Infinera Corporation, USA.

Organizers: Long Chen, Cisco, USA; Sylvie Menezo, SCINTIL Photonics, France; Shilong Pan, Nanjing University Aeronautics & Astronautics, China; Milos Popovic, Boston University, USA

Speakers: Philippe Abiol, IMEC, Belgium; Hyunil Byun, Samsung Electronics, Republic of Korea; Sen Lin, Aurora, USA; Clement Nouel, Valeo, Germany; Chris Poulton, Analog Photonics, USA

Description: LIDAR, i.e., "laser imaging, detection, and ranging", is a 3D scanning technology using optical signals. Soon after the invention of lasers, LIDAR was put in use in areas such as meteorology, geography, and military applications. For example, in 1971 during the Apollo 15 mission, astronauts used a laser altimeter to map the surface of the moon. Such LIDAR instruments for remote sensing are widely used.

Room 7AB
14:00–16:00  Tu2I  •  Panel: LiDAR Systems and Technologies with Integrated Photonics
Presider: Rui Lin; Chalmers Tekniska Högskola, Sweden

Organizers: Long Chen, Cisco, USA; Sylvie Menezo, SCINTIL Photonics, France; Shilong Pan, Nanjing University Aeronautics & Astronautics, China; Milos Popovic, Boston University, USA

Tu2I.1  •  14:00  Tutorial
On-Chip Engineering Entanglement for Photonic Quantum Computing, Jianwei Wang1,2; 1Peking Univ, China; 2Abstract not available.

14:00–15:45  Tu2H  •  Quantum Computing
Presider: Rui Lin; Chalmers Tekniska Högskola, Sweden

Room 8
14:00–16:00  Tu2J  •  Radio-Over-Fiber for 5G and Beyond Systems
Presider: Thomas Clark; JHU/APL, USA

Tu2J.1  •  14:00  Tutorial
Transparent Radio-Fiber-Radio-Fiber System in 100-GHz Band for Indoor Uplink Signal Transmission in Beyond 5G, Pham Tien Dat1, Yuya Yamaguchi1,2, Atsushi Kanno1,2, Naokatsu Yamamoto1, Tetsuya Kawanishi3,1, Kouichi Akahane1; 1NICT Network System Research Inst., Japan; 2Nagoya Inst. of Technology, Japan; 3Waseda Univ., Japan.

We demonstrate the first radio–fiber–radio–fiber system for delivery of 100-GHz radio signals from indoor to central offices. We transmitted single-carrier and OFDM signals with line rates of 30 and 40 Gb/s over the system.

Room 9
14:00–16:00  Tu2K  •  Panel: Radio-Over-Fiber for 5G and Beyond Systems
Presider: Thomas Clark; JHU/APL, USA
Fulfilling the UN Sustainability Goals, How Optical Technology in F5G Support Opportunities I—Continued

Tu2C.2 • 14:30 Invited How Optical Technology in F5G Support Fulfilling the UN Sustainability Goals, Marcus Brunner1; Huawei Technologies, Switzerland. Abstract not available.

Tu2C.3 • 14:30 Invited Development and Perspectives of Next-Generation Optical Fiber Cable Standardization, Peter L. Pondilio1; Corning Inc, USA. Provides an overview of recent standardization activities addressing new technological trends and advancements in optical fiber and cable performance specifications and/or test methods.

Tu2D.2 • 14:45 On Real-Time Optical Subcarrier Management in P2MP Networks With Mixed-Strategy Gaming, Qian Wang1, Qi Tang2; 1Sun Yat-sen University, China; 2Universitat Politècnica de Catalunya (UPC), Spain. We developed a mixed-strategy gaming approach for distributed and real-time optical subcarrier management in point-to-multipoint networks, achieving traffic loss rates close to those by ILP-based centralized optimization.

Tu2D.3 • 14:45 Fully Integrated Dual-Polarization Sili- con Photonic Transceiver With Automa- ted Polarization Control, Xinxin Wu1,2; 1Huawei Technologies Co., Ltd., China; 2Optical Systems Division, Technical University of Munich, Germany. We demonstrate a dual-polarization, single-wavelength transceiver with BER below soft-decision FEC (<2e-2) at 320Gb/s (PAM-4) aggregate rate. The silicon photonic chip includes integrated laser, ring modulators, SOA, and polarization demux with automated polarization control.

Tu2E.2 • 14:30 Top-Scored Ultra-High-Density Microduct Cable With Uncoupled 12-Core Fibers With Standard 250-µm Coating, Tsinghua Shenzhen International Graduate School, China. We introduce a 8-mm-outside-diameter cable using the 12-core fibers, which demonstrates the feasibility of ultra-high-core-count optical cables that can be blown into widely-deployed small-diameter microducts.

Tu2E.3 • 14:45 Explaining Machine Learning-Enabled Just-Enough Margin Configurations in Dynamic S+Cl-Band Optical Networks, Zeyuan Yang1,2; 1Beijing Univ. of Posts and Telecommunications, China; 2Telecom China, China. We configure an explainable machine learning-enabled just-enough margin for each lightpath in dynamic S+Cl-Band optical networks. Explainable decisions improve blocking ratio and spectral efficiency performances by 35% and 17% compared with the benchmarks.

Tu3C • Deployment and Field Trials—Continued

Tu2F.2 • 14:30 Experimental Demonstration of ML-Based DWDN System Margin Estimation, Jason Miller1, Frank Sleyter2, Kaida Kaefal2, Sebastian Troia1, Tobias Fehenseger2, Jörg-Peter Elbers1, Daniel C. Kilper3, Marco Ruffini1, Carmen Mas Machuca1, ADHIA, Germany; 1Chair of Communication Networks, Technical Univ. of Munich, Germany; 2Connect Research Centre, School of Computer Science and Statistic, Trinity College Dublin, Ireland; 3Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Italy.SNR margins between partially and fully loaded DWDN systems are estimated without detailed knowledge of the network. The ML model, trained on simulation data, achieves accurate predictions on experimental data with an RMSE of 0.16 dB.
Tu2G • Subsea and Long-Haul Transmission—Continued

Tu2G • 14:30
128Gbd Record QPSK Transmission Over 20 631 km and PCS16QAM Transmission Over 12 558 km Using InP Technology Platform, Juan Esparza1, Henrique Pavan1, Andrea Quintana Zambrano1, Richard Garuz1, Sebastien Dupont1, Stephane Ruggien1; ASN, France. We experimentally demonstrate the generation, transmission, and detection of 128Gbd QPSK and PCS16QAM signals in optical submarine systems. We have validated the transmission of 33 channels PCS16QAM along the C-band over 12 558 km with an average of 0.74 dB margin from 25% soft FEC threshold.

Tu2G.3 • 14:45
Longitudinal Power Monitoring Over a Deployed 10,000-km Link for Submarine Systems, Alix A. May1, Fabien Bohier1, Alessio Carbo Messagger1, Juan Esparza1, Philippe Plentady1, Alain Calas1, Patricia Layec1; Nokia Bell Labs France, France; Alcatel Submarine Networks, France. We demonstrate the power profile estimation over a deployed 10,000-km submarine link using digital processing at the receiver. We experimentally show that we estimate span lengths with 0.49km uncertainty and locate multiple power losses.

today. In addition, over the last decade, with the rapid advancements in 3D face recognition, autonomous vehicles, and industrial automation, low-cost, compact, and reliable LiDAR systems are seen as a key technology for precision sensing in many consumer and industrial applications.

This panel aims to provide a glimpse of LiDAR systems in different applications and different technology directions, and how integrated photonics can help drive down the size, cost, and improve reliabilities of LiDAR systems. In particular, the panel will discuss the pros and cons of direct detection in time-of-flight LiDAR and coherent detection in frequency-modulated continuous wave LiDAR, and their suitability in different sensing applications, and discuss the 2D scanning mechanisms, comparing mechanical beam steering with integrated photonics based solutions such as optical phase array and switched beam array.

Tu2J.2 • 14:15 ★ Top-Scored
14.1Tb/s CPRI-Equivalent Rate 1024-QAM Transmission via Combs-Cloned Self-Homodyne WDM Digital-Analog Radio-Over-Fiber System, Chenbo Zhang1, Yuxiao Zhu1, Ilbo He1, Rongwei Liu1, Yicheng Xu2, Qunbi Zhuge2, Weiwai Hu2, Weisheng Hu3, Zhangyuan Chen1, Xiaopeng Xie2; Peking Univ., China; Shanghai Jiao Tong Univ., China. We leverage cutting-edge photonic approaches to demonstrate a clone-combs-based self-homodyne WDM digital-analog RoF system for mobile fronthaul. We achieve a 240GHz(=12λ×20GHz) aggregated bandwidth with an unprecedented 14.1Tb/s CPRI-equivalent data rate supporting the 1024-QAM signal.

Tu2J.3 • 14:30 Tutorial
Towards Mobile Fronthaul for 6G Networks, Nathan J. Gomes1; Univ. College London, UK. In less than a decade, rapid developments have taken place in mobile fronthaul technology. As research and development for 6G commences, the future possible directions for fronthaul technology will be outlined in this tutorial.
Tu2A • Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities — Continued

Tu2C • Deployment and Field Trials—Continued

Tu2D • Network Planning and Operation—Continued

Tu2E • Co-Packaged and PIC for Data Center Applications—Continued

Tu2F • AI and Optimization in (Disaggregated) Networks—Continued

Tu2A.3 • 15:00 Invited Standards and Optical Technologies to Decrease Power Consumption: What is Being Done and Remains to be Done, Naveena Geray, "Orange Labs, France. Abstract not available.

Tu2C.4 • 15:00 Top-Scored 114 Pbit/s transmission Using Three Vendor-Installed 60-km Standard Cladding Multi-Core Fiber Spans With Multiple Fusion Splicing, Doki Soma, Stohel Beppu, Yuichi Miyagawa, Noboru Yoshikane, Takehiro Tsumita, KDDI Research, Inc., Japan. A cable link with 288 four-core multicore fibers and 288 pairs of fanout devices was deployed in the field and its losses were evaluated. No excess losses were observed from MCF-related components in field installation.

Tu2C.5 • 15:15 Invited Improved QoT Estimations Through Refined Signal Power Measurements in a Disaggregated and Partially-Loaded Live Production Network, Yan He, "China Unicom Research Institute, China; "China United Network Communications Group Company Limited, China. A fast and accurate QoT estimation scheme using deep neural network is proposed for dynamic C+C-band large-scale mesh networks. The calculation time is decreased dramatically and it is applied to measure the fiber broken case.

Tu2D.5 • 15:00 Invited Advancements in Heterogeneously Integrated Silicon Photonics for IMDD and Coherent Data Transmission, Yuliy A. Akulova, Richard Jones, Kimchau Vu, Saeed Fathololoumi, David Patel, Christian Takeda, Nikhil Angra, Usman Nasir, Karl Fotheringham, The Hong Kong Polytechnic Univ., Hong Kong; "Alibaba Cloud, Alibaba Group, Hangzhou, China; "Alibaba Cloud, Alibaba Group, Beijing, China; "Alibaba Cloud, Alibaba Group, New York, USA, USA; "Photonics Research Inst., Department of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong. We proposed to combine signal power measurements from optical amplifiers and channel monitors in a disaggregated and partially-loaded live production network to reduce the standard deviation of OSNR estimation error from 0.6347dB to 0.4387dB.
Tu2G.4 • 15:00
Unrepeatered C-Band Transmission of 35.5 Tb/s Capacity Over 291 km Using 128 Gbd DP-16-QAM, Alexis Busson1, Hans Bissessur1, Darya Kravchenko1, Farana Hedaryal1, Juan Uriel Esparza1, 1Alcatel Submarine Networks, France. We present a 128 Gbd high baud rate record unrepeatered experiment with 39 channels carrying DP-16-QAM with offline post-processing over 291 km of low-loss high effective-area optical fiber, applying co-Raman propagation and third-order counter-Raman amplification.

Tu2G.5 • 15:15
On the Road to 1-Pbps Systems: Experimental Demonstration of an Energy Efficient 500-Tbps Transatlantic Cable With 200-μm Outer Diameter Fibers, Alexis Carbo Meseguer1, Andrea Quintana Zambrano1, Jean-Christophe Antonia1, Juan Uriel Esparza1, Juliana Tiburcio de Araujo1, Olivier Courtois1, Vincent Letellier1, 1Alcatel Submarine Networks, France. We experimentally emulate an energy efficient 500-Tbps subsea cable with 24 fiber pairs of 200 μm outer diameter Pure Silica Core Fiber and then we draw projections to assess how to achieve a 1-Pbps submarine cable for distances from 3000 to 12000 km.

Tu2H.2 • 15:00
Analysing the Effect of Quantum Network Interconnect on the Performance of Distributed Quantum Computing, Sima Bahrami1, Rui Wang1, Romerson Oliveira1, Reza Nejabati1, Dimitra E. Simeonidou1, 1Univ. of Bristol, UK. We investigate how a dynamically reconfigurable network supports short-range distributed quantum computing in a data center scenario by analysing the penalties and benefits of adopting such architecture in the NetSquid platform utilising two use cases.

Tu2H.3 • 15:15
Invited Fault-Tolerant Photonic Quantum Computing, Zachary Vernon1, 1Xanadu Quantum Computing, Canada. A hardware and architectural progress report on our efforts to build a large-scale, fault-tolerant quantum computer using photonics. Relevant aspects of both component development and manufacturing requirements will be discussed.
<table>
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<tr>
<th>Time</th>
<th>Session</th>
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<tr>
<td>15:30</td>
<td>Tu2A.4 • 15:30 Invited The Role of Photonics in Sustainability and in Quantifying Greenhouse Gas Emissions, Thomas Karagiannis, Microsoft Research Ltd, UK. Abstract not available.</td>
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<tr>
<td>15:45</td>
<td>Tu2B.5 • 15:45 Uncooled Operation of Si Mach-Zehnder Modulator Integrated With Membrane Semiconductor Optical Amplifiers Inside Interferometer Arms, Takuma Aihara, Tatsunori Hiraki, Takuro Fujii, Koji Takeda, Hiroshi Fukuda, Takaaki Kakitsuka, Tai Tsuchiawa, Shinya Matsuo, NTT Corporation, Japan. Membrane SOAs are integrated inside the interferometer arms of Si-MZM, in which the SOAs have on-chip gain of 11.5-3 dB at 25-80°C. In this configuration, SOAs can be used in saturated region suppressing pattern effect.</td>
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<td>15:30</td>
<td>Tu2C.6 • 15:30 Invited Advances in Fiber Technologies and Undersea Systems, Marsha A. Spalding, SubCom LLC, USA. Abstract not available.</td>
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<tr>
<td>15:45</td>
<td>Tu2D.7 • 15:45 Resource Allocation in Optical Networks With Mode Group Division Multiplexing and Light Trail, Qiulun Zhang, Yihou Wang, Alberto Gatto, Massimo Tornatore, Politecnico di Milano, Italy. We quantitatively evaluate resource efficiency enabled by mode-group-division multiplexing (MGDM) and light-trail (LT) in optical metro networks. Combining MGDM with LT reduces 95% of MIMO complexity of Full-MIMO with only 11% additional spectrum occupation.</td>
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<td>15:30</td>
<td>Tu2E.5 • 15:30 Invited System-on-Chip Photonic Integrated Circuits in Silicon Photonics and the Role of Plasmonics, Claudia Hoessbacher, Benedict Baeuerle, Eva De Leo, Wolfgang Heni, Stephan Koch, Juerg Leuthold, Plasmon Technologies AG, Switzerland; Inst. of Electromagnetic Fields (IEF), ETH Zurich, Switzerland. This paper reviews photonic integrated circuits on silicon photonics. We focus on system on chips in applications for optical communications, sensing, and quantum technologies, and outline the role of plasmonics in silicon photonics.</td>
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<td>15:30</td>
<td>Tu2F.6 • 15:30 Invited Dynamic Optical Networks as Arcade Games: Lessons Learnt and Next Steps, Alessandra L. Beghelli, Moshe Simon, Univ. College London, UK. We transformed the dynamic routing and spectrum allocation problem into an Arcade-like game and trained a reinforcement learning agent to play it. Preliminary results show the agent outperforms the K-SP-FF heuristic.</td>
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**Tuesday, 7 March**

16:00–16:30 Coffee Break, Upper Level Corridors and Exhibit Hall
Tu2G.6 • 15:30
420-Gb/s/Channel WDM PS-64QAM Transmission Over 4,000-km ULAF Using Ring-Wise Neural Network Equalization, Bohan Sang1, Xiao Kong1, Wen Zhou1, Jinyu Long2, Li Zhao2, Bing Ye2, Weizhang Chen1, Xiangjun Xin2, Bo Lu2, Jianjun Yu1; Beihang Univ., China; ZTE Corp., China; Beijing Univ. of Posts and Telecommunications, China. We realized 420-Gbps/channel WDM coherent transmission over 4,000-km ULAF utilizing a novel well-expandable Ring-Wise Neural Network equalizer (RW-NNE) targeted to PS-64QAM signals. Results show that our RW-NNE with 25% lower complexity outperforms normal NNE by 25% reach improvement.

Tu2G.7 • 15:45
Real-Time 33.6 Tb/s (42 × 800 Gb/s) Unrepeatered Transmission Over 302 km Using ROPA System, JianJun Wu1, Jiekui Yu1, Jiasheng Liu1, Qianggao Hu1, MingXiong Duan1, WenZhiqng Wang1, Chao Huang1, Han Long1, Shujuan Sun1, Man Tan1, Liyan Huang1, Jian Xu1; Wuhan Guangxun Technology Co., Ltd., China. This paper demonstrates a record unrepeatered transmission with the capacity of 33.6 Tb/s (42 × 800 Gb/s) over 302.7 km (47.52 dB) with a single fiber configuration, using forward Raman pump, backward ROPA, and ultra-low loss & large effective area fiber.

Tu2J.4 • 15:30
Enhancing NOMA Performance in Uplink MMW-RoF Mobile Fronthaul Systems by Using Index Modulation, Shen-Chen Tsai1, Jhih-Heng Yan1, Kai-Ming Feng1; National Tsing Hua Univ., Taiwan; Chunghwa Telecom Co. Ltd, Taiwan. A novel OFDM-based index modulation (IM) assisted multi-users NOMA wireless uplink system is demonstrated in MMW-RoF mobile fronthaul. With IM, the proposed scheme achieves higher flexibility on spectral efficiency and power ratio than conventional NOMA.

Tu2J.5 • 15:45
Constellation Independent Look-up Table Enabled Digital Predistortion for Digital-Analog Radio-Over-Fiber System, Xiaobo Zeng1, Yixiao Zhu1, Yicheng Xu1, Mengfan Fu1, Mengtao Guo1, Weisheng Hu1, Qunbi Zhuge1; Shanghai Jiao Tong Univ., China. A constellation independent look-up table (LUT) method for transceiver nonlinearity predistortion in digital-analog radio-over-fiber system is proposed and experimentally demonstrated, achieving a SNR gain of 1.04dB. The table size can be reduced to 0.3% of the conventional LUT.
Tu3A 16:30–18:30
Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities II
Presider: To be announced.

Tu3A.1 16:30
Invited
Standards and Optical Technologies to Decrease Power Consumption: What is Being Done and Remains to Be Done, Naveena Genay, Orange Labs, France. Abstract not available.

Tu3B 16:30–18:30
Photonic Integrated Circuits
Presider: Milos Popovic; Boston Univ., USA

Tu3B.1 16:30
Tutorial
Thin Film Lithium Niobate Integrated Circuits - a Tutorial Introduction and Overview, Arnan Mitchell; Royal Melbourne Inst. of Technology, Australia. This tutorial will present an introduction and overview of integrated photonic circuits using the thin-film lithium niobate platform, starting with the fundamentals and history and leading to a speculative outlook for future technologies and applications.

Tu3C 16:30–18:30
New Materials and Technologies
Presider: Mitsuru Takenaka; The Univ. of Tokyo, Japan

Tu3C.1 16:30
Invited
Advances in Ultra-Wideband LiNbO3 Thin-Film Modulators, Xinlun Cai; Sun Yat-Sen Univ., China. We review recent advances and design considerations for thin-film lithium niobate (TFLN) modulators with ultra-wide bandwidth and CMOS-compatible voltage, and we discuss how to approach the limits of the electro-optic bandwidth of the TFLN-based modulators.

Tu3D 16:30–18:30
Network Orchestration
Presider: To be announced.

Tu3D.1 16:30
Heuristic-Assisted Deep Reinforcement Learning for Resource-Efficient and QoS-Guaranteed 5G RAN Slice Migration in Elastic Metro Aggregation Optical Networks, Jiahua Gu, Min Zhu, Yunwu Wang, Xiaofeng Cai, Yuancheng Cai, Jiao Zhang; Southeast Univ., China; Purple Mountain Laboratory, China. We propose a heuristic-assisted deep reinforcement learning framework for resource-efficient and QoS-guaranteed 5G RAN slice migration in EONs, which can optimize the spectrum resource consumption, traffic migration, and power consumption, simultaneously.

Tu3E 16:30–18:30
SDM - For Short Reach and Long-Haul Transmission Systems
Presider: John Downie; Corning Inc, USA

Tu3E.1 16:30
Invited
SDM and Parallelism in Submarine Cable Systems, Jin-Xing Cai; SubCom LLC, USA. We review the most recent achievements in undersea transmission with high optical power efficiency and the associated enabling technologies and discuss the economics of SDM and the corresponding reduction in cost per bit for submarine cable systems.

Tu3F 16:30–18:30
Coexistence and Emerging Use-Cases of PON
Presider: Annachiara Pagano; Telecom Italia, Italy

Tu3F.1 16:30
Invited
An Operator’s Approach on the Coexistence in Future Optical Access Networks, Fabienne Saliou, Philippe Chanclou, Gael Simon, Jeremy Potet, Georges Galliard, Stephane Le Huérou; Orange, France. Main challenges of coexistence of future access transmissions are detailed. Important tradeoffs are identified: wavelength plan for triple PON coexistence, optics for high optical budget, considering OOB and SRS penalties. Multiplicity of technical implementations for P2P and PON transceivers are against future interoperability.

Tu3D.2 16:45
End-to-end Orchestration in Support of IIoT Applications Over Optically Interconnected TSN Domains, Albert Pagés, Fernando Agra, Salvatore Spadaro; Universitat Politècnica de Catalunya, Spain. We demonstrate that joint orchestration of TSN and optical network domains in support of IIoT applications reduces the TSN blocking by four orders of magnitude and the usage of high priority queues by a 28-100%.

Tu3D.3 16:45
Heuristic-Assisted Deep Reinforcement Learning for Resource-Efficient and QoS-Guaranteed 5G RAN Slice Migration in Elastic Metro Aggregation Optical Networks, Jiahua Gu, Min Zhu, Yunwu Wang, Xiaofeng Cai, Yuancheng Cai, Jiao Zhang; Southeast Univ., China; Purple Mountain Laboratory, China. We propose a heuristic-assisted deep reinforcement learning framework for resource-efficient and QoS-guaranteed 5G RAN slice migration in EONs, which can optimize the spectrum resource consumption, traffic migration, and power consumption, simultaneously.

Tu3E.2 16:45
SDM and Parallelism in Submarine Cable Systems, Jin-Xing Cai; SubCom LLC, USA. We review the most recent achievements in undersea transmission with high optical power efficiency and the associated enabling technologies and discuss the economics of SDM and the corresponding reduction in cost per bit for submarine cable systems.
Tu3G.1 • 16:30 Tutorial
High-Capacity Submarine Cables: Past, Present and Future, Georg Mohs¹; ¹SubCom LLC, USA. Abstract not available.

Tu3H.1 • 16:30 Tutorial
Quantum Interconnects, Galan Moody¹; ¹Electrical and Computer Engineering, Univ. of California Santa Barbara, USA. Quantum interconnects—devices that can transfer quantum states across different physical systems—are a vital component for quantum information technologies. In this tutorial, I will discuss recent advances and the challenges going forward.

Tu3I.1 • 16:30 Top-Scored
106.25 Gbaud 4-Level Pulse Amplitude Modulation Links Supporting (2x)100Gigabit Ethernet on Single Lambda, Oskars Ozolins¹,¹¹, Armands Ostrovskis¹,¹¹, Toms Salgals¹,¹¹, Benjamin Krüger¹, Fabio Pettala¹,¹¹, Mehdieh Johari¹,¹¹, Richard Schatz¹, Di Che¹,¹¹, Yauhio Matsui¹,¹¹, Thomas Dippon¹,¹¹, Yuchuan Fan¹, Aleksejs Udalcovs¹, Marek Chacinski¹, Urban Westergren¹, Lu Zhang¹, Hao Mardoyan¹, Xinbin Yu¹, Sandis Spolitis¹,¹¹, Sergij Popov¹, Markus Gruner¹, Vjačeslavs Bobrovs¹, Hadrien Louchet¹, Xiaodan Pang¹; ¹RISE Research Inst. of Sweden AB, Sweden; ²KTH Royal Inst. of Technology, Sweden; ³Riga Technical Univ., Latvia; ⁴Keysight Technologies, Germany, ⁵Nokia Bell Labs, USA, ⁶Coherent, USA, ⁷Coherent, Sweden; ⁸Zhejiang Univ., China; ⁹Nokia Bell Labs, France; ¹⁰Communication Technologies Research Center, Riga Technical Univ., Latvia. We experimentally demonstrate and compare EML- and DML-based optical interconnects with 106.25 Gbaud NRZ-OOK and PAM4 for computing applications. The results show that both transmitters can be used to enable optical-amplification-free transmissions with low-complexity DSP.

Tu3J.1 • 16:30
Real-Time 125-Gb/s DP-QPSK Signal Delivery Over 150 m Based on a Dual-Polarized Single-Channel W-Band Wireless Link Enabled by Photonics, Yuancheng Cai¹, Min Zhu¹, Jiao Zhang¹, Mingzheng Lin¹, Bingshang Hua¹, Yucong Zou¹, Wei Luo¹, Shitong Xiang¹, Jiang Tian¹, Junjie Ding¹, Liye Ma¹, Yongming Huang¹, Jianjun Yu¹, Xiaohu You¹; ¹National Mobile Communications Research Laboratory, Southeast Univ., China; ²Purple Mountain Laboratories, China; ³Fudan Univ., China, ⁴China Mobile Research Inst., China. In a photonics-enabled fiber-wireless-fiber system, we successfully demonstrate the first real-time 125-Gb/s DP-QPSK signal delivery over a 150-m dual-polarized single-channel wireless link with a record of real-time transmission capacity and wireless distance at W band.

Tu3J.2 • 16:45
Bi-Directional 5G NR Fiber-Wireless Systems With Single-Carrier Optical Modulation and Phase Modulation Scheme, Yu-Sheng Lin¹, Wei-Cheng Fan¹, Cheng-Jun Lin¹, Chung-Yi Lin¹, Hai-Hei Lu¹; ¹National Taipei Univ. of Technology, Taiwan; ²National Taipei Univ., Taiwan. 5G MMW/sub-THz signals through a bi-directional fiber-wireless system with single-carrier optical modulation for downstream and PM scheme for upstream are implemented. It shows promise for performing 5G NR communication towards MMW and sub-THz bands.

Tu3I.2 • 16:45
56 GBaud PAM-4 Direct Detection With High-Speed Avalanche Photodiodes, Tobias Becker-berth¹, Christoph Kortke¹, Volker Jungnickel¹, Ute Troppan¹, Martin Moehrle¹, Patrick Munzer¹, Martin Schell¹; ¹Fraunhofer Heinrich Hertz Inst., Germany, ²Technical Univ. Berlin, Germany. We demonstrate 56 GBaud PAM-4 transmission by using a high-speed waveguide avalanche photodiode (WG APD) and an electro absorption modulated laser (EML). Compared to a PIN photodiode, the WS APD reduces the power budget in a B2B setup by 6 dB.
Tu3A • Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities II—Continued

Tu3A.2 • 17:00 Invited
The Role of Photonics in Sustainability and in Quantifying Greenhouse Gas Emissions, Thomas Karagiannis1, Microsoft Research Ltd, UK. Abstract not available.

Tu3B • Photonic Integrated Circuits—Continued

Tu3C • New Materials and Technologies—Continued

Tu3C.2 • 17:00
200 Gbit/s Transmitter Based on a Spin-on Ferroelectric Waveguide Modulator, Shiyoshi Yokoyma1,2, Jawei Mao1, Futa Uemura1, Hiromu Sato3, Guo-Wei Lu4, Toshio Kawai5,6, The Univ. of Aizu, Japan; 2Fina, Japan; 3ATrionics, Japan; 4Prahran Photonics, Australia; 5University of Cape Town, South Africa; 6University of Queensland, Australia. This work demonstrates a 200 Gbit/s PAM4 transmitter using a ferroelectric waveguide Mach-Zehnder modulator. It has BER below FEC threshold, drive voltage of 1.3 Vpp, and possible reliable operation.

Tu3C.3 • 17:15
200 Gbit/s Barium Titanate Modulator Using Weakly Guided Plasmonic Modes, Daneliia Chelidouri1, Manuel Kohl1, Benedikt Braun2, Jonas Blattner1, David Moor3, Joel Wingert1, Andreas Messerer4, Clarissa Conventino4, Felix Eltes5, Yuri Fedoryshyn6, Juerg Leuthold1; 1ETH Zurich, Switzerland; 2Lumiphase AG, Switzerland. A plasmonic Mach-Zehnder modulator based on thin-film barium titanate is introduced demonstrating line rates up to 200 Gbit/s. The structure enables low insertion loss and high optical power stability without a DC bias during operation.

Tu3D • Network Orchestration—Continued

Tu3D.3 • 17:00 Invited
End-to-End Interdomain Transport Network Slice Management Using DLT-Enabled Cloud-Based SDN Controllers, Richard Vialla1,2, Pol Alemany1, Lluis Gifre1, Ricard Martinez3,4, Ramon Casellas3,5, Raúl Murias3,6, CTFC, Spain. This paper discusses the advantages and challenges of multiple architectures that consider the negotiation of inter-domain transport network slices using blockchain technologies. To this end, we present results obtained using cloud-native ETSI TeraFlowSDN controller.

Tu3E • SDM - For Short Reach and Long-Haul Transmission Systems—Continued

Tu3E.2 • 17:00
108-Ch (12-Core×9-WDM) Self-Homodyne Transmission Using Only a Single Laser for 8.64-Tb/s Short-Reach Optical Links, Shota Ishimura1, Takashi Kari2, Shuntaro Maeda3, Takuo Tanimura4, Yoshiki Nakano4, Hidenori Takahashi4, Takehiro Tsuritani1,2, KDIDI Research, Inc., Japan; 3The Univ. of Tokyo, Japan. We demonstrate 108-ch (12-core×9-WDM) frequency comb-based self-homodyne multi-core transmission with a net bit rate of 8.64-Tb/s. This demonstration shows the feasibility of high-capacity short-reach SDM/WDM systems using only a single laser.

Tu3E.3 • 17:15
Experimental Investigation of Reduced Complexity MIMO Equalization in a 55-Mode Fiber SDM Transmission System, Ruby S. Bravo Ospina1,2,1, Georg Rademacher1,2,1, Ruben S. Luisi1, Benjamin J. Puttnam1, Nicolas K. Fontaine3, Mikael Mazur4, Kazuo Chiren5, Roland Ryf3, David Neilson4, Daniel Dahl6, Joel Carpenter1, Pierre Silard1, Frank Achten1, Marianne Chanclou1, Fabienne Saliou1, Gael Simon1, Jeremy Potet1, Philippe Chancolou1, Orange, France. Critical 0.67 dB of power depletion due to SRS on the upstream signals of 50G-E.PON US is measured experimentally when contra-propagating in 20 km SMF with 50G-E.PON Downstream.
Tu3G • Subsea and Sensing Networks—Continued

Tu3H • Quantum Interconnect and Hybrid Classical/Quantum Systems—Continued

Tu3I • High-Baud Rate Data Center Technologies—Continued

Tu3J • W-Band Fiber-Wireless Links—Continued

Tu3J.3 • 17:00  Invited
The Future of Multi-Terabit Datacenter Interconnects Based on Tight Co-Integration of Photonics and Electronics Technologies, Maria Spyropoulou1, Giannis Kanakis1, Yuqing Jiao1, Salim Abdil1, Zhaowei Chen1, Desalegn Feyisa Wolde1, Ripalta Stabile1, Nicola Calabretta1, K.A. Williams1, Virginie Nodjadjim2, Romain Hersent2, Agnieszka Konczykowska3, Muriel Riet3, Richard Schatz4, Oskars Ozols5, Xiaodan Pang1,5, Mahdieh Joharifar6, Jakub Zverina6, Martin Zoldák6, Boaz Atias7, Paraskevas Bakopoulos8, Elad Mentovich8, Hercules Avramopoulos9, Photonic Research Communications Laboratory, School of Electrical and Computer Engineering, National Technical Univ. of Athens, Greece; 2Eindhoven Hendrik Casimir Inst. (EHCIL), Eindhoven Univ. of Technology, Netherlands; 3III-V Lab, France; 4School of SCI, KTH Royal Inst. of Technology, Sweden; 5RISE Research Insts of Sweden AB, Sweden; 6Argotech A.S., Czechia; 7NVIDIA, Israel. We propose a novel co-packaged optical transceiver architecture capable of operating at 112 Gbaud per lane and scalable to 1.6 Tb/s capacity and beyond for next generation 51.2T and 102.4T digital switches.

Tu3J.3 • 17:00  Invited
Prospects and Technologies for Mobile Terahertz 6G Communications, Jonas Tebart1, Peng Lu1, Thomas Haddad1, Shuya Iwamatsu1, Andreas Stohr1, Universität Duisburg-Essen, Germany. Prospects and challenges for mobile 6G communications using terahertz frequencies are discussed. For the first time, THz wireless communications with 15 Gbps to multiple mobile users employing a photonic-assisted beam steering antennas is experimentally demonstrated.
energy saving, and introduces the work of optical access networks in the field of energy saving. This work reviews the standardization of energy saving of optical access systems (OAS) and introduced the opportunities for reducing power consumption in optical access networks.

Room 2

Tu3A • Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities—Continued

Tu3A • Energy Saving of Optical Access Systems, Dezhi Zhang¹, Zhe Du², China Telecom Corp Ltd, Beijing Res Inst, China; ²China Telecom Research Inst, China. This work reviews the standardization work of access networks in the field of energy saving, and introduces the development and application of energy saving technologies for optical access networks.

Tu3B • Photonics Integrated Circuits—Continued

Tu3B.2 • TOP-SCORED
Integrated Micromes Coupler for Photonic Integrated Circuits, Jianheng Luo¹, Johanne Henriksen², Myung-Ki Kim³, Daniel Klawson⁴, Chun-Yuan Fan⁵, Ming C. Wu¹; ¹Univ. of California Berkeley, USA; ²KU-KIST Graduate School of Converging Science and Technology, Korea Univ, Korea (the Republic of). We design and experimentally demonstrate a new silicon photonic fiber coupling method using integrated micromes couplers. Efficient and broadband coupling to a single mode fiber with the best coupling loss of 0.9 dB is achieved.

Tu3B.3 • 17:45
On-Chip Universal Linear Optics Using a 4x4 Silicon Photonic Coherent Crossbar, George Giamougiannis¹, Nikitas Maralitis², Papasolomous-Thiselou³, Nicos Bannioukavê, Nicos Bannioukavê, Aristotelio Panepistimio Thessalonikis, Greece; ²Cesal, USA. We demonstrate the first on-chip and fidelity-restorable universal linear optical circuit that relies on a novel 4x4 silicon photonic coherent crossbar architecture. Its experimental characterization yields a fidelity of 99.93±0.06%, calculated over 10,000 arbitrary matrices.

Tu3B.4 • 18:00
Large Scale Opto-Electro-Mechanical Integrated Circuits, Ming C. Wu¹, University of California Berkeley, USA. Not available.

Tu3C • New Materials and Architectures—Continued

Tu3C.5 • TOP-SCORED
An Active Visible-Light Photonic Platform on 200-mm Si, Thomas D. Scales¹, Yiding Lin², Hong Chen², Saeed S. Azadeh³, Zheng Yang³, Xiaohu Luo³, Hongyu Chua³, Jason C. C. Mak³, Alperen Guldoveli⁴, Ankit Sharma⁴, Jared C. Mikkelsen³, Xin Mu³, Andrei Talasimashinski⁴, Guo-Qiang Lu⁴, Joyce Poon⁴; ²Max Planck Inst. of Microstructure Physics, Germany; ³Department of Electrical and Computer Engineering, Univ. of Toronto, Canada, ⁴Advanced Micro Foundry Pte. Ltd, Singapore. We present a foundry-fabricated monolithically integrated photonic platform for the visible spectrum (ν=445–640nm) with two layers of silicon nitride waveguides, silicon photodiodes, and efficient under/over thermo-optic phase shifters, in situ trimming, and electrothermal MEMS devices.

Tu3D • Network Architectures—Continued

Tu3D.4 • TOP-SCORED
Disaggregated Optical Network Orchestration Based on the Physical Layer Digital Twin, Giacomo Borraccini¹, Renato Ambrosone¹, Alessio Giorgetti², Stefano Stafruch³, Francesco Aquilina³, Emanuele Virgilio³, Andrea D’Amico³, Rosco Dingillo³, Nicola Sambo³, Filippo Cugini³; ¹Politecnico di Torino, Italy; ²Consortium GARR, Italy; ³DIBRIONC, Italy. The architecture and functionality of an open and disaggregated optical network is presented, focusing on the orchestration of the physical layer digital twin and the optical network controller, implemented on an experimental multi-vendor triangular-topology setup.

Tu3D.5 • 17:45
Dynamic Bypass of Wavelength Switching in SDN-Enabled WDM VNIs over SDN Networks With High Bit-Rate Optical Channels, Paul Muñoz¹, Carlos Manso¹, Filippos Balasís¹, Daki Somás¹, Shahri Beppu¹, Ramon Casellas¹, Ullis Gfere¹, Ricard Vilalta¹, Ricard Martínez¹, Noboru Yoshikane¹, Takahiro Tsuritani¹; ¹CTTC, Spain; ²KDDI Research, Japan. We experimentally demonstrate an SDN architecture for WDM VNIs to offload pass-through high-bit-rate optical channels from overloaded ROADMs by provisioning spatial channels between the source and destination ROADMs’ add-drop stages, and rerouting the optical channels.

Tu3E • For Short Reach and Long-Haul Transmission Systems—Continued

Tu3E.5 • TOP-SCORED
Real-Time 6-Mode 19-Core Fiber Transmission, Shohri Beppu¹, Masahiro Kituka¹, Daki Somás¹, Yoshio Yagashii¹, Koji Igarashi¹, Masahiro Shigihara¹, Kazuhiko Aizawa¹, Noboru Yoshikane¹, Takahiro Tsuritani¹; ¹KDDI Research, Inc., Japan; ²NEC Technologies Co. Ltd., Japan; ³Osaka Univ., Japan. We demonstrate the real-time five-mode multiplexed fiber transmission for the first time. The C- and L-band WDM DP-QPSK signals transmitted over an 11-km 6-mode 19-core fiber were demodulated in real-time by an FPGA-based MIMO DSP.
We report field test results of surface and underwater surveillance based on fiber-optic distributed acoustic sensing. We experimentally demonstrate VCSEL+MMF nonlinear Digital Pre-Distortion, optimized using Convolutional Neural Networks, for fulfilling the IEEE P802.3dd™ D3.2 TDECC requirements for net 100 Gb/s/k optical transmitters.

We propose simple methods to calculate LLR for IM-DD system with MLSE and SD-FEC and show that an advanced MLSE with the LLR calculation methods makes NGMI higher in 128-Gb/s PAM4 0-Band Transmission Using Advanced MLSE With Simple LLR Calculation for SD-FEC Scheme. We experimentally demonstrate a W-band photon-assisted millimeter-wave transmission system using delta-sigma modulation and envelope detection. The proposed IMDD-MMW-RoF system can support 8192 QAM signaling over a 20-meter wireless link using DSM while meeting the SD-FEC threshold of 4.2×10⁻³.

We propose an integrated W-band Photonic-Wireless Transmitter Enabled by Silicon Microring Modulator and on-Chip Dual-Mode DBR Laser, Xuying Liu, Shiyong Zhang, Qiuwu Yi, Yuxian Wu, Wenjia Zhang, Fangxia Zhang, and Junyang Peng. We experimentally demonstrate an off-chip free-running and on-chip DBR laser.
### Room 1AB
- **Tu3A** • Symposium: The Crucial Role of Photonics in Achieving the UN Sustainability Development Goals: Learnings and Opportunities II—Continued

### Room 2
- **Tu3B** • Photonic Integrated Circuits—Continued

### Room 3
- **Tu3C** • New Materials and Technologies—Continued

### Room 6C
- **Tu3D** • Network Orchestration—Continued

### Room 6D
- **Tu3E** • SDM - For Short Reach and Long-Haul Transmission Systems—Continued

### Room 6E
- **Tu3F** • Coexistence and Emerging Use-Cases of PON—Continued

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**Tu3C.6 • 18:15**
Heterogeneously Integrated Near-Infrared DFB Laser on Tantalum Pentoxide, Ali Eshaghian Dörche\(^1\), Nima Nader\(^2\), Eric J. Stanton\(^3\), Sae Woo Nam\(^4\), Richard P. Mine\(^5\), National Inst of Standards & Technology, USA; \(^6\)Physics, Univ. of Colorado Boulder, USA. We present a diode laser heterogeneously integrated with tantalum pentoxide waveguides on a silicon substrate emitting 5 mW continuous-wave power per facet at 1020 nm wavelength with a 14 mA threshold and a 22 dB side-mode-suppression ratio.

**Tu3D.7 • 18:15**
DRL for VNF Placement in Inter-Data Center Elastic Optical Networks, Carlos Hernandez-Chulide\(^1\), Ramon Casellas\(^2\), Ricardo Martinez\(^2\), Ricard Vilalta\(^2\), Raul Muñoz\(^1\); Packet Optical Networks and Services, Centre Tecnoloíca de Telecomunicacions de Catalunya (ICTC/CERCA), Spain. A novel DRL solution for service provisioning over a cloud/EON stratum is presented. The benefit of DRL is that it can be adopted in different (unseen) EON topologies attaining better service blocking compared to traditional heuristics.

**Tu3E.6 • 18:15**
Real-Time 179.2 Tb/s Transmission Using Commercial 400Gb/s Transceivers Over 350 km Multicore Fiber, Lipeng Feng\(^1\), Anxu Zhang\(^1\), Hao Guo\(^2\), Dongxiang Wang\(^2\), Chuyu Peng\(^2\), Yuyang Liu\(^1\), Kai Lv\(^1\), Hao Liu\(^1\), Xiaoli Hu\(^1\), Junjie Li\(^1\); China Telecom Research Inst., China; \(^2\)FiberHome Fujikura Optic Technology Co., Ltd, China. We firstly demonstrate the feasibility of 179.2 Tb/s transmissions over a 350 km 7-core fiber link while considering the splicing loss and link budget reservation for field deployment, using real-time 400Gb/s/carrier commercial transceivers.

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**17:15–18:15**  **Exhibitor Reception, Center Terrace**

**18:30–20:00**  **Conference Reception, Upper Level, Ballroom 20BCD**

**19:30–21:30**  **Rump Session: Is the Silicon Photonics Platform about to be Standardized, Diversified or Supplanted?, Room 6F**
Tu3G • Subsea and Sensing Networks—Continued

Tu3H • Quantum Interconnect and Hybrid Classical/Quantum Systems—Continued

Tu3I • High-Baud Rate Data Center Technologies—Continued

Tu3J • W-Band Fiber-Wireless Links—Continued

Tu3G.4 • 18:15  ⭐ Top-Scored
Field Trial of FPGA-Based Real-Time Sensing Transceiver Over 524km of Live Aerial Fiber, Mikael Mazur1, Dennis Wallberg1, Lauren Dallachiesa1, Erik Börjesson1, Roland Ryf1, Magnus Bergroth2, Borje Josefsson1, Nicolas K. Fontaine1, Haozhuo Chen1, David Nelson1, Jochen Schröder1, Per Larsson-Edefors1, Magnus Karlsson1; ‘Nokia Bell Labs, USA; 1Sunet, Sweden; ‘Chalmers Univ. of Technology, Sweden. We perform fiber sensing over a 524km live network using a real-time coherent transceiver prototype. Polarization and length changes from the link consisting exclusively of aerial fiber wound around high-voltage power cables are continuously monitored.

Tu3H.5 • 18:15
Programmable, Latency-Aware and Dynamic Quantum-Secured Optical Network With Key Refresh Rate Negotiation and QKD Sharing, Ramerson Oliveira1, Ekin Arabul1, Rui Wang1, Constantinos Vrontos1, Reza Nejabati1, Dimitra E. Simeonidou1; 1Univ. of Bristol, UK. We have demonstrated a dynamic QKD network with a latency-aware and QKD-capacity sensitive algorithm. This scheme negotiates the optimal key refresh period and assigns priorities for preferred channels. Network reconfiguration time is within 49ms.

Tu3I.7 • 18:15
19-Core SDM Self-Homodyne Coherent Transmission Using Fan-in/Fan-Out Photonic Lantern, Min Yang1, Chengjun Cai1, Yuchen Shao2, Lei Zhang1, Jun Chu1, Jianjun Yu2; 1Huazhong Univ. of Science and Tech, China; 2State Key Laboratory of Optical Fiber and Cable Manufacture Technology, China; 3Hisence Broadband Inc., USA. We experimentally demonstrate space-division multiplexing (SDM) self-homodyne coherent transmission in 19-core fiber with low-cost, MHz-linewidth distributed feedback (DFB) laser, using fan-in/fan-out (FIFO) photonic lantern based on femtosecond laser direct writing technique.

Tu3J.7 • 18:15
Autoencoder Learning of Nonlinear Constellation Shape for Fiber-Wireless Convergence System, Xiang Liu1,2, Jiao Zhang1,2, Min Zhu1,2, Weidong Tong1,2, Zhigang Xie1, Yunwu Wang1,2, Mingzheng Lei1,2, Bingchao Hu1,2, Yuanzheng Cai1,2, Yucang Zou1, Jinjun Yu1,2; 1Southeast Univ., China; 2Purple Mountain Laboratories, China; 3Pudan Univ., China. We propose and experimentally demonstrate a novel nonlinear constellation shape auto-optimization method with a complex-valued 2D-ANN equalizer. Up to 70% lower BER compared with the conventional format is achieved at 50 Gbps in fiber-MMW system.

17:15–18:15  Exhibitor Reception, Center Terrace

18:30–20:00  Conference Reception, Upper Level, Ballroom 20BCD

19:30–21:30  Rump Session: Is the Silicon Photonics Platform about to be Standardized, Diversified or Supplanted?, Room 6F
Room 1AB  Room 2  Room 3  Room 6C  Room 6D  Room 6E

07:30–08:00  Coffee Break, Upper Level Corridors

07:00–08:30  International Women’s Day Breakfast, Upper Level, Ballroom 20A

08:00–10:00
W1A  •  Advanced Photodetectors
Presider: Martin Schell; Fraunhofer HHI, Germany

W1A.1 • 08:00
High-Speed Photodetectors, Patrick Runge1; Fraunhofer HHI, Germany. The paper highlights recent developments of high-speed photodetectors for 200 Gb/s and beyond communication applications. Designs for standard photodiode types as well as avalanche photodiode types with internal amplification are reviewed in terms of their high-speed performance.

W1A.2 • 08:30
Top-Scored Demonstration of an Ultra-High-Responsivity All-Silicon Avalanche Photodetectors, Yiwei Peng1, Yuan Yuan1, Wayne Sohn1, Stanley Cheung1, Boon S. Ooi1; 1Hewlett Packard Enterprise, USA. We demonstrate an all-Si: 20 Gb/s microring avalanche photodiodes that can compete with current commercial Ge and III-V photodetectors.

W1B  •  Special Session: Photonics for Visible Wavelengths
Presider: Cheryl Sorace-Agaskar; MIT Lincoln Laboratory, USA

W1B.1 • 08:00
Visible Wavelength PICs for Fluorescence Microscopy and Flow Cytometry, Jeremy Witzen1, Alireza Tabatabaei1, Martin Büscher1, Thomas Kloé1, Marc Spahr1, Douwe Geuzebroek1, Florian Merget1; 1Inst. of Integrated Photonics, Germany; 2RWTH Aachen Univ., Germany; 3Miltonyi Biotec, Germany; 4TOPTICA Photonics, Germany; 5LioniX International, Netherlands. The paper highlights recent developments of Top-Scored Invited Paper.

W1B.2 • 08:20
Underwater Visible Light Communication, Boon S. Ooi1, King Abdullah Univ of Sci & Technology, Saudi Arabia. Recent development and advances in underwater wireless optical communication (UWOC) will be presented. We will focus our discussion on device and system challenges facing multi-Gbit/s laser-based UWOC, and its future perspective.

W1C  •  Fiber Characterization and Fiber Sensing
Presider: Sara Garrett; SubCom LLC, USA

W1C.1 • 08:00
Bending Radius Dependency of Power Coupling Coefficient and Spatial Mode Dispersion in Coupled Multi-Core Fibers, Masaki Nakamori1, Atsushi Nakamura1, Masaharu Ohashi1, Yusuke Koshikih1; 1NTT Corporation, Japan; 2Osaka Metropolitan Univ., College of Technology, Japan. We experimentally investigated the dependence of the power coupling coefficient (PCC) on the bending radius in coupled multi-core fibers for the first time. We also discuss the relationship between the PCC and spatial mode dispersion.

W1C.2 • 08:15
Characterization of Coupled Multi-Core Fiber Nonlinearity Using Modified CW-SPM Method, Taiji Sakamoto1, Ryota Imada1, Kazuhide Nakajima1; 1NTT Access Service Systems Laboratories, Japan. Narrow bandedwidth continuous-wave-based SPM method is proposed for measuring the effective nonlinear coefficient γeff of coupled multi-core fibers. We confirmed that the measured γeff with 2- or 4-core fibers agreed well with the theoretical model.

W1C.3 • 08:30
Distributed Polarization and Coupling Analysis of a 3-Coupled-Core Fiber, Martina Cappelletti1, Daniele Orsuti1, Riccardo Veronese1, Marco Santagiustina1, Andrea Galtarossa1, Luca Palmieri1; 1Univ. of Padua, Italy; 2Pysmian Group, Italy; 3Nokia Bell Labs, USA. OFDR-based, distributed characterization of polarization and coupling properties of a 3-coupled-core fiber is reported. Results highlight the beating among the supermodes of the fiber, enabling the evaluation of their polarization and modal birefringence.

W1D  •  Panel: Advanced Packaging Technologies for Optical Modules
Presider: Di Che; Nokia Bell Labs, USA

W1D.1 • 08:00
DSP Design for Point-to-Multipoint Transmission, Thomas Dutheil1, Chris Fludger1, Bo Liu1, Antonio Napoli1, Amir Rashidinejad1, Steino Ranani1, Sezer Erkilinc1, Aditya Kakkar1, Atul Mathur1, Vince Dominis1, Parmjit Sarna1, Sun Han2, Atmoko Somani1, Dave Welch3; 1Infinera GmbH, Germany; 2Infinera Canada Inc., Canada; 3Infinera AB, Sweden. Coherent optical transmission systems using digital sub-carriers are ideal for point-to-multipoint applications. Many functional blocks are similar to the ones of single-channel processors. But, several aspects, specific to digital sub-carriers and point-to-multi-point, need consideration in the DSP implementation. (Invited)

W1E  •  DSP and System Modeling
Presider: Daniel Kilper; Univ. of Dublin Trinity College, USA

W1E.1 • 08:00
Invited Tutorial
Optical Satellite Networks, Vincent W. Chan1; 1Massachusetts Inst. of Technology, USA. Abstract not available.

W1E.2 • 08:30
Parallel Extension of High-Speed Analog-Circuit FIR Equalizer for Low-Latency Optical Transceiver/Receiver, Shuhei Otsuka1, Ryo Kaguchi1, Takahide Sakamoto1; 1Tokyo Metropolitan Univ., Japan. We experimentally demonstrate parallel extension of analog FIR equalizer. By a dual parallel extended configuration, an 18-tap FIR filter with an 18-ps tap delay is constructed, which adaptively equilizes real-time 11.1-Gbaud NRZ signals.
07:30–08:00 Coffee Break, Upper Level Corridors

07:00–08:30 International Women’s Day Breakfast, Upper Level, Ballroom 20A

08:00–10:00
W1G • Optical Networks for Machine Learning Systems
Presider: To be announced.

W1H • Optical Performance Monitoring
Presider: Ezra Ip; NEC Laboratories America Inc., USA

W1I • Flexible Coherent PON
Presider: Dora van Veen; Nokia Corporation, USA

W1J • Fiber Sensing
Presider: Mikael Mazur, Nokia Bell Labs, USA

W1G.1 • 08:00 Top-Scored
SiP Architecture for Accelerating Collective Communication in Distributed Deep Learning, Zhenguo Wu1, Liang Yuan Dai1, Ziyi Zhu1, Ascher S. Novick1, Madeleine Glick1, Karen Bergman1;1 Columbia Univ., USA. We present a silicon photonic architecture for accelerating collective communications in distributed deep learning. We demonstrate a 22% job completion time improvement in a small-scale testbed and 1.4 to 5.9x improvement in large-scale simulations.

W1H.1 • 08:00 Tutorial
Methods for Geophysical Sensing on Submarine Cables, Valey Kamalov1;1 Google LLC, USA. We will review basic physics to establish five methods to use subsea optical fiber networks for network resiliency improvements, earthquake and tsunami early warning, and climate change: i) Optical interferometry-based, ii) Optical polarization-based, iii) Coherent Rayleigh backscattering; iv) Microwave frequency fiber interferometry, v) Faraday’s law of induction to explain correlation of voltage disturbance and the strength of the geomagnetic perturbation.

W1I.1 • 08:00 Invited
Reusing Data Center Optics and Solutions for Beyond 25Gb/s PON: Is the Gap Really Bridged?, Vincent Houtsma1, Dora van Veen1;1 Nokia Bell Labs, USA. In this paper we will review the benefits as well as challenges to overcome in adoption of data center technologies for next-generation TDM-PONs.

W1J.1 • 08:00 Invited
Geophysical Studies Using DAS, Nate Lindsey1;1 Fiber Sense Pty Ltd, USA. φ-OTDR/DAS enables dense, long-range (1 - 200 km), array recordings of strain fields with exceptional sensitivity (< 1×10⁻⁹ strain) wherever optical fiber exists. The measurement is conventionally based on interferometrically extracting dynamic phase information of the Rayleigh backscattered light from one end of a single-mode fiber. Recently, φ-OTDR/DAS has expanded into telecommunications networking, seismology and geophysics, water infrastructure monitoring, and civil engineering.

W1G.2 • 08:15
MAESTRO: MAke-BEfore-Break StraTegy for Reconfiguration in Optical Datacenters, Sandeep Kumar Singh1, Che-Yu Liu1, Roberto Pratelli2, S. J. Ben Yoo1;1 Univ. of California Davis, USA; 2Politenico di Torino, Italy. We present a MAke-bEfore-break StraTegy for Reconfiguration in Optical datacenters (MAESTRO). The simulation results show a reduction in packet loss by up to 98% compared to a baseline reconfiguration method.

W1G.3 • 08:30
On the Performance of a Fast Optically Switched Network for Machine-Learning Accelerator Clusters, Marijn Rombouts1, Nicola Calabretta1;1 Eindhoven Univ. of Technology, Netherlands. We investigate the viability of optically switched network for ML accelerator clusters and compare it to a leaf-spine network with 256/1024 GPUs. Results show almost ideal throughput, sub-µs latency and zero packet-loss for <0.6 traffic-load.

W1I.2 • 08:30 Top-Scored
Rate-Flexible Coherent PON Up to 300 Gb/s Demonstrations With Low Complexity TDM Burst Design, Haipeng Zhang1, Zhensheng Jia1, Luis A. Campos1, Curtis Krystle1;1 R&D, CableLabs, USA; 2Next-Gen Systems, CableLabs, USA. Two flexible-rate coherent PON architectures have been demonstrated, featuring a low complexity TDM burst DSP. A peak data rate of up to 300-Gb/s and transmission over 50-km link and 1×32 split ratio has been achieved.

W1J.2 • 08:30 Observation of Local Small Magnitude Earthquakes Using State of Polarization Monitoring in a 250km Passive Arctic Submarine Communication Cable, Kristina Shizuka Yamase Skarvang1, Steinar Bjørnstad2, Robin André Rørstadbotnen3, Kurosh Bozorgebra-himi1, Dag Roar Hjelme1;1 NTNU, Norway; 2Tampnet, Norway; 3SIKT, Norway. We demonstrate local small-magnitude earthquake observation using State of Polarization sensing on an alien wavelength in a live single-span passive submarine cable communication system. Distributed Acoustic Sensing verifies seismic waves propagating along the cable.
Wednesday, 8 March

W1A • Advanced Photodetectors—Continued

W1A.3 • 08:45
80-GHz Bandwidth and High Responsivity of InP Coherent Receiver PIC With Butt-Joint Waveguide PDs, Takuya Okimoto1, Hideki Yagi2, Ken Ashizawa2, Kouichiro Yamazaki1, Koji Ebihara3, Satoru Okamoto4, Kazuhiko Hino1, Munetaka Kurokawa1, Yosihiko Sugimoto5, Seiji Kumagai6, Keiji Tanaka7, Masao Takeishi8, Mitsuru Ekawa9, Yoshihiro Yonezawa10, and Toshikazu Kohda11. Abstract not available.

W1B • Special Session: Photonics for Visible Wavelengths—I—Continued

W1B.3 • 08:40
Invited
Indoor Visible Light Communication (LiFi), Harald Haas1; Univ. of Strathclyde, UK. Abstract not available.

W1C • Fiber Characterization and Fiber Sensing—Continued

W1C.4 • 08:45
Distributed Characterization of Low-Loss Hollow Core Fibers Using EDFA-Assisted Low-Cost OTDR Instrument, XuHao Wei1, Bo Shi1, David J. Richardson2, Francesco Poletti1, Radan Slavik1, Univ. of Southampton, UK. We use a low-cost commercially-available Optical Time Domain Reflectometer (OTDR). Sensitivity is boosted by 28 dB using two EDFAs, enabling characterization with spatial resolution of 1.5 m, which is 10 times better than previously reported.

W1D • Panel: Advanced Packaging Technologies for Optical Modules—Continued

W1E • DSP Design and System Modeling—Continued

W1E.3 • 08:45
Simultaneous Frequency-Dependent Impairments Calibration for 96Gbaud Coherent Optical Transceivers, Longquan Dai1, Shuchang Yao1, Zhenbing Zhang1, Jing Dai2, Ming Luo3, Xi Xiao4, Yaqin Wang5, Qi Yang6, Ming Tang7, Deming Liu3, Lei Deng3, Xiaosheng Liu1, and Weidong Zhang2. 1Huazhong Univ. of Science and Technology, China; 2Fiberhome Telecommunication Technologies Co., LTD., China; 3China Information and Communication Technologies Group Corporation (CICT), China; 4National Information Optoelectronics Innovation Center, China. We report a calibration method to simultaneously characterize all the frequency-dependent impairments of coherent optical transceivers. With calibration operation, dual-polarization 96Gbaud Nyquist-14QAM signal transmission is achieved by using a silicon photonics-based 4x4Gbaud-class coherent optical transceiver.

W1F • 5G and Beyond—Continued

W1F.2 • 09:00
Access Point Selection Based on Regular Coding in Walker-Delta Optical Satellite Networks, Yuanjun Zhang1, Wei Wang1, Yangli Zhao2, Hua Wang2, Ying Jie3, and Jie Zhang4. 1Beijing Univ. of Post and telecomm, China. In this paper, a mobile-side access satellite selection algorithm based on regular coding is proposed. Simulation results show it can effectively reduce the connection latency and blocking ratio in walker-delta optical satellite networks.
W1G • Optical Networks for Machine Learning Systems—Continued

W1G.4 • 08:45 A Vectorised Packing Algorithm for Efficient Generation of Custom Traffic Matrices, Christopher W. Parsonson1, Joshua Benjamin2, Georgios S. Zervas1; 1Univ. College London, UK. We propose a new algorithm for generating custom network traffic matrices which achieves 13x, 38x, and 70x faster generation times than prior work on networks with 64, 256, and 1024 nodes respectively.

W1H • Optical Performance Monitoring—Continued

W1H.2 • 09:00 Tutorial Optical Switching Will Innovate Intra Data Center Networks, Ken-ichi Sato1,2; 1National Inst. of AIST, Japan; 2Information and Communication Engineering, Nagoya Univ., Japan. This tutorial will discuss how optical switching technologies can innovate future data center networks. The two core technologies, large-port-count optical switches that have pay-as-you-grow scalability, and simple and fast optical switch network control are reviewed.

W1J • Fiber Sensing—Continued

W1J.3 • 08:45 Optical Fiber Artificial Neuromast for Versatile Underwater Safe Navigation, Liangye Li1, Xihao Fan1, Shunfeng Sheng1, Xinfu Liu1, Wengyong Xu1, Wei Xiang1, Qahen Sun1; 1Huazhong Univ of Science and Technology, China. We present an optical fiber artificial neuromast inspired by fish lateral lines for versatile underwater safe navigation, exhibiting an ultra-high flow sensitivity of 62.02 nm/s/mL (0.05mL/s) and a resolution of 0.32 µL/s.

W1I • Flexible Coherent PON—Continued

W1I.3 • 08:45 Top-Scored Pilot-Aided Continuous Digital Signal Processing for Multi-Format Flexible Coherent TDM-PON in Downstream, Guoqiang Li1, An Yan1, Sahe Xing1, Zhangyi Li1, Wangwei Shen1, Jiaoye Wang1, Junwen Zhang2, Nan Chi2; 1Fudan Univ., China. To avoid burst-signal processing in downstream transmission during modulation-format switching, we propose and experimentally demonstrate a pilot-aided DSP scheme with continuous SOP tracking, carrier-phase recovery, and channel estimation in the 300G flexible CPON based on 4/16/64-QAMs.

W1I.4 • 09:00 Low-Cost 100G Coherent PON Enabled by TFDM Digital Subchannels and Optical Injection Locking, Haipeng Zhang1, Zhensheng Jia1, Luis A. Campos2, Curtis Knittle1; 1R&D, CableLabs, USA; 2Next-Gen Systems, CableLabs, USA. We demonstrate a novel 100G TFDM coherent PON architecture featuring low-cost ECL-free ONU enabled by remote optical carrier delivery through injection locking. System performance shows no degradation compared to a regular ECL based system.

W1J.4 • 09:00 Simultaneous Communications and Vibration Sensing Over a Single 100-km Deployed Fiber Link by Fiber Interferometry, Yaxi Yan1,2, Liwang Lu3, Xiong Wu3, Jingchuan Wang3, Yan He1, Daru Chen2, Chao Lu3, Alan Pak Tao Lau1; 1Department of Electrical Engineering, The Hong Kong Polytechnic Univ., Hong Kong; 2Hangzhou Inst. of Advanced Studies, Zhejiang Normal Univ., China; 3Department of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong. We demonstrate simultaneous 60 Gbaud 16-QAM transmissions and vibration sensing over a single 100-km deployed fiber link. Vibration localization is realized by extracting the phases of a co-propagating pilot and a counter-propagating tone.
We discuss the techniques and challenges with bringing visible wavelengths to a chip platform.
W1H.4 • 09:30
0.77-dB Anomaly Loss Localization Based on DSP-Based Fiber-Longitudinal Power Estimation Using Linear Least Squares, Takeshi Sasaki1, Masanori Nakamura1, Etushi Yamazaki1, Hideki Nishizawa1, Yoshiaki Kisaka1, NTT Corporation, Japan. We experimentally demonstrate that DSP-based fiber-longitudinal power estimation achieves good agreement with OTDR with a root-mean-square error of 0.18 dB and thus localizes a 0.77-dB anomaly loss, which may occur as a connector loss.

W1I.5 • 09:15
Demonstration of Beyond 100G Three-Dimensional Flexible Coherent PON in Downstream With Time, Frequency and Power Resource Allocation Capability, Wangyue Shen1, Suhai Xing1, Guoqiang Li1, Zhiyang Li1, An Yan1, Jiaye Wang1, Junwen Zhang1, Nan Chi1, Fudan Univ., China. We propose and demonstrate a novel three-dimensional flexible coherent PON with the resource-allocation capability in time, frequency and power domain. High flexibility is demonstrated with >100G over 20-km fiber for coherent PON in downstream.

W1J.5 • 09:15
Field Trial of High-Resolution Distributed Fiber Sensing Over Multicore Fiber in Metropolitan Area With Construction Work Detection Using Advanced MIMO-DAS, Sterren Guerrier1, Antonio Mecozzi1, Christian Darize2, Cristian Antonelli3, Lauren Dallachiesa1, Hau Mordyson4, Ele Awwad5, Daniele Orsuti1, Luca Palmieri1, Mikael Mazur4, Tetsuya Hayashi1, Roland Ryl, Jérémie Renaudier1, Nokia Bell Labs, France; Sumitomo Electric Industries, Ltd., Japan; Università degli Studi dell’Aquila, Italy; Fudan Bell Labs, Nokia Bell Labs, Murray Hill, NJ, US, USA; Télécom Paris Département Communications et Electronique, Telecom Paris Département Communications et Electronique, Paris, Ile-de-France, FR, academic, France; Università degli Studi di Padova, Padova, Veneto, IT, academic, Italy. We demonstrate a successful field trial of MIMO-DAS over multicore fiber (MCF) allowing for accurate localization of acoustic events in the city of L’Aquila, Italy. We show a 2m spatial resolution and 1mHz-380Hz acoustic bandwidth.

W1J.6 • 09:30
Full Link SNR Equalization DAS System Over 80km Based on Gradient Discrete Scattering Enhanced Fiber, Cunsheng Fan1, Xiangpeng Zhao1, Hao Li2, Weilian Zhao1, Zhiyun Yan1, Guoqiang Li1, Zhisheng Tang1, Huaizhong Univ of Science and Technology, China. We proposed a full-link SNR-equalization DAS based on gradient discrete scattering enhanced fiber with backscattering rates increase gradually according to optical loss. The experimental results show a 15pW/Hz strain resolution over 80km.
W2A.1 Apparatus for Fast Inspecting and Cleaning MPO Connector, Yu Huang, Jose Castro, Thomas Sadoc, Rick Pimpellena, Bolten Kose, Brett Lane, 1Panduit, USA. In this paper, we present an apparatus that can inspect and clean the end face of the fiber-optic connector without the need to switch the connector from one tool to another.

W2A.2 A 200Gb/s Low Power DSP-Based Optical Receiver and Transmitter With Integrated TIA and Laser Drivers, Ark Zafar, Daniel Bungus, Li Cuai, Sau Siung Cheung, Colin Crameri, Sadegh Dichta, Vahal Ghindarian, Vivek Gumoutroom, Belal Heali, Cheng-Ru Ho 1 , Amnutha 1 , Steve Jantz 1 , Chang-Feng Lai 1 , The Linh Nguyen 1 , Kevin Parker 1 , Ed Pillai 1 , Karthik Raviprakash 1 , Sagar Ross 1 , Paolo Rossi 1 , Zhouchao Sun 1 , Amber Tan 2 , Lawrence Te 2 , Brian Wall 1 , Luke Wang 1 , Jeffrey Wang 1 , Tzu-Fan Wu 1 , Manvel Semiconductors, USA. Fully integrated low power 200Gb/s DSP based optical receiver and transmitter ICs with transmitter chip incorporating fully integrated laser drivers and receiver chip with fully integrated Transimpedance amplifier (TIA) in 16nm FinFET using wirebond technology.

W2A.3 Error-Tolerant Integrated Optical Unitary Processor Based on Multi-Plane Light Conversion, Rydol Trinh, Rui Tang 1 , Simon Ng 1 , John Rollinson 1 , Moscoso-Mártir 1 , Florian Merget 1 , Jeremy Witzens 1 , 1Inst. of Integrated Photonics RWTH, Germany. 2Furukawa Electric, Japan; 3Furukawa FITEL (Thailand), Ltd., 4Fujitsu Consulting (Canada) Inc., Canada. Tuner-Free Lumped-Element Resonantly Enhanced Mach-Zehnder Modulator in Ultra-Wide Conversion Wavelength Range, Manuel Ackermann 1 , Alvara Moscoso-Mártes 1 , Florian Merget 1 , Jeremy Witzens 1 , 1Inst. of Integrated Photonics RWTH, Germany. We demonstrate a resonantly enhanced Mach-Zehnder modulator utilizing highly overcoupled ring resonators with staggered resonances to achieve a 7-nm 1-dB penalty operating range. It can be operated lumped element without tuning any of the resonators.

W2A.4 Silicon Photonic Tunable Flat-top Filters Based on Circular Core Photonic Crystal (PC) Fanout, Yu Wen 1 , Xin Guo 1 , Xingxiang Wang 1 , Yu Liu 1 , Guangxi Song 1 , Wei Zhong 1. 1University of Alberta, Canada. We experimentally demonstrate tunable flat-top filters based on the PC fanout composed of two tunable gratings.

W2A.5 Inverse-Designed Grating Arrays for High-Sensitivity Planar Photonic Time-of-Flight Pixels, John Rollinson 1 , Robert Karlicek 1 , Monia Hella 1 , Renesas Electronics Corp. 1, Japan. We present a planar photonic time-of-flight pixel design using grating arrays with inverse-designed passive photonic power combining to achieve scalable signal-to-noise ratio. Experimental results are presented as a proof-of-principle demonstration of the pixel architecture.

W2A.6 Tuner-Free Lumped-Element Resonantly Enhanced Mach-Zehnder Modulator in Ultra-Wide Conversion Wavelength Range, Manuel Ackermann 1 , Alvara Moscoso-Mártes 1 , Florian Merget 1 , Jeremy Witzens 1 , 1Inst. of Integrated Photonics RWTH, Germany. We demonstrate a resonantly enhanced Mach-Zehnder modulator utilizing highly overcoupled ring resonators with staggered resonances to achieve a 7-nm 1-dB penalty operating range. It can be operated lumped element without tuning any of the resonators.

W2A.7 On-Chip Tunable Mode-Locked Comb Laser in Generic Foundry Platform, Mu-Chieh Lo 1 , Alex Berretz 1 , Eichuan Zhou 1 , Alfonso Rocca 1 , Zhiwu 1, 1College of London, UK. An integrated, passive, harmonically mode-locked laser fabricated utilizing a generic integration technology is reported. The device features both emission wavelength and comb spacing variability by using a colliding-pulse cavity composed of two tunable gratings.

W2A.8 Enhancement of Bandwidth-Responsivity Product in High-Speed Photodetectors With Optically Non-Linear Flip-Chip Bonding Package for Coherent Detection, None Naeem 1 , Nan-We Chen 1, 1Sun Yat-sen University, China. We present an optically non-linear flip-chip bonding package with high responsivity and high bandwidth.

W2A.9 MMW-Over-Fiber Passive Optical Network Transceiver With 12.5mA Isat under 0.9V br., Jin-Wei Shi 1 , H.-S. Chen 3, Hsiang-Szu Chang 3, Jack J. Huang 3, 1Department of Electrical Engineering, Yuan Ze Univ., Taiwan; 2Southeast Univ., China; 3Nanjing University of Information Science and Technology, China. We have developed a bundle-type fan-in/fan-out device that can achieve a high return loss by using a low-loss core-fiber/single-core fiber component comprising a high-precision molded plastic ferrule.

W2A.10 Bundle-Type fan-in/fan-out Device for 4-Core Multi-Core Fiber With High Return Loss, Kohon Oka 1 , Yoshitaka Tsuchida 2,4, 1Teikyo University, Japan; 2Infinera, Portugal; 3Infinera, Germany; 4Instituto de Telecomunicaciones, Portugal. We have developed a bundle-type fan-in/fan-out device that can achieve a high return loss by using a low-loss core-fiber/single-core fiber component comprising a high-precision molded plastic ferrule.

W2A.11 Quasi-Constant Signal Power Transmission With Low Signal RIN By DRA With Incoherent-Forward and Coherent-Backward Pumps, Shyamal Witsaka 1, Nonhro Oshishi 1, Satoru Ichihara 1, Nitudet Salingkarnamakul 1, Nayoja Hojo 1, Yasuto Tatamida 1, Jurji Yoshida 1, Sanguan Anantarathasaran 1, Toshio Kimura 1, Furukawa Electric, Japan; 2Furukawa FITEL (Thailand), Japan; 3Furukawa FITEL Optical Device, Japan. We measure characteristics of a transmitted WDM signal in an 80-km-long MDF under bi-directionally pumped DRA with incoherent-forward and coherent-backward pumps. The signal shows OSNR of 50.0 dB and RIN less than -140 dBc/Hz.

W2A.12 4-Core Fiber Narrow Pitch Fanout Comprised of Tapered High-A-MC, Masanori Takahashi 1, Tsubasa Sasaki 1, Ryushi Sugizaki 1, Yoshitaka Arashitani 1, Furukawa Electric, Japan. Narrow pitch all fiber base fanout comprised of 4-core fiber is developed. Core pitch and insertion loss of the fanout are reduced to 19.4 μm and 0.6 dB, respectively.

W2A.13 First Field Trial of FTTR Based on Native Management and Control Architecture of Core-Backhaul, Jingzhong Zhu 1, Junesu Li 1, Nannan Zhang 1, Ning Wang 1, Dechang Zhao 1, Han Li 1, Xiaodong Duan 1, Kunming Wu 1, Lingran Bai 1, 1Department of Fundamental Network Technology, China Mobile Research Inst., China; 2Optical Research Dept, Huawei Technologies Co., Ltd., China; 3China Mobile Communications Corporation Group Co., Ltd., China. We firstly propose a native management and control architecture of FTTR, based on which a field trial for 5G small cell backhaul is demonstrated. The download speed of each user equipment reaches nearly 800 Mbps.

W2A.14 Degradation Detection and Severity Estimation by Exploiting an Optical Time and Frequency Diversity Twin, Mariano Devigili 1, Marc Ruiz 1, Sara Balsells 1, 1Universitat Politecnica de Catalunya, Spain; 1Inst. Unipessoal Lda., Portugal; 2Telecommunications Technology Institute of IST, Portugal. We exploit the intrinsic advantages of a time and frequency domain optical twin to detect degradations and to estimate their severity.

W2A.15 Speedy and Cost-Effective Optical Network Modem Enhancement Through Quantum-Inspired Computing, Masahiko Sugimura 1, Mahamid Jokobal Kaji 1, Hidetoshi Motsumura 1, Xi Wang 1, Paparoza Palcharala 1, Shahrokh Valesae 1, 1The Univ. of Toronto, Canada; 2Fujitsu Network Communications Inc., USA; 3Fujitsu Limited, Japan. We present a migration plan optimization solution to accelerate the removal of legacy devices and minimize travel costs in network modernization utilizing Fujitsu Digital Analyzer. Our method found more cost-efficient plans by up to 70%.

W2A.16 Optimal Design of Filterless Hosehose Networks Supporting Point-to-Multipoint Transceivers, Mohammad Mohammad Hosseini 1, João Pedro 1, José Costa Poey 1, 1The Univ. of Tokyo, Japan. We propose an ILP framework to optimize multi-aggregation filterless hosehose networks for digital subcarrier multiplexing point-to-multipoint (P2MP) transceiver deployment. The results show that this significantly reduces amplifier requirements while ensuring end-to-end performance.

W2A.17 Self-Failure Identification and Localization Method Based on Received Optical Signal Quality and Repeater Nodes’ Performance, Hiroshi Yamamoto 1, Kouji Aoki 2, Yasuaki Date 1, Daisaku Shima 1, Yutaka Fukuuchi 1, Hidetaka Maeda 1, 1NTT Corporation, Japan; 2Toyo Univ. of Science, Japan. We propose a novel methodology to identify and localize software failures in multi-core fiber networks.

W2A.18 400ZR+-Enabled IPoWDM Networks, Nicolás A. Roque A. Ciufo Poeys 1, Jean-Pierre Von Roque A. Ciufo Poeys 1, 1Rensselaer Polytechnic Institute, USA; 2Telecom Italia, Italy. We demonstrate a multi-core fiber network with 400ZR+-enabled IPoWDM network without using MIMO-DSP for mode-multiplexing.

W2A.19 Towards an Analytical Tool to Support Planning of 400ZR+-Enabled IPoWDM Networks, Nicolas A. Roque A. Ciufo Poeys 1, Jean-Pierre Von Roque A. Ciufo Poeys 1, 1Rensselaer Polytechnic Institute, USA; 2Telecom Italia, Italy. We propose a new analytical tool to support planning of 400ZR+-enabled IPoWDM networks without using MIMO-DSP for mode-multiplexing. This report shows the potential for future large-capacity short-reach optical interconnects.
A Post-Equalization Technique for PDL Compensation

W2A.24 Optical Multipath Interference Mitigation for PAM4 Transmission Using Line Coding and High-Pass Filtering, Ning Chen1, Dechao Zhang2, Dawei Ge3, Yan Song4, Meijuan Lv1, Shanglin Li1, Bin Liu1, Xueze Zheng1, 1Innolight, China; 2China Mobile, China; 3Sun Yat-sen Univ., China; 4The Hong Kong Inst. of Technology, Japan; 5Network, Huawei Technologies Canada, Canada. Soft information quality of different DSP schemes followed by hybrid soft/hard decision FEC is investigated. We demonstrate in simulations that BCJR achieves a significant gain over DFE by experimentally showing a low-complexity cutoff approach to enhance SNR in strong pre-emphasis.

W2A.25 On the Impact of Spatial Mode Dispersion for Strongly-Coupled Multicore Fiber Submarine Transmission, Lin Sun1, Bin Chen1,199, Gordon Ning Liu1, Y. Cai1, Zheng Liu1, Chao Lu1, Gangxiang Shen1, 1Network, Huawei Technologies Canada, Canada. Multicore fibers exhibit the improved tolerance to coupling length and spatial mode dispersion.

W2A.26 A Post-Equalization Technique for PDL Compensation in Coherent Optical Systems, Ahmed M. Medra1, Hossein Nagi1,2, Chuandong Li1, Zhuhong Zhang1, 1Network, Huawei Technologies Canada, Canada. A practical post-equalization technique is proposed to compensate the loss due to polarization gain imbalance in an optical channel. The proposed scheme is implemented after legacy adaptive channel equalization and shown to provide significant performance gains.

W2A.27 Low-Complexity RMS-Enhanced Digital Pre-Emphasis Under Limited Transmitter Power and EOB, Wang Dao2,1,199, Ying-Chou Ng1, Yinggu Guo1, Jinho Chang1, Tianyi Zhao1, Meng Gui1, Xueting Jing1, Zhiping Ji1, Chuandong Li1, 1Huawei Technologies Canada, Canada; 2Teachers College, University of Texas at Arlington, USA. We experimentally demonstrate phase-preserving amplitude regeneration in a Masmeyregen Regenerator With mid-stage Optical Phase Conjugation, Cheng Gu1, Michael Vasilev1, 1Department of Electrical Engineering, University of Texas at Arlington, USA. We experimentally demonstrate phase-preserving amplitude regeneration of an RZ-QPSK signal by placing an optical phase conjugator between two Masmey regenerators, improving intensity noise 2.8 times, Q-factor by 2.4 dB and EVM by 4%.

W2A.28 Statistical Properties of NPNL in Presence of PDL, On Golani1, David Dahan1, 1Toga Networks - a Huawei company, Israel; 2Holon Inst. of Technology, Israel; 3Tel Aviv Univ., Israel. We model and investigate the statistical properties of the time-varying ISI/SIM model of XPM induced NPNL affected by PDL along the fiber link. We validate the analytical model by comparing it to SSFM simulations.

W2A.29 A Closed-Form Expression for the IRSN GM Model Supporting Distributed Raman Amplification, Henrique Buglia1, Mindaugas Jarmolovich1, Anastasia Vasilychekova1, Eric Silleker1, Lidia Galdino1, Polina Bayvel1, Robert I. Kelley1, 1Univ College London, UK; 2Corning, UK. A closed-form model for the nonlinear interference in distributed Raman amplified links is presented. The formula accounts for both forward- and backward pumping. The model accurately estimates the received SNR over a 1 THz bandwidth.

W2A.30 Nonlinear Distortion Mitigation With Non-Orthogonal DFT-Precoding for DML-Based OFDM Optical Systems, Peij Song1, Zhoub Hu1, Yanhai Dai1, Chun-Kit Chan1, 1Department of Information Engineering, The Chinese Univ. of Hong Kong, China; 2Aston Inst. of Photonic Technologies, Aston Univ., UK. We propose to use non-orthogonal DFT-matrix precoding to mitigate the nonlinear distortion induced by chirp and fiber dispersion in a 10-Gbit/s DML-based OFDM optical system, with 0.83-dB sensitivity improvement over the third-order Volterra nonlinear equalizer.

12:10–14:00 IEEE/Optica Publishing Group Journal of Lightwave Technology 40th Anniversary Luncheon, Upper Level, Ballroom 20A

12:30–14:00 Unopposed Exhibit-only Time, Exhibit Hall
W2B.1 Thin-Film Lithium Niobate Photonic Devices on 8-Inch Silicon Substrates, Hengyu Wang, Yang Xu, Zhenyi Li, Jian Li, Shuang Zhe, Yu Wang, Zheng Yao, Shaoan Zheng, Qie Zheng, Yuan Dong, Ting Hu, Shanghui Unru, China; Shanghai Inst. of Microsystem and Information Technology, China; Huawei Technologies, China. Thin-film lithium niobate photonic devices are first demonstrated on 8-inch silicon substrates. The fabrication is done in a commercial semiconductor foundry. A waveguide propagation loss of 0.47±0.09 dB/m is achieved at 1550 nm wavelength.

W2B.2 Heterogeneous Balanced Photodetector on Silicon Nitride With 30 GHz Bandwidth and 26 dB Common Mode Rejection Ratio, Junyi Gao, Ta Ching Tzu, Taseem Fatema, Xiangguo Wu, Qianhua Yu, Gabelev Nivovits, Michael Zenaro, Michael Gesellmann, Andreas Beilng, Univ. of Virginia, USA; UIGENTEC SA, Switzerland. We demonstrate InGaAs/InP balanced photodiodes on SiN waveguides with record-high 3-dB bandwidth of 30 GHz, 0.72 AW responsivity, and high common mode rejection ratio (CMRR) of 26 dB at 30 GHz.

W2B.3 Spectral-Spatial Mapping for Channel-Definable Information Transmission in Multimode Fiber, Ming Zhu She, Zhao Wang, Wei Li Zhang, Qingqiao Bai, Univ. of Electronic Science & Tech China. The concept of spectral coding to control light is proposed for analyzing and quantifying multimode fiber where, utilizing the randomness of speckle pattern, transmission channel is established for encryption information.

W2B.4 Multimode Fiber Bandwidth Uniformity and its Impact on Optical Links in Hyperscale Datacenters, Qin Chen, Rui Li, Peng Wang, Chong Xie, Alibaba Cloud, Alibabac Cloud, USA. We characterize multimode fiber bandwidth uniformity and its impact on optical links in data centers, discussing the importance of MFM bandwidth uniformity to data center deployment of the next-generation 100-Gb/s multimode products.

W2B.5 Nonlinear Impairment Scaling in Few-Mode Fiber Transmission Systems With Mode Permutation Technique, Rui Xing, Xiaofan Li, Yaping Liu, Zhihao Xiang, Zhanhao Huang, Lin Zhang2, Tianjun University, China; Peng Cheng Laboratory, China. A novel permutation-based transmission system with three states of the permutation strategies are evaluated using a GN model with MDL considered, for the first time. The strategy outperforms by 0.3 dB in terms of SNR difference among modes with an MDL of 0.1 dB/km.

W2B.6 Demonstration of Range Scanning in a Few-Mode Fiber Within Small Detuning Range, Hongtao Cheng, Shengji Zhu, Liang Cui, Xiaoying Li, Tianjun University, China. We measure the intensity of small detuning range in different spatial polarization and made in a common core circular few-mode fiber, and show the existence of principle mode affect the degree of Range scanning.

W2B.7 A Novel Distributed Spin Fiber Twistor Sensor Based on Frequency-Scanning φ-OTDR, Can Chen, Zhiyue Zhao, Zhihang Lin, Can Chen, Can Chen, Ming Tang, Huashang University of Science and Tech, China. A novel distributed twist sensor utilizing frequency-scanning φ-OTDR in a spin fiber is theoretically analyzed and experimentally demonstrated by tracking the fiber twist induced frequency shift of correlation peak, enabling distributed quantitative twist measurement.

W2B.8 Reliable and Low-Complexity Multiple Performance Parameters Prediction for Optical Network Equipment, Yu Chen, Danshui Wang, Chunyu Zhang, Bing Yan, Yinjiu Jia, Jin Li, Min Zhang, BUPT, China, State Key Laboratory of Mobile Network and Mobile Multimedia Technology, China. A multi-objective and multi-step performance parameters prediction scheme based on SCINet for optical network equipment is proposed. It not only saves 83.96% of training time on average, but also has high reliability.

W2B.9 Experimental Demonstration of an AWGR-Based Nanosensors Optical Switching DCN, Yunrui Tang, Xianwen Xue, Bingli Guo, Dabing Dong, Yisong Zhao, Rui Ding, Jiaping Zhao, Zhenghang Yang, Shangguo Huang, Beijing Unvers of Posts and Telecommunications, China. An arrayed waveguide grating router based nanosensors optical switching data center network is experimentally demonstrated and investigated. Experimental assessments validate the system achieves error-free communication with 460 ns server-to-server latency even at load of 0.9.

W2B.10 Real-Time Demonstration of a Low-Complexity PS Scheme for 100Gb/s WDM-OFDM-PON, Long Zhang, Kaili Wang, Chen Wang, Junjie Ding, Ming Chen, Bohan Sang, Junting Shi, Bowen Zhu, Feng Wang, Li Zhao, Yun Chen, Ze Dong, Xiangyun Xin, Wen Zhou, Jianjun Yu, Fudan Unvers, China; Huanan Normal Unvers, China; Beijing Inst. of Technology, China. We experimentally demonstrated a low-complexity probabilistic shaping scheme, in a real-time 16QAM-OFDM-based WDM-PON. The PS-OFDM signal with a net rate of 131.88-Gb/s transmission over 25-RSM can be achieved with the BER less than 3.8×10⁻³.

W2B.11 A Low-Latency DSM-Based ONU Activation Scheme for in-Service TDM-PON Without Quiet Windows, Yang Zou, Buon Li, Linsheng Zhong, Shenzhang Mao, Kaosuo Dai, Mengfeng Chen, Lei Deng, Qiang Yang, Deming Liu, Huashang University of Science and Technology, China; Access Optical Technologies Lab, Optical Product Business Line, Huawei Technologies Co., Ltd., China. An activation method using DSM generated electrical tone as the identity of joining ONUs is proposed. The activation requests can be detected and distinguished without a quiet window or degradation on the upstream window.

W2B.12 Deep Reservoir Computing for 100 Gb/s PM6 IM/DD Transmission Impairment Mitigation, Mengyao Han 1,2, Yuchuan Fan 3, Tomos Salas, Hadrien Louchet 6, Richard Schatz 2, Markus Salgals 5, Richard Schatz 2, Markus Salgals 5, Huashang University of Science and Technology, China; Access Optical Technologies Lab, Optical Product Business Line, Huawei Technologies Co., Ltd., China. A deep learning method using DSM generated electrical tone as the identity of joining ONUs is proposed. The activation requests can be detected and distinguished without a quiet window or degradation on the upstream window.

W2B.13 Experimental Demonstration of an AWGR-Based Nanosensors Optical Switching DCN, Yunrui Tang, Xianwen Xue, Bingli Guo, Dabing Dong, Yisong Zhao, Rui Ding, Jiaping Zhao, Zhenghang Yang, Shangguo Huang, Beijing Unvers of Posts and Telecommunications, China. An arrayed waveguide grating router based nanosensors optical switching data center network is experimentally demonstrated and investigated. Experimental assessments validate the system achieves error-free communication with 460 ns server-to-server latency even at load of 0.9.

W2B.14 Noisy Samples-Robust Neural Network Equalizer for Coherent Optical Transceiver Nonlinearity Compensation, Zai Cao, Shuang Yu, Longquan DAI, Zheng Zhang, Jing Dai, Ming Lu, Xiao JIAO, Yaqing WANG, Qi Yang, Deming LIU, Lei DENG; School of Optical and Electrical Information, Huazhong University of Science and Technology, China; Fiberhome Telecommunication Technologies Co., LTD, China; China Information Integration Technology and Application Group, China; CITC, China; National Information Optoelectronics Innovation Center, China. We experimentally demonstrate a neural network equalizer with robustness for noisy samples on a silicon photonics coherent transceiver with a complexity reduction of over 50% at the BER of 1×10⁻5 compared with a general structure.

W2B.15 Learned Perturbation-Aided Advanced Digital Backpropagation With Nonlinear Compensation for Subcarrier-Multiplexing Systems, Du Tang, Zhen Wu, Shuangyang Liu, Jating Luo, Li Luo, Bofang Zheng, Yuanqin Qiao 1, The State Key Laboratory of Information Photonics and Optical Communications, School of Information and Communication Engineering, Beijing Unvers of Posts and Telecommunications, China; Department of Mobile Communications and Terminal Research, Research Inst. of China Telecommunication, China; IBM Laboratory, Huawei Technologies Co., Ltd., China. A learned perturbation-aided advanced digital backpropagation (LP-ADBP) with nonlinear compensation is proposed for subcarrier-multiplexing systems. 1-Step and 5-Step LP-ADBP provide similar performance as 5-Step and 10-Step ADBP but save ~73.3% and ~44.5% complexity, respectively.

W2B.16 32×4400 Gb/s Single-Carrier 120-GbAud PSK Coherent Transmitter With Over 3075-km G.652-D Fiber Link Using OE-MCM Prototype Under Field-Deployed Configuration, Mingjing Zuo, Baoluo Yuan, Dawei Guo, Dawei Wang, Jiaxie Wang, Xuping Fan, Chunchuan Chen, Hu Shui, Philippe Jennevé, Shaoliang Zhang, Miquel A. Mestre, Dayou Qian, Sheng Liu, Yunbo Li, Liyan Han, Dechaoh Zhang, Lin Xia, Yifan Liu 1,2, KTH Royal Inst. of Technology, Sweden; RISE Research Inst. of Sweden, Sweden; Zhejiang University, China; KTH Royal Inst. of Technology, Sweden; University of Electronic Science and Technology, China. A parity-time symmetric optoelectronic amplifier is constructed based on stimulated Brillouin scattering. A stable microwave signal at 9.66 GHz is generated with a phase noise of ~103.9 dBc/Hz at an offset frequency of 10 kHz.

W2B.17 208km Ultra-Long Single Span Hybrid BOTDR and φ-OTDR With ROPA Technology, Jasheng Liu 1,2, Ming Li 1,2, Jian Xu 1,2, Jiekiu Yu 1,2, Minghao Nie 1,2, Shuyu Zhang 1,2, Xinxing Chen 1,2, Guoxiang He 1,2, Shujian Sun 1,2, Man Tan 1,2, Qinggao Hu 1,2, Accesslink Technologies Co. Ltd, China; State Key Laboratory of Optical Communication Technologies and Networks, China; Wuhan Research Inst. of Posts and Telecommunications, China. Ultra-long single span hybrid BOTDR and φ-OTDR system with ROPA technology is proposed. Using double heterodyne detection configuration, high order Raman amplifiers, cascaded ROGs, 208km unrepeated real time simultaneous temperature and vibration measurement is achieved.

W2B.18 Optoelectronic Oscillator Based on SBS-Assisted Path-Symmetry, Lin Wang, Yan Li, Yuan Yu 1,2, Xianliang Zhang 1,2, Huashang Univ. of Science and Technology, China; Optics Valley Laboratory, China; Huawei Technologies Co. Ltd., China. A low-complexity optical feedback is proposed and a stable microwave signal is generated using an optoelectronic oscillator based on SBS-Assisted Path-Symmetry. The phase noise and generation of a stable microwave signal is achieved.

W2B.19 Accurate Extraction of Brillouin Frequency Shift Using Single Deep Neural Network in BOTDA Sensing System With Non-Local Effect, Yuhao Qian, Gujiang Yang, Kyan Zeng, Liang Wang, Ming Tang, Deming Liu, Huashang University of Sci. & Tech, China. A single DNN model has been developed for accurate extraction of both Brillouin frequency shift and NLE. The proposed method is cost-effective and greatly improves the system tolerance to NLE without any hardware modification.
Guan, Wang, Weifeng Zhang. Accuracy of 5.6 MHz are experimentally demonstrated a high resolution using a hybrid optical filter. A identification of broadband microwave signal with a photonic approach for frequency detection. We propose a photonic approach for frequency detection. We experimentally demonstrate the simultaneous measurements of the microwave angle of arrival and Doppler frequency shift by silicon modulators. The measurement errors of AOA and DFS are less than 3° and 7.2×10^{-11} Hz at 30 GHz, respectively.

PAM8 WDM Transmission Based on a Single-Time Lens Source With Geometric Shaping, Xiaoju Xu, Peter David Girouard, Metodi Plamenov Yankov, Michael Galili, Leif Katsuo Oxenløwe, Pengyu Guan, OTU Electro, Denmark. We demonstrate a PAM8 WDM-PON transmission using a single-time lens source. Geometric shaping is used to minimize the impact of power-dependent noise. 28×1.5 Gb/s WDM signals are transmitted over 26 km with BER below 3×10^{-10}.

WDM • Posts Session II (Remote)—Continued

Demonstration of PDM-2048QAM W-Band Signal Delivery Over 4.6 km Wireless Transmission Employing One bit DSM, Wen Zhou, Xianwei Yang, Weigui Li, Fensong Wang, Bowen Zhu, Huajiong Lin, Junting Shi, Tangyao Xie, Xiaohu Wang, Li Zhao, Jianguo Yu, Feng Zhao, Jinyun Yu, Fudan Univ., China. We here propose a novel cost-effective millimeter-level resolution photonic multiband radar system using a single MZM driven by a 1-GHz-bandwidth LFM signal. It experimentally shows an 8.5-mm range resolution through coherence-processing-free multiband data fusion.

High-Resolution Frequency Identification of Wideband Microwave Signal Using a Hybrid Optical Filter, Haoyan Liu, Yihao Cheng, Bin Wang, Weifeng Zhang. We propose a photonic approach for frequency identification of broadband microwave signal with a high resolution using a hybrid optical filter. A frequency resolution of 20 MHz and a measurement accuracy of 5.6 MHz are experimentally demonstrated under a measurement range of 2.35 GHz.

Integrated Source of Telecom-Band Photonic Pairs Based on High Index Silica Glass Spiral Waveguides, Liang Cui, Hao Feng, Xiaotian Zhu, Changting Wang, Z. Y. Ouy, Xiaoyang Li, Brent E. Little, Sa T. Chiu, Tianjin Univ., China; ‘City Univ. of Hong Kong, Hong Kong; ‘WXP Inc., China. We generate correlated photon-pairs via spontaneous four-wave mixing in high index silica glass spiral waveguides. Results show that spontaneous Raman scattering is the main noise origin, and propagation loss limits the optimum length of waveguides.
14:00–16:00  
W3A • Symposium: Beyond the Hype of Network Analytics: Use Cases, Feasibility and Barriers  
President: Loukas Paraschis; IEEE Communication Society and Alphawave Semi, USA and Elaine Wong; Univ. of Melbourne, Australia

W3A.1 • 14:00  
Invited  
Title to be Announced, Andrew Lord1; BT Applied Research, UK. Abstract not available.

W3B.1 • 14:00  
Invited  
Visible Light Components: Fibers and Photodetectors, Joyce K. Poon1; Max-Planck-Institut fur Mikrostrukturphysik, Germany. Abstract not available.

W3C.1 • 14:00  
Invited  
Nonlinear and Quantum Optics in Periodically-Poled Optical Fiber, Li Qian1; Univ. of Toronto, Canada. We will review methods of generating entangled and hyper-entangled photon pairs directly in periodically-poled silica fiber (PPSF) through spontaneous parametric down conversion (SPDC), based on the induced second-order nonlinearity in PPSF. Due to the extreme low birefringence in fiber, broadband polarization-entangled photon pairs can be generated without compensation or erasure of which-way information.

W3C.2 • 14:20  
Invited  

W3D.1 • 14:00  
Invited  
State of Art of 800G/1.6T for Datacom and Coherent and Outlook of 3.2T, Xiang Zhou1, Cedric Lam1, Ryosuke Urata1, Hong Liu1; Google LLC, USA. We review state-of-the-art datacenter technologies for 800G, 1.6T and beyond interconnect speeds, focusing on 200G per-lane IM-DD (intensity modulated-direct detect) and 800G-LR1 coherent-lite transmissions.

W3D.2 • 14:20  
Invited  

W3E.1 • 14:00  
Invited  
Recent Advances in Carrier Phase Recovery Algorithms, Fernando Guimar1, Manuel Neves1, Abel Lorences-Riesgo1, Celestino Sanchez Martinez1, Sami Mumtaz1, Yann Frignac1, Gabriel Charlet1, Paula Monteiro1; Instituto De Telecomunicacoes, Portugal; Huawei Technologies France, France. We review the most recent advances in carrier phase estimation algorithms for coherent optical communications, with special emphasis on multi-carrier modulation systems and on the interplay between linear and nonlinear phase noise sources.

W3E.2 • 14:20  
Invited  
Open RAN Mobile Access: the View of an Operator on an End-to-End Implementation, Carlo Cavazzoni1, Marco Caretti1, Alessandro Peracca1, Mauro Agus1; TIM (Telecom Italia), Italy. This paper describes some challenges that an operator must face when setting up the environment to evaluate end-to-end 5G mobile networks, with a specific focus on the RAN segment implemented by disaggregated Open RAN solutions.
**W3G.1 • 14:00 **
DDOS Neural Network With 50 GHz Input and Weight Update, Apostolis Iakynidas; George Garmougianis; Miltiadis Moralis-Pegkas; George Mourgas-Alexandris; Angelina Totovic; George Dobas; Manos Kirtsas; Nikolaos Passalis; Anastasios Tefas; Dimitris Kalavrouzotos; Dimitro Syrivelis; Paraskes Bekopoulou; Elad Mentovich; Nikos Pioros; Anistote Univ of Thessaloniki, Greece; NVidia, Greece; NVidia, Israel. We experimentally demonstrate distributed denial of service (DDOS) attack identification using Deep Learning over a photonic neuromorphic engine that supports both input signal and weight update at 50 GHz, reporting the broadcast and aggregation network consists of a 400 Gb/s hub transceiver achieving post-FEC error-free communication with 4×100 Gb/s leaf nodes, 5–50 km away.

**W3H.1 • 14:00 **
Real-Time Point-to-Multipoint for Coherent Optical Broadcast and Aggregation – Enabled by Digital Subcarrier Multiplexing, Amir Rashidnejad; Amir Yekani; Tobias A. Eriksson; Antonio Napoli; Robert Maher; Adiya Kakka; Vince Dominic; Thomas Duthel; Mark Missey; Farmaj Samra; Dan Pavinski; Peter Evans; Warren Sande; Mehrdad Ziarani; Chris Flugder; Han Sun; Mehrdad Ziarani; Fady Masoud; Azmina Somani; Dave Welch; Infimera Canada, Canada; Infimera Sweden, Sweden; Infimera Germany, Germany; Infimera USA, USA. We report on the first real-time operation of coherent point-to-multipoint in high-speed fiber-optic communications. The broadcast and aggregation network consists of a 400 Gb/s hub transceiver achieving post-FEC error-free communication with 4×100 Gb/s leaf nodes, 5–50 km away.

**W3I.2 • 14:00 **
Plasmonic Modulators for Future Highest-Speed Free Space Optical Communications, Laurence Kulmer1; Yannik Horst; Bertold Ian Bitchcher; Marcel Destrazi; Tobias Blatter; Matthieu Rimlinger; Killian Keller; Valentino Tedaldi; Patrick Habegger; Eva De Leo; Wolfgang Herl; Claudia Hoessbach; Aurélie Bonfessois; Caroline Lem1; Jean-Marc Canan; Joseph Montri1; Beatrice Sorrente2; Cyril Petit; Nicolas Vedenevi; Loano Pommarel; Hannah Lindberg; Laurent Francois; Daniel Matter; Amaur Le Kernec; Anaiselle Mahoz; Simon Leveque; Michael Sotom; Benedikt Baueuerle1; Jaeger Leuthold1; ETH Zurich, Switzerland; Polaeten Technologies AG, Switzerland; ONEIRA, France; UNE SYRTE, France; Thales-Aellite Space Switzerland, Switzerland; Thales-Aellite Space France, France. Plasmonic modulators have been assessed for operation up to 200 GBaud in a turbulent 53 km free-space-optical link. They are shown to withstand space radiation and large temperature ranges making them ideal for space applications.

**W3J.2 • 14:15 **
Plastic Considerations on Using Gaussian Shape Pulses in phi-OTDR Systems, Felipe M. Mequero1; Pedro O. Mariz de Carvalho; Sergio Barcelona; Luis Ernesto Y Herrera2; Photonics Innovation Inst, Brazil; Fiberwork Optical Communications Ltda, Brazil; Future Photonics, USA. This paper experimentally demonstrates practical advantages and limitations on using Gaussian shape pulses for phi-OTDRs systems by measuring the SNR of the detected vibration in the far end of a standard single mode fiber.
Wednesday, 8 March

W3A • Symposium: Beyond the Hype of Network Analytics: Use Cases, Feasibility and Barriers—Continued

W3B • Special Session: Photonics for Visible Wavelengths II—Continued

W3C • Devices for Quantum Technologies (Joint DS/SCQ)—Continued

W3D • Modulators and Transceivers—Continued

W3E • Transmission Impairment Mitigation and Compensation Techniques—Continued

W3F • Convergent Optical Access for Mobile Connectivity—Continued

W3A.3 • 14:40

Invited

Analytics for Datacenter Interconnect Optical Networks, Chongjin Xie1; Alibaba Group, USA. Abstract not available.

W3B.3 • 14:40

Invited

Scaling Visible SN Integrated Photonics and its Applications, Michael Geisemann1; LIGENTEC, Switzerland. Abstract not available.

W3C.3 • 14:45

An Acousto-Optic Modulator Based High Performance Optical Switch for Quantum Technology in Fiber Communication Band, Wen Qi Li, Qiqi Deng1, Xuewei Guo1, Xiaoying Li1; Tianjin Univ., China. We demonstrate an optical switch based on the interferometric enhancement of acousto-optic diffraction. The high transmitting efficiency of 92% and the high isolation of 74 dB make it a powerful tool for quantum technology.

W3D.3 • 14:45

Top-Scored

800 Gbps Silicon Photonics Transmitter PIC With Integrated Lasers in an Open Platform Market. Molly Piats1, John Sonky1, Kryształ Szafera1, Brandon Gomez, Han Yuan, Jared Bauters, Hongwei Zhao1, Mark Williams1, John Parker1, Anand Ramaswamy1, Erik Norberg1; OpenLight Photonics, USA. An uncooled 800Gbps-DR8 silicon photonics transmitter PIC with fully integrated lasers and 1.0 Vpp drive swing modulators in an open market platform is demonstrated for data center applications.

W3E.3 • 14:45

MIMO Coding Technique for PDL and Crosstalk Mitigation in Optical Transmission Systems, Akram A. Abouseif1, Ghaya Rekaya-Ben Othman1,2; NuCrypt, USA. We propose new coding technique, called IQ-code, to mitigate PDL and inter-channel crosstalk on optical fiber transmission. We present results of simulations and experiments with 50 Gbps 64QAM over 10-km SSMF with an optical link budget 2.5 dB higher at FEC limit for any number of sub-carrier by simple ZF decoding.

W3A.1 • 09:00

Room 2

W3B • Devices for Quantum Technologies (Joint DS/SCQ)—Continued

W3C • Devices for Quantum Technologies (Joint DS/SCQ)—Continued

W3D • Devices for Quantum Technologies (Joint DS/SCQ)—Continued

W3E • Devices for Quantum Technologies (Joint DS/SCQ)—Continued

W3F • Devices for Quantum Technologies (Joint DS/SCQ)—Continued

Room 3

W3A.1 • 09:00

Room 3

W3A.3 • 14:40

Invited

Analytics for Datacenter Interconnect Optical Networks, Chongjin Xie1; Alibaba Group, USA. Abstract not available.

W3B.3 • 14:40

Invited

Scaling Visible SN Integrated Photonics and its Applications, Michael Geisemann1; LIGENTEC, Switzerland. Abstract not available.

W3C.3 • 14:45

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W3D.3 • 14:45

Top-Scored

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W3E.3 • 14:45

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<th>Room 6F</th>
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<td>W3G • Photonic Processing for Computing and ML—Continued</td>
<td>W3H • Coherent Pluggable and Field Trials—Continued</td>
<td>W3I • Enabling Technology for Free Space Optical Communications—Continued</td>
<td>W3J • Sensing, Devices and OTDR—Continued</td>
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<td><strong>W3H.3 • 14:30</strong></td>
<td><strong>W3H.4 • 15:00</strong></td>
<td><strong>W3I.3 • 14:30</strong></td>
<td><strong>W3J.3 • 14:30</strong></td>
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<tr>
<td><strong>Invited</strong></td>
<td><strong>Top-Scored</strong></td>
<td><strong>Alignment-Tolerant Fi-Fi Free-Space Optical Bridge, Florian Hort, Aina Val-Martí, Philip Walther, Hannes Hübner, Bernhard Schrenk; AIT Austrian Inst of Technology, Austria; Faculty of Physics, Univ. of Vienna, Universitat Wien, Wien, Wien, AT, academic, Austria.</strong></td>
<td><strong>Simultaneous Temperature and Acoustic Sensing With Coherent Correlation OTDR, Andre Sandmann, Florian Aenderfer, Michael Essel; ADVA Optical Networking SE, Germany. Superimposed temperature variations and dynamic strain applied through a 400 Hz acoustic signal on a 195 m single-mode fiber section are successfully measured using a coherent correlation optical time domain reflectometry as an interrogator.</strong></td>
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<td><strong>2Z 400G &amp; 800G Use Cases, Trials, Deployments and Future Prospects, Russell Davey, Md Asif Iqbal, Paul Wright; Networks, BT, UK; Applied Research, BT, UK. The paper will review options and use cases for 400Gb/s and 800Gb/s deployed in the core of a major national operator, including 400Gb/s ZR/ZR+ optics embedded in routers and external transponders.</strong></td>
<td><strong>High-Speed and Energy-Efficient Non-Volatile Memristive III-v-on-Silicon Photonic Phase Shifter, Zhurui Fang, Bassem Tossou, Antoine Dessens, Di Liang, Xue Huang, Geza Kurczveil, Arka Majumdar, Raymond Beausoleil; Univ of Washington, USA; Hewlett Packard Labs, USA. We demonstrated a non-volatile III-V-on-silicon photonic phase shifter based on HfO2 memristor with ~400 fJ switching energy, volatile III-V-on-silicon photonic phase shifter based of over 800 cycles.</strong></td>
<td><strong>High Data Rate Optical Wireless Communication Over Wide Range by Using Nonuniform-Space Optical Phased Array, Yingzhi Li, Baosheng Chen, Min Tao, Quanxin Na, Xianlun Luo, Guo-Qiang Lu, Qie Xie, Junfeng Song; Jilin Univ, China; Peng Cheng Laboratory, China; Advance Micro Foundry, Singapore. We demonstrate a high-data-rate optical wireless communication (OWC) system over wide steering range by using a nonuniform-space optical-phased-array (PA) chip. More than 70 Gb/s data transmission covering 100° steering range over 10 m is achieved.</strong></td>
<td><strong>Simultaneous Temperature and Acoustic Sensing With Enhanced Accuracy by Using Forward Brillouin Scattering in Highly Nonlinear Fiber, Guijiang Yang, Keyan Zeng, Liang Wang, Ming Tang, Deming Liu; Huazhong Univ of Science &amp; Tech., China. Simultaneous temperature and strain sensing has been demonstrated for the first time by using forward Brillouin scattering in highly nonlinear fiber. The accuracy is improved by seven times compared with that using backward Brillouin scattering.</strong></td>
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<td><strong>W3I.4 • 14:45</strong></td>
<td><strong>W3J.4 • 14:45</strong></td>
<td><strong>W3J.5 • 15:00</strong></td>
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<td><strong>Field Trial of Coexistence and Simultaneous Switching of Real-Time Fiber Sensing and 400GbE Supporting DCI and 5G Mobile Services, Yue-Kai Huang, Zhaohua Wang, Eza Jr, Zherhao Qi, Gil Zusman, Daniel C. Kilper, Koji Asahi, Hideo Kageyama, Yoshiaki Aono, Tingjun Chen; Trinity College Dublin, Ireland; Electrical and Computer Engineering, Duke Univ., USA; NEC Laboratories America, USA; Electrical Engineering, Columbia Univ., USA; Photonic System Development, NEC Corporation, Japan. Coexistence of real-time constant-amplitude distributed acoustic sensing (DAS) and 400GbE signals is verified by field trial over metro fibers, demonstrating no QoT impact during co-propagation and supporting preemptive DAS-informed optical path switching before link failure.</strong></td>
<td><strong>Hybrid Coding Ultra-Weak Fiber Bragg Grating (UWFBG) Array for High Spatial Resolution Temperature Sensing, Xiangpeng Xiao, Qingguo Song, Weiliang Zhao, Hao Li, Qihen Sun, Zhijun Yan; Huazhong Univ of Science and Technology, China; Wuxi Research Inst., Huazhong Univ of Science and Technology, China. An UWFBG array containing 1000 UWFBGs spaced 10cm apart by time and wavelength division multiplexing was fabricated in UV-transparent coating optical fiber. The temperature sensing precision is around 0.1 under 1pm wavelength measuring accuracy.</strong></td>
<td><strong>Simultaneous Measurement of Temperature and Strain With Enhanced Accuracy by Using Forward Brillouin Scattering in Highly Nonlinear Fiber, Guijiang Yang, Keyan Zeng, Liang Wang, Ming Tang, Deming Liu; Huazhong Univ of Sci. &amp; Tech., China. Simultaneous temperature and strain sensing has been demonstrated for the first time by using forward Brillouin scattering in highly nonlinear fiber. The accuracy is improved by seven times compared with that using backward Brillouin scattering.</strong></td>
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<td><strong>W3L.4 • 14:30</strong></td>
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<td><strong>W3J.5 • 15:00</strong></td>
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<td><strong>Coherent Phased Array, Yingzhi Li, Baosheng Chen, Min Tao, Quanxin Na, Xianlun Luo, Guo-Qiang Lu, Qie Xie, Junfeng Song; Jilin Univ, China; Peng Cheng Laboratory, China; Advance Micro Foundry, Singapore. We demonstrate a high-data-rate optical wireless communication (OWC) system over wide steering range by using a nonuniform-space optical-phased-array (PA) chip. More than 70 Gb/s data transmission covering 100° steering range over 10 m is achieved.</strong></td>
<td><strong>Chaotic-Cavity Surface-Emitting Lasers for Optical Wireless Communication, Omar Alkhazragi, Ming Dong, Liang Chen, Dong Liang, Tien Khee Ng, Jierping Zhang, Hakan Bagci; 1King Abdullah Univ. of Sci. &amp; Technology, Saudi Arabia; 2Huawei Technologies Co., Ltd., China. We demonstrated using chaotic cavities to lower the spatial coherence of vertical-cavity surface-emitting lasers. Our design achieved a 10-Gb/s data rate with a 60% increase in the optical power and double the number of modes.</strong></td>
<td><strong>Simultaneous Measurement of Temperature and Strain With Enhanced Accuracy by Using Forward Brillouin Scattering in Highly Nonlinear Fiber, Guijiang Yang, Keyan Zeng, Liang Wang, Ming Tang, Deming Liu; Huazhong Univ of Sci. &amp; Tech., China. Simultaneous temperature and strain sensing has been demonstrated for the first time by using forward Brillouin scattering in highly nonlinear fiber. The accuracy is improved by seven times compared with that using backward Brillouin scattering.</strong></td>
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W3A • Symposium: Beyond the Hype of Network Analytics: Use Cases, Feasibility and Barriers — Continued

Room 1AB

W3B • Special Session: Photonics for Visible Wavelengths II — Continued

Room 2

W3C • Devices for Quantum Technologies (Joint DS/SCQ) — Continued

Room 3

W3D • Modulators and Transceivers — Continued

Room 6C

W3E • Transmission Impairment Mitigation and Compensation Techniques — Continued

Room 6D

W3F • Convergent Optical Access for Mobile Connectivity — Continued

Room 6E

W3A.5 • 15:20 invited Analytics for Next-Gen Network Planning, Jan Kong1; 1Microsoft Corp, USA. Abstract not available.

W3C.5 • 15:15 invited Modulator-Free Intensity- and Phase-Modulated Optical Transmitter for Quantum Communications, Robert I. Woodward1, Yuen San Lo2,3, Nathan Walk1, Marco Lucamarini1, Innocenzo De Marco1, Taoqiu Paraiso1, Mirej Pittaluga1, Thomas Rogel1, Mirko Sanzaro1, Zhiyang Yuan1, Andrew Shields1, 1Toshiba Europe Ltd., UK; 2Quantum Science & Technologies (Joint D5/SCQ)—Continued

W3C.6 • 15:30 invited Interference Beyond the Coherence by Using Classical Light, Yoon-Ho Kim1, 1Pohang Univ of Science & Technology, Korea (the Republic of). The intensity correlation between the outputs of two unbalanced Mach-Zehnder interferometers with two classically correlated beams of thermal light at the input exhibits genuine second-order interference beyond the coherence length of the thermal light.

W3D.6 • 15:30 invited Monolithically Integrated InP-Based Transceiver Photonic ICs for 800G Solutions, Vikrant Lali1, 1Invinea Corporation, USA. Abstract not available.

W3E.6 • 15:30 invited Inline Optical Compensation of Group Delay Ripple for Long-Haul Transmission Using Offloaded 2x2 MIMO Filter, Masaki Sato1, Manabu Anakawa2, Hitomi Naguchi1, Junichiro Matsui1, Junichi Abe1, Emmanuel Le Taffandier de Gabory1, 1NEC Corporation, Japan; 2Nagoya Inst. of Technology, Japan. We demonstrated inline optical compensation of group delay ripple estimated with offloaded 2x2 MIMO filter for 84-Gbaud PM-PCS-16QAM over 10,200 km SMF. We showed 38% reduction of MIMO taps, compared to the conventional method.

W3E.7 • 15:45 invited New Mode-Group-Permutation Strategies for MDL Reduction in Long-Haul MDM Systems, Huihui Wang1, Xutao Wang1, Yichen He2, Zhiqun Yang1, Yongping Liu1, Gang Guo1, Ruizhou Zhu1, Xinhua Xiao1, Zhanhua Huang1, Lin Zhang1, Tianjin Univ., China; 2Peng Cheng Laboratory, China; 3Huawei Technologies Co., Ltd., China. We compare 9 types of mode-permutation strategies (MPSs) aiming at MDL reduction in MDM systems, based on in-house low- latency real-time link and layer-2 networking demonstrations will be discussed.

16:00–16:30 Coffee Break, Upper Level Corridors and Exhibit Hall
A Modified Mesh With Individually Monitored Interferometers for Fast Programmable Optical Processors

Hassan R. Majayeri1, Bokun Zhao2, Odile Liborion-Ladouceur2, 1McGill Univ., Canada.

We demonstrate a novel mesh of interferometers for programmable optical processors. Employing an efficient programming scheme, the proposed architecture improves energy efficiency by 83% maintaining the same computation accuracy for weight matrix changes at 2 kHz.

VCSEL Based Neuromorphic Computing

Antonio Hurtado1, Daoyid Oen-Newns3, Marej Heyda2, Joshua Robertson1, 1Univ. of Strathclyde, UK.

We report an indoor setup emulating hundreds of meters link. 10Gbit/s OOK signals are successfully transmitted on an indoor setup emulating hundreds of meters link. Using an integrated programmable optical processor, Space Optical communication link is demonstrated with 380 µm point. We demonstrate the distributed measurement technique with a broadband ASE probe light. We propose a fast BOTDA-based large dynamic strain measurement technique with a broadband ASE probe light. We demonstrate the distributed measurement of 25 Hz vibration with the 380 µm amplitude.
16:30–18:30
W4A • Symposium: Beyond the Hype of Network Analytics: Use Cases, Feasibility and Barriers II
Presider: Paolo Monti; Chalmers Univ of Technology, Sweden and Christine Tremblay; École de technologie supérieure, Canada

W4A.1 • 16:30
Invited
When Digital Twins Meet Optical Networks Operations, Darli Melo1, UNICAMP, Brazil. Abstract not available.

W4A.2 • 16:50
Combining Machine Learning and Analytical Models, Jelena Pesci1, Nokia, France. Abstract not available.

W4B.1 • 16:30
8-Channel CWDM TOSA for CPO External Laser Sources Employing a Blind Mate Connector, Taketugu Sawamura1, Kyoko Nagai1, Kazuhiro Kashima1, Kohei Umetsu1, Daiki Takeda1, Tsunetoshi Saito1, Hideyuki Nasu1, Telecommunication & Energy Laboratories, Fukuwaki Electric Co., Ltd., Japan. We report an 8-channel CWDM TOSA designed for CPO ELS modules adopted with a blind mate optical connector. The mechanical size of the TOSA is as small as 22.5 mm x 13.0 mm x 4.0 mm to be built in a standard QSFP housing. The fiber-coupled power is >20 dBm, PER is >20 dB for all channels over the case temperature range of 25 °C to 55 °C.

W4B.2 • 16:45
Solving the Escape Density Problem: Making Connections Count With SCIP, Rebecca K. Schasvitz1, Karl Muth1, Ying Luo1, Vivek Raghuraman1, Near Margalit1, Broadcom Corporation, USA. Silicon Photonics Chiplets in Package (SCIP) creates a paradigm shift, enabling escape densities in optics that match the core silicon and creating a scalable platform that meets requirements of future data center and compute architectures.

W4C.1 • 16:30
Invited
Fabrication of Multicore Fibers for High Power Lasers, Sensing, and Communications, Nicoleta Haarlammer1, Johannes Nold1, Stefan Kuhn1, Christian Hupel1, Sigrun Hen1, Arno Kienst1, Cesar Juarez1, Jens Lempp1, Thomas Schreiber1, Andreas Tunnemann1,2,2Fraunhofer IOF, Germany; 1Inst. of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-University, Germany; 1Heinrich-Institut Jena, Germany. Many fiber applications require novel fiber concepts to overcome existing limitations. The advantages of multicore fibers as a promising fiber concept for fiber lasers, sensing and communications are discussed. Different fabrication technologies are presented.

W4C.2 • 17:00
Top-Scored
Direct Electrostriction Measurement Using SPIM for Fiber Type Identification, Fatima Al-Shaikhli1, Maurice O’Sullivan2, Rangjeng Hu1, Univ. of Kansas, USA; 1Ciena, Canada. We present a simple technique for in-field determination of fiber types through the measurement of electrostriction effect based on self-phase modulation.

W4D.1 • 16:30
Invited
Birefringent and Low Loss Semi-Tube Hollow-Core Fiber, Yingying Wang1, Yifeng Hong1, Shoufei Gao1, Xiaosong Lu1, Zhe Zhang1, Wei Ding1, Inst. of Photonics Technology, Jinan Univ., China. We summarize our recent work on design, fabrication and characterization of birefringent, low loss and broadband semi-tube hollow-core anti-refractive fiber. We also show its low loss interconnection with panda fiber.

W4D.2 • 17:00
Top-Scored
Demonstration of Real-Time Receiver for 30-GBaud PAM-6 Signal in IM/DD Transmission, Sherman Zhang1, Xiaoao Dai1, Zhe Chen1, Qi Yang1, Chen Liu1, Lei Deng1, Mengfan Cheng1, Deming Liu1, Xinsheng Xie1, Jinan Univ., China. We experimentally demonstrate a real-time reception of 30-Gb/s PAM-6 signal with a baud-rate analog-to-digital converter (ADC).
With Composable ML and End-to-End QoT Estimation and Forecasting


- Panahi 1; Silva 1, Nasser Mohammadiha 2,1, Ashkan Network Automation, W4G.3 • 17:00 ati1, Wanda Baltzer1, Johannes Karl Fischer1; W4G.2 • 16:45
-複雑性と有効性のトレードオフ
- Nonlinear Propagation Models, Gabriella Bosco1; Politecnico di Torino, Italy. Some of the most widespread analytical models for nonlinear propagation in fiber optic coherent systems are reviewed, highlighting the tradeoffs between accuracy and complexity in different transmission scenarios, including wide-band optical systems and short-reach links.

QoT Violation in Low-Margin Optical Networks, Pooyan Safari1, Behnam Shariat1,2, Vanda Balája1, Johannes Karl Fischer1; Fraunhofer HHI, Germany. We approach the QoT estimation problem from a novel perspective revealing the hidden aspects of QoT violation avoidance procedure during lightpath provisioning and quantifying the potential complexity when applied to low-margin networks.

Machine-Learning-as-a-Service for Optical Network Automation, Carlos Natalino da Silva1, Nacira Mhammediha1, Askar Panahi1, Chalmers Tekniska Högskola, Sweden; Ericsson AB, Sweden. MLaaS is introduced in the context of optical networks, and an architecture to take advantage of its potential is proposed. A use case of QoT classification using MLaaS techniques is benchmarked against state-of-the-art methods.

Complexity Versus Accuracy Tradeoffs in Nonlinear Propagation Models, Gabriella Bosco1; Politecnico di Torino, Italy. Some of the most widespread analytical models for nonlinear propagation in fiber optic coherent systems are reviewed, highlighting the tradeoffs between accuracy and complexity in different transmission scenarios, including wide-band optical systems and short-reach links.

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W4A • Symposium: Beyond the Hype of Network Analytics: Use Cases, Feasibility and Barriers II—Continued

W4B • Lasers and CPO—Continued

W4C • Advanced Optical Technologies—Continued

W4D • Hollow Core Fiber—Continued

W4E • Direct Detection and Short Reach Transmission Systems—Continued

W4F • Converged Fixed and Mobile Networks—Continued

W4A.3 • 17:10 Invited
Is Intelligence the Answer to Deal With the 5 v’s of Telemetry Data?, Luis Velasco1; Universidad Politecnica de Catalunya, Spain. Abstract not available.

W4B.3 • 17:15
16-ch 1060-nm Single-Mode Bottom-Emitting Metal-Aperture VCSEL Array for Co-Packaged Optics, Liang Dong1, Xiaodong Gu1, Fumio Koyama1, Tokyo Inst. of Technology, Japan; Ambition Photonics Inc., Japan. We demonstrate 16-ch 1060-nm bottom-emitting metal-aperture VCSEL array for co-packaged optics transceivers. The transverse-control and bandwidth-enhancement is realized thanks to coupled cavity. A record bandwidth and fiber distance product of 250Gbps×5km is obtained.

W4C.3 • 17:15
Broadband and Fine-Resolution Micro-wave Photonic Filtering With High-Speed Electronic Reconfigurability, Xinyi Zhu1, Benjamin Crockett1, Connor M. Rowe1, Jose Azaire1; INRS-EMT, Canada. We experimentally demonstrate electronically programmable, user-defined time-varying filtering of continuous broadband signals, over a 22 GHz frequency tuning range and with >1 GHz reconfiguration speed, using electro-optic modulation of a reversible time-mapped spectrogram.

W4D.3 • 17:15
A Method to Compute the Local Birefringence Vector in Twisted and Bent Anti-resonant Hollow-Core Fibers, Gianluca Guerra1, Seyed Mohammad Akbohgham Mousavi1, Austin Taranta1, Eric Numkam Fokoua1, Marco Santagustina1, Andrea Gal-torssaf1, Francesco Poletti1, Luca Palmieri1; Optoelectronics Research Centre, Univ. of Southampton, UK; Univ. of Padova, Italy. This work proposes a technique to elucidate mode coupling when antiresonant fibers are twisted and bent. From this, we show how the birefringence of a nested antiresonant nodeless fiber changes as function of the deployment.

W4E.3 • 17:15
Dispersion Compensation Over C-Band WDM Grid for 100Gb/s PAM4 System by Low-Complexity Optoelectronic Feedforward Equalization (OE-FFE), Pakun Zhu1, Yuki Yoshida1, Atsushi Kanno1, Koudhi Aka-hane1, Ken-ichi Kitayama1; National Inst of Information & Comm Tech (NICT), Japan; Nagoya Inst. of Technology, Japan; Hama-matsu Photonics Central Research Laboratory, Japan. We experimentally investigate OE-FFE-enabled C-band 100Gb/s PAM4 transmission over 50km with different carrier frequencies and linewidths. 3.8-THz range on ITU-T G.694.1 grid is supported with a single 1-tap optical delay line and ≤32-tap digital FFE.

W4F.4 • 17:30 Top-Scored
Picosecond-Precision Clock Synchronized Radio Access Networks Using Optical Clock Distribution and Clock Phase Caching, Kari Clarke1, Zichuan Zhou1, Zhixin Liu1; Univ. College London, UK. We show 0.98-ps precision clock synchronization for radio access networks, in a real-time field-trial demonstration on 37.6-km dark fiber, with optical clock frequency synchronization and clock phase caching operating using 25.6-Gb/s commercial transceivers.
Forecasting—Continued

We implement an LSTM-based algorithm to predict and analyse transmission performance and detect anomalies. Cross-validation of the model over two experimental datasets shows high precision of up to 96% for $R^2$ model over two experimental datasets. We assess the accuracy via OSNR measurements in the line.

W4H.4 • 17:30
Top-Scored
241.92-bit/s/Hz Spectral-Efficiency Transmission Over a 493-km 7-Core Ring Core Fiber With Low-Complexity 4x4 MIMO Equalization, Zengquan Xu1, Junyi Liu1, Jie Liu1, Zhennui Lin1, Junwei Zhang1, Zhenhua Li2, Lei Shen1, Siyu Yu3, Sun Yat-sen Univ, China; 1State Key Laboratory of Optical Fiber and Cable Manufacture Technology, China. The transmission of 84 OAM modes with spectral efficiency of 241.92 bit/s/Hz over 14 km 7-core ring core fiber whose cladding diameter is 180μm is demonstrated, using 4 × 4 MIMO equalizations.

W4H.4 • 17:30
Digital Twin of Unrepeatered Line Based on Raman and Remote Optically Pumped Amplifier Machine Learning Models, Arthur MinaKhvstov1, Berjamin Prieur1, Mael Le Monnier1, Delphine Rouvillain1, Bruno Lavigne1, Alcatel Submarine Networks, Nokia, France. We demonstrate an accurate digital representation of an unrepeatered line based on separate measurement-based machine learning models of Remote Optically Pumped Amplifier and Raman amplification. We assess the accuracy via OSNR measurements in the line.

W4J.4 • 17:30
Invited
Optically Upconverted, Spatially Coherent Phased-Array-Antenna Feed Networks for Beam-Space MIMO in 5G Cellular Communications, Dennis W. Prather1, 2, Univ of Delaware, USA; 2Phase Sensitive Innovations, USA. We present an RF-photonic phased-array receiver that provides simultaneous multi-band and multi-beam operation in the millimeter-wave region of the spectrum. It uses a photonic integrated circuit to perform RF beamforming with near unlimited beambandwidth-product.

W4J.4 • 17:30
An Integrated Radar Detection and Microwave Frequency Measurement System Based on an Optically Injected Semiconductor Laser, Zhiang Tang1, Fei Zhou1, Jian Zhu1, Nanqiang Li1, Shilong Pan1, Soochow Univ, China; 1Nanjing Univ. of Aeronautics and Astronautics, China. An integrated radar detection and microwave frequency measurement system has been proposed and experimentally demonstrated based on an optically injected semiconductor laser. Both high-resolution radar detection and accurate microwave frequency measurement are realized simultaneously.

W4K.4 • 17:30
London Quantum-Secured Metro Network, Andrew Lord1, Robert Woodward2, Shinya Murai3, Hideaki Sato4, James Dynes5, Paul Wright1, Catherine White1, Russell Davey1, Mark Wilkinson1, Piers Clinton-Tarestad1, Ian Hawkins1, Kristopher Farrington1, Andrew Shields1, 2BT, UK; 3Toshiba Research Europe, UK; 4EY, UK. We describe a London Quantum-Secured Metro Network using Quantum Key Distribution between three London nodes together with customer access tails. The commercially-ready solution is fully integrated into the BT network and onboarded its first customer.

W4K.3 • 17:15
Optimum Switching Scenario Analysis in a Dynamic Entanglement Network, Rui Wang1, Marcus Clark2, Siddarth Koduru K. Jash1, Sima Bahrani1, Obada Alia1, Matej Perančič2, Martin Lontand2, Maria Stipčevič2, John Ranty1, Reza Nejabati1, Dimitra E. Simeonidou1, Univ. of Bristol, UK; 2Institut Ruder Bošković, Croatia. We investigate the performance of a dynamical entanglement-based QKD network with various switching scenarios. The simulation results suggest the optimum scenario for different heralding efficiencies and detectors’ jitter and the experimental results verify the benefit.
Continued

Feasibility and Barriers II—Analytics: Use Cases, the Hype of Network
W4A • Symposium: Beyond the Hype of Network
Room 2
Lasers and CPO—Continued
Room 3
Advanced Optical Technologies—Continued
Room 6C
Hollow Core Fiber—Continued
Room 6D
Direct Detection and Short Reach Transmission Systems—Continued
Room 6E
Converged Fixed and Mobile Networks—Continued

W4B.5 • 17:45
Lithium-Niobate-Based Narrow-Line-width Frequency-Agile Integrated Lasers With Petahez Frequency Tuning Rate, Vlachoslav Sgrigrev, Anna Riedhauser, Grigori Liashchev, Johann Remersberger, Rui N. Wang, Charles Moehl, Mikhail Churavy, Anat Siddharth, Guanhao Huang, Youri Popoff, Ute Drechsler, Daniele Caimi, Simon Hoeni, Junqiu Liu, Paul Seidler, Tobias Kippenberg; EPFL, Switzerland; IBM Research Europe, Switzerland; ETH Zurich, Switzerland. We demonstrate an electro-optically tunable hybrid integrated laser self-injection locked to a mode of a heterogeneously integrated lithium-niobate-on-Damascene-silicon-nitride microresonator. An intrinsic linewidth of 3 kHz and a frequency tuning rate of 12 × 10^15 Hz/s were observed. Proof-of-principle coherent LiDAR experiments were performed.

W4B.6 • 18:00
Invited
FM CW Lidar, Mehdi Asghari; SLTC Technologies, Inc., USA. Abstract not available.

W4C.5 • 17:45
Experimental Demonstration of Chaotic Secure Transmission With Mutual-Interjection of Semiconductor Laser Over 130-km Multi-Core Fiber, Lei Shen, Zhongyang Wang, Min Yang, Zhi Yang, Lei Zhang, Changkun Yan, Liubo Yang, Ruichun Wang, Jun Chu, Jian Wang; Huazhong Univ. of Science and Techn, China; 1 State Key Laboratory of Optical Fiber and Cable M anufacture Technology, China. We propose and demonstrate chaotic synchronization and communication based on mutual-injection of the semiconductor laser over long-distance multi-core fiber (MCF). It achieves chaotic secure transmission with successful encryption and decryption through 130-km seven-core fiber in the experiment.

W4C.6 • 18:00
Hybrid Distributed Acoustic Sensing and Kramers-Kronig Communication System Over a two-Mode Fiber, Juan M. Marin, Efficient Electronics, Eurecom, France. We report on the co-propagation of distributed acoustic sensing (DAS) and Kramers-Kronig communication scheme over a two-mode fiber, achieving DAS with a signal-to-noise ratio larger than 2 dB and gross data rate of 2.04 Gbps.

W4D.5 • 17:45
Wideband Transmission in the 1-μm Band Based on a Hollow-Core Fiber and Wideband YDFA, Yong Hong, Xin Huang, Yang-Min Jung, Hans C. Mulvad, Hesham Sakr, Natsupa Taengnai, Kyle R. Bottl, Francesco Polent, Periklis Petropoulos, David J. Richardson; 1 Optoelectronics Research Centre, University of Southampton, UK; 2 Nokia Bell Labs, France. We show the potential of combining a hollow-core nanofiber with a wideband YDFA for 1μm transmission through a conceptual demonstration. Penalty-free transmission over a 2.24-km nanofiber at >100Gb/s is reported across a 16.33THz bandwidth (1020-1080nm).

W4D.6 • 18:00
Invited
Single-Ended Coherent Receivers: From DC-Coupled to AC-Coupled Photodetectors, Son T. Le; 1 Nubie Communications, USA. We review the concept of single-ended coherent receivers and discuss how LO power and signal power can be accurately estimated when AC-coupled photodetectors are used instead of DC-coupled photodetectors.

W4E.5 • 17:45
Performance Evaluation of Low-Complexity Channel-Polarized Multilevel Coded 146-Gb/s PDM Probabilistically Shaped 16QAM Over 101-km Transmission, Takeshi Kikazaki, Masanori Nakamura, Fukusato Hamaoka, Yoshiaki Kisaka; 1 NTT Corporation, Japan. We experimentally show that low-complexity channel-polarized multilevel coding enables up to 74% decoding-complexity reduction compared to concatenated codes over a 101-km 146-Gb/s probabilistically shaped 16QAM signal transmission.
W4G • Machine Learning for Estimation and Forecasting—Continued

W4H • Transmission Systems and Modelling—Continued

W4I • Open Networking Summit: Top to Bottom: Practical Approaches to Openness, Disaggregation, and Reagggregation in Optical Communication—Continued

W4J • Hybrid Communication/Sensing Systems—Continued

W4K • Quantum Networks—Continued

W4G.5 • 17:45
986 km Field Trial of Cascaded ANN-Based Link-Penalty Models for QoT Prediction, Ruiyi Yang1, Sen Shen1, Haiyuan Li2, Ziming Shi3, Rui Wang1, Reza Nejabati1, Shuangyi Yan1, Dimitri E. Simeonidou; 1Univ. of Bristol, UK; 2Cascaded ANN-based link penalty models are developed and demonstrated for QoT predictions over a 986-km field trial testbed, with precision of ± 0.16 dB. Co-training of ANN models allows network-level QoT prediction feasible.

W4H.5 • 17:45
110.4 Tbit/s Same-Wavelength Bidirectional Optical Fiber Transmission Over 100 km, 654D Fiber in Super-C Band With Rayleigh Scattering Noise Suppressed by Raman Amplifiers, Chengcheng Wu1, Wei Li2, Ming Lu2, Shaohua Xu1, Zhue He1, You Wang1, Zhangshuai Feng1, Peil He1, Weihua Lian1, Muyang Mei1, Xu Zhang1, Liang Mei1, Xuefeng Wu1, Huazhong Univ of Science and Technology, China; 2State Key Laboratory of Optical Communication Technologies and Networks, Wuhan 430070, China, China; 3Peng Cheng Laboratory, Shenzhen, China, China; 1Fiberhome Telecommunication Technologies Co., Ltd, Wuhan, China, China. We have demonstrated a capacity of 111.6 Tbit/s over a 75-km G.654D fiber along with a capacity of 110.4 Tbit/s over 100 km in super-C-band based on the same-wavelength bidirectional optical fiber transmission scheme.

W4I.5 • 18:00
Top-Scored «Photonic-Based W-Band Flexible TFDM Integrated Sensing and Communication System for Fiber-Wireless Network, Boyu Dong1, Junlian Jia1, Guoqiang Li1, Jiangyang Shi1, Haipeng Wang1, Zhenzhuan Tang1, Junwen Zhang1, Shilong Pan1, Nan Chi1,2, Fudan Univ., China; 2Peng Cheng Laboratory, China; 3Nanjing Univ. of Aeronautics and Astronautics, China. We proposed and experimentally demonstrated a novel W-band photonic-based integration of sensing and communication system for the fiber-wireless integrated network with flexible waveforms and TFDM resource allocation capability, achieving adaptive sensing resolution and communication data-rates.

W4J.5 • 18:00
Robust Longitudinal Power Profile Estimation in Optical Networks Using MMSE With Complex Scaling Factor, Inweong Kim1, Olga Vassileva1, Ruy Shirazi2, Motohiko Eto1, Shoichiro Oda1, Paparao Palacharla1; Fujitsu Network Communications, Inc, USA; 2Fujitsu Limited, Japan. We propose a power profile estimator using MMSE, that automatically adjusts the scaling and nonlinear rotation of constellation with complex scaling factor. We demonstrate robust performance in simulation and experiment, even at higher launch powers.

W4K.5 • 17:45 • Invited
Quantum Networks: the Path Beyond Just QKD, Siddarth Koduru K. Joshi1; 1Univ. of Bristol, UK. Abstract not available.
W4C.7 • 18:15
Direct Intensity Detection of Complex Communication Data Signals Using a Real-Time Photonics Spectrogram, Connor M. Rowe¹, Benjamin Crockett¹, Jose Azaña¹; INRS, Canada. We use a time-lens spectrogram for real-time recovery of complex modulation data signals using a single photodiode, no local oscillator, and simple decision method. Our proof-of-concept experiment decodes QAM4 and QAM8 under the FEC limit.
W4G • Machine Learning for Estimation and Forecasting—Continued

W4H • Transmission Systems and Modelling—Continued

W4I • Open Networking Summit: Top to Bottom: Practical Approaches to Openness, Disaggregation, and Reaggregation in Optical Communication—Continued

W4J • Hybrid Communication/Sensing Systems—Continued

W4K • Quantum Networks—Continued

W4G.7 • 18:15
Traffic Prediction Based on P-ConvLSTM in Optical Transport Networks, Xin Qin1, Qian Hu1, Xiaozi Hu1, Jiugao Xie1, China Telecom Research Inst., China. Based on Prophet-guided neural network, P-ConvLSTM is proposed for traffic prediction. Proved by multi-group real traffic data in OTN, P-ConvLSTM has high accuracy and strong generalization.

W4H.7 • 18:15
Nonlinear-Penalty-Free Real-Time 40×800Gb/s DP-64QAM-PCS Transmission With Launch Power of 28 dBm Over a Conjoined-Tube Hollow-Core Fiber, Dawei Ge1, Shoufei Gao2, Mingang Zuo2, Huyang Gao3, Yingsong Wang3, Dezhao Zhang3, Wei Deng4, Han Li1, Xiaodong Duan1, Zhangyuan Chen5, China Mobile Research Inst., China; 1Jinan Univ., China; 3Peking Univ., China. Real-time 40×800Gb/s DP-64QAM-PCS transmissions over three different optical fibers (i.e., CTF, G.652.D, G.654.E) are tested under 28-dBm launch power for the first time. No nonlinear penalty is observed in the CTF link.

W4I.6 • 18:15
Duobinary-Coded Coherent ΣΔ Radio-Over-Fiber Transmission at 9 GHz Downlink Channel Spacing, Bernhard Schrenk1, Florian Hur1, AIT Austrian Inst. of Technology, Austria. We show digitized radio-over-fiber transmission using coherent envelope detection. A low EVM of 1.3%, a high optical budget of 34.6dB and 25% improvement in spectral occupancy are found when introducing duobinary signaling and coherent detection.

W4J.7 • 18:15
Nonlinear-Penalty-Free Real-Time 40×800Gb/s DP-64QAM-PCS Transmission With Launch Power of 28 dBm Over a Conjoined-Tube Hollow-Core Fiber, Dawei Ge1, Shoufei Gao2, Mingang Zuo2, Huyang Gao3, Yingsong Wang3, Dezhao Zhang3, Wei Deng4, Han Li1, Xiaodong Duan1, Zhangyuan Chen5, China Mobile Research Inst., China; 1Jinan Univ., China; 3Peking Univ., China. Real-time 40×800Gb/s DP-64QAM-PCS transmissions over three different optical fibers (i.e., CTF, G.652.D, G.654.E) are tested under 28-dBm launch power for the first time. No nonlinear penalty is observed in the CTF link.

W4K • Quantum Networks—Continued
Device and Applications

**Th1A • Novel Photonic Devices and Applications**

*Presider: Samuel Palermo; Texas A&M Univ., USA*

**Th1B • Nonlinear-Optical Amplifiers and Oscillators**

**Th1D • Data Center Networks and Control**

**Th1E • Beyond 400G Transmission**

**Th1F • Machine Learning and Advanced Digital Signal Processing**

**Organizers:** Connie Chang-Hasnian, Brexel Photonics, China; Fotini Karinou, Microsoft Research Ltd., UK; Hai-Feng Liu, HG Generic System, China; Jim Lott, Technical University Berlin, Germany

**Speakers:** Ernesto Caramella, Scuola Superiore Sant’Anna, Italy; John J. Joseph, OptiPulse Inc, USA; Cy Lu, Lumentum Operations Inc, USA; Ramana Murty, Broadcom, USA; Jiaxing Wang, Berxel Photonics, China

**Description:** We aim for thought-provoking presentations and discussions on future promises and challenges of VCSELs for data center interconnects, free-space optical communications, and sensing applications.

VCSELs are the light source of choice for short-reach data center interconnects, with 53 Gbps per lane (26.5 Gbaud PAM4) arrays being widely deployed and 106 Gbps per lane (vias 53 Gb/s PAM4) arrays under pilot runs. However, can they scale up to 200 Gbps per channel with the same oxide-confined VCSEL structure? Will it require a radically different device technology to bring the bandwidth to 40 GHz and to mitigate the reliability issues due to increased operating temperatures when moving the pluggable transceivers from the front plate to the ASIC? What are the cost drivers and operating temperatures when moving the gate the reliability issues due to increased complexity than the conventional methods.

**Th1A.1 • 08:00 \- Invited**

**Integrated Comb-Driven Silicon Photonics, Xingjun Wang, Bitao Shen, Haowen Shu, Lin Chang, Yuansheng Tao, Weiquang Xue, John E. Bowers**

**Room 1AB**

**Room 2**

**Room 3**

**Room 6C**

**Room 6D**

**Room 6E**

**06:00–07:30 Rise and Shine Morning Run/Walk, Hilton Bayfront**

**07:30–08:00 Coffee Break, Upper Level Corridors**

**Th1A.1 • 08:00 \- Invited**

**Design and Applications of Highly Nonlinear Fibers, Ryuichi Sugizaki, Masa-noe Takahashi, Shigeo Takasaki, Toshihiko Kimura, Furukawa Electric, Japan.**

**Characteristics of highly nonlinear fiber and requirements from various applications are summarized.**
Th1G • Signal Processing in Next-Generation PON
Presider: Paola Parolari; Politecnico di Milano, Italy

Th1G.1 • 08:00
Interoperability and Experimental Evaluation of TDEC(Q) Testing for 50 and 100G PONs, Dora van Veen1, Robert Borkowski2,1, Amitkumar Mahadevan1, Vincent Houtum1; Nokia Bell Labs, USA. We detail the TDEC(Q) method and its usage in the context of system level specifications for 50 and 100G PONs. Real-time experimental results obtained with representative PON transmitters are used to analyze and validate interoperability of these PONs.

Th1G.2 • 08:15
Study of TDEC for 50G-PON Upstream at 50 Gb/s in Negative Dispersion Regime Using 25G-Class Transceivers, Giuseppe Caruso1,2,1, Ivan N. Cano1,2, Politecnico di Torino, Italy; 2Munich Research Center, Huawei Technologies, Germany; 3Ipswich Research Center, Huawei Technologies, UK. We evaluate TDEC and Rx sensitivity in a negative dispersion regime with 25G-class DML and EML modulated at 50 Gb/s. Results show that TDEC can effectively predict the performance of both transmitters for 50G-PON upstream.

Th1J • Panel: How Can We Start to Consistently and Quantitatively Account for End-to-End Power Consumption, Beginning with a Focus on 100 Meter Datacenter Links?
Organizers: Troy Green, NVIDIA, USA; Clint Schow, University of California, Santa Barbara ECE, USA
Speakers: Andreas Bechtolsheim, Arista Networks, USA; Tom Gray, Nvidia Research, USA; Thomas Lijeborg, Intel Corporation, USA; Alexander Rylakov, Nokia, Canada
Description: The power efficiency of short (<100 m) datacenter optical links has become increasingly important, and pJ/bit has become a ubiquitous figure of merit. However, it is difficult or often impossible to assess and compare true end-to-end power dissipation for various link architectures. Optical link papers often stop power accounting at the optical transducer edges, and do not include the power costs of [de] serialization and clock distribution on the PIC. Furthermore, as we progress toward co-packaged optics, we need a consistent framework for estimating the power of various electrical links to the host ASIC. This panel has a broad scope that extends from systems to devices, and is targeted at beginning to build consensus on how to consistently and quantitatively account for end-to-end power in optical links.

Our goal is to provide researchers with the tools they need to fit their link components into an overall link power consumption budget. We hope to start discussions on the power costs of:
• FEC power per bit vs BER
• DFE, FFE, and receiver linear EQ
• Clock distribution and data (de)serialization at various symbol rates.
• ‘Gear Boxes’ for converting data stream formats between optical vs electrical layers.
• The electrical links for CPO vs NPO vs pluggable.
• Optical losses at package connections and within PICs that drive up laser power.

Th1J.1 • 08:00 Tutorial
Thz Technologies for Optical Communications, Alwyn J. Seeds1; Univ. College London, UK
Connections between user devices and the immense bandwidth of the optical fibre network are usually by microwave wireless, limiting the user bandwidth. This tutorial describes how the use of Thz technologies could overcome this limitation. Abstract not available.

Th1J.2 • 08:15
Gbps-Class Solar-Blind WDM Optical Wireless Communication by (264, 274, 282) nm Deep-UV LEDs and CsTe Photomultiplexer Tube, Yuk Yoshida1, Kazunobu Kojima2, Masaki Shiraawa3, Atsushi Kanno4, Akira Hirano4, Yosuke Nagasawa5, Masaharu Iijima5, Naokatsu Yamamoto1, Shigefusa F. Chichibu1,2,3,4,5,6, Tomoaki Saito6, Atsushi Kanno7, Fujitsu Laboratories Ltd., Japan; 2Nagoya Inst. of Technology, Japan; 3National Inst of Information & Comm Tech, Japan; 4Graduate School of Engineering, Osaka Univ., Japan; 5Nagoya Inst of Technology, Japan; 6UV Craftcy Co. Ltd., Japan; 7Inst for Multidisciplinary Research for Advanced Materials, Tohoku Univ., Japan. A Gbps-class wavelength-division multiplexing transmission within the solar-blind band was demonstrated for the first time with (264, 274, 282) nm AlGaN-based LEDs and a CsTe photomultiplexer tube over a 2-m weakly-collimated free-space link in standard indoor illumination.

Th1H • Satellite Communications and UV, LWIR Free Space Optical Communications
Presider: Morio Toyoshima; National Inst of Information & Comm Tech, Japan

Th1H.1 • 08:00
8.1 Gbps PAM4 Long-Wave IR FSO Transmission Using a 9.15-µm Directly-Modulated QCL With an MCT Detector, Mahdieh Joharifar1, Mengyao Han1,2, Richard Schatz1, Rafael Puerta3,1, Yan-Ting Sun1, Yuchuan Fan4, Grégory Maisons1, Johan Abatu1, Roland Teissier5, Lu Zhang1, Sandis Spolitis1,2, Muquang Wang1, Vjaceslav Babrovs1, Sebastian Louroudjissi1, Xinbin Yu1, Sergei Popov1, Oskars Ozolina1,2, Xiaodan Pang1,1, KTH, Sweden; 1Inst of Lightwave Technology, Key Lab of All Optical Network & Advanced Telecommunication Network, Ministry of Education, Beijing Jiaotong Univ., China; 2Ericsson, Sweden; 3RISE Research Insts., Sweden; 4mirSense, France; 5College of Information Science and Electronic Engineering, Zhejiang Univ., China; 6Inst of Telecommunications, Riga Technical Univ., Latvia. We experimentally demonstrate a Long-Wave IR FSO link with a 9.15-µm directly modulated quantum cascade laser at room temperature. Up to 8.1 Gb/s PAM4 transmission over 1.4 meter is achieved with a wideband MCT detector.

Th1H.2 • 08:15
OFC 2023 • 05–09 March 2023
Thursday, 9 March

**Room 1A**

**Th1A** • Novel Photonic Devices and Applications—Continued

**Th1B** • Nonlinear-Optical Amplifiers and Oscillators—Continued

**Th1D** • Data Center Networks and Control—Continued

**Th1C** • Panel: Promises, Prospects and Challenges of VCSELs for Data Center Interconnects, Free-Space Communications, and Sensing—Continued

**Th1E** • Beyond 400G Transmission—Continued

**Th1F** • Machine Learning and Advanced Digital Signal Processing—Continued

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**Room 2**

**Th1A.2** • 08:30
Automatic in-Situ Optical Linearization of Silicon Photonic Ring-Assisted MZ Modulator for Integrated RF Photonic SoCs, Md Jubayer Shawkat 1, Vishal Saena1; 1Univ. of Delaware, USA. We experimentally demonstrate automatic optical linearization of a Ring-Assisted MZ modulator with SFDR > 110dB Hz/2, fabricated in a silicon photonic foundry process. The linearization algorithm reconfigures the modulator to its optimum SFDR or other desired regimes regardless of random phase offsets and process/temperature variations.

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**Room 3**

**Th1B.2** • 08:30
Temperature-Tuned two-Segment Highly-Nonlinear Fiber With Increased Stimulated Brillouin Scattering Threshold, Cheng Guo1, Michael Vasiylev1, Youichi Akasaka2, Paparo Palacharla1, Shigehiro Takasaki1, Ryuzo Sugizaki1; 1Department of Electrical Engineering, Univ. of Texas at Arlington, USA; 2Advanced Technology Labs, Fujitsu Network Communications, USA; 2Funakawa Electric Co. Ltd, Japan. We apply temperature tuning to align zero-dispersion wavelengths of two fiber segments with different Brillouin frequencies. The resulting two-segment highly-nonlinear fiber exhibits 2-1 dB increased stimulated Brillouin scattering threshold and flattened parametric gain.

**Th1D.4** • 09:00
**P4INC-AOI:** When in-Network Computing Meets All-Optical Interconnect for Adaptive and Low-Latency Optical DCN, Xuejia Xie1, Hao Yang1, Ziqun Zhu1; 1Univ. of Science and Technology of China, China. We propose and experimentally demonstrate P4INC-AOI for orchestrating in-network computing and all-optical interconnect in an optical data-center network. Experimental results show that P4INC-AOI reduces job completion time of Hadoop MapReduce jobs by 77.9% on average.

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**Room 6C**

**Th1E.2** • 08:30
Transmission and Reception of 17G400 Gbit/s PDM-16QAM With Tx/Rx I/Q Imbalance Compensation and Simplified MLSE for Metro-Regional 400G Optical Communications, Fan Li1, Dongdong Zou1, Wenhao Ni1, Zhiwei Chen1, Xingwen Yi1, Zhaohui Li1; 1Sun Yat-Sen Univ., China. We experimentally demonstrate a single-carrier 400G Metro/regional communications based on 60-Gbaud PDM-16QAM over 430 km SMF-28. Joint GPD and GSCOP and 4×4 MIMO LMS equalizer are adopted to compensate Rx/I/Q imbalance, and simplified MLSE with 99.61% computational complexity reduction is employed to mitigate channel bandwidth constraint.

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**Room 6D**

**Th1F.2** • 08:30
Pre-Link Compensation of Nonlinear Signal Distortion by a Phase Conjugation and Parameter Profiled Fiber Module, Mark D. Pelusi1, Rysztesy Matsumoto1, Takashi Inoue1, Shu Namiki1; 1AIST, Japan. Pre-compensation of nonlinear signal distortion in a transmission link by optical phase conjugation is enhanced by a Raman-amplified parameter-profiled fiber for improved propagation symmetry. Application to 5×12-Gbit/s OP-16GAM signals before a 2×10-km link demonstrates 2.2-dB higher Q-factor.

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**Room 6E**

**Th1E.3** • 08:45
Impact of Laser Impairments on DSCM-Based 800G Point-to-Point Coherent Transmission Systems, Sami Mumtaz1, Trung-Hien Nguyen1, Abir Hraghi1, Abel Lorences-Riesgo1, Yann Frignac1, Gabriel Charlet1, Yu Zhao1, Hao Yang1; 1Huawei Technologies, France. We experimentally investigate the impact of laser frequency linewidth and jitter on the design of uplink point-to-point DSCM transmissions. The performance degradation due to sub-band overlap, bandwidth limitation and DSP penalty is quantified.

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**Room 1AB**

**Th1A.4** • 09:00
Slim Push-Pull Fiber Array Connector for Optical Chips, Lars Brinberg1, Jurgen Mattes1, Jason Grenier1, Jeffrey Clark1, Betsy Johnson1, Chad Teller1; 1Corning Inc, USA. Corning Optical Communications GmbH & Co KG, Germany. We report connector loss of 0.42 dB for a low-profile fiber-to-chip connector to replace fiber pigtail and enable flip-chip electronic assembly of optical chips for co-packaged optics.

**Th1B.4** • 09:00
Low-Noise Phase-Sensitive Optical Pre-Amplifier With Local Pump Generation Using Digital Frequency and Phase Control, Rasmus Larson1, Kovenand Vigyan1, Jochen Schröder1, Peter A. Andreae1; 1Chalmers Univ. of Technology, Sweden. We demonstrate a novel, lossless approach, eliminating the need to co-propagate pumps in phase-sensitive parametric amplifier-based links, by control loops creating a locked pump within the amplifier. Gain, noise and BER measurements validate the performance.

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In this Panel, we will discuss state-of-the-art VCSEL technologies, remaining device and systems challenges, synergies across different market segments, and future emerging applications.

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Decades of manufacturing and deployment experience in communication systems have provided a foundation in two new markets for VCSELs: 3D sensing and automotive LiDAR. Can the rapid innovations in 3D sensing and LiDAR help to transform the VCSEL in other market segments, and if yes, how? We present four live talks on VCSELs that are suitable for next generation automotive LiDAR and 3D sensing.
Th1G • Signal Processing in Next-Generation PON—Continued

Th1J • Panel: How Can We Start to Consistently and Quantitatively Account for End-to-End Power Consumption, Beginning with a Focus on 100 Meter Datacenter Links?—Continued

Th1I • THz Optical Communications—Continued

Th1H • Satellite Communications and UV, LWIR Free Space Optical Communications—Continued

Th1G.3 • 08:30
Equalizer Convergence for Various Transmission Channels and Multi-Rate Upstream 5G-PON, Gael Simon, Flavio Nogueira Sampaio, Fabienne Salou, Jeremy Potet, Georges Gaillard, Philippe Chancieu, Orange, France. We assess the feasibility of multiple transmission channel and multi-rate upstream 5G-PON. The TDEC shows that a unique preset filter may be used at both 50Gb/s and 25Gb/s to meet interoperability without adaptive equalization.

Th1I.2 • 09:00
OFDM-1024QAM Transmission Over 400m at THz Band With Delta-Sigma-Modulation, Kahu Wang, Jianyun Yu, Weiping Li, Jaxie Ding, Feng Wang, Chen Wang, Wen Zhou, Jiao Zhang, Min Zhu, Tanguay Xie, Jiangyu Yu, Li Zhao, Feng Zhao, Fudan Univ., China; Purple Mountain Laboratories, China; Beijing Univ. of Posts and Telecommunications, China; X’an Univ. of Posts and Telecommunications, China. For the first time, we successfully transmit 1.25GBaud OFDM-256QAM/1024QAM signals over 20km SMF and 400m wireless link at the terahertz band with 1-bit DSM. The BER of OFDM-256QAM/1024QAM can satisfy the FEC threshold of 3.8×10^-3/4.0×10^-2.

Th1F.4 • 09:00
Space-Grade Analogue and Digital Photonics for Satellite Communications, Antonella Bogoni, CNIT, Italy. The talk concerns the potential, the current issues and the emerging technologies for space-grade photonics for satellite communications and not only.

Th1G.4 • 08:45
Real-Time Software Implementation of Coherent Receiver DSP Adopting Multiplication-Based Parallel Frequency Offset Compensation for Fully Virtualized Access Networks, Takahiro Suzuki, Sang-Yuep Kim, Jun-ichi Kani, Tomoaki Yoshida; NTT Corporation, Japan. This paper proposes multiplication-based parallel frequency offset compensation (FOC) for virtualized access networks and demonstrates real-time softwareization of the full DSP function suite, including polarization demultiplexing, FOC, carrier phase recovery, and decoding, on a server.

Th1G.5 • 09:00
FEC and Equalization Implementation Options for 50Gb/s PON and Beyond: a Reality Check, Alexandre Graell i Amat, Chalmers Univ., Sweden. Abstract not available.
Th1A • Novel Photonic Devices and Applications—Continued

Th1B • Nonlinear-Optical Amplifiers and Oscillators—Continued

Th1C • Panel: Promises, Prospects and Challenges of VCSELs for Data Center Interconnects, Free-Space Communications, and Sensing—Continued

Th1D • Data Center Networks and Control—Continued

Th1E • Beyond 400G Transmission—Continued

Th1F • Machine Learning and Advanced Digital Signal Processing—Continued

Th1A.5 • 09:15
Self-Aligned Fiber Attach on Monolithic Silicon Photonic Chips: Moisture Effect Mitigation

Th1B.5 • 09:15
Low-Noise, Flat-Spectrum, Polarization-Maintaining All-Fiber Frequency Comb for Wideband Communications

Th1D.5 • 09:15
P4-Based Hitlless FaaS Load Balancer for Packet-Optical Network Edge Continuum

Th1E.5 • 09:15
1.96Tbps and 256-Gbaud Dual-Carrier Faster-Than-Nyquist Signal Transmission Using Two Narrow-Bandwidth Modulators and Single Coherent Receiver

Th1F.5 • 09:15
PPIN for Power Evolution Prediction and Raman Gain Spectrum Identification in C+L-Band Transmission System

Th1A.6 • 09:30
Pioneering Silicon Photonics for Wearable Sensors

Th1B.6 • 09:30
High-Efficiency Microcombs Aligned With ITU-T Grid for WDM Optical Interconnects

Th1D.6 • 09:30
Interconnection Networks With Co-Packaged Photonics

Th1E.6 • 09:30
4.8 Tb/s PS-PAM-8 Bidirectional Transmission Over 10-km Fiber Using Linear Equalization at O-Band, Chao Yang

Th1F.6 • 09:30
Digital Pre-Distortion Coefficients Identification Using Gauss-Newton Based Direct Learning Architecture, heun jang

Th1A.7 • 09:45
Top-Scored
30-Gbaud PM-16QAM Transmission Over E-, S-, C- and L-Band With Hybrid Raman Amplifier

Th1B.7 • 09:45
Four-Wave Mixing Mitigation by Using Waveguide-Based 4x4 WDM Filters for 800 and 400 GBe, Ai Yanagihara

Th1C.7 • 09:45
Knowledge Distillation Applied to Optical Channel Equalization: Solving the Parallelization Problem of Recurrent Connection, Sasipp Sivivallapanondh, Pedro J. Freire, Bernhard Spinnler, Nicolai Costa, Antonio Napolitano, Serge K. Turyan, Jaroslav E. Pribil

Th1D.7 • 09:45
Channel Equalization: Solving the Parallelizability of Recurrent Neural Networks, Balazs Sonkoly
Th1I.3 • 09:15
Mitigating the Timing-Jitter in Terahertz Communications via Nyquist Pulse Shaping, Mohamed Shehata, Ke Wang, Julian Webber, Masayuki Fujita, Tadao Nagatsuma, Withawat Withayachumnankul; School of Electrical and Electronic Engineering, The Univ. of Adelaide, Australia; School of Engineering, Royal Melbourne Inst. of Technology, Australia; Graduate School of Engineering Science, Osaka Univ., Japan. We propose and experimentally demonstrate a Nyquist pulse that can improve the error rate of a 311 GHz photonic-terahertz communications system by more than an order of magnitude at a normalized timing-jitter of 22.5% and 1.44 Gbit/s bit rate.

Th1I.4 • 09:30
300-GHz-Band Wireless Link Using Photonics-Based Ultralow-Noise Transmitter and Receiver, Keisuke Maekawa, Yuma Kawamoto, Tomoya Nakashita, Toshi Yashika, Takashi Horii, Brendan Heffernan, James Greenberg, Rubab Amin, Tatsuya Tengawa, Antoine Rollan, Tadao Nagatsuma; Osaka Univ., Japan; IMRA America Inc., Japan. We present a THz wireless link using photonics-based signal generators using ultralow amplitude- and phase-noise Brillouin laser sources for both the transmitter and receiver, and demonstrate successful transmission of over-100-Gbit/s signals at 300 GHz with on-line signal processing.

Th1I.5 • 09:45
Demonstration of Wireless Transmission of QPSK Signals at 2 THz, Isao Morohashi, Yoshihisa Irimajiri, Akira Kawai, Tadashi Kishimoto, Pham Tran Dat, Atsushi Kanno, Nonhiko Sekine, Iwao Hosako; National Inst of Information & Comm Tech, Japan. Wireless transmission of QPSK signals at 2 THz has been demonstrated using modulator-based optical combs for the transmitter and hot electron bolometer mixers combined with phase-locked terahertz quantum cascade lasers for the receiver.
Th2A.1 Transfer Learning-Based ROADAM DFA Wave-length Dependent Gain Prediction Using Minimized Collection, Xiaowei Ma, Tesla, Inc.; Wei Zhang; C. Kilper; Tingyun Chen; “Duke Univ., USA; ‘CONNECT Centre, Ireland. We implement and test transfer learning-based gain models across 16 ROADAM DFAs, which achieve less than 0.17/0.30 dB mean absolute error for booster/pre-amplifier gain prediction using only 0.5% of the full target DFA dataset.

Th2A.2 First Monolithically-Integrated Silicon CMOS Coherent Optical Receiver, Ghazanfar Arif, Mohammad Amiri, Kevin Arnautegui, Aaron Mahany, Evan D. Chansky, Junqian Liu, Hector Andrade, Clint Schow, James Buschwalter, UIC Santa Barbara, USA. An O-band coherent optical receiver (CORX) is integrated in a 45-nm monolithic CMOS SOI process. The CORX operates to 80 Gbps with FEC-acceptable BER at 1.2 pJ/bit energy efficiency. To our knowledge, this is the first monolithically-integrated silicon CMOS CORX.

Th2A.3 Automatic Tuning of Vernier Microring Filters Using Comprehensive Characterization Models and Hybrid Optimization Algorithms, Saif Alharari, Benjamin Wohlfeld, Stevan Djordjevic, Berndt Schmauss, “ADVA Optical Networking SE, Germany; ‘Inst. of Microwaves and Photonics (LHTP), Friedrich-Alexander-Universitat Erlangen-Nurnberg, Germany. An efficient approach to automatically configure and tune Vernier microring filters by utilizing hybrid optimization algorithms and robust characterization models is presented. Automatic tuning of a four-ring Vernier filter over the entire C-band is experimentally demonstrated to evaluate this method.

Th2A.4 Composite Morphology Laser Written 3D Waveguides With Reduced Bend Loss, Andrew J. Ross-Adams, Michael Withford, Simon Gross, University of Exeter, UK. We demonstrate a composite laser written 3D waveguide in boron-aluminosilicate glass, with an estimated index contrast of 1.7%, providing a 2.5x improvement of minimum bend radius down to 4.0 mm at 1550 nm.

Th2A.5 Broadband High-Performance 2+2 MMi 3-DB Coupler Enabled by SWG Lateral Cladding for the Silicon-on-Insulator Platform, Luijia Ku, Weijs Li, Jiaojiao Zhang, Dung Mad, Md Samial Alam, Yanick D’Mello, Santiago Berna, Zixian Wei, David Plant; “CMC Microsystems, Canada; ‘Department of Electrical and Computer Engineering, McGill Univ., Canada. We demonstrate a high-performance silicon photonic 2+2 MMi 3-DB coupler enabled by SWG lateral cladding. Measured imbalance below 0.3 dB and phase error below 1.83° are achieved over a 130 nm bandwidth covering the C band.

Th2A.6 Temperature-Insensitive Pulse and 120°C CW Operation of 1550nm-Band p-Doped InAs-InGaAs Quantum Dot Lasers on InP(311)B Substrate, Ryota Yabuki, Atsushi Matsumoto, Ryumi Katsumura, Shirou Kaminaka, Yuki Ipposhita, Yuto Nakamura, Shinya Hamada, Hiroshi Ishikawa, Katsuyuki Utaka, Waseda Univ., Japan. ‘National Inst. of Information and Communications Technology (NICT), Japan. We fabricated 1550nm-band, p-doped, InAs/InGaAs quantum dot (QD) lasers on an InP(311)B substrate. The device showed extremely high temperature stability and lasting up to 120°C was confirmed under CW condition. © 2022 Ryota Yabuki

Th2A.7 High-Power Performance of Type-II GaAs-InP InP Uniform Absorber Uni-Traveling Carrier Photodiodes, Rimjhim Chaudhary, Akshay M. Shinde, Ian W. Tolson, Marco Eppenberger, Martin Leich, Olivier Ossendrijver, Jürg Leuthold, Colombo Bolognesi, ETH Zurich, Switzerland. We report the first characterization of Type-II GaAs-InP InP UTC-PDs. The UTC-PDs all exhibit a zero bias output power of -14 dBm at 100 GHz, one of the highest reported for any zero-bias photodiodes.


Th2A.9 Full 3-Inch Wafer Processed 1060 nm Single-Mode Transverse Coupled-Cavity VCSEL for Data Transmission in Standard 1300-nm Single-Mode Fiber, Chang Ge, Boxuan Zhang, Xingxiang Gu; “SINET6: Nationwide 400GE-Based Academic Backbone Network in Japan, Katsuki Kurimoto, Kyo Sasayama, Osamu Akashi, Shigeo Usushihashi, “NICT, Japan. This paper describes the practical network design of a newly-launched nationwide 400GE-based academic backbone network called SINET6. Its fully-meshed architecture with respect to network coordinator and coordination services, network operations with on-demand capabilities, and performance evaluations are reported.

Th2A.10 Low Fusion Splice Loss Technique for Multicore Fiber With 2- and 3-Electrode Fusion Splicer, Yoshiaki Fujii, Masanori Takahashi, Ryoichi Sugazaki, Aki Tanabe, Yoshihiro Arashitani; “Fukuraku Electric Co., Ltd., Japan. Splice loss of 4-core fiber using 2-electrode fusion splicer by automatic rotational alignment with duration time of 150 sec is reduced to 0.07 dB, getting closer to 0.02 dB by 3-electrode fusion splicer.

Th2A.11 Pump Optimization of E-Band Bimuth-Doped Fiber Amplifier, Aleksandar Donadic, Egger Maruyohi, Vladislav Doyvyn, Forsyak Wladell, Serguei K. Turonyt; “Aston Univ., UK. We experimentally investigate different directional pumping schemes of an E-band bimuth-doped fiber amplifier. Best performance is achieved with 1302nm pumps, and features a 25dBm gain, 4.7dB NF, and 32.6% power conversion efficiency.

Th2A.12 Nonlinear Optical Loop Mirror for Waveband-Split Free Optical Phase Conjugation, Vladimir Gordi enko, Maria Bastamova, Andrew Ellis, Nick Doran; “Aston Univ., UK. We introduce a novel concept for waveband-splitt free optical phase conjugation and experimentally demonstrate idler-to-signal extinction ratio up to 80% by recombining signals and idlers at different output ports of a nonlinear optical loop mirror.

Th2A.13 SINET6: Nationwide 400GE-Based Academic Backbone Network in Japan, Takashi Kurimoto, Kyo Sasayama, Osamu Akashi, Shigeo Usushihashi, “NICT, Japan. This paper describes the practical network design of a newly-launched nationwide 400GE-based academic backbone network called SINET6. Its fully-meshed architecture with respect to network coordinator and coordination services, network operations with on-demand capabilities, and performance evaluations are reported.

Th2A.14 Technical Study on the Viability of Hollow-Core and Ultra-Low-Loss Silica Fibers in Metro-Core Optical Networks, Md Aliqbal, Paul Wright, Andrew Lord; ‘British Telecom Telecommunications, UK. We numerically compare the performance benefits and viability of deploying hollow-core fibers (HCF) and ultra-low-loss (ULL) fiber in metro-core optical network considering practical traffic growth, limitations of transceiver OSNR and output power from commercial optical amplifiers.

Th2A.15 Software-Defined, Programmable 1L Dataplane: Demonstration of Fabric Hardware Resilience Using Optical Switches, Giannis Patrinos, Dimitris Syvridis, Paraskevas Bakopoulous, Prethivi Kashyapathi, Louis Capps, Nikos Argyris, Nikos Terzidinis, Eitan Zavah, Luke Yeager, Eldi Mentovitch, Julie Bernauer; “NVIDIA, USA; ‘NVIDIA, Israel; ‘NVIDIA, Greece. We propose a programmable optical fabric design for Data Center networks that extends SDN to L1. We present our experiments on our HPC/ML testbed leveraging the programmable network to automatically failover from hardware or software failures.

Th2A.16 Confidential Detection of Multiple Failures in Optical Networks: An Experimental Evaluation, Misos P. S. F-test, Andrea Sgamelluti, Alessandro Piacini, Francesco Paolucci, Andrea Green, David Mascare nas, Luca Varcagni; “Scuola Superiore Sant’Anna di Pisa, Italy; ‘Carludovico National Laboratory (CNR), ‘ITAL,Inside. This paper presents a Machine Learning technique based on Principal Component Analysis (PCA) combined with temlate data scanning to detect multiple types of failure in optical network while preserving data confidentiality. Experiments in an optical testbed show the effectiveness of the proposed solution.

Th2A.17 Reinforcement Learning for Provisioning OTN Leased Lines, Ashwin Gumaste, João Pedro, Andrea Sgamelluti, Alessandro Piacini, Andrea Fumagalli, 1Aston Univ., UK; 2Los Alamos National Laboratory, USA; 3Los Alamos National Laboratory, USA. We propose a multi-node cooperative recovery method against IP node failure through joint selection and flow table splitting. The recovery time stays below 89.5%, and the success rate improves by 25.6% in heavily loaded network.

Th2A.18 Real-Time 50Gb/s Upstream Transmission in TDM-PON With Class E1 Power Budget Using Ge/Si Avalanche Photodiode and Bismuth-Doped Fiber as Preamplifier, Ning Wang, Junwei Li, Jiechao Zhang, Han Li, Jin Cheng, Wang Chen, Vitaly Mikhailov, Daryl Innis, Yan Chen, Xiaodong Duan, Lirong Bai, Rangsheng Yu; ‘China Mobile Research Institute, China; ‘S Fotonic Technologies Co., Ltd., USA; ‘OSF Laboratories, USA; ‘China Mobile Communications Corporation Group Co., Ltd., China. We experimentally demonstrate a real-time transmission of 50Gb/s upstream using SOG-92 and a Ge/Si APD receiver. The sensitivity of -27.8dBm is achieved due to the low noise figure of the BOFA.

Th2A.21 Nonlinear Phase Shift Pre-compensation for Improved Power Budget in a 200 Gbps Simplified Coherent PON, Pablo Torres-Ferrera, M. Saifuddin Faruk, Ivan B. Kovacs, Seb J. Savory; ‘Univ. of Cambridge, UK. We report a 98% improvement in the power budget of a 10.0 dB is achieved for 50 km reach in C-band.
Device Engineering and Performance Optimization of Silicon PICs for 800Gb/s Coherent Transmission, Hao Wu, Chen Zhu, Ning Cheng, Chenlei Li, Min Teng, Pan Su, Fang Wang, Yingchao Du, Gang Cheng, Xiaoyi Zhang; "Inlight Technology Research Inst. (ITRI), InnoLight Technology Shuxian Ltd., China; ‘Network Infrastructure Development, Baidu, China’. An end-to-end link model is developed to optimize silicon PIC and evaluate the coherent system performance. 1280Gb 16QAM-DATA transmission based on silicon photonics is achieved with -9.1dBm Tx output power and 26dB Rx OSNR sensitivity.

Maximizing 425G SWDM VCSEL-MMF Links Through Variable Rate Solutions, Benoit Plamatnoyforkov, Universidade Federal de Campina Grande, Brazil; ‘DTU Elektro, Technical Univ. of Denmark, Denmark’. Fiber nonlinearity compensation of extended reach multi-channel WDM systems with adaptive turbo equalization is investigated for the first time. Potential for more than 100 m transmission reach extension is demonstrated by combining probabilistic shaping, single-channel digital backpropagation, and adaptive turbo equalization.

Adaptive Turbo Equalization of Probabilistically Shaped Constellations, Edson Porto da Silva; ‘Metodologia Plamenov (Kavgor), Universidade Federal de Campina Grande, Brazil’. ‘DTU Elektro, Technical Univ. of Denmark, Denmark’. Fiber nonlinearity compensation of extended reach multi-channel WDM systems with adaptive turbo equalization is investigated for the first time. Potential for more than 100 m transmission reach extension is demonstrated by combining probabilistic shaping, single-channel digital backpropagation, and adaptive turbo equalization.

Reach Through Variable Rate per λ, Alejandro Gómez-Lozada; ‘Universitat Politècnica de Catalunya, Barcelona, Spain’. Mixed fibers lines including dispersion modes are measured. The maximum reach for 425G SWDM systems based on silicon photonics is achieved with -9.1dBm Tx output power and 26dB Rx OSNR sensitivity.

An adaptive LLR calculation algorithm is proposed for non-additive-White-Gaussian-noise (non-AWGN) optical channels. The noise distribution is continuously updated based on previous decisions. The performance is tested experimentally using 16-QAM and soft-DQPSK systems.
and 1.5×10^{-13} fractional frequency stability performance. A 27 Hz 1/π integral linewidth reference cavity of 5 billion quality factor, microfabricated micro-Fabry-Perot dielectric semiconductor laser to a manufacturable, are measured.

We review advancements in silicon photonic (SiPh) devices and integrated circuits (SiP/PIA) to enable high density, low power, multi-Tb/s optical solutions for next-generation Ethernet networking and compute connectivity.

A Highly Temperature-Insensitive Bi-
Doped Fiber Amplifier in the E+5-Band With 20 dB Flat Gain From 1435-1475 nm, Y. Wang, Arindam Holder, D. Richardson, J. Yang, K. Sahu, T. Liljeberg, OBF, France. We report a bismuth-doped fiber amplifier operating in the E+5-band providing a 20.5±1 dB flat gain with 5.5±2 dB NF from 1435-1475 nm for -10dBm input signal. The gain coefficient and temperature-dependent-gain coefficient are 0.065dB/mW and -0.005±0.001dB/°C, respectively.

27 Hz Integral L bandwidth Laser Based on a 5-Billion Q Microfabricated Refer-
cence Cavity, Andrea Ishchenko, Flame Feng, Nijun Jin, Kaiyi Liu, Mark W. Harrington, Peter Rabin, Daniel J. Blumental, Department of Electrical and Computer Engineering, UC Santa Bar-
bara, USA, Department of Applied Physics, Yale Univ, USA. We stabilize a semiconductor laser to a manufacturable, microfabricated micro-Fabry-Perot dielectric reference cavity of 5 billion quality factor, achieving transform-limited noise-limited performance. A 27 Hz 1/f integral linewidth and 1.5×10^{-12} fractional frequency stability are measured.

27 Hz Integral L bandwidth Laser Based on a 5-Billion Q Microfabricated Refer-
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We experimentally demonstrate a 4WDM real-time 100 Gbit/s PAM-4 fiber link supporting 30 km of fiber propagation and 23.5 dB supported channel insertion losses using analog pre-equalization and common semiconductor based optical pre-amplification.

A high-speed germanium on silicon APD is demonstrated for DSP-free 50G-PONs.

A uncooled high-speed Ge/Si avalanche Photodiode for 50 Gbit/s PON With 60 km Reach, Jeremy Poter, Gisl Simon, Georges Gaillard, Camille Dessemberg, Fabienne Salou, Mathilde Gay, Philippe Chanclo, Orange, France; Univ Rennes, CNRS, Institut POTION, France. We experimentally demonstrate a 4WDM real-time 100 Gbit/s PAM-4 fiber link supporting 30 km of fiber propagation and 23.5 dB supported channel insertion losses using analog pre-equalization and common semiconductor based optical pre-amplification.

A simple 25 and 12.5 Gb/s dual-rate burst-mode receiver compliant with ITU-T G.9804.3 N1-class, Hayato Suga, Takahiro Kawarasaki, Satoshi Yoshima, Sato Shira, Mitsubishi Electric, Japan. Our simple dual-rate burst-mode receiver in a TO-46 package is compliant with the 50G-PON N1-class specifications. Receiver sensitivities of -24 dBm at 58.2 Gbit/s and -26.5 dBm at 50 Gbit/s over 60 km of fiber are experimentally obtained in real time with temperature from -40°C to 80°C.

A simple 25 and 12.5 Gb/s dual-rate burst-mode receiver compliant with ITU-T G.9804.3 N1-class, Hayato Suga, Takahiro Kawarasaki, Satoshi Yoshima, Sato Shira, Mitsubishi Electric, Japan. Our simple dual-rate burst-mode receiver in a TO-46 package is compliant with the 50G-PON N1-class specifications. Receiver sensitivities of -24 dBm at 58.2 Gbit/s and -26.5 dBm at 50 Gbit/s over 60 km of fiber are experimentally obtained in real time with temperature from -40°C to 80°C.
Thursday, 9 March

**Room 1AB** Room 2 Room 3 Room 6C Room 6D Room 6E

OFC 2023 • 05–09 March 2023

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**Th3A** • Novel Enabling Devices—Continued

**Th3B** • Silicon Photonics Devices and Integrated Circuits—Continued

**Th3C** • Doped Fiber Amplifiers—Continued

**Th3D** • Advances in Data Center Switching and Interconnects—Continued

**Th3E** • Modulation Formats—Continued

**Th3F** • Wideband Transmission Systems—Continued

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**Th3A.3 • 14:45**
Low-Loss Wide-PSR Miniaturized Race-track Style Microring Filters for ∼1 Tbps DWDM, Asher S. Novick 1, Kayle Jiang 1, Anthony Rizzo 1, Robert Parsons 1, Keren Bergman 1; Columbia Univ., USA. We demonstrate add-drop microring filters based on ~180° varied-width hybrid Euler bends, suitable for supporting >1 Tbps DWDM. We measure FSR=40nm, 0.64mA/mW thermal tuning efficiency, and IL ≤ 0.02dB across the C- and L-bands.

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**Th3B.3 • 15:00**
**Invited**
Foundry's Perspective on Laser and SOA Module Integration With Si-Photonics, Chao Li 1, Feng Gao 1, James You Sian Tan 1, Guo-Qiang Lo 1; Univ. of Southampton, UK. We report a double-pass L-band erbium-doped fiber amplifier providing ≥20dB gain from 1535–1565nm, with 4dB maximum OSNR, gain coefficient, and temperature-dependent-gain-coefficient were 7.2dB, 25dB, 0.045dB/mW, and -0.037dB/°C, respectively.

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**Th3A.4 • 15:00**
Dispersive-Engineered and Fabrication-Robust SOI Waveguides for Ultra-Broadband DWDM, Yuyang Wang 1, Sangi Wang 1, Asher S. Novick 1, Aneel James 1, Robert Parsons 1, Anthony Rizzo 1, Keren Bergman 1; Columbia Univ., USA. We present a measurement-validated design methodology for engineering the width of silicon-on-insulator waveguides for co-optimized group velocity dispersion and fabrication robustness, paving the way for ultra-broadband dense-wavelength division multiplexing silicon photonics communication solutions.

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**Th3B.3 • 15:00**
**Invited**
Foundry's Perspective on Laser and SOA Module Integration With Si-Photonics, Chao Li 1, Feng Gao 1, James You Sian Tan 1, Guo-Qiang Lo 1; Univ. of Southampton, UK. We report a double-pass L-band erbium-doped fiber amplifier providing ≥20dB gain from 1535–1565nm, with 4dB maximum OSNR, gain coefficient, and temperature-dependent-gain-coefficient were 7.2dB, 25dB, 0.045dB/mW, and -0.037dB/°C, respectively.

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**Th3C.4 • 14:45**
Record Gain of 18-dB for Broadband Single-Model Cr-Doped Crystaline Core Fiber by Small Core Diameter, Kai-Chih Chang 1, Chia-Ling Tsai 1, Wei-Chih Cheng 1, Zon Ma 1, Liu-Chun-Nien 1, Tien-Tsong Shihi 1, Shih-Lung Huang 1, Wood-Hi Cheng 1; Graduate Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taiwan. Here, we discuss the integration solutions (i.e., hetero-epitaxial, heterogeneous and hybrid integration) and present foundry’s perspective toward implementing of such.

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**Th3C.5 • 15:00**
**Invited**
Foundry's Perspective on Laser and SOA Module Integration With Si-Photonics, Chao Li 1, Feng Gao 1, James You Sian Tan 1, Guo-Qiang Lo 1; Univ. of Southampton, UK. We report a double-pass L-band erbium-doped fiber amplifier providing ≥20dB gain from 1535–1565nm, with 4dB maximum OSNR, gain coefficient, and temperature-dependent-gain-coefficient were 7.2dB, 25dB, 0.045dB/mW, and -0.037dB/°C, respectively.

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**Th3C.6 • 15:15**
Self-Segregation of Spectral Hole Burning Effect in Super C-Band EDFA, Lizhao Li 1, Laurence Schmalen 1, Karlsruhe Inst. of Technology, Germany. We show that separating the in-phase and quadrature component of SOA-based Broadcast & Select switches are experimentally assessed using 100Gb/s commercial transceivers. Results show error-free operation for a 32-port switch with <1.8dB power penalty and 10^-8 for a 64-port switch.

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**Th3D.3 • 14:45**
Scalability Assessment of O-Band SOA-Based Broadcast and Select Switch With 100Gb/s LWDM Commercial Transceivers, Marin Rombourdes 1, Nicola Calabretta 1, Eindhoven Univ. of Technology, Netherlands. Scalability and operation of O-Band SOA-based Broadcast & Select switches are experimentally assessed using 100Gb/s commercial transceivers. Results show error-free operation for a 32-port switch with <1.8dB power penalty and 10^-8 for a 64-port switch.

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**Th3D.3 • 14:45**
Geometric Constellation Shaping With Low-Complexity Demappers for Wiener Noise-Compensation Channels, Kai-Wei Rode 1, Keren Bergman 1; Columbia Univ., USA. We report a universal, foundry-based SOA platform for SOI waveguide bends using agnostic, broadband, and ultra low-loss photonics platform would be highly useful. Here, we discuss the integration solutions (i.e., hetero-epitaxial, heterogeneous and hybrid integration) and present foundry’s perspective toward implementing of such.

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**Th3E.3 • 14:45**
Geometric Constellation Shaping With Low-Complexity Demappers for Wiener Noise-Compensation Channels, Kai-Wei Rode 1, Keren Bergman 1; Columbia Univ., USA. We report a universal, foundry-based SOA platform for SOI waveguide bends using agnostic, broadband, and ultra low-loss photonics platform would be highly useful. Here, we discuss the integration solutions (i.e., hetero-epitaxial, heterogeneous and hybrid integration) and present foundry’s perspective toward implementing of such.

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**Th3F.3 • 14:45**
38.4-Tbps Inline-Amplified Transmission Using PPLN-Based Optical Parametric Amplifiers Over 6-λ Bandwidths, Wataru Kobayashi 1, Akira Kawai 1, Ross Addar 1, Yuko Tanaka 1, Tatsuki Kato 1, Yutaka Miyamoto 1, Tomoyuki Katsuyama 1, Kenichi Suzuki 1, Kengo Nakanishi 1, Takashi Arai 1, Takeshi Umeki 1; NTT Device Technol.-ology Laboratories, NTT Corporation, Japan. We demonstrate a 5+80-km WDM transmission over 6 λ within 1597.19–1649.93 nm. PPLN-based optical parametric amplifiers provide sufficient gain for wideband amplification of 60-channel 640-Gbps signals in line- and un-bands.

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**Th3F.4 • 15:00**
Modulation Experimentation of Optimized 5+4+1 CHL WDM Coherent Transmission System, Salma Escobar Landero 1, Xiaohui Zhao 1, Alejandro Orellano-Riesgo 1, Dylan Le Gac 1, Yann Frignac 1, Gabriel Charlet 1, Huawei Technologies France, France. Using accurate 5/4/1 CHL modeling and the fast-converging ASE-NL optimization algorithm, we demonstrate 2 × 2 Tbit/s throughput improvement in a 2-span ultra-wide-band channel thanks to the use of the predicted total and per channel power.

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**Th3F.5 • 15:15**
Coherent O-Band Transmission of 4x25 Gb/s DF-P16QAM Channels Over a 50 km EDFA-Equipped Link, Natsupa Taengnoi 1, 2, Kyoko Sato 1, Kyle Bottini 1, Kyle Mong 1, Yu Wang 1, Kayle Jiang 1, James You Sian Tan 1, Guo-Qiang Lo 1, Univ. of Southampton, UK. We show that the best trade-off between spectral efficiency and energy efficiency occurs for simplex constellations.
Th3G • High Data-Rate Direct Detection in Access—Continued

100G and Beyond for PON and Short Reach Optical Networks, Weisheng Hu1; Shanghai Jiaotong Univ., China. Abstract not available.

Th3H • Free Space and Optical Camera Communications—Continued

3-Bit DAC and Self-Coherent Detection, Romil Patel1,2; Guillaume A. Domingues1, Nelson J. Muga1, Armando N. Pinto1, Marco A. Fernandez1,2, Gil M. Fernandez1, Paula Monteiro1,2, Fernando Guimarães1,2; Instituto de Telecomunicações, Portugal; 3DETI, Universidade de Aveiro, Portugal. Using a virtual-carrier-assisted self-coherent system aided by a digital resolution enhancement technique, we experimentally demonstrate 100 Gbps FSO transmission over an outdoor 42 m link, supported by a single photoreceiver and a simplified transmitter with a 3-bit DAC.

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Thursday, 9 March

Show Floor Programming

SF14 • MOPA: Mobile Optics (MOPA) for the 6G Era 13:30–15:00, Theater III

SF15 • 3D Sensing in High Volume Consumer and Automotive Applications 14:45–15:45, Theater I

SF16 • F5G Update: The Second Release of Use Cases and Demonstrations 14:45–15:45, Theater II
### Th3A • Novel Enabling Devices—Continued

#### Th3A.6 • 15:30

**Novel Blue-Green Light Phase Array by Light-Sheet-Excited One-Dimension Strip Grating Array**

- Weiwei Liu, Binghui Li, Caming Sun
- Peng Cheng Laboratory, China
- The Chinese Univ. of Hong Kong (CUHK), Shenzhen, China

We demonstrate a novel blue-green light phased array by light-sheet-excited 1D strip waveguide grating with nearly spot emission profile. By tuning wavelength, the range 15° of beam steering was achieved.

#### Th3A.7 • 15:45

**Multifunctional Anisotropic Thermo-Optic Mach-Zehnder Interferometer on LNOI**

- Lijsa Song, Weixi Liu, Huan Li, Yaoyue Shi, Daowin Dai, Zhejiang Univ., China

Harnessing the strong anisotropy of lithium niobate, we have proposed a multifunctional thermo-optic Mach-Zehnder interferometer on x-cut LNOI and experimentally demonstrated its versatile configurations as a polarization-insensitive switch and a polarization beam splitter.

### Th3B • Silicon Photonics Devices and Integrated Circuits—Continued

#### Th3B.4 • 15:30

**Single Lane 330 Gba/s Silicon Photonic Microring Modulator With sub 2 Vpp Driving Voltage**

- David Chan, Kong Wu, Alan Pak Tao Lau, Charles Lo, Hon Ki Tang
- Department of Electronic Engineering, The Chinese Univ. of Hong Kong, Hong Kong
- Department of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong

We present the first silicon photonic microring modulator operating at 330 Gba/s with driving voltage under 2 Vpp in C-band using a polynomial non-linear equalizer.

#### Th3B.5 • 15:45

**Illiv-on-Silicon Nitride Narrow-Linewidth Tunable Laser Based on Micro-Transfer Printing**

- Biwei Pan, Jerome Bourdignon-net, Vincent Billault, Arnaud Brignon, Delphine Néel, Joan Ramirez, John D. Downie
- IMEC, Belgium
- III-V Lab, France
- CELEPRINT, Ireland

We demonstrate a narrow-linewidth tunable laser through micro-transfer printing a pre-fabricated III-V gain section on imec’s 200-mm Si/SiN platform. Lasing in distinct bands in the C+L band is demonstrated, with linewidth down to 2.87-kHz.

### Th3C • Doped Fiber Amplifiers—Continued

#### Th3C.7 • 15:30

**High Power EDFAs for Free Space Communication**

- Jeffrey W. Nicholson, Andrew Greimes, Anand Harirhan, V. Sudarshanam, Cang Jin, Yinghui Sun
- OFS, USA

Performance and high-power, cross-polarization tolerant doped fiber amplifiers for free space communications will be discussed.

#### Th3C.8 • 15:45

**Interconnects—Continued**

- Jing Zhang, Bart Kuyken, Gunther Roelens, Guo, Jifang Qiu, Jian Wu
- Beijing Univ., China

We present a filter-free silicon photonic microring modulator operating at up to 330 Gba/s. The modulator can support PAM-8 with driving voltage under 2 Vpp in C-band using a polynomial non-linear equalizer.

### Th3D • Advances in Data Center Switching and Interconnects—Continued

#### Th3D.5 • 15:30

**Integrating Nanosecond Optical Switching in Deep Distributed Learning System**

- Cen Wang, KDD R&D Laboratories, Japan

We present the first silicon photonic microring modulator operating at 330 Gba/s with driving voltage under 2 Vpp in C-band using a polynomial non-linear equalizer.

### Th3E • Modulation Formats—Continued

#### Th3E.6 • 15:30

**Demonstration of Polar Coded Truncated Probabilistic Shaped 64-QAM Transmission Over 2000-km G.654E Fiber**

- Xiaohua Jia, Ming Luo, Yan Li, Chao Yang, Wu Liu, Xiaobin Hong, Hongxiang Guo, Jian Qiu, Jian Wu
- China Information and Communication Technologies Group Corporation, State Key Laboratory of Optical Communication Technologies and Network, China

In this paper, we discuss the truncated probabilistic shaping scheme and experimentally demonstrate its performance over 2000-km transmission over the G.654E fiber. Results show that about 2000-km transmission could be achieved using the novel scheme.

#### Th3E.7 • 15:45

**C-Band 100 Gba/s Transmission Over 40 km SMF Using a Silicon Photonic Vestigial Sideband Transmitter Based on Dual-Drive MZM and Passive Optical Delay Line**

- Esam Benkadda, Md Samuil Alam, Yixiang Hu, Weijia Li, David Plant, Weijia Li, McGill Univ., Canada

We demonstrate a filter-free silicon photonic VSB transmitter, enabling a C-band transmission of 56 Gbaud PM4 over 40 km of dispersion-uncompensated SMF under the 6.7% overhead HD-FEC with a single DAC channel and nonlinear equalization.

### Th3F • Wideband Transmission Systems—Continued

#### Th3F.6 • 15:30

**U-Band Transmission of Real-Time 200-Gba/s Signal Co-Propagating With C+L-Band WDM Signal**

- Tomoyuki Kato, HidenoBU Muranaka, Yu Tanaka, Yuchi Akiyama, Takeshi Hoshida
- Fujitsu Limited, Japan

We propose a U-band transmission added to the C+L-band that can mitigate large loss at long wavelength by inter-channel SRS. The benefit is demonstrated in 80-km SMF transmission of real-time 200-Gba/s DP-QPSK signal.
Th3G • High Data-Rate Direct Detection in Access—Continued

Th3I • Panel: Roadmap for Photonic AI Accelerators—Continued

Th3H • Free Space and Optical Camera Communications—Continued

Th3J • Advanced Control in Quantum Systems—Continued

Th3H.7 • 15:30
First Demonstration of 512-Color Shift Keying Signal Demodulation Using Neural Equalization for Optical Camera Communication, Yukito Ohodera1, Daisuke Hisanob1, Kazuki Maruta1, Yu Nakayama1, Yukito Onodera1.
1Tokyo Univ. of Agriculture and Technology, Japan; 2Tokyo Univ. of Science, Japan.
This paper experimentally demonstrates 512 color shift keying (CSK) signal transmission for optical camera communication (OCC). We achieved error-free operation with a CMOS image sensor module and a multi-label classification neural network-based equalizer.

Th3J.6 • 15:30
Enhancing the Quantum Correlation of Biphotons via Coherent Energy Redistribution, Benjamin G. Crockett1, Nicola Montaut1, James van Howe1, Piotr Roztocki1, Yang Liu1, Robin Helsten1, Wei Zhao1, Roberto Morandotti1, Jose Azaña1.
1INRS, Canada; 2Department of Physics and Astronomy, Augustana College, USA; 3Ki3 Photonics Technologies, Canada; 4Xi’an Inst. of Optics and Precision Mechanics, Chinese Academy of Sciences, China; 5Univ. of Chinese Academy of Sciences, China.
Towards meeting the strict demands of practical quantum networks, we leverage coherent energy redistribution for noise-tolerant quantum signal processing. We demonstrate the enhancement of noisy biphoton coincidence-to-accidental ratios by up to 3.8 times.

Th3J.7 • 15:45
Spectroscopy Characterization of Quantum Modes in an on-Chip Squeezed Microcomb, Mandana Jahanbozorgi1, Zijiao Yang1, Emily Parnell1, Dongin Jeong1, Shubham Sun1, Oliver Phister1, Hansuek Lee1, Xu Yi1.
1Univ. of Virginia, USA; 2Korea Advanced Inst. of Science and Technology, Korea (the Republic of).
We characterized the spectrum of 40 quantum modes in an on-chip squeezed microcomb. A theoretical model is developed to explain how cavity dispersion affects the squeezing and the frequency equidistance of these quantum modes.

16:00–16:30 Coffee Break, Upper Level Corridors

16:30–18:30 Postdeadline Paper Sessions, Room 6C, 6D, 6E, 6F
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