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The information in this program is as of 14 February 2024. All times reflect Pacific Daylight Time (PDT, UTC-07:00).

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*. 

OFC 2024 • 24–28 March 2024
# Conference Schedule at a Glance

All times reflect Pacific Daylight Time (PDT, UTC-07:00).

<table>
<thead>
<tr>
<th>Optica Executive Forum at OFC 2024</th>
<th>Sunday, 24 March</th>
<th>Monday, 25 March</th>
<th>Tuesday, 26 March</th>
<th>Wednesday, 27 March</th>
<th>Thursday, 28 March</th>
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<tbody>
<tr>
<td>Registration</td>
<td>07:30–19:00</td>
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<td>07:00–18:00</td>
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## Programming

<table>
<thead>
<tr>
<th>Short Courses</th>
<th>08:30–17:00</th>
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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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</tbody>
</table>

## Technical Sessions

| Symposium: Green Transformation: Where Do We Stand? | 08:00–18:30 | 14:00–18:30 | 08:00–18:30 | 08:00–18:30 | 16:30–18:30 |
| Special Session: Frontiers of Optical Network Architecture Summit | 14:00–16:00 | 14:00–16:00 | 14:00–16:00 | 14:00–16:00 | 14:00–16:00 |

## Poster Sessions


## Symposium: Embracing Fiber Sensing: What's the "Killer App" for Large-Scale Deployments? | 14:00–18:30 |

## Symposium: PICs for Quantum Communication and Quantum Computing: Challenges and Opportunities | 14:00–18:30 |

## Special Events

- Simulating Datacom/Telecom Applications Following Standards Specifications | 13:30–17:30 |
- Hack Your Research! Tools and Tricks for Today's Telecommunications Techies | 19:00–21:00 |
- Student Party | 19:00–21:00 |
- Plenary Session | 08:00–10:00 |
- The Art of Writing the Perfect OFC Paper | 10:15–12:00 |
- Awards Ceremony and Luncheon Supported by CORNING | 12:30–14:00 |
- Conference Reception | 18:30–20:00 |
- OFC Fun Run | 06:00–07:00 |
- The Journal Review Process: All You Need to Know! | 12:30–14:00 |
- Challenges and Solutions for Realizing Quantum Fiber-Based Networks | 12:45–13:45 |
- Photonics Society of Chinese (PSC) Heritage Workshop and Networking Social | 17:00–19:00 |

## Exhibition and Show Floor Activities

- Show Floor Activities (Exhibit-Only Time) | 10:00–17:00 | (10:00–14:00) | 10:00–17:00 | (12:30–14:00) | 10:00–16:00 |
- Career Zone | 10:00–16:45 | 10:00–16:30 | 10:00–15:45 | 10:00–16:00 | 10:00–16:00 |
- Suzanne R. Nagel Lounge | 10:00–17:00 | 10:00–17:00 | 10:00–16:00 | 10:00–16:00 | 10:00–16:00 |
- Market Watch - Expo Theater I Sponsored by Cisco | 10:15–17:00 | 10:15–17:00 | 10:15–17:00 | 10:15–16:00 | 10:15–16:00 |
- Other Expo Theater I Programming, Theater II and Theater III Programming | 10:15–17:00 | 10:15–17:00 | 10:15–17:00 | 10:15–16:00 | 10:15–16:00 |
- Data Center Summit – Expo Theater II | 12:00–15:45 | 12:00–15:45 | 12:00–15:45 | 12:00–15:45 | 12:00–15:45 |
- Network Operator Summit - Expo Theater I | 10:15–14:00 | 10:15–14:00 | 10:15–14:00 | 10:15–14:00 | 10:15–14:00 |

## Other Expo Theater I Programming, Theater II and Theater III Programming | 10:15–17:00 | 10:15–17:00 | 10:15–17:00 | 10:15–16:00 | 10:15–16:00 |

## Data Center Summit – Expo Theater II | 12:00–15:45 | 12:00–15:45 | 12:00–15:45 | 12:00–15:45 | 12:00–15:45 |

## Network Operator Summit - Expo Theater I | 10:15–14:00 | 10:15–14:00 | 10:15–14:00 | 10:15–14:00 | 10:15–14:00 |

## Special Events

- Simulating Datacom/Telecom Applications Following Standards Specifications | 13:30–17:30 |
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## Student Party | 19:00–21:00 |

## Plenary Session | 08:00–10:00 |

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## Challenges and Solutions for Realizing Quantum Fiber-Based Networks | 12:45–13:45 |

## Photonics Society of Chinese (PSC) Heritage Workshop and Networking Social | 17:00–19:00 |
OFC thanks the following corporate sponsors for their generous support:

[Logos of corporate sponsors]

OFC thanks the following media partners:

[Logos of media partners]
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
- General conference information
- Lost and Found (for after-hours Lost and Found, please go to Registration in Lobby D.

Exhibition
Exhibit Halls A-H
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, 26 March</td>
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<td>12:30–14:00</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

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<tr>
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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, room 5B. The media room is restricted to registered media/analysts holding a media badge. Room 4 is available for exhibiting companies to host news conferences.

Media Center Hours

<table>
<thead>
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<th>Day</th>
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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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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.
Conference App
OFC offers more than 110 sessions featuring 140+ invited speakers and 16 tutorial presentations in the technical conference, along with hundreds of exhibitors. Manage your conference experience by downloading the conference app to your smartphone or tablet. (See steps below).

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 alphabetically and set bookmark reminders to stop by booths. View the interactive exhibit floor map.

Technical Digest Papers
Full technical registrants can navigate directly to the technical papers from the conference app. Locate the session or talk in “Event Schedule” and click on the “Download PDF” link in the description.

IMPORTANT: Log in with your registration email and password to access the technical papers. Access is limited to Full Conference attendees.

Download the Conference App!
Plan your day with a personalized schedule and browse exhibitors, maps and general show information while engaging with fellow attendees. 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

Conference App Help Desk
Need assistance? Find an App Coach near registration or contact our Conference App support team, available 24 hours a day Monday through Friday, and from 09:00 to 21:00 EST on weekends, at +1 888.889.3069, option 1.

Registration
Lobby D
Hours:
<table>
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<tr>
<th>Date</th>
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Join the Conversation!
Get the latest updates from OFC via X (formerly Twitter) at @OFCConference. Use #OFC24 and join the conversation today!

Speaker Ready Room
Room 11
All speakers and presiders are required to report to the Speaker Ready Room at least two hours before their sessions begin. Computers will be available to review uploaded slides.

Speaker Ready Room Hours*
<table>
<thead>
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</table>

*Sponsors 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.

Sponsoring Society Exhibits
IEEE ComSoc
IEEE Photonics Society

Wireless Internet Access
OFC is pleased to provide free wireless internet service throughout the 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.

- Wi-Fi Network: OFC
- Password: OFC_2024

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.
Conference Materials

Technical Digest
The Technical Digest, composed of the 3-page summaries of invited and accepted contributed papers, and tutorial presentation notes, will be accessible on the OFC website. The Technical Digest is included with a technical conference registration.

Accepted and presented papers are published in the IEEE Xplore Digital Library and on the Optica Publishing Group platform. In addition OFC further supports the visibility of the paper by indexing in Ei Compendex, Scopus and Google Scholar.

Online Access to Technical Digest
Technical attendees have EARLY (at least one week prior to the meeting) and FREE continuous online access to the Technical Digest. These tutorial slides and 3-page summaries of invited and accepted contributed papers can be downloaded individually or by downloading daily .zip files. (.zip files are available for 60 days after the conference).

1. Visit the conference website at ofcconference.org
2. Select the purple “Download Digest Papers” button on the right side of the web page
3. Log in using your email address and password used for registration. You will be directed to the conference page where you will see the .zip file links at the top of the page. [Please note: if you are logged in successfully, you will see your name in the upper right-hand corner.]

Access is limited to Full Conference attendees only. If you need assistance with your login information, please use the “forgot password” utility or “Contact Help” link.

Postdeadline Papers
The 3-page summaries of accepted Postdeadline Papers will be available to download online on Tuesday, 26 March. The papers will be presented Thursday, 28 March, 16:30–18:30.

Short Course Notes
Notes typically include a copy of the presentation and any additional materials provided by the instructor. Each course has a unique set of notes, which are distributed on-site to registered course attendees only. Notes are not available for purchase separately from the course.

Buyers’ Guide
The Buyers’ Guide comprises 50-word descriptions and contact information for exhibiting companies, a cross-referenced product-category index, general conference services information and extensive details regarding exhibit floor activities. Guides will be given to every OFC attendee as part of registration.

Captured Session Content
We are delighted to announce that all technical sessions, including workshops, panels, symposia and special sessions, are being digitally captured for on-demand viewing and accessible with your technical registration. All captured session content will be posted for on demand viewing within 24 hours of being recorded.

To access the presentations, select the “View Presentations” button prominently displayed on the conference homepage (ofcconference.org). As access is limited to Full Conference attendees only, you will be asked to validate your credentials based on your registration record.
## Short Course Schedule

### Sunday, 24 March 2024

<table>
<thead>
<tr>
<th>Time</th>
<th>Course</th>
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| 08:30–12:30 | SC105: Modulation Formats and Receiver Concepts for Optical Transmission Systems  
Peter Winzer, Nubis Communications, USA, and Vivian Chen; Nokia Bell Labs, USA |
|         | SC203: 400, 800Gb/s and Beyond Optical Communications 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 |
|         | SC216: An Introduction to Optical Network Design and Planning  
George Rouskas, North Carolina State University, 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, and Howard Wang, Nokia, USA |
|         | SC432: Hands on: Silicon Photonics Component Design and Fabrication  
Lukas Chrostowski, University of British Columbia, Canada |
|         | 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, Stealth Startup, 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 |
| 13:00–16:00 | SC408: Space Division Multiplexing for Optical Communication Systems and Networks  
Roland Ryf, Nokia Bell Labs, USA |
|         | SC512: Modern Subsea Cable Systems  
Mei Du, Tata Communications, USA |

### Monday, 25 March 2024

<table>
<thead>
<tr>
<th>Time</th>
<th>Course</th>
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</table>
| 08:30–12:30 | 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: Hands-on Test and Measurement for Signals with Complex Optical Modulation  
Fabio Pittala and Michael Koenigsmann, Keysight, Germany |
|         | SC393: Digital Signal Processing for Coherent Optical Transceivers  
Chris Fludger, Infinera, Germany |
|         | SC433: Introduction to Photodetectors and Optical Receivers  
Andreas Beling, University of Virginia, USA |
|         | SC443: Optical Amplifiers: From Fundamental Principles to Technology Trends  
Peter Andrekson, Chalmers University of Technology, Sweden, Michael Vasilyev, University of Texas, Arlington, USA |
|         | SC444: Optical Communication Technologies for F5G evolution  
Dr. Xiang Liu, Huawei Technologies, China |
|         | SC448: Evolving Software Defined Optical Network: Architecture and Design Principles  
Ramon Casellas, Ph.D., IEEE SM; OSA M, CTT, Spain |
|         | SC452: FPGA Prototyping for Optical Subsystems  
Noriaki Kaneda, Nokia, USA, Robert Elschnier, Fraunhofer HHI, Germany |
SC453A: Hands-on: Fiber Optic Handling, Measurements, and Component Testing
Steve Baldo, Seikoh Giken, USA, Chris Heisler, Santec California Corporation, USA, Jérome Allaigre, Data-Pixel, France, Julien Maille, Data-Pixel, France

SC454: Hands on: Silicon Photonics Design - Circuits
Wim Bogaerts, University of Ghent, Belgium

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

SC513: Data Center Short Links – Link Design, Modeling, Test and Measurements
Petar Pepeljugoski, IBM Research, USA, Greg D. Le Cheminant, Keysight Technologies, USA

SC525: Photonic and Electronic Packaging - Materials, Processes, Equipment and Reliability NEW
Peter O’Brien, Tyndall National Institute, Ireland

SC527: Optical Satellite Networks NEW
Vincent Chan, MIT, USA

09:00–12:00
SC465: Transmission Fiber and Cables
John Hedgpeth, Corning Optical Communications, USA

13:30–16:30
SC114: Technologies and Applications for Passive Optical Networks (PONs)
Yuanqiu Luo, Futurewei, USA

SC217: Applications of Radio-over-fiber Technologies Including Future 5G Networks
Dalma Novak, Octane Wireless, USA

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

SC447: The Life Cycle of an Optical Network: From Planning to Decommissioning
Andrew Lord, British Telecom, UK

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

SC526: Optical Wireless Technologies, Systems and Applications NEW
Harald Haas, University of Strathclyde, Scotland

SC528: Hands-on Fiber Optic OFCnet Course: Practical Fiber Optic Network Testing in a Realistic Network Environment NEW
Gwenn Amice, EXFO, USA, Christine Tremblay, École de Technologie Supérieure, Canada

13:30–17:30
SC325: Highly Integrated Monolithic Photonic Integrated Circuits
Chris Doerr, Doerr Consulting, LLC, USA

SC327: Fiber Transmission and Design of Long-haul 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

SC357: Circuits and Equalization Methods for Coherent and Direct Detection Optical Links
Alexander Rylyakov, Nokia, USA, Sudip Shekhar, University of British Columbia, Canada

SC384: Background Concepts of Optical Communication Systems
Alan Willner, University of Southern California, USA

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, Santec California Corporation, USA, Jérome Allaigre, Data-Pixel, France, Julien Maille, Data-Pixel, France
Special Programming
All times reflect Pacific Daylight Time (PDT, UTC-07:00).

Workshops

Sunday, 24 March, 13:00–15:30

S1A: How Can OFC, with a Real Life Test-Bed, Accelerate Innovation in the Design and Operation of the Next Generations Optical Photonic Networks?
Room: 2

Organizers: Cees de Laat, University of Amsterdam, Netherlands; Reza Nejabati, University of Bristol, UK; Andrew Lord, British Telecom, UK; Gwen Amice, EXFO, Canada

Started in 2023 OFCnet brings a new opportunity to the exhibition and demonstrate products, concepts, solutions, research and architectures in live high speed optical networks connected to the leading research and education networks worldwide. This increased focus on designing and building next generation optical networks will expand exposure on connectivity, emerging and next generation network technologies such as quantum networks, programmable and software defined optical networks and their applications such as big data, security and distributed classical and quantum computing. This workshop brings together the innovators and researchers that work on the mentioned topics to further enrich the OFCnet community and expand the contributing parties. We discuss: How should this initiative develop to ensure OFCnet enriches future community participation?

Panelists:
Chris Janson, Nokia, USA
Joe Mambretti, Northwestern University, USA
Corey McCllelland, Qubitek, USA
Mehdi Namazi, QuConn, USA
Jerome Prior, Aurea Technology, USA
David Rodgers, EXFO, USA
Jean-Robert Morax, ID Quantique, Switzerland

Rump Session Speakers:
Ben Dixon, MIT Lincoln Laboratory, USA
Jorg-Peter Elbers, Adtran, Germany
Prem Kumar, Northwestern University, USA
Julia Larikova, Infinera, USA
Dimitra Simeonidou, University of Bristol, UK

S1B: How Can Generative AI be used for Network Operations?
Room: 6C

Organizers: Ashwin Gumaste, Infinera Corp, USA; Ricard Vilalta, CTTC, Spain; Anurag Sharma, Google Inc., USA

Recently, conversational generative AI chatbots have taken the concept of democratizing AI to the next level. They can now automate routine tasks and generate creative content that is nearly unparalleled. This has thrown many user communities into a professional, ethical, and situational dilemma. There are already many ongoing initiatives that are using generative AI to create logical, relational, and process-oriented content that is valuable to end users. From a network perspective, generative AI can be used for a wide range of activities, including compiling reports, automating the network, building tools to resolve network outages, optimizing business processes, and many more. Generative AI can manifest as a tool that network planners/operators use as an outsourced aid, or as an in-house tool that can be used for complete network ops. In simple cases, generative AI can be used to respond to outage tickets, connecting users to commonly experienced problems. Generative AI can in this case become the backbone of an auto-response system, communicating with users of a network on one side and the operations team on the other, while precisely and in a timely fashion identifying failures in network behavior. Over time, generative AI can start to run networks autonomously – where it can detect faults, gather customer feedback, create reports, and take action on those reports with minimal or no human intervention. Imagine a network that can run itself, diagnosing faults, responding to customer requests for bandwidth, and even responding to requests from other generative AI instances, doing all of this efficiently and effectively. When generative AI identifies issues in a network, it can execute the DevOps process by creating its own patches or code snippets to resolve the issues, making the network more efficient, resilient, and restorative. Similarly, generative AI can be used to automatically generate Request for Proposal (RFP) documents by identifying the network’s needs and matching them with available technologies.

Some of the above use cases may seem like a SciFi movie ensemble, but these are all aspects of the network that can be impacted, albeit in small increments over time. The question is, which parts of network automation and network operations can be handled by generative AI, and what is the path to get there? We discuss these and similar topics with industry and academic experts. The topics to be discussed will include, but are not limited to:

- Generative AI for network operations
- Generative AI for failure detection and resolution
- Challenges in generative AI for business continuity
- Adapting generative AI for network ops
- Using generative AI framework for network service development
- Can we trust generative AI for network ops? What safeguards can be put in place?
- Legalities and boundary conditions on the use of generative AI from the perspective of data integrity, privacy, and anomalies.
This workshop will discuss challenges, opportunities, and risks of each strategy.

- Are high fiber count cables and ducts just ‘kicking the can down the road’? Is deploying new fiber infrastructures (with sometimes heavy and costly civil engineering) in line with the objective of sustainable development and carbon dioxide reduction imposed by governments to telecom operators?
- Is the installation of high fiber count cable fibers or multicore/multimode fiber cables is of nature to make decrease the cost of loan/rented fiber infrastructure for service providers?
- Are telecom operators ready for large infrastructure projects while they are just finishing deployment of FTTH infrastructure?
- Are the transmission techniques (in particular, digital signal processing) and related components / sub-systems (e.g. ROADM…) sufficiently mature to address transmission on multicore and/or multimode fibers given the related propagation impairments (core / mode coupling)?
- Is scaling by increasing the number of cores per fiber a long-term solution; will this ever give us more than one order of magnitude in capacity?
- Is there a need to develop more amplifier bands beyond C and L-band given the known impairments (e.g. Stimulated Raman Scattering) in ultra-wideband transmission and the cost of amplifier development?
- Will the need for multiple amplifiers and components that operate in different bands create unnecessary inventory problems?
- Is ultra-wideband transmission using the 50 THz SMF window inevitable, or a researchfad?
- Will hollow core fiber solve the capacity scaling problem, in particular for multiband transmission?

How do the above considerations depend on the perspectives of the different network operators, e.g., communications service providers, multiple-system operators, or hyperscale cloud providers. This workshop will explore all sides of this debate with industry representatives from both communications service providers, hyperscale cloud providers, system and device manufacturers, and academic researchers.

Speakers:
Binbin Guan, Microsoft, USA
Takemi Hasegawa, Sumitomo Electric Industries Ltd., Japan
Sergej Makovej, Coming, UK
Todd McWhirter, Zayo Group, USA
David Neilson, Nokia Bell Labs, USA
Pierluigi Poggioioli, Politecnico di Torino, Italy
Emilio Riccardi, Telecom Italia, Italy
Yusuke Sasaki, NEC Corporation, Japan
ZhuHong Zhang, Huawei, Canada
Ligia Zorello, Meta, UK

S1D: Are Coherent Transceivers About to Experience a Bandwidth Crunch?
Room: 6E
Organizers: David Millar, Infinera Canada, Canada; Toshiaki Koike-Akino, Mitsubishi Electric Research Labs, USA; Di Che, Nokia Bell Labs, USA

As future spectral efficiency growth prospects are limited, scaling to 1.6 Tb/s and beyond will be achieved almost entirely by increasing transceiver bandwidth. Single-wave line rates will hit the bandwidth ceiling if we cannot achieve a penalty-free transceiver bandwidth scaling of 2x every generation. When will this happen? If this does happen, what will transceivers look like? Multi-wave optics? Ever more power-constrained pluggables? Can we scale bandwidth indefinitely?

Speakers:
Long Chen, Cisco, USA
Romain Hersent, III-V Labs, France
Andreas Leven, Nokia, Germany
Yoshihiro Ogiso, NTT, Japan
Mohammad Pasandi, Ciena, Canada
Tony Wang, Marvell, USA
Glenn Wellbrock, Verizon, USA
Chongjin Xie, Alibaba, China
Mian Zhang, Hyperlight, USA
Mehrdad Ziai, Infinera, USA

S1E: Co-packaged Optics: Is it Only for the Cloud or Also for the Edge AI Services?
Room: 6F
Organizers: Shu Namiki, AIST, Japan; Nicola Calabretta, Technische University Eindhoven, Netherlands; Mahdi Nikdast, Colorado State University, USA

The rapid evolution of artificial intelligence (AI) technologies with numerous parameters, including large language model (LLM)-based services, presents critical issues on yet further scaling the network and interconnect of data centers in the age of AI. Recently, co-packaged optics (CPO) and optical switching have attracted considerable attention as ways to address the bottlenecks of I/O and switching in data center networks. Consequently, a question has arisen whether advances in CPO, including optical-layer switching, will enable further scaling of AI clusters.
Another important issue pertains to the operations of various LLM-based services that process enormous amounts of data. Most of these data are collected through Internet-of-Things (IoT) devices or mobile networks, while cloud data centers tend to be situated in locations remote from edges. Indeed, with a continuous increase in the volume of edge data, moving and storing data not only consumes significant amounts of energy but also incurs undesirable levels of latency. This will lead to an issue in regard to how and where such data are collected, transferred, stored, and processed for training and inference tasks. Then, the compute and network resources must not be treated separately but optimized holistically by redressing the allocation of edge and cloud computing. To achieve this, the flow of data must be optimized by identifying the roles of CPO and optical-layer switching at all levels of interconnect, from the chip-scale, on-board, rack-scale, and intra-/inter-data center (DC) levels to even mobile-edge and wide-area levels. Thus, such an approach may completely change the landscape of digital infrastructure.

This workshop will bring together AI-DC architects and networking experts from both industry and academia to discuss the future of AI-related digital infrastructure along with expectations and target specs of emerging optical network technologies, including CPO and optical-layer switching. The workshop comprises two technical sessions followed by a panel. In the first session, requirements for networks and interconnect will be discussed from the perspectives of various systems, whereas the second session will be a discussion of CPO and optical switch technologies. The panel will serve as a cross-examination between the two sessions.

**Speakers Session 1:**
- Keren Bergman, Columbia University, USA
- Zuowei Shen, Google, USA
- Shintaro Mizuno, NTT, Japan
- M. Ashkan Seyedi, NVIDIA Corporation, USA

**Speakers Session 2:**
- Joris Van Campenhout, IMEC, Germany
- Katsumi Fukumitsu, Fujitsu, Japan
- Ling Liao, Intel Capital, USA
- Peter Winzer, Nubis Communications, USA
- Ming Wu, University of Berkeley, USA

**S1F: Neural Networks for Optical Fiber Transmission: Hype or Hope?**

**Room: 7**

**Organizers:** Ming-Fang (Yvonne) Huang, NEC Labs America, USA; Yi Cai, Soochow University, China; Amirhossein Ghazisaeidi, Nokia Bell Labs, France

Neural network (NN) based machine learning has been investigated for applications in optical fiber communications for many years. The studies covered almost all aspects of the field including optical transmission modeling, optical link optimization, linear and nonlinear impairment mitigation, etc. Despite the extensive research, practical applications of neural network-based machine learning in optical fiber communications remain elusive. This workshop would like to discuss a crucial question: Can NNs replicate their successes in this field, as they have in natural language processing with ChatGPT?

The workshop shall cover but not limited to the following scopes:

1. Implementation complexity challenges faced by the NN based machine learning to be practical for high-speed optical communications;
2. Requirements on order and length of the PRBS dataset employed for the training and testing;
3. Requirement on training and testing dataset ratio;
4. Verification of the tracking bandwidth of the NN for dynamic transmission system effects;
5. Ethical considerations of using NN-based machine learning in optical fiber communications, such as data privacy and security concerns.

**Speakers:**
- Alan Lau, Hong Kong Polytechnic University, Hong Kong
- Takeo Sasai, NTT Network Innovation Labs, Japan
- Faith Yaman, NEC Labs America, USA
- Lilin Yi, Shanghai Jiao Tong University, China

**S2A: Will Heterogeneous Integration Meet the Needs of Future Applications and their Performance Requirements?**

**Room: 2**

**Organizers:** Dan Pitt, Palo Alto Innovation Advisors, USA; Mengjie Yu, University of Southern California, USA; Patrick Lo, Advanced Micro Foundry Pte Ltd, Singapore; Lukas Chrostowski, University of British Columbia, Canada

Heterogeneous Integration opens new capabilities for technologies, use cases, and market participants. Integrating devices developed separately and often on different substrates (e.g., III-V semiconductors and Silicon Photonics) into a single composite device enables miniaturization, simplifies interconnection, saves materials, and reduces energy consumption. It fosters the creation of new optical products that serve new applications with more demanding performance requirements. In this session we explore how well (and when) the various approaches to heterogeneous integration will meet these challenging needs, and the status and challenges for the service providers (e.g., type of integration platforms, process/tools maturity, and how to handle non-traditional Si materials).

**Speakers:**
- Alex Chikhaoui, X-Celeprint, Ireland
- Ivan Huang, Avicena, USA
- Michael Lebby, Lightwave Logic, USA
- Sylvie Menezo, Scintil, France
- Edward Preisler, Tower Semiconductor, USA
- Jing Zhang, IMEC and Ghent University, Belgium
- Mian Zhang, Hyperlight, USA
- Mengjie Yu, NEC Labs America, USA; Yi Cai, Soochow University, China

**Sunday, 24 March, 16:00–18:30**

**Special Programming**
Special Programming

OFC 2024 • 24–28 March 2024

S2B: Will Optical Switches Become a Key Element in High-Performance AI/ML Datacenter Networks?
Room: 6C
Organizers: Wenhua Lin, Intel Corp., USA; Qixiang Cheng, Cambridge University, UK; Kazuhiro Ikeda, AIST, Japan

The application of optical switching in data center networks has been extensively studied. Google’s recent announcement showcasing the implementation of an optical circuit switch in a production data center has re-sparked interest in the requirements and challenges associated with optical switching. In addition, generative AI models are extensively advancing with the number of parameters exponentially increasing. This requires GPU clusters with a very high bandwidth density and low energy consumption, which has revamped research on photonic switch fabrics co-integrated and optically interconnected with multiple GPUs/TPUs/CPUs. This workshop discusses the challenges and opportunities of optical switching for large-scale data center networks, especially for GPU clusters and HPC networks, from system networking perspective (capacity demand, latency, fast configuration and control scheme, flexibility and scalability, cost, power consumption), optical switch architectures (switch radix, topology, size and scale, performance), to device performance (loss, bandwidth, switching speed, crosstalk, and integration platform). We will explore innovative photonic technologies and network architectures for enabling the optical switching for AI/ML applications. Some of the topics that we intend to dive into in this workshop are:

1. What are the requirements and challenges for broad adoption of optical circuit switching?
2. How do optical and electrical switch systems co-exist to enable the scaling and optimize the cost-to-performance metric for AI/ML systems?
3. Will semiconductor-based optical switches (e.g. Silicon Photonics) play a significant role in large-scale integrated optical switches, after the MEMS-based OCS systems deployment? What hurdles need to be overcome?
4. Is there a role of fast optical switching in AI/ML systems? What are the requirements for fast optical switching?
5. Novel system architectures and packaging techniques involving co-packaged optics, optical interposers and I/Os, with GPU/CPU/TPU for future AI/ML computing?

Speakers: Session 1
Keren Bergman, Columbia University, USA
Ben Lee, NVIDIA, USA
Shu Namiki, AIST, Japan
George Papen, UCSD/Google, USA
Stefano Stracca, Ericsson, Italy

Speakers: Session 2
Darius Bunandar, Lightmatter, USA
Richard Penty, Cambridge University, USA
Daniel Perez-Lopez, iPronics, Spain
Ming Wu, University of California, Berkeley, USA

S2C: Which Types of Fiber Will Be the Most Suitable for Network Operators in the Near Future?
Room: 6D
Organizers: TJ Xia, Verizon Communications Inc, USA; Mattia Cantono, Google LLC, USA; Binbin Guan, Microsoft, USA; Atsushi Nakamura, NTT, Japan

In recent years, the development of new types of fiber has made a lot of progress. Hollow-core fiber (HCF) has shown low attenuation and wide optical bandwidth comparable to traditional single mode fiber with lower latency, while multi-core fiber (MCF) has shown capability to support long-distance transmission and enable submarine cables for 1+Pbps systems. These types of new fiber provide certain advantages compared with traditional fiber, also, require further improvement in performance, scalability and progress in the whole ecosystem. As network operators and fiber service providers are considering new fiber cable deployment to support continuous data-bandwidth growth and new applications, it is a good time to examine and compare which fibers will be most suitable for long-term growth and short-term deployment. Fiber developers, fiber cable manufacturers and fiber network operators will share their latest thoughts on this particular topic at the workshop.

Speakers Session 1:
Mark Allen, Ciena, USA
Kazuhide Nakajima, NTT, Japan
Pascal Pecci, Meta, France
Max Salsi, Google, USA
Glenn Wellbrock, Verizon, USA

Speakers Session 2:
Rodrigo Amezcu Correa, University of Central FloridaCREOL, USA
Lidia Galdino, Corning, UK
Yuki Kawaguchi, Sumitomo Electric Industries, Japan
Madoka Ono, Tohuka University, Japan
Han Damsgaard, OFS Fitel LLC, USA
Francesco Poletti, Southampton University, UK

S2D: Coherent Optics for Next Generation 100G/200G PON: Single-Carrier or Multi-Carrier?
Room: 6E
Organizers: Haipeng Zhang, CableLabs, USA; Ashkan Seyedi, NVIDIA Corporation, USA; Linl Yi, Shanghai Jiao Tong University, China; Jim Zou, ADVA, Germany; Dario Pilori, Politecnico di Torino, Italy

Coherent technology is considered as a future-proof solution for future generation PON thanks to its high spectral efficiency and superior receiver sensitivity, which enables higher capacity, extended reach, and larger splitting ratio in PON applications. Several coherent PON technologies have been studied and developed, including coherent time-division-multiplexing (TDM) PON, coherent wavelength-division-multiplexing (WDM)-PON, and coherent time-and-frequency-division multiplexing (TFDM)-PON.

A question commonly raised among network operators and equipment vendors is that for future coherent PON, will it adopt single-carrier solutions, which use only TDM bandwidth sharing, or will it utilize multi-carrier configurations, either wavelength or frequency division multiplexed (WDM/FDM)?

Although TDM-PON offers a practical and relatively simple solution, it may need a new scheduling algorithm for latency reduction in a big covering group. On the other hand, multi-carrier PON can provide a
more flexible bandwidth allocation, but they will introduce additional cost and operational complexity.

This workshop will bring together experts from academia, industry, and standardization bodies to discuss topics such as benefits, challenges, technical feasibility, and economics of adopting single carrier versus multi-carrier solutions in the next generation coherent PON.

Speakers:
Md Mosaddek Hossain Adib, Nokia Bell Labs, Germany
Roberto Gaudino, Politecnico di Torino, Italy
James Harley, Ciena, Canada
David Hillerkuss, Infinera, Germany
Maxim Kuschnerov, Huawei, Germany
Jeffery Lee, Coherent Inc., Germany
Maryam Niknamfar, Charter Communications, USA
Bhushan Padhiar, AT&T Labs, USA
Matthew Schmitt, CableLabs, USA
Tom Williams, Acacia Communications / Cisco, USA

S2E: Will Linear Pluggable Optics (LPO) Have a Future Beyond 112G?
Room: 6F
Organizers: Jiangqiang Li, LightsAI, USA, Andreas Matiss, Corning, USA, Katharine Schmidtke, Eribel Systems, USA, Clint Schow, University of California, Santa Barbara, USA

Linear drive targets the elimination of DSP/retimers between host ASICs and optical engines for potential cost/power/latency benefits. Linear drive is well suited to co-packaged optics (CPO) or near package optics (NPO) applications that offer tight integration with short electrical links between the IC and optics. However, there has also been intense promotion, advocacy and compelling demonstrations of linear drive applied to traditional pluggable optics. Although the early results for linear pluggable optics (LPO) are encouraging, considerable challenges remain to be overcome to enable widespread adoption. Examples include signal integrity limits and specifications, interoperability, testability, and ecosystem establishment. This workshop will provide a forum for sharing opinions and insights from different segments of the ecosystem: end users, standardization bodies, and suppliers of ICs, transceivers and optical components, and systems. This workshop will address the following questions.

- Which use case will LPOs be highly possible to land?
- Will there be a broad window to adopt 100G/lane LPOs? Are 200G/lane LPOs feasible?
- What are the limits imposed by signal integrity and what specifications are needed?
- Will LPOs have a strong impact on deployment, commissioning and operation practices for end users?
- Are AOCs a more promising form factor to implement linear drive?
- How much power/cost/latency savings are expected for LPOs?
- Will LPOs be ecosystem friendly?
- Will interoperability between LPOs and traditional pluggables be required?
- Will LPOs transfer design complexity from transceivers to hosts?
- Which types of optical engines are best suited for implementing LPOs: VCSEL, SiPh, DML or EML?
- Will it be feasible to push toward direct drive in pluggables by further eliminating in-module drivers?
- Will new modulator materials (TFLN, BTO, etc.) help enable the adoption of LPOs and the evolution to 200G/lane?
- Will LPOs be a step on the way to CPO or an alternative to CPO?
- How much know-how and standardization legacy from LPOs can be transferred to CPO?

S2F: QKD – An End-Game or Just a Stepping Stone to the Quantum Internet?
Room: 7
Organizers: Andrew Lord, British Telecom, UK; Tobias Gehring, Technical University of Denmark, Denmark; Gregory Kanter, NuQuant, USA

Some see QKD as the end-game – all other quantum comms applications are vague and lacking usefulness (e.g., quantum digital payments, quantum money, etc.). Others see trusted-node QKD networks as a stepping stone, ultimately leading to a secure network based on quantum repeaters. Yet others believe that the security benefits are not worthwhile since PQC is a more practical solution and see trusted node QKD networks as merely an early stage testbed for a quantum internet with the true goal being to connect quantum computers. Which of these viewpoints is the most realistic or are they all valid? Or, are none of them actually likely to find long-term applications?

Speakers:
Noel Goddard, QuConn, USA
Bruno Huttner, IDQuantique, Switzerland
Prem Kumar, Northwestern University, USA
Robert Keys, Ciena, USA
John Prisco, SafeQuantum, USA
Andrew Shields, Toshiba, UK
Feihu Xu, USTC, China
Hack Your Research! Tools and Tricks for Today’s Telecommunications Techies (formerly Lab Automation Hackathon)

Sunday, 24 March, 19:00–21:00
Room: 6A

Organizers: Henrique Buglia, University College London, UK; Marco Eppeberger, 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

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 concentrating 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 primarily 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. 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 2024. Please refer to the abstract section or conference app for full details.

PICs for Quantum Communication and Quantum Computing: Challenges and Opportunities
Wednesday, 27 March 14:00–18:30
Room: 9

Organizers: Eleni Diamanti, CNRS, France; Michael Kues, Univ. of Hannover, Germany; Cheryl Sorace-Agaskar, MIT Lincoln Laboratory, USA; Michael Vasilyev, Univ. of Texas at Arlington, USA; Jianwei Wang, Peking Univ., China; Rui Wang Univ. of Bristol, UK

Recent advancements in quantum technology have led to the transition from lab-scale demonstrations to practical applications. Quantum technologies, including quantum communication and cryptography, quantum random number generation, and quantum processing accessible on the cloud, have gradually matured to provide commercial services. Photonic Integrated Circuits (PICs) have emerged as a crucial technology for quantum communication and computing due to their compact size, robustness, and ability to accommodate multiple elements on a single chip. Various PIC platforms are being developed to enable different quantum modalities and architectures. However, significant progress is still needed regarding hybrid integration to expand and mature PIC platforms, as well as the development of supporting infrastructure (electronic control, packaging, etc.) for leveraging PICs in quantum communication and computing systems. This symposium will focus on the potential benefits of PICs in these applications, the field’s current state, including desired system architectures, and the key challenges in PIC development that need to be overcome.

Key questions that this symposium aims to discuss include:

- How can PICs accelerate the development of photonic-based quantum technologies?
- Will PICs be the solution for complex quantum information processing and what are the critical challenges in realizing large-scale photonic chips?
- How can PIC chips and integrated systems contribute to developing a quantum internet? Will it play a central role?
- What would be the commercially available and sustainable business model for PIC development suitable for quantum systems and networks?
- Can a viable supply chain for quantum PICs at a global scale be envisioned?
- Can photonic-electronic co-packaging offer advantages for enabling hybrid quantum chips?

This symposium will delve into these questions, focusing specifically on the role of PICs in quantum technologies. The first session will discuss PICs for quantum communication, followed by a panel discussion. The second session will explore photonic integration technologies for quantum computing and quantum interconnect, concluding with a panel discussion.

Session I: Photonics Integration for Quantum Communications.

This session will provide a broad overview and in-depth discussions of key emerging research areas, including PIC for quantum communications and quantum memories. The scope is to leverage the advances of PICs to explore the capabilities enabled by this technology and identify the benefits and challenges in achieving quantum communication devices and systems compatible with existing telecom technologies. The panel will discuss the current state of the art, the key research challenges and the perspective from industry and foundries on developing applications and services with a quantum advantage.
Session II: Photonics Integration for Quantum Computing and Quantum Interconnects
This session will explore another set of research areas - PICs for quantum computing and quantum interconnects. The talks will cover PICs for photonics-based quantum computers, quantum transducer technologies for interfacing flying qubits and matter qubits, and novel PIC architectures for non-photonics-based quantum computing. The panel will discuss recent research advancements in these areas, development and vision from the relevant industry, and challenges ahead to realize useful quantum computing.

Speakers:
Davide Bacco; University of Florence, Italy
Bryan DeBono; Quantumuum, USA
Benjamin Dixon; MIT Lincoln Laboratory, USA
Blair Morrison; Xanadu, Canada
Ségolène Olivier; CEA-LETI, France
Philip Silbson; KETS Quantum, UK
Chi Xiong; IBM TJ Watson Research Center, USA
Wenmiao Yu; Quantum Dice, UK

Commercialising Qrngs - From Lab to Product

Green Transformation: Where Do We Stand?
Monday, 25 March, 08:00–12:30
Room: 2
Organizers: Saifuddin Faruk, Bangor University, UK; Naveena Genay, Orange Labs, France; Luca Valcarenghi, Scuola Superiore Sant’Anna, Italy; Ting Wang, NEC Labs, USA

Part 1:
Green ICT: Are next-generation telecommunication systems “green” enough? On a global scale, ICT power consumption equals about 5% of the global energy consumption, and this percentage is increasing over time. For example, it is estimated that the power consumption of optical transport infrastructure in telecommunication providers increases by about 12 percent per year.

Part 2:
ICT for Green Transformation: The massive utilization of ICT, encompassing data center networks, holds the potential to significantly reduce greenhouse gas (GHG) emissions across various sectors, as exemplified during the COVID-19 pandemic with lockdowns resulting in decreased emissions, notably in the transportation sector. For instance, expanding fiber-optic connectivity to every corner and facet of our digital landscape might enable vertical sectors, including those reliant on data center networks, to transition to more eco-friendly practices. The symposium will not only explore how ICT, encompassing data center networks, can contribute to reducing GHG emissions but also delve into the energy efficiency methodologies and strategies for carbon footprint reduction and carbon footprint improvement that have been implemented by vendors and operators within the ICT industry.

Speakers:
Session I
Lieven Levrue; Nokia, France
Energy Efficient in Open Optical Transport

Paolo Gemma; ITU-T, Italy
Assessment of Fixed Network Energy Efficiency
Andreas Gladisch; Deutsche Telekom AG Laboratories, Germany
Rethinking Telcos Central Offices for Green Transformation
Session II
Alessandro Percelsi; TIM, Italy
How ICT can Positively Impact the Environment
Fabio Cavaliere; Ericsson, Italy
Can Photonics Help in Reducing the Power Consumption in Radio Access Networks?
Nicola Sambo; Scuola Superiore Sant’Anna, Italy
Solutions to Increase Energy Efficiency of Optical Networks
Masaki Kozai; NTT, Japan
Effective Use of Renewable Energy in Data Centers

Embracing Fiber Sensing: What’s the “Killer App” for Large-Scale Deployments?
Wednesday, 27 March, 14:00–18:30
Room: 6C
Organizers: Ezra Ip, NEC, USA; Sander Jansen, Adtran, USA; Jeremie Renaudier, Nokia Bell Labs, France
Fiber sensing technology has revolutionized the capabilities of telecommunication networks around the world. With coherent detection technology, there are a variety of potential applications for fiber sensing, from enhancing network efficiency to detecting anomalies in real time. Despite the vast potential benefits, few providers have fully embraced this technology on a large scale, prompting the question of what could be “killer apps” for fiber sensing to be implemented first. This symposium will address this question by examining real-world applications of fiber sensing in global telecom networks, including best practices for field deployment, large-scale implementation considerations, and the use of AI, ML, and digital twin technologies for processing sensing data. The symposium will also explore the potential returns on investment and revenue generation associated with fiber sensing adoption, providing attendees with
the knowledge they need to make informed decisions about this cutting-edge technology. By the end of the workshop, participants will have a comprehensive understanding of the current state of fiber sensing technology and its potential for successful implementation in global telecom networks.

Speakers:
Session I
Ezra Ip, NEC, USA; Sander Jansen, Adtran, USA; Jeremie Renaudier, Nokia Bell Labs, France
Fiber Sensing for the Telecommunication Industry in a Nutshell
Paul Dickinson; FOSA/Duraline, USA
Existing and Emerging Market Opportunities for Distributed Fiber Optic Sensing
Andrew Lord; British Telecom, UK
How Can Sensing on Telecoms Fibres Bring Revenues to Operators?
Yoshifumi Wakisaka; NTT, Japan
Environmental Monitoring Using Widely Deployed Telecommunication Optical Fiber Cables and Distributed Acoustic Sensing
Session II
Glenn Wellbrock, Verizon, USA
The “Killer App” is that the Fiber Already Exists!
Michael Morgan; Exelon, USA
Fiber Sensing Use Cases and Applications for an Electric Utility
Kang-Kuen Lee, Hong Kong Polytechnic University, Hong Kong
Progression from Discrete Fiber Bragg Grating Sensors to Distributed Optical Fibre Sensing in the Railway Industry
Paul Westbrook; OFS, USA
Monitoring and Sensing Applications Enabled by Enhanced Scattering Fibers in Future Telecom Networks
Panels
Nine panels are scheduled for OFC 2024. Please refer to the abstract section for full descriptions.

The Role of Digital Twins in Optical Networking
Date: Monday, 25 March, 10:30–12:30
Room 7
Organizers: Kostas Christodoulopoulos, University of Athens, Greece; Yvan Pointurier, Huawei, France; Chongjin Xie, Alibaba Group, USA

The Road Towards 3.2 Tb/s Intra-Data Center Communications
Date: Monday, 25 March, 14:00–16:00
Room 6E
Organizers: Stephan Pachnicke, Christian-Albrechts Universität zu Kiel, Germany; Juthika Basak, Nokia Corp., USA; James Chien, Marvell, USA

Wideband Optical Amplifiers for Datacenters, Hyperscale Networks and Telecom Networks
Date: Monday, 25 March, 16:30–18:30
Room 7
Organizers: Vladimir Gordenko, Aston University, UK; Michael Vasilyev, University of Texas at Arlington, USA; Raja Ahamd, Cisco Systems Inc, USA; Seongwoo Yoo, University of Glasgow, UK

Can New Access Technology and Architectures Support the Beyond 5G Network Vision
Date: Tuesday, 26 March, 14:00–16:00
Room 7
Organizers: Chathu Ranaweera, Deakin University, Australia; Annachiara Pagano, TIM, Italy; Lihua Ruan, Chinese University of Hong Kong, China, Marco Ruffini, Trinity College Dublin, Ireland

Beyond Two-Core Fibers: Single-Core vs Multi-Core Amplifiers in Long-Haul SDM Links
Date: Tuesday, 26 March, 14:00–16:00
Room 6E
Organizers: Atsushi Nakamura, NTT, Japan; Victor Kopp, Chiral Photonics, USA; Masato Tanaka, Sumitomo Electric Industries Ltd, Japan; Bera Pálsdóttir, OFS Fitel Denmark I/S, Denmark

Cutting-Edge Technologies for Interconnecting AI/ML Clusters
Date: Tuesday, 26 March, 16:30–18:30
Room 6E
Organizers: Brandon Buscaino, Nokia, USA; Norm Swenson, Norman Swenson Consulting, USA; Qiong Zhang, Amazon, USA

Next Generation Disaggregated Data Centers Using Future Chip to System Photonic Technologies
Date: Wednesday, 27 March, 08:00–10:00
Room 6E
Organizers: George Michelogiannakis, Lawrence Berkeley National Laboratory, USA; Liam Barry, Dublin City University, Ireland

Photonic Components for In-Physics Computing
Date: Wednesday, 27 March, 08:00–10:00
Room 7
Organizers: Joyce Poon, Max Planck Institute of Microstructure Physics, Germany; Patrick Runge, Fraunhofer HHI, Germany; Wei Shi, Laval University, Canada

Role of Optics for Space Communication
Date: Wednesday, 27 March, 14:00–16:00
Room 7
Organizers: Chi-Wai Chow, National Yang Ming Chiao Tung University, Taiwan, Stephanie Ralph, Georgia Tech, USA, Katherine Newell, Johns Hopkins University Applied Physics Lab, USA, Yi Sun, OFS Fitel LLC, USA
Special Sessions

Frontiers of Optical Network Architecture Summit
Monday, 25 March, 14:00–16:00
Room 3
Organizers: Jun Shan Wey, Verizon, USA; Vincent Chan, MIT, USA

Evolving Optical Network Architecture Towards the Next Decade
Over the past five decades, we have witnessed optical networks growing from simple connectivity to today’s hyper-connected network providing all sorts of services.

In the early decades, telecommunications operators led the development and drove the optical industry forward, building massive optical networks connecting homes, businesses, metropolitan, countries, and continents. A new era arrived when web-scale operators propelled the industry to another tremendous growth period, providing intra and inter datacenter, metro, long-haul, and transoceanic connectivity. Another turning point is now emerging. As telecommunications networks are adopting datacenter design concepts, such as openness and disaggregation, and web-scale operators are starting to provide some form of telecommunications services, the topic of whether a common architecture is the right future direction is calling for an in-depth debate.

This summit will examine how the optical network will evolve in the next decade. How will the web-scale architectural approach be adopted in future telecommunications network infrastructure? Should there be a common architecture or should there be separate ones? How to design a service-based architecture with dynamically tailored network configurations? How do web-scale operators incorporate key requirements to build smart networks: open and modular, commodity hardware, intelligence in software, scalable and efficient, and highly programmable? What will be the profitable business cases? Does the cost of the network have to be bundled with the applications for a sustainable business?

Five invited speakers representing traditional telcos, web-scale operators, system and component vendors will discuss their views and debate the most promising path forward. The audience will have an opportunity to join the conversation through interactive Q&A and real-time polls.

Speakers:
Ori Gerstel; Cisco, Israel
The Future of Optical Networking in Service Provider Networks: Defined by External Factors
Hiromi Oohashi; Furukawa Electric, Japan
Next-Generation Optical Devices for Future Network
Greg Steinbrecher, Meta, USA
Reconfigurable Photonics and Flexible AI Systems
Masahito Tomizawa; NTT Innovation Devices Corp., Japan
An Operator’s View on the Future Optical Networks, and Enabling Device Technologies: Innovative Optical and Wireless Network Program
Glenn Wellbrock, Verizon, USA
More Fiber, Less Equipment
Moore’s Law: A Photonics Perspective for the Next Decade
Tuesday, 26 March, 14:00–16:00
Room 6D
Organizers: Di Che, Nokia Bell Labs, USA; Paul Gunning, BT, UK; Kaida Kaeval, Tallinn Univ. of Technology, Estonia; Emerson Moura, Cisco Systems, Brazil

Gordon Moore observed that the cost of a silicon transistor got cheaper the smaller you could make it. Moore’s Law states that the number of transistors on a silicon integrated circuit doubles every 18 to 24 months. Across six decades, the silicon semiconductor industry has been able to pack more and more transistors

Functional groups of transistors form CPU/GPU/NPU/TPU silicon chips of great capability. But will all this potentiality be stranded on these chips, like remote islands cut off from the outside world? Where can photonics help?

Moore’s Law is entering the Angstrom node era, so what are the prospects for electronics and photonics over the next decade? What exciting technologies will have been implemented and deployed when we re-convene for our retrospective workshop at OFC 2034? Our invited experts will provide their best insights on how the continued advancement of Moore’s Law will directly impact:

FUNDAMENTALS
- Does Moore’s Law apply to photonics - and if so, what are the limits?
- Opportunities from Quantum technologies.

APPLICATIONS
- Aggregate bisection bandwidths of silicon switching ASICs approach hundreds of Terabit/s;
- Migration from copper to optical backplanes within chassis;
- Evolution of compact pluggable transceivers, co-packaged optics and other advanced technologies;
- Advancements in A/D & D/A and DSP logic ASICs;
- High-bandwidth, low-latency, low-jitter, error-free interconnects to support the evolution of AI and photonic AI ‘logic chips’.

ECOSYSTEM DEVELOPMENT
- Datacom and non-datacom;
- Business opportunities and technology outlook;
- Refreshment cycles e.g. shorter versus longer operational lifetimes; system dependability.

SUSTAINABILITY
- The need for lower energy per bit (fJ/bit?…aJ/bit?) whether computed, switched, transmitted, or stored;
- Space reduction and power consumption;
- Perhaps we don’t need to evolve Moore’s Law; the focus should be on better Network efficiency and better existing resource utilization.
Special Programming

OFC 2024 • 24–28 March 2024

Speakers
Andreas Bechtolsheim; Arista, USA
Keeping up with Moore’s Law

Amit Nagra, Intel, USA
Keeping up with and Enabling Moore’s Law: Role of Photonics I/O

Katharina Schmidtke; Erial Systems, USA
Moore’s Law Redefined for AI/HPC Systems

Rebecca Schaeivitz; Lightmatter, USA
Breaking Down the Interconnect Bottleneck - A Third Dimension

Vladimir Stojanovic; Ayar Labs, USA
In-Package Optical I/O: Bridging the Gap Between Moore’s Law and Amdahl’s Law in Modern Compute Systems

Anna Tauke-Pedretti; DARPA, USA
A Path towards Scaling Photonic Circuits

Demo Zone

Monday, 25 March, 14:00–16:00
Room 6A

The Demo Zone features live demonstrations of research projects and proof-of-concept implementations related to novel optical communication devices, systems, and networks.

Demos:
Please refer to the abstract section for full descriptions.

M3Z.1 Frank Slyne, Trinity College, Dublin, Ireland
Demonstration of Cooperative Transport Interface using open-source 5G OpenRAN and virtualised PON network

M3Z.2 Zu-Kai Weng, National Institute of Information and Communications Technology, Japan
Demonstration of Robust Mobile Free Space Optical System using high-speed Beam Tracking and 2D-PDA-based Spatial-Diversity Reception

M3Z.3 Mihail Balanici, Fraunhofer HHI, Germany
Live Demonstration of Autonomous Link-Capacity Adjustment in Optical Metro-Aggregation Networks

M3Z.4 Joaquin Fernando Chung Miranda, Argonne National Laboratory, USA
Orchestration of Entanglement Distribution over a Q-LAN using the IEGNET Controller

M3Z.5 Saverio Pellegrini, Politecnico di Torino, Italy
Real-Time Demonstration of Anomalous Vibration Detection in a Metro-like Environment using a SOP-based Algorithm

M3Z.6 Alberto Gatto, Politecnico di Milano - DEIB, Italy
Quantum-Assisted Digital Signature in an SDN-controlled Optical Network

M3Z.7 Mario Wenning, Adva Network Security GmbH, Technical University of Munich, Germany
Quantum Key Management System with Dynamic Routing for Meshed QKD Networks

M3Z.8 Luis Velasco, Universitat Politècnica de Catalunya, Spain
Deployment of Secure Machine Learning Pipelines for Near-Real-Time Control of 6G Network Services

M3Z.9 Vignesh Karunakaran, Adtran Networks SE, TU Chemnitz, Germany
TAPI-based Telemetry Streaming in Multi-domain Optical Transport Network

M3Z.10 Huy Quang Tran, Nokia Bell Labs, France
Demonstration of a Compositional Learning Framework for Open and Disaggregated Optical Network Control

M3Z.11 Haoshuo Chen, Nokia Bell Labs, USA
Artificial Intelligence (AI)-Powered Robot for Optical Network Operation Automation

M3Z.12 Luis Velasco, Universitat Politècnica de Catalunya, Spain
Distributed Multi-Agent System fed with Telemetry Data for Near-Real-Time Service Operation

M3Z.13 Luis Velasco, Universitat Politècnica de Catalunya, Spain
Experimental Demonstration of Optical Encryption Using Quantum Keys: Two Scenarios

Open Networking Summit: Open and Disaggregated Optical Networking: Where We’ve Been and What’s Coming Next

Monday, 25 March, 16:30–18:30
Room: 6E

Organizers: Lynn Nelson, AT&T, USA; Shen Shikui, China Unicom, China; Norman Swenson, Infinera, USA

Open and disaggregation have grown in popularity and appeal across networking segments, including optical networks, in the past few years. With open and disaggregated networks, operators/hyperscalers can use best-in-class equipment and avoid vendor lock-in, thereby gaining faster innovation, flexibility, and scalability as their network needs grow.

Deployment status varies by network segments, working distances, and geographic regions, including data center networks with backbone long-haul and metro, core networks, and customer premises equipment (CPE) in metro and edge layer. Operators/hyperscalers from different geographic regions also have different attitudes and adopt varied approaches.

This summit aims to gather service providers, cloud providers, equipment vendors, and component vendors across the ecosystem to share learnings and experiences, highlight innovation, and discuss the future of open and disaggregated optical networking, including software-defined networking (SDN), south-bound interfaces, information modeling, interoperable DSP, IP over DWDM, and coherent pluggable transceivers.

Topics to be targeted by this summit include but will not be limited to:

1. In what segments of the network have openness and disaggregation been applied, i.e., long-haul/backbone, metro, or access?

2. What were the anticipated pros and cons of openness and disaggregation? Were those realized in deployment? (e.g., Have the projected cost savings been realized?)
3. Will openness and/or disaggregation help or hinder convergence of different network segments (e.g., metro and long-haul) and layers (IP + optical)?

4. Will nascent interoperable DSP stimulate increased adoption of openness and disaggregation in optical networks?

5. Will openness and disaggregation be a key enabler for IP over WDM?

6. What advances are needed in managing smart coherent pluggables in routers to enable IP over WDM?

Speakers:
Sebastien Gareau, Ciena, Canada
Steven J. Hand, Infinera, USA
Emerson Moura, Cisco, Brazil
Kirsten Rundberget, AT&T, USA
Chongjin Xie, Alibaba Group, China

Rump Session: How Much Optics Does AI Need?
Tuesday, 26 March, 19:30–21:30
Room: 6F

Organizers: Peter Winzer, Nubis Communications, USA; Shu Namiki, AIST, Japan; Laurent Schares, IBM, USA

Description
AI systems have attracted enormous interest over the past couple of years and commensurate investments into the AI infrastructure for data processing and movement. This rump session will debate how deep optical technologies should penetrate AI clusters. This year’s rump session will address a broad range of aspects concerning the role of optics in AI clusters. Everybody is invited to participate in two hours of lively (and not recorded) discussions.

Postdeadline Paper Presentations
Thursday, 28 March, 16:30–18:30
Rooms: 6C, 6D, 6E, 6F

Discover the best and most cutting-edge research in optical communications. The OFC 2024 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, 26 March. Please visit ofcconference.org and click the “Download Digest Papers” button to access these papers.
Special Events

Simulating Datacom/Telecom Applications Following Standards Specifications
Sunday, 24 March, 13:30–17:30
Room 31C

Organizers: Optica Foundation and VPIphotonics

This training will show you how to conceptualize and investigate optical transmission systems based on recommendations from standardization committees or multi-source agreements (MSAs) using professional simulation software. You will learn to model photonic components on different abstraction levels up to entire optical transmission systems corresponding to specifications. Then, evaluate the defined parameters and efficiently automate the design and analysis for new recommendations using the VPIphotonics Design Suite. We will investigate several standardized applications ranging from data center interconnects to high-capacity core network links. We will explore characterization and measurement concepts, demonstrate how to examine the impact of performance-limiting effects, and assess how to mitigate or compensate for them using machine learning algorithms.

Topics include:
• Examine a professional simulation software design environment
• Model photonic component characteristics
• Simulate application scenarios following standards specifications (e.g., 400G ZR, 800G FR-4, TDECQ)
• Investigate new mitigation techniques using machine learning algorithms

This interactive course 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 private laptops. Arrive by 1:00 pm for software setup.

Separate sign-up is required.

Optica Executive Forum at OFC 2024
Monday, 25 March, 07:30–19:00
Hilton San Diego Bayfront

Executive Forum - The Premier Annual Event for Leaders in Optical Networking and Communications

Co-located with OFC, the Premier Event in Telecom and Data Center Optics’ this is an Optica Industry Event. The Executive Forum features C-level panelists in an informal, uncensored setting discussing the latest issues facing the industry and your business. Leaders from top companies discuss critical technology advancements and business opportunities that will shape the network in 2024 and the future.

For over 25 years, the Optica Executive Forum has been the premier annual event for leaders in optical networking and communications. The forum will be co-located with OFC 2024, the largest and most important gathering of the optical communications community. The Optica Executive Forum is hosted by Optica’s corporate membership engagement program. The Executive Forum features C-level speakers in an informal, unscripted setting discussing the latest business issues facing the industry and your company. Leaders from top companies discuss the business opportunities that will shape the network in 2024 and the future.

Separate fee is required.

Student Party
Monday, 25 March, 19:00–21:00
Location: Coin-Op Game Room

Join us at the Student party for an evening of food, drinks, and networking! Don’t forget to bring your ID/Passport to the venue.

Separate sign-up is required. Please visit ofcconference.org to reserve your spot.

Conversation with the Plenary Speakers
Tuesday, 26 March, 10:15–10:45
Theater III, Exhibit Hall

Join OFC General Chairs Chris Fludger, Roland Ryf and Dimitra Simeonidou for a conversation with Plenary Speakers, Anita Döhler, Inder Monga and David J. Richardson.

The Art of Writing the Perfect OFC Paper
Tuesday, 26 March, 10:30–12:00
Room: 6A

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.
Conference Reception  
Tuesday, 26 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.

OFC Fun Run  
Wednesday, 27 March, 06:00–07:00  
Bottom of San Diego Convention Center Stairs (front entrance)  
Pack your running shoes and meet up for an early morning, 3 mile run or walk with fellow OFC colleagues. Can’t make it in person? No problem, join us virtually! Take a selfie, tag #OFC24 and #werunOFC and share it with the rest of the OFC X community @OFCConference.

The Journal Review Process: All You Need to Know!  
Wednesday, 27 March, 12:30–14:00  
Room: 6A  
Journal publications play a critical role in our industry. They serve as repositories where new results, ideas, and demonstrations are reported, providing a permanent resource for others in their research and design endeavors. This event offers a unique behind-the-scenes look into the journal publications process, allowing attendees to pose questions and interact with Editors and Reviewers from some of the highest-impact factor journals in optical communications and networking. The focus will be on understanding what happens once a new research paper is submitted to an IEEE or Optica journal.

The event will feature informative presentations and roundtable discussions hosted by individuals intimately involved in the review and publication process, eager to answer questions and engage with the audience. Importantly, for those interested in further insights, the event will guide participants in becoming involved in the review process for the most prestigious journal publications in the field of optical telecommunications.

A roundtable discussion with Editors from JLT, PTL, and JOCN will follow the presentations. Separate sign-up is required.

Organizers  
Andrew Lord, Editor-in-Chief, Journal of Optical Communications and Networking, Sr. Manager of Optical Networks Research, British Telecom, UK  
Boon S. Ooi, Editor-in-Chief, IEEE Photonics Technology Letters, Professor of Electrical and Computer Engineering, KAUST, Saudi Arabia  
Sorin Tibuleac, Journal of Lightwave Technology (JLT) Associate Editor, Director, Adtran, USA

Challenges and Solutions for Realizing Quantum Fiber-Based Networks  
Wednesday, 27 March, 12:45–13:45  
Room: 3  
You are invited to join the Optica Technical Group on Fiber Optics Technology and Applications for a panel discussion during lunch on Monday. Attendees will have the opportunity to hear from our featured panelists as they discuss recent developments and opportunities of quantum communications.

Please RSVP for this technical group event at bit.ly/OFCQuantumPanel to let us know you will be attending.

Photonics Society of Chinese Heritage (PSC) Workshop and Networking Social  
Wednesday, 27 March, 17:00–19:00  
Room 15  
Optics for AI Compute Era: Opportunities and Potential Disruptions  
Generative AI is gaining market momentum while AI Compute drives accelerated high bandwidth optical connectivity upgrades. On one hand, conventional pluggable optics suppliers are gaining huge boost from recent AI compute data center build-out by hyper data center operators; on the other hand, the accelerated AI compute is also driving potential disruption with architectures requiring high bandwidth density optical solutions integration deeper into compute and memory nodes with new technology like co-packaged optics. In this workshop, we will have invited speakers to discuss their view of AI-driven opportunities and potential disruptions to the optical industry, with representatives from AI data center operators, incumbent major optical suppliers, and new start-up companies focusing on disruptive solutions for AI.

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.

Partners: Optica, China International Optoelectronic Expo (CIOE) and Infostone
Plenary Session

Tuesday, 26 March, 08:00–10:00
Ballroom 20

How 6G will Impact Networking
Anita Döhler, Chief Executive Officer, Next Generation Mobile Networks Alliance (NGMN), Germany

This presentation explores NGMN’s pivotal role in advancing the Mobile Industry towards next-generation networks, encompassing Operator led requirements on 6G, sustainability, and cloud-native. With a prerequisite to deliver new use cases that create value and exceptional end-user experiences this presentation looks at trade-offs that will need to be made, for example energy consumption versus bit rates and identifies the critical role optical communications will play in enabling these Operator led requirements, for example disaggregation, resilience and energy efficiency.

Anita Döhler brings a wealth of international experience across diverse business sectors, including senior leadership roles within mobile network operators, technology vendors, and consulting firms. Between 2016 and 2020, she held prominent senior management positions at Accenture Industry X.0. Prior to her tenure at Accenture, Döhler amassed 16 years of experience at Vodafone Group, and earlier in her career, she contributed her expertise to E-Plus and Philips, among other notable organizations.

Döhler holds a Dipl.-Ing. degree in Telecommunication Engineering and has also earned an Executive MBA degree. She is also a Systemic Business Coach.

Döhler is passionate about propelling technological innovation for the betterment of humanity and societies, with a steadfast commitment to supporting the world’s foremost operators, vendors and research institutes.

Networking Alchemy: Transforming Science Through Connectivity
Inder Monga, Executive Director, ESnet, and Scientific Networking Division Director, Berkeley Lab, USA

Scientists are driven to answer some of the world’s most fundamental questions – from the origin of the universe to the future of humanity and our biosphere. Answers lie hidden in the deluge of data being gathered 24/7 from experiments, observations, and simulations. Energy Sciences Network (ESnet), the Department of Energy’s data circulatory system, seeks to harness and accelerate the creativity of vital research collaborations while pushing the boundaries of networking in experimenting with what a quantum computing network might look like. This talk will describe global-scale science and its workflows, innovations being explored to meet its rapidly evolving needs, and the engineering behind the science networks of today and the future.

Indermohan (Inder) S. Monga is the Director of Berkeley Lab’s Scientific Networking Division and Executive Director of Energy Sciences Network (ESnet), the Department of Energy’s high-performance network user facility. Optimized for large-scale science, ESnet connects and provides services to more than 50 DOE research sites, including National Laboratories, supercomputing facilities, and scientific instruments, as well as peers with 271 research and commercial networks worldwide. In addition to managing ESnet, Monga works to advance the science of networking for collaborative and distributed research applications by contributing to ongoing research projects, including quantum networking. He is the holder of 25 patents.

Emerging Fiber Technologies for Future Optical Networks
David J. Richardson, Partner Researcher, Microsoft, USA

Major advances have been made in recent years on the development of radically new transmission fibers offering improved optical properties and systems performance relative to conventional single mode fiber technology, with some of the most promising, including hollow core fiber, now deployed in the field. I review progress in these emerging technologies and discuss where they are likely to prove most disruptive and impactful in future optical networks.

David Richardson joined Microsoft as a Partner Researcher in February 2023 following their acquisition of Lumenisity Ltd, a spinout company that he co-founded in 2016 to develop hollow core fiber cables and solutions for telecoms and datacoms. Prior to joining Microsoft, Richardson had a remarkable 34-year career at the esteemed Optoelectronics Research Centre at the University of Southampton. For the last 24 years of his tenure there, he held the position of Deputy Director, leading a sizable research group that worked on the forefront of optical fiber technology and its applications in telecommunications, high-power lasers and sensing.

Throughout his career, Richardson has collaborated extensively with companies and universities worldwide, resulting in an impressive body of work that includes over 500 journal papers and 20 patents. He is a Fellow of both the Royal Society and of the Royal Academy of Engineering.
Awards Ceremony and Luncheon

Tuesday, 26 March, 12:30–14:00
Ballroom 20

Supported by CORNING

Join conference co-sponsors Optica, IEEE Communications Society, and IEEE Photonics Society for a special luncheon to recognize award and honor recipients from each society. This is a ticketed event.

The following awards and recognitions will be presented at the event.

2024 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 the IEEE Photonics Society and Optica and is funded by Corning, Incorporated.

Optica 2024 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.

IEEE Photonics Society 2024 Fellows
Recognizes IEEE members who have achieved extraordinary accomplishments that have contributed to the advancement or application of engineering, science, and technology, bringing the realization of significant value to society.

IEEE Communications Society 2024 Fellows
Recognizes the extraordinary contributions and accomplishments of IEEE members. Fellows are honored for their outstanding technical, educational, and leadership achievements.

IEEE/ Optica Journal of Lightwave Technology Best Paper Award
Recognizes the top cited original paper published in the Journal in 2021, as determined by a variety of citation metrics and databases. It is presented by the Journal’s Coordinating and Steering Committees. Copies of the winning paper will be available at OFC and will be made open access in the IEEE Xplore Digital Library.

IEEE Photonics Award
Established in 2002, the award is presented for outstanding achievements in photonics. Recipients are selected by the Technical Field Awards Council of the IEEE Awards Board.

David Richardson Medal
Established in 1966, the medal recognizes significant contributions to optical engineering, primarily in the commercial and industrial sector. It is presented by Optica and endowed by Cary Instruments (formerly Applied Physics Corporation) and Gary Duck.

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.

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.

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.

The Tingye Li Innovation Prize
Presented to an early career professional who has demonstrated innovative research, the prize honors the global impact Tingye Li made to 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.
Exhibition and Show Floor Activities

The OFC 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 supply chain continuum – from communications 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, standards and industry updates.

Learn about the state of the industry, emerging trends and recommended courses of action for how to tackle today’s toughest business challenges.

Exhibition
Halls A-H
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 2024 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 14 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:

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<th>Exhibit Hours</th>
<th>Coffee Breaks</th>
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<td>Tuesday, 26 March</td>
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<td>Wednesday, 27 March</td>
<td>10:00–10:30, 16:00–16:30</td>
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<td>Thursday, 28 March</td>
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Elevated Coffee Break Station
Booth 4217

Suzanne R. Nagel Lounge
Booth 1739
Sponsored by Infinera

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 complementary 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. Visit ofcconference.org/NagelLounge for a detailed schedule.

Lounge Hours

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Poster Presentations
Exhibit Hall B1
Wednesday, 27 March, 10:30–12:30
Thursday, 28 March, 10:30–12:30

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

Please refer to your 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 conference app for regular updates to show floor programming.
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**Market Watch**

This three-day panel discussion series engages the latest application topics and business issues in 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**

**Tuesday, 26 March**

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<th>Session</th>
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<tr>
<td>12:30–14:00</td>
<td>MW Panel II: Inside the Data Center Focused on AI/ML</td>
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<tr>
<td>14:15–15:45</td>
<td>MW Panel III: Coherent Technology Advancements to Address Next-Gen Networking Requirements</td>
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<tr>
<td>16:00–17:00</td>
<td>CISCO: Who Controls the DCO’s in Routers?</td>
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**Wednesday, 27 March**

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<tbody>
<tr>
<td>14:15–15:45</td>
<td>MW Panel IV: Next Generation PON Technologies</td>
</tr>
<tr>
<td>16:00–17:00</td>
<td>OIF: Coherent Optics Unleashed: From 400ZR Success to 800ZR/LR Advancements and 1600ZR Kick-off - An OIF Update</td>
</tr>
</tbody>
</table>

**Thursday, 28 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15–11:45</td>
<td>MW Panel V: Disaggregation Inside the DC</td>
</tr>
<tr>
<td>12:00–13:30</td>
<td>MW Panel VI: Disaggregation for Networks Operators</td>
</tr>
<tr>
<td>15:00–16:00</td>
<td>COBO: An Ecosystem Perspective on Scaling Integrated Photonics for the AI Revolution</td>
</tr>
</tbody>
</table>

**Network Operator Summit**

This dynamic program presents the inside perspective of service providers and network operators, their issues and drivers, and how their requirements may impact the industry's future. 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**

**Wednesday, 27 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15–10:45</td>
<td>Network Operator Summit: Keynote: Masahisa Kawashima, NTT, IOWN Development Office, IOWN Technology Director, Japan</td>
</tr>
<tr>
<td>10:45–12:15</td>
<td>NOS Panel I: Optical Network Automation</td>
</tr>
<tr>
<td>12:30–14:00</td>
<td>NOS Panel II: Optics for 5G/6G</td>
</tr>
</tbody>
</table>

**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**

**Tuesday, 26 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:45–11:45</td>
<td>OCP: Next generation Optical Interconnects for AI Clusters: Beyond Linear Drive Optics</td>
</tr>
<tr>
<td>12:00–12:30</td>
<td>Data Center Summit Keynote: Rich Baca, Principal, Strategic Accounts, Ciena, USA</td>
</tr>
<tr>
<td>12:30–14:00</td>
<td>Data Center Summit Panel I: ML/AI and Future Networks to Support It</td>
</tr>
<tr>
<td>14:15–15:45</td>
<td>Data Center Summit Panel II: Lowering Power Consumption in Optical Solutions</td>
</tr>
<tr>
<td>16:00–17:00</td>
<td>IEEE Future Directions: Photonics in Current and Future Machine Learning Network Infrastructure</td>
</tr>
</tbody>
</table>
Show Floor

Please refer to your 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 conference app for regular updates to show floor programming.

**Wednesday, 27 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15–11:15</td>
<td><strong>Ethernet Alliance:</strong> Ethernet Interconnect Solutions: Will the Advancement in Coherent Signaling Leverage DataCom Connectivity Solutions into the Telecom Closet?</td>
</tr>
<tr>
<td>11:30–12:30</td>
<td><strong>CableLabs:</strong> Empowering Access Networks with Coherent Optics</td>
</tr>
<tr>
<td>12:45–13:45</td>
<td><strong>ITU-T SG15:</strong> Standards Update on Higher Speed PON, Latest OTN Technologies and Interoperable Optical Interfaces</td>
</tr>
<tr>
<td>14:00–15:00</td>
<td><strong>IOWN GF’s Open APN for the Evolution of Mobile Networks and Cloud-and-Edge Computing</strong></td>
</tr>
<tr>
<td>15:15–16:15</td>
<td><strong>Amphenol:</strong> Exploring the Role of Interconnects in Energy Efficient Data Centers</td>
</tr>
</tbody>
</table>

**Thursday, 28 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30–12:30</td>
<td><strong>IPEC:</strong> Low-Latency High-Speed Optical Interconnection Technologies for AI Compute Era</td>
</tr>
<tr>
<td>12:45–13:45</td>
<td><strong>AIM Photonics:</strong> Presents PICs, Heterogeneous Integration, and Packaging for Next-Generation Silicon Photonic Applications</td>
</tr>
<tr>
<td>14:00–15:00</td>
<td><strong>Broadband Forum:</strong> Meeting Rural Broadband Needs with High Capacity PON</td>
</tr>
</tbody>
</table>

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

**Schedule**

**Tuesday, 26 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:15–10:45</td>
<td><strong>Conversation with the Plenary Speakers</strong></td>
</tr>
<tr>
<td>11:00–12:00</td>
<td><strong>MOPA:</strong> Mobile Optics (MOPA) for the 6G Era</td>
</tr>
<tr>
<td>13:00–13:30</td>
<td><strong>Infinera:</strong> Architecting the Network for the Terabit Era and in the Shadow of Shannon</td>
</tr>
<tr>
<td>13:45–14:15</td>
<td><strong>OFCnet:</strong> Telecom Fiber Networks as the Core of the Next Generation TerraScope</td>
</tr>
<tr>
<td>14:30–15:30</td>
<td><strong>F5G (ETSI):</strong> F5G Intelligent and Green Networks towards 2030</td>
</tr>
<tr>
<td>15:45–16:30</td>
<td><strong>OFCnet Panel:</strong> Quantum Key Distribution High-Speed Optical-Layer Encryption</td>
</tr>
</tbody>
</table>

**Wednesday, 27 March**

<table>
<thead>
<tr>
<th>Time</th>
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</tr>
</thead>
<tbody>
<tr>
<td>10:15–10:45</td>
<td><strong>Open XR Optics Forum:</strong> Open XR Optics Forum Update</td>
</tr>
<tr>
<td>11:00–11:45</td>
<td><strong>OFCnet Panel:</strong> Quantum Entanglement and Quantum Memory for Next Generation Quantum Networks</td>
</tr>
<tr>
<td>12:00–12:45</td>
<td><strong>OFCnet Panel:</strong> Beyond Point-to-Point Quantum Key Distribution</td>
</tr>
<tr>
<td>13:00–13:30</td>
<td><strong>OFCnet Panel:</strong> Software Define Infrastructures</td>
</tr>
<tr>
<td>13:45–14:15</td>
<td><strong>OpenROADM:</strong> Open ROADM MSA Updates and Demonstration</td>
</tr>
<tr>
<td>15:45–16:15</td>
<td><strong>ATOP:</strong> The Road to 200G per Lane</td>
</tr>
</tbody>
</table>

**Thursday, 28 March**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00–11:30</td>
<td><strong>OFCnet Panel:</strong> Optical Benchmarks</td>
</tr>
<tr>
<td>11:45–12:15</td>
<td><strong>OFCnet Panel:</strong> Optical Infrastructures and Services</td>
</tr>
<tr>
<td>14:45–15:45</td>
<td><strong>HyperLight:</strong> Current State and Future of Thin-Film Lithium Niobate Photonics</td>
</tr>
</tbody>
</table>
Other Show Floor Programming

OFCnet, Booth 923

OFC’s high-speed optical network, OFCnet, enables select demonstrations of networking products, solutions and architectures.

This live network is built to showcase emerging technologies, including quantum networking, network element interoperability, SDN and programmability, and networking for big data/big science applications.

OFCnet enables booth-to-booth fiber connectivity for on-site optical demonstrations while extending CENIC to the OFC Exhibitor show floor. This connectivity provides new opportunities for exhibitors collaborating with affiliated academic institutions to highlight advancements and capabilities in a live, real-time, fully operational network environment.

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Sergey Ten, Corning, USA
Chris Tracy, ESnet, USA
Christine Tremblay, ETS, USA
JP Velders, UVA, USA
Peter Wigley, Corning, USA
Carl Williams, CJW Quantum Consulting, USA

Demonstrations

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

Anritsu
AUREA Quantum
CESnet
Ciena/FABRIC/SDSC
Ciena/ID Quantique
Ciena/Toshiba
ICAIR/Northwestern University
NEC/Verizon/OF
Nokia/ID Quantique
NTT/IOWN Networking Hub
Nucrypt/Quantum Opus
Open ROADM MSA/IOWN
QuNett/University of Maryland
Qunnect
QTI/Telsy/TIM Group
University of Amsterdam
University of Bristol

OFCnet is supported by:
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Juthika Basak, Nokia Corp., USA
Janet Chen, Meta, USA
Molly Piel, OpenLight Photonics, USA
Sylvie Menezo, SCINTIL Photonics, France
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Joris Van Campenhout, IMEC, Belgium
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Liming Wang, Google, USA
Xi Xiao, NOIEC, China
Vivian Yang, Sicoya, China

D2: Passive Components
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Thalia Dominguez Bucio, University of Southampton, UK
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Laurent Viven, CNRS, France
Keita Yamaguchi, NTT, Japan
Mengjie Yu, University of Southern California, USA
Linjie Zhou, Shanghai Jiao Tong Univ, China

D3: Active Components
Connie Chang-Hasnain, Berxel Photonics, China, Subcommittee Chair
Omer Khayam, Google LLC, USA
Gong-ru Lin, National Taiwan University, Taiwan
Hai-Feng Liu, HG-Genuine, China
Guo-Qiang (Patrick) Lo, Advanced Micro Foundry, Singapore
Yi Luo, Tsinghua University, China
Joyce Poon, Max-Planck-Inst fur Mikrostrukturphysik, Germany
Johann Peter Reithmaier, Universitat Kassel, Germany
Patrick Runge, Fraunhofer Heinrich-Hertz Inst., Germany
M. Ashkan Seyedi, NVIDIA Corporation, USA
Wei Shi, Université Laval, Canada
Yuichi Tohmori, Tsurugi-Photonics Foundation, Japan

D4: Fiber and Propagation Physics
Takashi Matsui, NTT Corporation, Japan, Subcommittee Chair
Jose Antonio-Lopez, Creol, USA
Camille-Sophie Bres, Ecole Polytechnique Federale de Lausanne, Switzerland
Jin-Xing Cai, Subcom, USA
Ivana Gasulla Mestre, Universitat Politecnica de Valencia, Spain
Tristan Kremp, OFS Laboratories, USA
Georg Rademacher, NICT, Japan
Pierre Sillard, Prismian Group, France
Toshiki Tau, Sumitomo Electric Industries Ltd., Japan
Natalie Wheeler, University of Southampton, UK
Aramais Zakharian, Corning, USA

D5: Fiber Devices, Fiber Lasers and Amplifiers, and Nonlinear Waveguides
Yi Sun, OFS Fitel LLC, USA, Subcommittee Chair
John Ballato, Clemson University, USA
Lawrence Chen, McGill University, Canada
Vladimir Gordanienko, Aston University, UK
Victor Kopp, Chiral Photonics, USA
Xiaoying Li, Tianjin University, China
Atsushi Nakamura, NTT, Japan
Sergei P. Nikitin, T8 Sensor, Russia
Masato Tanaka, Sumitomo Electric Industries Ltd, Japan
Michael Vasilyev, The University of Texas at Arlington, USA
Seongwoo Yoo, Glasgow University, UK
Changyuan Yu, The Hong Kong Polytechnic University, Hong Kong

Track S: Subsystems and Systems

S1: Datacom Subsystems and Systems
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Robert Borkowski, Nokia Bell Labs, USA
Brandon Buscaino, Ciena, USA
Jingchi Cheng, Huazhong University of Science and Technology, China
Trey Greer, NVIDIA, USA
Fumio Koyama, Tokyo Institute of Technology, Japan
Fan Li, Sun Yat-Sen University, China
Wenhua Lin, Intel Corp., USA
Jeff Rahn, Meta, USA
Clint Schow, University of California, Santa Barbara, USA
Brian Taylor, Inphi, USA

S2: Transmission Subsystems
Hung-Chang (James) Chien, Marvell Technology Inc., USA, Subcommittee Chair
Yi Cai, Soochow University, China
Di Che, Nokia Bell Labs, USA
John Downie, Corning, Inc., USA
Ming-Fang (Yvonne) Huang, NEC Labs America, USA
Jianqiang Li, LightsoAI, USA
Gabriele Liga, Technical University of Eindhoven, Netherlands
David Millar, Infinera Canada, Canada
Dario Pilori, Politecnico di Torino, Italy
Ke (Desmond) Wang, RMIT Australia, Australia
Jiang Xu, Hong Kong University of Science and Technology, Hong Kong

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Fatima Garcia Gunning, Tyndall National Institute, Ireland
Amirhossein Ghazisaeidi, Nokia Bell Labs, France
Helmut Griesser, ADVA Optical Networking AG, Germany
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Toshiaki Koike-Akino, Mitsubishi Electric Research Labs, USA
Sergei Makovejs, Corning, Inc., USA
Antonio Mecozzi, University degli Studi dell’Aquila, Italy
Masanori Nakamura, NTT Network Innovation Laboratories, Japan
Yuta Wakayama, KDDI R&D Laboratories, Japan

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Prince Anandarajah, Dublin City University, Ireland
Bill Corcoran, Monash University, Australia
Tomoyuki Kato, Fujitsu, Japan
Tetsuya Kawanishi, Waseda University, Japan
Lan Liu, University of California San Diego, USA
Mikael Mazur, Nokia Bell Labs, USA
Lalitha Ponnampalam, University College London, UK
Xiaoke Yi, Univ. of Sydney, Australia
Darko Zibar, Denmark Technical University, Denmark
Stanislav Zivanovic, Czech Technical University in Prague, Czech Republic

S5: Free-Space (FSO), Ranging (LIDAR), and Radio-over-Fiber (RoF)
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Harald Haas, University of Strathclyde/pureLiFi Ltd., UK
James Lott, TU Berlin, Germany
Chao Lu, Sun Yat-sen-sen University, China
Maria Morant Perez, University Politecnica de València, Spain
Katherine Newell, Johns Hopkins University Applied Physics Lab, USA
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Oskaars Ozolins, RISE Research Institutes of Sweden, Sweden
Shihong Pan, Nanjing University of Aeronautics and Astronautics, China
Bernhard Schrenk, Austrian Institute of Technology, Austria
Perry Ping Shum, Southern University of Science and Technology, China
Edwarud Tangdiongga, Technische University Eindhoven, Netherlands
Jih-Heng Yan, Chunghwa Telecom, Taiwan

Track N: Networks and Services
N1: Advances in Development of Systems, Networks and Services
Dirk Van Den Borne, Juniper Networks Inc., Germany, Subcommittee Chair
Mattia Cantono, Google LLC, USA
Saifuddin Faruk, Bangor University, UK
Binbin Guan, Microsoft, USA
Sander Jansen, ADVA, Germany
Lynn Nelson, AT&T, USA

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Hitesh Ballani, Microsoft Research Ltd., UK
Liam Barry, Dublin City University, Ireland
Nicola Calabretta, Technische University, Eindhoven, Netherlands
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Shu Namiki, AIST, Japan
Mahdi Nikdast, Colorado State University, USA
Nikos Pleros, Aristotle Univ., of Thessaloniki, Greece
Volker Sorger, George Washington University, USA

N3: Architectures and Software-defined Control for Metro and Core Networks
Konstantinos (Kostas) Christodouloupoloulos, Nokia Bell Labs, Germany, Subcommittee Chair
Marija Furdek, Chalmers University of Technology, Sweden
Ashwin Gumaste, Indian Inst. of Technology Bombay, India
Hasegawa Hiroshi, Nyoju Univ., Japan
Jason Jae, The Univ. of Texas at Dallas, USA
Dan Kilper, Trinity College Dublin, Ireland
Yvan Pointurier, Huawei, France
Cristina Rottondi, Politecnico di Torino, Italy
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Ricard Vilalta, CTTC, Spain
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Zhu Ziqing, University of Science & Technology of China, China

N4: Optical Access Networks for Fixed and Mobile Services
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Nan Chi, Fudan University, China
Naveena Genay, Orange Labs, France
Huang Xingang, ZTE, China
Ruan Li, Peng Cheng Laboratory, China
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Annachiara Pagano, TIM, Italy
Chathu Ranaweera, Deakin University, Australia
Luca Valcarenghi, Scuola Superiore Sant’Anna, Italy
Lilin Yi, Shanghai Jiao Tong University, China
Jim Zou, ADVA, Germany
Haipeng Zhang, CableLabs, USA

N5: Market Watch, Network Operator Summit & Data Center Summit (Invited Program Only)
Lisa Huff, Omdia, USA, Subcommittee Chair
Martin Birk, Curbius, USA
Paulina Gomez, Ciena, Canada
Di Liang, Alibaba Group, USA
Kentaro Nakamura, Fujitsu, Japan
Sanjai Parthasarathi, II-VI Incorporated, USA
Lian Qin, Marvell Technology Inc., USA
Yoshiaki Sone, NTT Access Service Systems Laboratories, Japan
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Eleni Diamanti, CNRS, France
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Tobias Gehring, Technical University of Denmark, Denmark
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Josh Nunn, ORCA Computing, UK
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Zhiliang Yuan, Beijing Acad of Quantum Info. Sciences, China

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David Millar, Infinera, USA
Hideyuki Nasu, Furukawa Electric, Japan
Luiz Anet Neto, IMT Atlantique, France
Chigo Okonkwo, Technische Universität Eindhoven, Netherlands
Ben Puttnam, National Institute of Information and Communications Technology (NICT), Japan
Yikai Su, Shanghai Jiao Tong University, China
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Jun Shan Wey, Verizon Communications Inc., USA
Peter Winzer, Nubis Communications, USA
## Explanation of Session Codes

<table>
<thead>
<tr>
<th>Session Designation</th>
<th>Number</th>
<th>Series Number</th>
<th>Series Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(alphabetically)</td>
<td>(alphabetically)</td>
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</tbody>
</table>

### Notes:

- **Day Of The Week**
  - S = Sunday
  - M = Monday
  - T = Tuesday
  - W = Wednesday
  - Th = Thursday

- **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

- **Top Scored**
  - Top Scored Paper
## Agenda of Sessions — Sunday, 24 March

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 2</th>
<th>Room 6C</th>
<th>Room 6D</th>
<th>Room 6E</th>
<th>Room 6F</th>
<th>Room 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:30–12:30</td>
<td></td>
<td>SC105, SC203, SC208, SC216, SC328, SC395, SC432, SC461, SC463, SC469, SC470</td>
<td></td>
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<tr>
<td>09:00–12:00</td>
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<td></td>
<td>SC177, SC359, SC459</td>
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<tr>
<td>12:00–13:00</td>
<td>Lunch Break (on own)</td>
<td></td>
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</tr>
<tr>
<td>13:00–15:30</td>
<td>S1A • Workshop: How Can OFC, with a Real Life Test-Bed, Accelerate Innovation in the Optical Photonic Networks?</td>
<td>S1B • Workshop: How Can Generative AI be Used for Network Operations?</td>
<td>S1C • Workshop: Multi-Fiber/Multi-Core Is Inevitable, Do We Even Need the S-Band?</td>
<td>S1D • Workshop: Are Coherent Transceivers About to Experience a Bandwidth Crunch?</td>
<td>S1E • Workshop: Co-Packaged Optics: Is it Only for the Cloud or Also for the Edge AI Services?</td>
<td>S1F • Workshop: Neural Networks for Optical Fiber Transmission: Hype or Hope?</td>
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<td>13:00–16:00</td>
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<td>SC408, SC512</td>
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<tr>
<td>13:30–17:30</td>
<td>Simulating Datacom/Telecom Applications Following Standards Specifications, Room 31C</td>
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<tr>
<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: Will Heterogeneous Integration Meet the Needs of Future Applications?</td>
<td>S2B • Workshop: Will Optical Switches Become a Key Element in High-Performance AI/ML Datacenter Networks?</td>
<td>S2C • Workshop: Which Types of Fiber Will Be the Most Suitable for Network Operators in the Near Future?</td>
<td>S2D • Workshop: Coherent Optics for Next Generation 100G/200G PON: Single-Carrier or Multi-Carrier?</td>
<td>S2E • Workshop: Will Linear Pluggable Optics (LPO) Have a Future Beyond 112G?</td>
<td>S2F • Workshop: QKD – An End-Game or Just a Stepping Stone to the Quantum Internet?</td>
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<tr>
<td>19:00–21:00</td>
<td>Hack Your Research! Tools and Tricks for Today’s Telecommunications Techies, Room 6A</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, 25 March

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1A</th>
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<td>07:30–08:00</td>
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<tr>
<td>08:00–10:00</td>
<td>M1A • Fiber Sensing Devices</td>
<td>M1B • Fiber-Based Nonlinear-Optic and Optoelectronic Devices</td>
<td>M1C • Green Transformation: Where Do We Stand? I</td>
<td>M1D • High Power and Narrow Linewidth Lasers</td>
<td>M1E • DSP and Multiplexing Techniques</td>
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<tr>
<td>09:00–12:00</td>
<td>SC465</td>
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<td>10:30–12:30</td>
<td>M2A • Multi-Mode Propagation in Optical Fibers</td>
<td>M2B • Datacom: Coding and Equalization</td>
<td>M2C • Green Transformation: Where Do We Stand? II</td>
<td>M2D • VCSELs and Modulator Technologies</td>
<td>M2E • SDM Amplifiers and Multiplexers</td>
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<tr>
<td>12:30–14:00</td>
<td>Lunch Break (on own)</td>
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<td>13:30–16:30</td>
<td>SC114, SC217, SC261, SC447, SC485, SC526 (new), SC528 (new)</td>
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<tr>
<td>14:00–16:00</td>
<td>M3A • Hybrid Integration and Packaging</td>
<td>M3B • SDM Devices and Mode Manipulation</td>
<td>M3C • Quantum Dots Lasers and Comb Generation</td>
<td>M3D • Frontiers of Optical Network Architecture Summit</td>
<td>M3E • Coherent and Direct Detect Datacenter Transmission</td>
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<tr>
<td>14:00–16:00</td>
<td>M3Z • Demo Zone, Room 6B</td>
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<td>16:00–16:30</td>
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<tr>
<td>16:30–18:30</td>
<td>M4A • Silicon Photonics</td>
<td>M4B • Integrated Devices for Sensing and Metrology</td>
<td>M4C • Machine Learning and Neural Networks</td>
<td>M4D • Resilience in Access Networks</td>
<td>M4E • Data Centre and Submarine</td>
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<td>19:00–21:00</td>
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### Coffee Break (Upper Level Corridors)

**Optica Executive Forum at OFC 2024, Hilton San Diego Bayfront**

- M1F • Multi Band Transmission Systems
- M1G • Optical Networks for Disaggregated and Composable Computing Systems
- M1H • Machine Learning for Estimation and Forecasting
- M1I • Next Generation Coherent PON
- M1J • Waveguide Mode Converters and Fiber-to-Chip Couplers
- M1K • Distributed Sensing I

**Room 1A Room 1B Room 2 Room 3 Room 6C Room 6D Room 6E Room 6F Room 7 Room 8 Room 9**

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### Coffee Break (Upper Level Corridors)

- M2A • Multi-Mode Propagation in Optical Fibers
- M2B • Datacom: Coding and Equalization
- M2C • Green Transformation: Where Do We Stand? II
- M2D • VCSELs and Modulator Technologies
- M2E • SDM Amplifiers and Multiplexers
- M2F • Sub-Millimeter Wave and THz Communication
- M2G • Photonic Switched Data Center Networks
- M2H • High-Speed Transceivers and Transmission
- M2I • Panel: The Role of Digital Twins in Optical Networking
- M2J • Quantum Protocols, Simulations and Analysis
- M2K • Distributed Sensing II

### Lunch Break (on own)

**Room 1A Room 1B Room 2 Room 3 Room 6C Room 6D Room 6E Room 6F Room 7 Room 8 Room 9**

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<td>SC114, SC217, SC261, SC447, SC485, SC526 (new), SC528 (new)</td>
<td>SC325, SC327, SC347, SC357, SC384, SC431, SC451, SC453B</td>
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### Coffee Break (Upper Level Corridors)

- M3A • Hybrid Integration and Packaging
- M3B • SDM Devices and Mode Manipulation
- M3C • Quantum Dots Lasers and Comb Generation
- M3D • Frontiers of Optical Network Architecture Summit
- M3E • Coherent and Direct Detect Datacenter Transmission
- M3F • Radio-Over-Fiber and 6G Access
- M3G • Panel: The Road Towards 3.2 Tb/s Intra-Data Center Communications
- M3H • Advancement in Quantum Key Distribution Systems I
- M3I • Transmission Optimization
- M3J • Hollow-Core Fibers
- M3K • Emerging Modulator Technologies

**Room 1A Room 1B Room 2 Room 3 Room 6C Room 6D Room 6E Room 6F Room 7 Room 8 Room 9**

**M3Z • Demo Zone, Room 6B**

### Coffee Break (Upper Level Corridors)

- M4A • Silicon Photonics
- M4B • Integrated Devices for Sensing and Metrology
- M4C • Machine Learning and Neural Networks
- M4D • Resilience in Access Networks
- M4E • Data Centre and Submarine
- M4F • Advanced Optical Communication Technologies
- M4G • Panel: The Road Towards 3.2 Tb/s Intra-Data Center Communications
- M4H • Advancement in Quantum Key Distribution Systems II
- M4I • Panel: Wideband Optical Amplifiers for Datacenters, Hyperscale Networks and Telecom Networks
- M4J • Integrated Optics for Communication and Sensing
- M4K • Nonlinear Transmission

**Room 1A Room 1B Room 2 Room 3 Room 6C Room 6D Room 6E Room 6F Room 7 Room 8 Room 9**

**Student Party, Coin-Op Gaslamp**
## Agenda of Sessions — Tuesday, 26 March

<table>
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<tr>
<th>Time</th>
<th>Room 1A</th>
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<th>Room 6E</th>
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<tbody>
<tr>
<td>07:30–08:00</td>
<td>Plenary Session Coffee Break, Upper Level, Ballroom 20 Lobby</td>
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<td>08:00–10:00</td>
<td>Tu1A • Plenary Session, Ballroom 20</td>
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<td>10:00–17:00</td>
<td>Exhibition and Show Floor Programs, Exhibit Hall (concessions available)</td>
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<td>10:00–14:00</td>
<td>Exhibit-only Time, Exhibit Hall (coffee service 10:00–10:30)</td>
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<td>10:00–16:45</td>
<td>Career Zone, Exhibit Hall B1</td>
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<td>10:30–12:00</td>
<td>The Art of Writing the Perfect OFC Paper, 6A</td>
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<tr>
<td>12:30–14:00</td>
<td>Awards Ceremony and Luncheon, Upper Level, Ballroom 20</td>
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<td>14:00–16:00</td>
<td>Tu2A • Optical Transmission Techniques</td>
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<td></td>
<td>Tu2B • Nonlinear Photonic Devices and Material Platforms</td>
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<td>Tu2C • Quantum Components and Quantum PICs</td>
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<td></td>
<td>Tu2D • High Speed Transmitters</td>
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<td></td>
<td>Tu2E • Advanced Optical Fibers</td>
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<td>Tu2F • Moore’s Law: A Photonics Perspective for the Next Decade</td>
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<td>Tu2G • Panel: Beyond Two-Core Fibers: Single-Core vs Multi-Core Amplifiers in Long-Haul SDM Links</td>
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<td>16:00–16:30</td>
<td>Coffee Break, Exhibit Hall Elevated Coffee Break Sponsored by Infinera, Booth 4217</td>
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<td>16:30–18:30</td>
<td>Tu3A • CPO and Ecosystems</td>
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<td>Tu3B • 6G and Emerging Applications</td>
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<td>Tu3C • Quantum Information Generation, Distribution and Processing</td>
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<td>Tu3D • High Speed Photodetectors</td>
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<td>Tu3E • High Bit Rate High Capacity Transmission</td>
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<td>Tu3F • Optical Neural Networks</td>
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<td>Tu3G • Panel: Cutting-Edge Technologies for Interconnecting AI/ML Clusters</td>
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<td>19:30–21:30</td>
<td>Rump Session: How Much Optics Does AI Need?, Room 6F</td>
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<td>Exhibit Hall Theater II</td>
<td>Exhibit Hall Theater III</td>
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<td>Plenary Session Coffee Break, Upper Level, Ballroom 20 Lobby</td>
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<td>Tu1A • Plenary Session, Ballroom 20</td>
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<td>Exhibition and Show Floor Programs, Exhibit Hall (concessions available)</td>
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<td>The Art of Writing the Perfect OFC Paper, 6A</td>
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<td>Awards Ceremony and Luncheon, Upper Level, Ballroom 20</td>
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<td>Tu2A • Transceiver and Transmission Impairments Mitigation</td>
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<td>Tu2B • Panel: Can New Access Technology and Architectures Support the Beyond 5G Network Vision</td>
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<td>Tu2C • Fiber Sensing Applications I</td>
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<td>Tu2D • Fiber Sensing Applications II</td>
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<td>Tu2E • Indoor Optical Wireless Communication</td>
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<td>Tu3F • Advanced Optical Subsystems</td>
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<td>Tu3G • Disaggregated and Software Defined Access Networks</td>
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<td>Tu3H • Fiber Sensing Applications II</td>
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<td>Tu3J • High Capacity Radio-over-Fiber Communication</td>
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<td>Coffee Break, Exhibit Hall Elevated Coffee Break Sponsored by Infinera, Booth 4217</td>
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<td>Conference Reception, Ballroom 20BCD</td>
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<td>Rump Session: How Much Optics Does AI Need?, Room 6F</td>
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<tr>
<td>MW1 • MW Panel I: State of the Industry 10:45–12:15</td>
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<td>MW2 • MW Panel II: Inside the Data Center Focused on AI/ML 12:30–14:00</td>
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<td>MW3 • MW Panel III: Coherent Technology Advancements to Address Next-Gen Networking Requirements 14:15–14:45</td>
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<td>CISCO: Who Controls the DCO’s in Routers? 16:00–17:00</td>
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<tr>
<td>Next Generation Optical Interconnects for AI Clusters: Beyond Linear Drive Optics 10:45–11:45</td>
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<td>DCS1 • Keynote 12:00–12:30</td>
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<td>DCS2 • Panel I: ML/ML and Future Networks to Support it 12:30–14:00</td>
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<td>DCS3 • Panel II: Lowering Power Consumption in Optical Solutions 14:15–15:45</td>
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<td>Photonics in Current and Future Machine Learning Network Infrastructure 16:00–17:00</td>
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<td>MIC • MPA Panel II: State of the Industry 10:45–12:15</td>
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<td>MPA1 • MPA Panel II: Inside the Data Center Focused on AI/ML 12:30–14:00</td>
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<td>MPA2 • MPA Panel III: Coherent Technology Advancements to Address Next-Gen Networking Requirements 14:15–14:45</td>
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<td>MPA3 • MPA Panel III: Coherent Technology Advancements to Address Next-Gen Networking Requirements 14:15–14:45</td>
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<td>MPA4 • Panel I: ML/ML and Future Networks to Support it 12:30–14:00</td>
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<td>MPA5 • Panel II: Lowering Power Consumption in Optical Solutions 14:15–15:45</td>
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<td>Photonics in Current and Future Machine Learning Network Infrastructure 16:00–17:00</td>
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<td>Conversation with the Plenary Speakers 10:15–10:45</td>
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<td>MOPA: Mobile Optics (MOPA) for the 6G Era 11:00–12:00</td>
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<td>Infinera: Architecture the Network for the Terabit Era and in the Shadow of Shannon 13:00–13:30</td>
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<td>OFCnet Panel: Telecom Fiber Networks as the Core of the Next Generation TerraScope 13:45–14:15</td>
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<td>F5G Intelligent and Green Networks towards 2030 14:30–15:30</td>
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<td>OFCnet Panel: Quantum Key Distribution High-Speed Optical-Layer Encryption 15:45–16:30</td>
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OFC 2024 • 24–28 March 2024
## Agenda of Sessions — Wednesday, 27 March

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<th>Time</th>
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<td>06:00–07:00</td>
<td>OFC Fun Run, San Diego Convention Center Front Entrance</td>
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<td>07:30–08:00</td>
<td>Coffee Break, Upper Level Corridors</td>
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<td>08:00–10:00</td>
<td>W1A • Integrated Filters for Communication Systems</td>
<td>W1B • Monitoring and Sensing</td>
<td>W1C • Network Control and Orchestration</td>
<td>W1D • Doped Fiber Amplifiers and High Power Laser</td>
<td>W1E • Digital Subsystems for SDM and SCM Transmissions</td>
<td>W1F • Optical Computing and Memory</td>
<td>W1G • Panel: Next Generation Disaggregated Data Centers Using Future Chip to System Photonic Technologies</td>
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<td>10:00–17:00</td>
<td>Exhibition and Show Floor Programs, Exhibit Hall, (coffee service 10:00–10:30)</td>
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<td>10:30–12:30</td>
<td>W2A • Posters Session I, In-Person, Exhibit Hall B1</td>
<td>W2B • Posters Session II, Remote, eGallery on OFC website</td>
<td>Lunch Break (on own; concessions available in Exhibit Hall)</td>
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<td>12:45–13:45</td>
<td>Challenges and Solutions for Realizing Quantum Fiber-Based Networks, Room 3</td>
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<td>14:00–16:00</td>
<td>W3A • Transmitters and Receivers</td>
<td>W3B • Optical Signal Processing</td>
<td>W3C • Network Planning and Operation</td>
<td>W3D • Laser Stabilization and Comb Sources</td>
<td>W3E • Embracing Fiber Sensing: What’s the “Killer App” for Large-Scale Deployments? I</td>
<td>W3F • Submarine Long-Haul and Repatterless Transmission</td>
<td>W3G • Coherent DWDM pluggables</td>
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<td>16:00–16:30</td>
<td>Coffee Break, Upper Level Corridors and Exhibit Hall</td>
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<td>16:30–18:30</td>
<td>W4A • THz Processing and Communications</td>
<td>W4B • FSO for Turbulent and Underwater Channels</td>
<td>W4C • Coding and Modulation</td>
<td>W4D • Amplifier Architecture for Data Transmission</td>
<td>W4E • Embracing Fiber Sensing: What’s the “Killer App” for Large-Scale Deployments? II</td>
<td>W4F • Optical Architectures and Subsystems for Accelerating ML/AI Applications</td>
<td>W4G • Space Communication</td>
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<td>17:00–19:00</td>
<td>Photonics Society of Chinese (PSC) Heritage Workshop and Networking Social, Room 15</td>
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<td>Room 6F</td>
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<td>OFC Fun Run, San Diego Convention Center Front Entrance</td>
<td>Coffee Break, Upper Level Corridors</td>
<td>W1H • Short-Reach Transmission</td>
<td>W1A • Integrated Communications</td>
<td>NOS1 • Network Operator Summit: Keynote</td>
<td>Ethernet Interconnect Solutions: Will The Advancement in Coherent Signaling Leverage DataCom Connect</td>
<td>Open XR Optics Forum: Open XR Optics Forum Update</td>
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<td></td>
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<td>W1I • Panel: Photonic Components for In-Physics Computing</td>
<td>W1J • Access, Metro and Mobile Convergence</td>
<td>W1K • Photonic Integration and Integrated Receivers</td>
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<td>Exhibition and Show Floor Programs, Exhibit Hall, (coffee service 10:00–10:30)</td>
<td>W1L • Photonic Components for Server Interconnection</td>
<td>W1M • High-Speed Optical Interconnects, Coherent Signaling</td>
<td>W1N • Optical Interconnects and Interconnectivity</td>
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<td>Career Zone, Exhibit Hall B1</td>
<td>W2A • Posters Session I, In-Person, Exhibit Hall B1</td>
<td>W2C • Posters Session III, In-Person, Exhibit Hall B1</td>
<td>W2E • Posters Session V, Remote, eGallery on OFC website</td>
<td>W2G • Posters Session VII, Remote, eGallery on OFC website</td>
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<td>W2B • Posters Session II, Remote, eGallery on OFC website</td>
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<td>Exhibit-only Time, Exhibit Hall</td>
<td>W3A • Transmitters</td>
<td>W3B • Optical and Sensing Systems</td>
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<td>The Journal Review Process: All You Need to Know!, Room 6A</td>
<td>W3C • Network Control and Planning</td>
<td>W3D • Network Planning and SDM and SCM Applications</td>
<td>Open COFnet Panel: Quantum Entanglement and Quantum Memory for Next Generation Quantum Networks</td>
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<td>Challenges and Solutions for Realizing Quantum Fiber-Based Networks, Room 3</td>
<td>W3E • Embracing Scale Deployments? What's the &quot;Killer App&quot; for Large-Scale Deployments?</td>
<td>W3F • Submarine Computing and Measurement Coherence</td>
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<td>W3G • Coherent Technologies</td>
<td>W3H • Large Capacity Interconnect</td>
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<td>W3I • Panel: Role of Optics for Space Communication</td>
<td>W4A • Datacom Modulation and Linear Transceivers</td>
<td>W4B • FSO for Signal Processing</td>
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<td>W3J • Multi-Core Fiber Design and Transmission Characteristics</td>
<td>W4C • Coding and Operation Planning and Convergence</td>
<td>W4D • Amplifier Comb Sources Stabilization and Power Laser</td>
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<td>Coffee Break, Upper Level Corridors and Exhibit Hall Elevated Coffee Break Sponsored by Infinera, Booth 4217</td>
<td>W4E • Embracing SDM and SCM Applications Accelerating ML/AI Subsystems for Architectures and Systems</td>
<td>W4F • Optical Transmission Repaterless Long-Haul and</td>
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<td>W4G • Space DWDM Pluggables</td>
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<td>W4I • AI-Based Automation</td>
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<td>W4J • Multi-Core Fiber Characterization and Connection</td>
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<td>W4K • PICs for Quantum Communication and Quantum Computing: Challenges and Opportunities I</td>
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OFC 2024 • 24–28 March 2024
## Agenda of Sessions — Thursday, 28 March

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<td>08:00–10:00</td>
<td>Th1A • Programmable Circuits/Switches and Control Technologies</td>
<td>Th1B • Datacom: VCSELs, Multi-Lambda Sources, Spatial Multiplexing</td>
<td>Th1C • Wireless and Access Quantum Networks</td>
<td>Th1D • Integrated Nonlinear-Optical Devices and Amplifiers</td>
<td>Th1E • Advanced PON Technology</td>
<td>Th1F • Optical Methods and Sensing</td>
<td>Th1G • Open Line Systems and Digital Twins</td>
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<td>10:00–16:00</td>
<td>Exhibition and Show Floor Programs, Exhibit Hall, (coffee service 10:00–10:30)</td>
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<td>Th2A • Posters Session III, In-Person, Exhibit Hall B1</td>
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<td>14:00–16:00</td>
<td>Th3B • Practical Security Demonstration</td>
<td>Th3C • Free Space Optical Communication</td>
<td>Th3D • Photonic Integration for Novel Applications</td>
<td>Th3E • MCF Based Transmission</td>
<td>Th3F • Sub-THz and mm-wave Signal Processing</td>
<td>Th3G • Optical Computing and Accelerators</td>
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<td>Postdeadline Paper Sessions, Room 6C, 6D, 6E, 6F</td>
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<td>Coffee Break, Upper Level Corridors</td>
<td>Th1H • MMF Based Transmission</td>
<td>Th1I • Next Generation ROADMs, Multiband and SDM Networking</td>
<td>Th1J • Short-Reach Transmission Systems</td>
<td>MW5 • MW Panel V: Disaggregation Inside the DC 10:15–11:45</td>
<td>MW6 • MW Panel VI: Disaggregation for Network Operators 12:00–13:30</td>
<td>OFCnet Panel: Optical Benchmarks 11:00–11:30</td>
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<td>Exhibition and Show Floor Programs, Exhibit Hall, (coffee service 10:00–10:30)</td>
<td>Exhibit Hall Opens at 10:00</td>
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<td>Low-Latency High-Speed Optical Interconnection Technologies for AI Compute Era 11:30–12:30</td>
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<td>OFCnet Panel: Optical Infrastructures and Services 11:45–12:15</td>
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<td>Career Zone, Exhibit Hall B1</td>
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<td>AIM Photonics Presents PICs, Heterogeneous Integration, and Packaging for Next-Generation Silicon Photonics Applications 12:45–13:45</td>
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<td>Current State and Future of Thin-Film Lithium Niobate Photonics 14:45–15:45</td>
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<td>Th2A • Posters Session III, In-Person, Exhibit Hall B1 Lunch Break (on own; concessions available in Exhibit Hall)</td>
<td>Exhibition-only Time, Exhibit Hall</td>
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**M1A • Fiber Sensing Devices**
- **M1A.1 • 08:00**
  - Single Frequency Fiber Laser Strain Sensors: Principles and Applications, Geoffrey A. Cرانch1, Logan L. Richardson1, Caitlin Williams1, Gary Miller1, Ryan Seeley1, Evan Hardesty1, 1US Naval Research Laboratory, USA; 2Sequent Logic, USA.
  - This paper discusses challenges for optimizing energy efficiency in telecommunications networks, encompassing areas like data centers, network protocols, equipment, AI-driven management, and efficient data collection, with a focus on reducing environmental impact and operational costs.

**M1B • Fiber-Based Nonlinear-Optic and Optoelectronic Devices**
- **M1B.1 • 08:00**
  - Demonstration of a Stable, High-Performance Mach-Zehnder Polarization-Insensitive Fiber Optical Parametric Amplifier, Florent Besin1,2, Vladimir Gordinenko1, Filipe Ferreira1, Nick J. Doran1, 1Université d’Angers, LPHIA, SFR MA-TRIX, F-49000 Angers, France, France; 2Aston Inst of Photonic Technologies, Aston Univ., B4 7ET Birmingham, UK, UK.

- **M1B.2 • 08:15**
  - Employment of Polarization Diversity Architecture to Mitigate an Impact of the Pump Phase Modulation in FOPA, Maria Bastamova1, Vladimir Gordinenko1, Nick J. Doran1, Andrew Ellis1, 1Aston Univ., UK. We demonstrate via simulations and experiments that a FOPA-polarization-diverse architecture allows to mitigate an impact of pump phase modulation on amplified signals and thus reduce or almost eliminate the signal required-OSNR penalty.

**M1C • Green Transformation: Where Do We Stand?**
- **M1C.1 • 08:00**
  - CW-WDM MSA Compatible 100-mW Up to 50°C, 400-GHz Spacing Highly-Reliable CW-DFB 8-Channel Laser Array, Ryosuke Hata1, Kouji Nakahara2, Atsushi Nakamura3, Takayuki Nakajima1, Yoshitaka Kobayashi1, Takeo Kageyama1, Shigehisa Tanaka2, Lumentum Japan Inc, Japan. We demonstrate a CW-WDM MSA compatible 8-channel 400-GHz spacing 100-mW CW-DFB laser array, with uniform channel spacings (±100 GHz) from 20 to 75°C, small channel-to-channel power deviations (0.56 dB) and over 2000-hour-operation reliability at 80°C.

- **M1D • High Power and Narrow Linewidth Lasers**
  - **M1D.1 • 08:00**
    - CW-WDM MSA Compatible 100-mW Up to 50°C, 400-GHz Spacing Highly-Reliable CW-DFB 8-Channel Laser Array, Ryosuke Hata1, Kouji Nakahara2, Atsushi Nakamura3, Takayuki Nakajima1, Yoshitaka Kobayashi1, Takeo Kageyama1, Shigehisa Tanaka2, Lumentum Japan Inc, Japan. We demonstrate a CW-WDM MSA compatible 8-channel 400-GHz spacing 100-mW CW-DFB laser array, with uniform channel spacings (±100 GHz) from 20 to 75°C, small channel-to-channel power deviations (0.56 dB) and over 2000-hour-operation reliability at 80°C.

**M1E • DSP and Multiplexing**
- **M1E.1 • 08:00**
  - Electrical and Optical Multiplexing Technique for High Symbol Rate Signal Generation, Hiroshi Yamazaki1,2, 1NTT Network Innovation Laboratories, Japan; 2NTT Network Innovation Laboratories, Japan. This tutorial describes multiplexing technologies for generating high-speed optical signals with bandwidths exceeding those of DACs. Both electrical and optical approaches are covered based on a common analytical framework. Recent experimental results are also reviewed.

**M1F • Multi-Band Transmission Systems**
- **M1F.1 • 08:00**
  - Modeling and Experimental Verification in S+C+L+U Quadrable-Band WDM Transmission System Using C+L-Band Transceivers and Wavelength Converters, Hidenobu Muranaka1, Tomoyuki Kato1, Tomohiro Yamauchi1, Hiroyuki Irie1, Hiroki Oo1, Yu Tanaka1, Shimeji Shinsu1, Takuya Koyashi1, Takushi Kazama1, Masashi Abe1, Takeshi Uemuki1, Yutaka Miyamoto1, Takashi Hashida1, Fujitsu Limited, Japan; 2NTT Network Innovation Laboratories, Japan; 3NTT Device Technology Laboratories, Japan. We experimentally verify wideband WDM transmission modeling in over 17-THz 5+S+C+L+U quadrable-band transmission using PPLN-based wavelength converters. We confirmed within 3.3-db errors between modeling after 80-km SSMF transmission of DP-16QAM and DP-QPSK signal.

- **M1F.2 • 08:15**
  - Performance Enhancement of Long-Haul C+L+5 Systems by Means of CFM-Assisted Optimization, Yanchao Jiang1, Antonello Nespola1, Alberto Tarzu1, Stefano Piciacca1, Mahdi Ranjar Zefreh1, Fabrizio Fornieri1, Pierluigi Faggionato1, Politecnico di Torino, Italy; 1UNKS Foundation, Italy; 2CISCO Photonics Italy srl, Italy. We investigate C+L+5-long-haul systems using a closed-form-model for launch power and Raman pump optimization. We show a potential 4x throughput increase over standard C-band systems in 1000km links, using moderate S-only Raman amplification.
Programmable Silicon Photonics for the Implementation of Topological Systems, Andrea Blanco-Redondo, Andrea Blanco-Redondo, CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA. Topological photonics offers a platform to explore both fundamental physics and applications in integrated photonics. In this talk we unveil our latest results on the implementation of topological models in programmable integrated photonic platforms.

M1H.1 • 08:00 Machine Learning-Based Polarization Signature Analysis for Detection and Categorization of Eavesdropping and Harmful Events, Leyla Sadighi, Stefan Karlsson, Carlos Natale, Marja Furdek, Chalmers Univ. of Technology, Sweden; Swedish Defense Material Administration, Sweden. We propose a methodology that uses polarization state changes and machine learning to detect and classify eavesdropping, harmful, and non-harmful events in the optical fiber network. Our solution achieves 92.3% accuracy over 13 experimental scenarios.

M1I.1 • 08:00 Preamble Design for Joint Frame Synchronization, Frequency Offset Estimation and Channel Estimation in Burst Mode Coherent PON, Yongxin Sun, Hejun Jiang, Lilin Yi, Wusheng Hu, Qunbi Zhuge, Shanghai Jiao Tong Univ., China. We propose a preamble jointly achieving frame synchronization, frequency offset and channel estimation for burst-mode detection in coherent PON. The DSP converges within a 272-symbol preamble in a 15GBaud experiment.

M1J.1 • 08:00 3D Self-Aligning, Polarization-Independent Fiber-to-Chip Couplers, Ramesh K, Trisha Chakraborty, Thomas E. Murphy, Karen E. Grutter, Univ. of Maryland College Park, USA; Laboratory for Physical Sciences, USA. We demonstrate low-loss (<1 dB), broadband (BW~100 nm near λ~1550 nm) and polarization-independent fiber-to-chip couplers using 3D nano-printed polymer structures on SiN/SiO2 platform.

M1K.1 • 08:00 Distributed Acoustic Sensing Over Passive Optical Networks Using Enhanced Scatter Fiber, Benyuan Zhu, Paul Westbrook, Kenneth Feder, zhou shi, Ping Li, Robert Dykes, Xiaoyang Sun, Je Li, Daniel Peterson, David DiGiovanni, OFS Laboratories, USA; OFS, USA. Simultaneous fiber-optic sensing and NG-PON data transmissions over a 1x16 splitter is demonstrated by enhanced scatter fiber. Acoustic signals from a single distribution fiber are identified. The crosstalk between sensing and data channels is studied.

M1H.2 • 08:15 Autonomous Capacity Adjustment with Dynamic Margin Allocation for Optical Enterprise Links, Mihail Balanici, Behnam Shanab, Pooyan Safari, Germaino Bengt, Johannes Fischer, Fraunhofer HHI, Germany; Horváth AG, Germany. This work presents a novel machine-learning-based dynamic capacity allocation scheme for efficient bandwidth provisioning of optical links. It offers an average hourly capacity saving of over 75% compared to traditional static capacity allocation mechanisms.

M1J.2 • 08:15 Broadband and Low-Loss Metamaterial Silicon Nitride Edge Coupler, An He, Jinfeng Xiang, Yootian Zhao, Yushen Yin, Yiya Zhang, Xuan Guo, Yikai Su, Shanghai Jiao Tong Univ., China. We report a SiN edge coupler based on metamaterial structure with simple fabrication process, the coupling loss with SMF is <1.6/2.1 dB at 1310/1550 nm. The loss is smaller than 1.86/2.80 dB in O/S+C+L band.

M1K.2 • 08:15 Correlation-Based OTDR for High-Resolution Monitoring in Passive Optical Networks, Zhiyong Zhang, Wu Li, Ming Luo, Ming Li, Xi Xue, Fiberhome Telecommunication Technologies Co., Ltd, China; National Key Laboratory of Optical Communication Technologies and Networks, China; National Information Optoelectronics Innovation Center, China. Utilizing correlation detection and comb optical transceivers, we detected <58 dBm reflection signals with <10 cm spatial resolution in typical PON scenarios. Optical power monitoring and fault diagnosis are accomplished through analyzing the correlation results.
M1A • Fiber Sensing Devices—Continued

M1A.2 • 08:30 Optical Fiber Tags Based on Encoded FBG Array, Xiangpeng Xiao1,2, Weiliang Qiao2, Yi Pan1, Ke Ai1, Peng Wang1, Lei Deng1, Chen Liu1,2, Qa Yang1,2, Qizhen Sun1,2, Zhijun Yan1,2, Huazhong Univ of Science and Technology, China; 2HUST-Wuxi Research Inst., China; 3Jinyinhu Laboratory, China. We proposed an optical fiber tag for identifying the massive passive optical networks, which were encoded by the FBG array with 7 wavelengths and 5 intensity grades, and achieved 3 optical tag identification.

M1A.3 • 08:45 Three-Dimensional-Printed Hollow Fabry-Perot Fiber Sensor for Ultra-High Sensitivity Ultrasound Detection, Anqi Wang1,2, Xuhao Fan1, Dongchen Xu1, Geng Chen1, Chenhao Dai1, Zhi Zhang1, Wei Xiong1, Qishen Sun1,2, Huazhong Univ of Science and Technology, China. We demonstrate a hollow Fabry-Perot (FP) fiber sensor fabricated by 3D-printing technology for highly sensitive ultrasound detection. The sensor has a sensitivity of 167 mV/kPa which is 38 times higher than a solid FP fiber sensor.

M1B • Fiber-Based Nonlinear-Optic and Optoelectronic Devices—Continued

M1B.3 • 08:30 Invited All-Fiber Optoelectronics, Lei Wei1, Nan- yang Technological Univ, Singapore. The combination of insulating, semiconducting, and metallic elements in well-defined geometries with intimate interfaces is essential to achieve all-fiber optoelectronics. Here, we present the development of optoelectronic fibers, from the fundamentals to in-fiber device demonstration.

M1C • Green Transformation: Where Do We Stand? I—Continued

M1C.2 • 08:30 Invited Energy Efficient in Open Optical Transport, Koji Asahi1,2, NEC Corporation, Japan. We will share energy efficient use cases using open optical systems and our activities on them.

M1D • High Power and Narrow Linewidth Lasers—Continued

M1D.3 • 08:30 Invited Development of High-Power DFB Lasers with High Reliability, Yuanfeng Mao1,2, Yuanbing Cheng1, Guangnan Chen1, Yenbo Li1, Bo Wu1,2, Huawei Technologies Co., Ltd, China. High-power DFB lasers in O, S, C and L-band have been developed. RIN below -160 dB/Hz and linewidth less than 25 kHz of the lasers are obtained. Over 5000 hours of accelerated aging test has also been performed.

M1E • DSP and Multiplexing Techniques—Continued

M1E.2 • 09:00 Ten-Channel High Power DFB Laser Array with High Single Mode Stability and Low RIN, Yuanhao Zhang1,2, Qianru Lu1,2, Can Liu1,2, Mifeng Xiang1,2, Guosheng Li1,2, Jun Xie1,2, Qiaoyin Lu1,2, Weihua Guo1,2, Can Liu1,2, Huazhong Univ of Science & Technology, China. A high power 10-channel single-mode DFB laser array with 200-GHz-spacing is demonstrated. Output power over 85mW, SMSR over 55dB and RIN below -155dBc/Hz have been realized for all channels of the fabricated laser array.

M1F • Multi-Band Transmission Systems—Continued

M1F.3 • 08:30 Tutorial Practical Considerations for Ultra-Wideband Line System Development, Julia Larikova1,2, Infinera Corporation, USA. With the coherent transmission hitting the Shannon limit and spectral efficiency constraints, it is important to find other ways of extending fiber capacity using new but practical ways. The most realistic way to increase it by using optical fiber system with SuperC and SuperLinear amplification and Wavelength selective switches, allowing capacity increase on the order of 30% with a max capacity as high as 100Tbps on a single fiber without the need for novel fiber types.
Optically Networked Heterogeneous Data-Centric Computing System with Silicon Photonics Transceivers, Dae-Uk Kim¹, Ayung Chan Lee¹, Sanghwa You¹, Jongtae Song¹, Kyeong-Eun Han¹, Jiwook You¹, Bup Joong Kim¹, Chanho Park¹, Jooin Ki Lee¹, Electronics and Telecom Research Inst, Korea (the Republic of) An architecture is proposed for optically networked heterogeneous computing system supporting CXL. The proposed system is applied to AI applications and achieves a performance degradation of less than 2% compared with the server solution.

Dr. Zhensheng Jia is a CableLabs Fellow and Director of Advanced Optical Technologies. He has over 20 years of experience driving innovations in broadband fiber optic communications and networking. Dr. Jia has published 190+ peer-reviewed papers, 1 authored book, 11 book chapters, and he also holds 180 granted patents. Currently, he leads the development of coherent passive optical network technology to replace the next-generation 100Gbps and beyond access networks. Dr. Jia is a Fellow of Optica (formerly Optical Society of America).

We demonstrate the first 92.3-Gbits/s modulation using 3.3 μm MFD fiber is proposed to enhance coupling efficiency and fabrication tolerance. It’s experimentally demonstrated with < 1.25 dB/facet coupling loss and <0.1 dB PDL.

We present recent advancements in reducing polarization sensitivity in MFS components, Yusheng Bian¹, 1GlobalFoundries, USA. We present new improvements in reducing polarization-dependent-loss (PDL) for crucial S/P components. Our link-budget analysis reveals an almost 5.5dB reduction in total PDL for representative receiver circuits, resulting in a mere 0.35dB TE-TM path insertion-loss imbalance.

We present the first line-rate end-to-end post-quantum encryptable Optical Fiber Link Using Data Processing Units (DPU), Abraham Caro Aguera¹,², Rana Abu Bakar³, Faris Alhamd⁴, Carlos Rubio García¹, Jose Luis Mira Pascual¹, Iñigo Tafur Monroy¹, Juan José Vegas Olmos²; ¹Universidad Complutense of Madrid, Spain; ²Software Architecture, NVIDIA, Oldenburg, Germany. We demonstrate the first 92.3-Gbits/s line-rate, end-to-end post-quantum cryptography optical fiber link based on HW accelerators and processing offloading.

We present simultaneous monitoring of vehicle and railway traffic using BOTDA to identify fiber types present in two co-routed field deployed fibers in metropolitan environments. Dr. Jia is a Fellow of Optica (formerly Optical Society of America).
M1B.5 • 09:15
Positive (+0 dB) Wavelength Conversion Efficiency in Temperature-Tuned Five-Segment Highly-Nonlinear Fiber Without Pump Dithering, Hamed Rabbani1, Cheng Guo1, Michael Vasilyev1; 1Univ. of Texas at Arlington, USA. By temperature tuning, we align zero-dispersion wavelengths of several fiber segments while detuning their Brillouin frequencies. Despite 2.5-fold fiber length increase, we obtain 2–8 dB higher Brillouin threshold, enabling >0 dB conversion efficiency without pump modulation.

M1B.6 • 09:30 ✪ Invited
Nonlinear Optics in Silicon Core Fibers: Progress and Trends, Anna C. Peacock1; 1Univ. of Southampton, UK. Recent advances in the development and application of silicon core fibers for nonlinear photonics is reviewed. Focus will be placed on novel device designs that benefit from the fiber geometry and integration with existing components.

M1D.5 • 09:15
Reducing the Linewidth of Hybrid Integrated III-V/Silicon Laser by Utilizing High-Q Multimode-Waveguide-Based Silicon Ring Resonator, Xinhui Li1, Yuyao Guo1, Siyue Li1, Wei Hu1, Jifeng Wang1, Xin Wang2, Junliang Wang1, Zhiyong Zhou1, 1Shanghai Jiao Tong Univ., China. We demonstrate a hybrid integrated self-injection locking laser (SIL) with an intrinsic linewidth of 1.25 kHz and an external cavity laser (ECL) of 5.3 kHz by leveraging a high-Q multimode-waveguide-based silicon microring resonator (MR9).

M1D.6 • 09:30
Hertz-Linewidth, High-Power, Frequency-Agile Photonic Integrated E-DBR Laser, Anit Siddharth1, Amir Attanasio1, Grigory Leghari1, Xue Li1, Xiangfei Chen1, 1Univ. of Texas at Arlington, USA. We demonstrate hybrid integration of an RSOA with an extended-distributed Bragg reflector (EDBR) laser cavity implemented on a Si3N4 chip with monolithically integrated piezoelectronic. The laser exhibits intrinsic linewidth of 4 Hz with laser frequency tuning over 1.0 GHz at up to 1 MHz triangular chirp rate.

M1D.7 • 09:45
Multi-Wavelength DBR Laser with High Mode Stability and Uniform Spacing via REC Technique, Xinxiang Sun1, Jie Zhao1, Yue Zhang1, Zijiang Yang1, Kaiwei Tang1, Rulei Xiao1, Xiangfei Chen1, Nanjing Univ., China. The multi-wavelength DBR lasers with four and six wavelengths simultaneously emitted are experimentally demonstrated for the emerging optical I/O technology. The proposed structure shows high mode stability and high uniform wavelength spacing of 100 GHz.

M1D.8 • 09:50
Carrier Frequency Offset Estimation Using Godard Timing Recovery in Coherent Optical Systems, Hongliang Wu1, Xiangfei Chen1, Yutaka Miyamoto1, Yuyao Guo1, 1NTT Network Innovation Laboratories, NTT corporation, Japan. Based on conventional timing recovery (TR) algorithm, we propose a novel method for carrier frequency offset (CFO) estimation by exploiting the available spectrum information from TR. We experimentally validate our proposal in 4-subcarrier 100-Gbaud coherent systems.
M1G • Optical Networks for Disaggregated and Composable Computing Systems—Continued

M1H.6 • 09:15 ★ Top-Scored
Multi-Span Optical Power Spectrum Prediction Using ML-Based EDFA Models and Cascaded Learning, Zihao Wang1, Yue-Kai Huang2, Shaoao Han1, Ting Wang1, Daniel C. Kilper1, Tingjun Chen1, 2Duke Univ., USA, 1NEC Laboratories America, USA, 3CONNECT Centre, Ireland. We implement a cascaded learning framework using component-level EDFA models for optical power spectrum prediction in multi-span networks, achieving a mean absolute error of 0.14dB across 6 spans and 12 EDFA inputs with only one-shot measurement.

M1H.7 • 09:30
Network-Wide QoT Estimation Using SGD with Gradient Transfer Between WaveLENGTHS, Kayel S. Mayer1, Jonathan A. Soares2, Marcos Paulo A. Dal Maso2, Christian E. Rothenberg1, Dalton S. Araujo3, Dari A. A. Mello3, 1Unicamp, Brazil. We propose an SGD-based QoT estimation technique that operates on a network-wide scale by transferring gradients among neighboring wavelengths. Simulation results indicate effective and low-complexity QoT estimation using only transponder SNR telemetry.

M1H.8 • 09:45 ★ Top-Scored
Demonstration of ROADM Status Visualization Based on Receiver DSP and Digital Twin Modeling, Meng Cai1, Xiaomin Lu1, Mengtan Fu1, Xiaobo Zeng1, Yichen Liu1, Yihao Zhang1, Liin Yi2, Wesheng Hu1, Guoli Zhege1, Shanghai Jiao Tong Univ., China. We propose a coherent receiver-based telemetry to visualize ROADM status. 100% accuracy of failure localization and 0.67 GHz RMSE of failure estimation are achieved in an 847-km fiber link with 6 WSS nodes.

M11 • Next Generation Coherent PON—Continued

M1L3 • 09:15
Symmetric Bidirectional 200 Gb/s PON Solution Demonstrated Over Field Installed Fiber, Istvan B. Kovacs1, Md Saifuddin Faruk1, Adrian Wontor1, Sae Savory1, 1Univ. of Cambridge, UK. We demonstrate 200 Gb/s bidirectional coherent PON solution with simplified ONU on field installed fiber. We achieve 30.5/37 dB power budget for the downstream transmission with single-ended/balanced photodiode and 30.1 dB for the upstream transmission.

M1L4 • 09:30
Demonstration of Auxiliary Management and Control Channel Transmission and Data-Channel Signal Compensation for Beyond 100G FDM Coherent PON, Wangqun Shen1, Xue Fei Wang2, Xue Fei Wang2, Guoqiang Li2, Zhengyu Li2, An Yan2, Zewen Li2, Chao Shen2, Jianyang Shi2, Nan Chi2, Junwen Zhang2, 1Fudan Univ., China. We propose and demonstrate the transmission of AMCC and a novel signal-compensation method for data-channel in coherent FDM-PON. Sensitivity improvement of 6 dB is demonstrated with 1500-km capacity over 20-km fiber for PDM-FDM with AMCC.

M1L5 • 09:45 ★ Top-Scored
Hybrid, Multi-Format, Flexible-Rate Coherent PON Supporting Ultimate-Simplified Coherent and Full-Coherent Receivers with Composable OLT in Downstream, An Yan1, Guoqiang Li2, Xue Fei Wang2, Hongyu Hu3, Wangqun Shen1, Junhua Zhao3, Zewen Li2, Chao Shen2, Jianyang Shi2, Nan Chi2, Junwen Zhang2, 1Fudan Univ., China. We propose and demonstrate a hybrid, multi-format and flexible-rate coherent PON system supporting ultimate-simplified coherent and full-coherent receivers based on the compatible OLT setup, achieving 50 to 300 Gbps access in FLCS-CFPON based on 4/16/64-QAMs.

M1J • Waveguide Mode Converters and Fiber-to-Chip Couplers—Continued

M1J.6 • 09:15
Broadband Polarization Beam Splitter Rotator Using Only Silicon Nitride, Fatemeh Ghaedi Varani1, Ali Reza Fardoust2, Guangfu Li2, Christopher Doerr2, 1Univ. of Central Florida, USA; 2Aloé Semiconductor, USA. We designed and fabricated a CMOS-compatible polarization beam splitter and rotator purely in SiN, achieving experimentally an insertion loss of ~1.5dB and a polarization extinction ratio greater than 15dB from 1280 to 1300nm.

M1K • Distributed Sensing I—Continued

M1K.7 • 09:30
Real-Time Urban Sensing by in-Fiber Interferometric System Over Field-Deployed Uncoupled 4-Core Fiber Cable, Marco Fasano1, Tetsuya Hayashi1, Takui Nagashima1, Antonio Meccaci2, Cristiano Antonelli3, Pierpaolo Baldi4, Politecnico di Milano, Italy; 1Suni-tomo Electric Industries, Ltd., Japan; 2Univ of L’Aquila, Italy; 3CNIT, Italy. We demonstrate urban antropic events monitoring through a sustainable and cost-effective interferometer sensor built by exploiting two cores of an uncoupled 4-core fiber in the first deployed multi-core fiber cable in L’Aquila, Italy.
**M2A.1 • 10:30**
Scaling to 100 Modes by Exploiting Topological Confinement, Vineetha Ashok1, Aaron Peterson-Greenberg2, Zelin Ma3, Isabelle L. Boeselhok4, Cheng Peng1, Paul Kristensen1, Siddharth Ramachandran1; 1Boston Univ., USA; 2OFS-Fitel, Denmark.

**M2A.2 • 10:45**
Differential Modal Delay Controlling of 4-LP Mode Optical Fiber by High-Density Cable with Low Cabling Loss, Masashi Kachi1, Takayoshi Morii1, Yuusuke Yamada1; 1Nokia Bell Labs, USA.

**M2A.3 • 11:00**
Comparison of Polarization Rotations Caused by Fiber Bending in Single- and Multi-Mode-Fibers, Christian M. Spenser1, Klaus Petermann1, Peter Krummrich1; 1TU Dortmund, Germany; 2TU Berlin, Germany.

**M2B.1 • 10:30**
Probabilistic Shaping for Direct-Detection Optical Systems, Joseph M. Kahn1, Ethan M. Liang2; 1Stanford Univ., USA. We study probabilistic shaping for direct-detection systems that modulate the intensity or Stokes vector and are limited by thermal or amplifier noise, obtaining analytical formulas for the optimal (non-Gaussian) input distributions and corresponding shaping gains.

**M2B.2 • 10:45**
Differential Modal Delay Controlling of 4-LP Mode Optical Fiber by High-Density Cable with Low Cabling Loss, Masashi Kachi1, Takayoshi Morii1, Yuusuke Yamada1; 1Nokia Bell Labs, USA.

**M2B.3 • 11:00**
Comparison of Polarization Rotations Caused by Fiber Bending in Single- and Multi-Mode-Fibers, Christian M. Spenser1, Klaus Petermann1, Peter Krummrich1; 1TU Dortmund, Germany; 2TU Berlin, Germany.

**M2C.1 • 10:30**
How ICT can Positively Impact the Environment, Alessandro Porcelli1; 1TIM S.p.A., Italy. In many sectors, ICT can significantly decrease global GHG emissions, optimizing resource use. However, ICT industry relies on high resource-demanding infrastructures; sustainable processes and efficiency are mandatory for ICT operators to reach full environmental benefits.

**M2C.2 • 10:45**
Cryogenic Oxide-VCSEL at 2.8 K Demonstrates Record Bandwidth and 100 Gbps Direct SubTHz-to-Optical Conversion, Stefano Trettel1, Elisabetta Croti1, Emman Duda1, Antoine Prissa1, Mirko Hosser1, Matthias Paul1, Evgeny Zibik1; 1Coherent IL-Vi Laser Enterprise GmbH, Switzerland. This paper reports the first demonstration of lithographic aperture VCSELs with bandwidth above 29 GHz. Large-signal measurements and preliminary lifetime data are reported, putting forward lithographic aperture as an enabling technology for applications beyond 100G.

**M2C.3 • 11:00**
Energy Efficient Multicore Fiber Amplifiers, Yong-ming Jung1, Siqing Liang1, John D. Downing1, Sergei Malovec1, Merman Edwards1, Periklis Petropoulos1; 1Univ. of Southampton, UK; 2Corning Research and Development Corp., Corning, USA; 3Corning Optical Communications, Corning, USA; 4Cryomodule and Cryogenics, Switzerland. Energy-efficient multicore fiber (MCF) amplifiers are crucial for establishing future high-capacity submarine transmission systems. This paper reviews recent advancements and explores future directions in MCF amplifier development, highlighting their potential for cost-effective and power-efficient operation.

**M3.1 • 10:30**
Invited
Can Photonics Help in Reducing the Power Consumption in Radio Access Networks?, Fabio Cavalleri1, Alessandra Bigongiari1, Antonio Tartaglia1; 1Ericsson, Italy. We discuss the challenges of future radio access networks in meeting the growth of traffic without a parallel explosion of energy consumption. The opportunities offered by integrated photonics technologies are analyzed.

**M3.2 • 10:45**
Toward 2000 Gbps Over 100 km with 400 fs 1.28 THz Fiber, Yulong Xiao1, Feng Liang1, Cameron MacDonald1, Paul French1, Dwight Bluhm1; 1Boston University, USA. This paper reports the first demonstration of a 36-dB power penalty in the long-term transmission of 800 Gbps over 100 km of fiber. This result is consistent with the theoretical limits for the transmission of 2000 Gbps over 100 km.

**M3.3 • 11:00**
Invited
Recent Advances in Fanout Technology for SDM Applications, Victor I. Kopp1, Jiang-Chen Park1, Jing Zhang1, Jon Singer1, Dan Neugroschel1; 1Chiral Photonics Inc, USA. Real-world SDM deployment requires the development of a supporting ecosystem. Recent technological advancements allow for volume production of key components of this ecosystem, MCF fanouts, which meet demanding performance requirements.
M2G.1 • 10:30 • Invited
Photonic Switched Networking for Data Centers and Advanced Computing Systems, Paraskevas Bakopoulos1, Giannis Patras1, Nikos Terzedinis1, Zach-Alon Wenthoren1, Preethi Kashikunte1, Dimitris Syvridis1, Eitan Zahavi1, Louis Capps1, Nikos Argyris1, Luke Yeager1, Julie Bernauer1, Elad Mentovich1; TINA-Networks, Greece. We explore optical switching to extend network programmability to the physical layer. We present applications of our Layer-1 SDN for improving fabric resilience against hardware failures and saving network power and cost in Deep-Learning training.

M2H.1 • 10:30 • Invited
Toward a 1.4T Low-Power Coherent DSP: Challenges, and Lessons Learned From Preceding Generations, Shu Hao Fan1; Manavell Semiconductor Inc., USA. We reviewed the progression of coherent mixed-signal ASIC technology since 40nm silicon and identified the critical path toward beyond-terabit-per-wavelength pluggable modules. Challenge in aspects of ASIC design and optical components was explored.

M2H.2 • 11:00 • Top-Scored
Mode-Selective Reconfigurable Optical Add-Drop Multiplexers Experimentally Validated With 40 Gbps NRZ/PAM4, Kaveh Hassan Rahbardar Moghavvam1, Suram Saganam Morrison1, S. Mohammad Reza Safaei1, Odile Liboiron-Ladoucette1, McGill Univ., Canada. We experimentally demonstrated a mode-selective ROADAM for two transverse-electric modes using a mode-selective phase shifter in the switch. We show 40 Gbps NRZ transmission and 20 GBAud PAM4 transmission for two simultaneously transmitted optical modes.

M2I.1 • 10:30 • Invited
Secure Architecture for Quantum Key Distribution Networks, Bruno Hutter1; ID Quantique SA, Switzerland. We present a new architecture, designed to improve security of QKD networks. The trusted Nodes are divided into Core Nodes, which XOR the keys from various QKD devices, and Edge Nodes, connected to key users.

M2I.2 • 10:45 • Top-Scored
A Machine Learning-Assisted Quantum and Classical Co-Existence System, Mark Yang1, Rui Wang1, Alex Setfendis1, Treni Omgbodun1, Sima Bahrami1, Romerson Oliveira1, Reza Nejabad1, Dimitra E. Simeonidou1; Fujitsu Laboratories of America, USA. A machine learning framework is presented for the coexistence of C-band quantum and classical channels over the same fibre with various fibre lengths, co-existence powers, channel allocations, and identifying the region where co-existence is viable.

M2J.1 • 10:30
Performance Comparison Considering Physical Layer QKD Limitations, Nikolaos Makris1, Alkinoos Papageorgopoulos1, Persefoni Konteli1, Iliana Tsoni1, Konstantinos Tsimvradakis1, Ilia Papastamatou1, Konstantinos (Kostas) Christodouloupolous1, George T. Kanellos1, Dimitris Syvridis1, Informatics and Telecommunications, National and Kapodistrian Univ. of Athens, Greece; 2GRNET S.A. – National Infrastructures for Research and Technology, Greece. We experimentally evaluated the SKR generation for unoptimized QKD pairs in switched QKD and compare the performance of the switched-QKD with relaxed-QKD networks to reveal they perform better for short distances and at large network sizes.

M2J.2 • 10:45
Comparing Between Phase and Polarization Sensing Using Coherent Transceivers Over Deployed Metro Fibers, Lorenzo Andreacci1, Dario Filor1, Savero Pellegrini1, Leonardo Minelli1, Gabriella Bosco1, Claudio Cragale1, Stefano Piccigallo1, Roberto Gaudino1, Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, Italy; 3Cisco Photonics, Italy. We experimentally compare SOP and phase extraction under identical system conditions over a deployed 32km unamplified metro fiber link for vibrations sensing applications using coherent receivers.

M2J.3 • 11:00
Pressure Wave Detection and Localization in Deployed Underground Fiber Using Coherent Correlation OTDR, Florian Azendof1, Andrea Sandmann1, Michael Eiselt1, Advanced Technology, Adtran Networks SE, Germany. A deployed fiber with an in-house and underground sections is interrogated with a coherent correlation OTDR. The origin and propagation speed of a hammer-generated pressure wave in the underground section is detected and acoustic signals are monitored.
M2A.4 • 11:15
Broadband Characterization of Randomly Coupled 19-Core Multicore Fiber, Lauren Dallachiesa1, Nicolas K. Fontaine1, Roland Ryf1, Mikael Mazur1, Haoshuo Chen1, Georg Rademacher1, Ruben S. Lust1, Benjamin J. Puttnam1, Hideaki Funakawa1, Ayumi Inoue1, Takuj Nagashima1, Tetsuya Hayashi1, Kazumasa Takahashi2, Hidemasa Takahashi3, Tsutaya Sasaki1, Ryuichi Sugizaki1, Fukuma Electric, Japan. We evaluate 19-core randomly-coupled multi-core fiber using swept wavelength interferometry in the C-, E-, C- and L-bands. We show a different modal mode delay reduction when unspooling the fiber and increased randomization length at shorter wavelengths.

M2B.2 • 11:30
Trellis Shaping-Based Selection for Inter-Datacenter Single-Span Links, Xiang Li1, Junyang Tang1, Zhipeng Gong1, Pengpeng Wei1, Xuzeng Hu1, Tianye Huang1, Xiao Kao1, Chen Univ. of Geosciences, China, Zhejiang University (Wuhan) Science and Technology, China. We propose trellis shaping technique to implement selection sequence for fiber non-linearity mitigation in inter-datacenter single-span link. A gain in AFD of 0.2 bits/4D-symbol compared with MB shaping is achieved experimentally over a five-channel 80-km fiber link.

M2C.3 • 11:30
Solutions to Increase Energy Efficiency of Optical Networks, Nicola Sambò1, Scuola Superiore Sant’Anna, Italy. Power consumption of devices and network functionalities in optical infrastructures is reviewed. Then, possible short-, medium-, and long-term solutions to reduce and make energy consumption scalable are discussed.

M2D.4 • 11:30
Single-Mode VCSEL with Zn-Diffusion Apertures and Strong Immunity Against Optical Feedback for Improved Data Transmission, Min-Long Wu1, Cheng-Wei Lin1, Jin-Wei Shu1, National Central Univ., Taiwan. We demonstrate state-of-the-art performances of single-mode VCSELs, including wide-bandwidth (27GHz), high-power (5.7mW), low-RIN (-137dB/Hz), and invariant 56Gbps eye patterns under strong optical feedback (-6dB). It achieves error-free 46Gb/s transmission through 0.5km MMF without using equalizers.

M2D.5 • 11:45
59-J/bit Si Photonic Crystal Slow-Light Modulator with FinFET-Compatible Driving Voltage, Keisuke Kawahara1, Tai Touchiwa1, Nontsugu Yamamoto1, Yuriko Maegami1, Koji Yamada1, Toshikiko Baba1, Yokohama National Univ., Japan, National Inst. of Advanced Industrial Science and Technology, Japan. Si Mach-Zehnder modulator with slow-light enhancement of photonic crystal phase shifter consumes a low bit energy of 59 J/bit and transmits a 64-Gbaud NRZ signal with a FinFET-compatible driving voltage of 0.87 V.

M2E.4 • 11:30
Energy-Efficient Cladding-Pumped Amplifier for Coupled Multi-Core Fiber Transmission, Tao Sakamoto1, Masaki Wada1, Ryota Imada1, Kazuhide Nakajima1, NTT Access Network Service Systems Laboratories, Japan. We review energy-efficient cladding-pumped multi-core amplification technologies and experimentally demonstrate the advantages of using a coupled-12-core amplifier for improving the amplification efficiency.

M2F.4 • 11:30
Demonstration of 200 Gbps D-Band Wireless Delivery in a 4.6 km 2×2 MIMO System, Yi Wei1, Jianjun Yu2, Minggu Wang3, Xianming Zhao4, Xiongwei Yang1, Pei Li1, Feng Tian1, Yong Han1, Guotong Zhang1, Jingwen Tan1, Bing Zhang1, Feng Zhao1, Wen Zhou1, Kaishi Wang1, Fujian Univ., China, Harbin Inst. of Technology, China, Xian Univ. of Posts and Telecommunications, China. A 4.6-km 2×2 MIMO wireless system at D-band is experimentally demonstrated with a total data rate of 200 Gbps and a record-breaking capacity-distance product of 920 Gbps×km at D-band.
Intra-Datacenter Optical Circuit Switch Architecture with Multi-Band Transmission Technologies, Takuma Kuroi, Reij Noguchi, Kazutaka Satake, Hayato Yuasa, Yojir Mori, Hiroshi Hasegawa; NTT Network Innovation Laboratories, Japan. We experimentally confirmed the performance of 1,280 × 1,280 switch with 32-Gbaud dual-polarization QPSK signals aligned on 33-GHz grid in the C- and L-bands.

L-bands. QPSK signals aligned on 33-GHz grid in the C- and L-bands.

The temperature shift is measured with an accuracy of remotely pumped Erbium doped fiber amplifiers. We demonstrate a Brillouin OTDR sensing over 250 km using a C-band net-200Gb/s IM-DD PAM4 transmission over single-span up to 100-km SSMF using only a single-drive intensity modulator, one PD, one ADC, low-complexity DSP and practical FEC, based on a theory-backed optoelectronic equalization (OE-EQ) technique.

Reach Extension of Net-200Gb/s IM-DD PAM4 Links to Beyond-100km with Low-Complexity Using OE-EQ, Paikun Zhu, Yuki Yoshida, Kouichi Akahane, Ken-ichi Kaneko, Jun-ichi Kajiyama; National Inst of Information & Comm Tech, Japan; NTT Access Network Service Systems Laboratories, NTT, Japan. We propose a DCN that directly connects server racks distributed among DCs through ROADM-based nodes. External light sources are introduced to coherent transceivers to avoid laser-diodes being operated under high temperature conditions on top-of-rack switches.
M2A • Multi-Mode Fibers—Continued

M2A.6 • 12:00 Invited
Advances in Few-Mode Fiber Manufacturing and Characterization, Frank Achten1, Marianne Bigot-Astruc1, Pierre Sillard1, ‘Prysmian Group, Netherlands. A review of recent advances in manufacturing and characterizing low-differential-mode-group-delay few-mode fibers is presented. These fibers can support up to 10 mode groups, i.e., 55 spatial modes.

M2B • Datacom: Coding and Equalization—Continued

M2B.4 • 12:00
912-Gbits/channel PDM-PS-256QAM NanF Transmission Using IQ-Crosstalk Robust MIMO Equalizer Integrated with Decision-Directed CPE, Chen Wang1, Jianyu Liu1, Kaihui Wang1, Wen Zhou1, Lei Shen1, Peng Li1, Jianjun Yu1, Fudan Univ., China, ‘Yangtze Optical Fiber and Cable, China. We realized 912-Gbits/channel coherent PDM-PS-256QAM transmission over 2-km NanF utilizing a novel multiple-input multiple-output real-valued equalizer embedded with the decision-directed carrier phase estimation algorithm.

M2C • Green Transformation: Where Do We Stand? II—Continued

M2C.4 • 12:00 Invited
Effective Use of Renewable Energy in Data Centers, Masaki Koza1, NTT Corp., Japan. This presentation will introduce a technology that adjusts demand to fluctuating renewable energy generation by optimizing the temporal and spatial placement of workloads between distant data centers.

M2D • VCSELs and Modulator Technologies—Continued

M2D.6 • 12:00
112-Gb/s Optical PAM8 Modulation Based on Segmented Thin Film Lithium Niobate Modulator, Yang Liu1, Qiangsheng Wang1, Changqing Wang1, Dingyi Wu1, Peng Zhou1, Ye Liu1, Hongguang Zhang1, Daiga Chen12, Xi Xiao12, ‘National optoelectronics innovation center, China; 3State Key Laboratory of Optical Communication Technologies and Networks, China Information and Communication Technologies Group Corporation (CICT), China. We experimentally demonstrate an optical transmission of 112 Gb/s PAM8 based on a segmented thin film lithium niobate modulator in an IMDD link. The Vpp of two single-ended RF signals are 2.5 V and 3.5 V.

M2E • SDM Amplifiers and Multiplexers—Continued

M2E.6 • 12:00
Ultra-Wideband Mode Selective Couplers for Weakly-Coupled WDM-MDM Transmission, Chenglong Long1, Jai Cui1, Yuyang Gao1, Gang Qiao1, Baolong Zhu1, Jianyu Zhang1, Yu Yang1, Le Shen1, Jie Luo1, Yongqi He1, Zhanzhan Chen12, Juhao Li12, ‘Peking Univ., China; 2Department of Networks, China Mobile Communications Group Co., Ltd., Beijing (10033, China, China, ‘Peking Cheng Laboratory, China; 3State Key Laboratory of Optical Fiber and Cable Manufacture Technology, China. Ultra-wideband mode selective couplers satisfying strict phase-matching conditions across S+C+L bands for mode multiplexing/demultiplexing of a 4-LP-mode FMF are designed and fabricated with side-polishing processing, based on which weakly-coupled FMF transmission is experimentally demonstrated.

M2F • Sub-Millimeter Wave and THz Communication—Continued

M2F.6 • 12:00
Expanded Gain-Switched Comb Source for 180–260 GHz Sub-THz Analog Radio-Over-Fiber 6G Wireless System, Amal Delmad1, Cristian Vargas1, Alison Kearney1,2, Simon Nellen1, Robert B. Kohlhaas1, Martin Schell1, David Coffey1, Frank Smyth1, Liam P. Barry1, ‘Dublin City Univ., Ireland; 2Pilot Photonics Pte., Ireland; 3Fraunhofer Inst. for Telecommunications, Heinrich Hertz Inst. (HHT), Germany. We demonstrate the successful generation and transmission of low-subcarrier spacing (up to 500 kHz) 6G-compatible sub-THz OFDM signals in the 180 to 260 GHz frequency band using an expanded gain-switched laser comb source and waveguide-integrated photodiode antenna.

M2G • 12:15
Investigation of Concatenated K4 FEC with Single-Party-Check Codes for Short-Reach IM/DD Systems, Tom Wettlin1, Stefan Calabro1, Nebosa Stepnov1, Youxi Lin1, Talha Rahman1, Huawei Technologies, Germany. We investigate the concatenation of K4 FEC with short single-party-check codes. This represents an intermediate solution in terms of performance, complexity and latency between standalone K4 FEC and concatenated schemes based on stronger soft-decision codes.

M2H • 12:15
An Ultimate-High Linear Silicon Modulator Based on All-Optical Linearization Method, Fan Jingyang1, Qing Zhang1, Shengyu Yuan1, Tingyi Jiang1, Shuyue Zhang1, Hui Yu1, ‘College of Information Science and Electronic Engineering, Zhejiang Univ., China; 2Zhejiang Lab, China. We proposed an ultimate-linear high linear silicon-based modulator based on all-optical linearization method, which demonstrates an SFDR as high as 131/132 dBc/Hz at 1/10 GHz.

M2I • 12:15
Characterization of Ten-Mode EDFA Using Swept Wavelength Interferometer and Digital Holography, Yetian Huang1,2,3,4,5,6,7,8,9,10, Harri Huang1,2,3,4,5,6,7,8,9,10, Jian Cui1,2,3,4,5,6,7,8,9,10, Jinan Wang1,2,3,4,5,6,7,8,9,10, Xinlu1,2,3,4,5,6,7,8,9,10, Lin Tian1,2,3,4,5,6,7,8,9,10, Hongyu Zhao1,2,3,4,5,6,7,8,9,10, Hongqian Li4,5,6,7,8,9,10, Guangyi Yang1,2,3,4,5,6,7,8,9,10, Tingting Gu1,2,3,4,5,6,7,8,9,10, Junwei Song1,2,3,4,5,6,7,8,9,10, Weiming Xue1,2,3,4,5,6,7,8,9,10, Xueqian Wang1,2,3,4,5,6,7,8,9,10, Changqing Wang1,2,3,4,5,6,7,8,9,10, Shengyu Fang1,2,3,4,5,6,7,8,9,10, Xingyi Jiang1,2,3,4,5,6,7,8,9,10, Shuyue Zhang1,2,3,4,5,6,7,8,9,10, Peiqi Zhou1,2,3,4,5,6,7,8,9,10, Jianjun Yu1,2,3,4,5,6,7,8,9,10, Yan Zhang1,2,3,4,5,6,7,8,9,10, Changdong Sun1,2,3,4,5,6,7,8,9,10, Yuxiu Lin1,2,3,4,5,6,7,8,9,10, Zichuan Zhou1,2,3,4,5,6,7,8,9,10, Amany Kassem1,2,3,4,5,6,7,8,9,10, James Seddon1,3,4,5,6,7,8,9,10, Eric Silfverberg1,3,4,5,6,7,8,9,10, Izzat Danawez1,3,4,5,6,7,8,9,10, Polina Bayvel1,3,4,5,6,7,8,9,10, Zhixin Liu1,3,4,5,6,7,8,9,10, ‘Univ. College London, UK. We generate and transmit 75-GHz-bandwidth OFDM signals over the air using three mutually frequency-locked lasers, achieving minimal frequency gap between the wireless W and D bands using optical-assisted approaches, resulting in 173.5 Gb/s detected capacity.

M2J • 12:15
Dual Band Wireless Transmission Over 75-150GHz Millimeter Wave Carriers Using Frequency-Locked Laser Pairs, Zichuan Zhou1, Amany Kassem1, James Seddon1, Eric Silfverberg1, Izzat Danawez1, Polina Bayvel1, Zhixin Liu1, ‘Univ. College London, UK. We generate and transmit 75-GHz-bandwidth OFDM signals over the air using three mutually frequency-locked lasers, achieving minimal frequency gap between the wireless W and D bands using optical-assisted approaches, resulting in 173.5 Gb/s detected capacity.

Room 1A  Room 1B  Room 2  Room 3  Room 6C  Room 6D

Monday, 25 March

13:30–16:30  SC114, SC217, SC261, SC447, SC485, SC526 (new), SC528 (new)
13:30–17:30  SC325, SC327, SC347, SC357, SC384, SC431, SC451, SC453

12:30–14:00 Lunch Break (on own)
### M2G • Photonic Switched Data Center Networks—Continued

**M2G.6 • 12:00 Invited**
Performance of Radix Sort Using All-to-all Optical Interconnection Network in an Eight-FPGA Cluster, Kenji Misutani⁴, Yutaka Urino, Takanori Shimizu, Hiroshi Yamaguchi, Shigeru Nakamura, Tatsuya Usuki, Kyoko Ishi, Ryosuke Matsumoto, Takashi Innoue, Shu Namiki, Michihiro Kobuchi, Akst, Japan; **PETRA, Japan; NLL, Japan.** This paper presents a high-throughput dataflow processing using all-to-all communication with eight FPGAs. We demonstrated a parallel radix sorting throughput of 37.2 GB/s for 32-bit key range and 16-GiB data size.

### M2H • High-Speed Transceivers and Transmission—Continued

**M2H.6 • 12:00 Invited**
Recent Advances in High Symbol-Rate Transceivers, Sebastian Randel, Karlsruher Institut für Technologie, Germany. We discuss how the efficiency of optical transceivers in terms of cost and energy per bit can be further scaled by increasing the symbol rate. We address challenges and review alternatives like multi-wavelength transceivers and analog multiplexing.

### M2I • Panel: The Role of Digital Twins in Optical Networking—Continued

**M2I • 12:30–14:00 Lunch Break (on own)**

### M2J • Quantum Protocols, Simulations and Analysis—Continued

**M2J.6 • 12:00 Invited**
Quantum Simulations Using Single-Photon Quantum Walks, Peng Xue, Southeast Univ. (China), China. A quantum walk is the generalization of a classical random walk in the quantum world. One of the most popular applications of quantum walks is quantum simulations. In the past, the research on quantum walking focused on the unitary evolution of quantum systems. In this talk, we provide a detailed proposal of non-Hermitian quantum walks, in which we characterize and demonstrate the non-Hermitian skin effect and non-Hermitian bulk-boundary correspondence.

### M2K • Distributed Sensing II—Continued

**M2K.7 • 12:00 Invited**
Applications of Functional Nanomaterials in Sensing and Fiber Optics Devices, Devanarayan Meena Narayana Menon, Alberto Rovera, Davide Jenner, Politecnico di Torino - DISAT, Italy. Nanomaterials in different forms revolutionized sensing and opened new perspectives for fiber-optics devices. We will cover the most recent advancements in fiber optics devices based on thin-films, 2D/nanostructured materials, and the relative optical interrogation/usage scheme.

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**12:30–14:00 Lunch Break (on own)**

**13:30–16:30 SC114, SC217, SC261, SC447, SC485, SC526 (new), SC528 (new)**

**13:30–17:30 SC325, SC327, SC347, SC357, SC384, SC431, SC451, SC453**
**M3A • 14:00**
High-Power Micro-Ring Modulator and Multi-Channel Coupled Ring Resonator for WDM Design on a 300-mm Monolithic Foundry Platform, Gadi Liu1, Abdel-salam Abokestaf2, GlobalFoundries, USA. We present scaled, bidirectional silicon photonic ring modulator and multi-channel coupled ring resonator models, offering advanced simulation capabilities for high-power and thermal time constant analysis, facilitating comprehensive on-chip EO system design with GlobalFoundries PDK.

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**M3B • 14:00**
Uncooled O-Band InAs/GaAs Quantum Dot Photonic Platforms for Optical Communications, Alexey Kovsh1, Aallume Inc., USA. The progress in SiPh and other light modulation technologies helped to revive CW InAs/GaAs QD lasers. It positions GaAs tech as an alternative to traditional InP material system, bringing various advantages which will be discussed.

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**M3C • 14:00**
An Operator’s View on the Future Optical Networks, and Enabling Device Technologies: From Innovative Optical and Wireless Network Programs—Masahito Tomizawa1, NTT Innovative Devices, Japan. In this presentation, future vision of optical networks is discussed from the viewpoint of service requirements from operators, demanding higher capacity & quality, and lower latency & power consumption. Also enabling device technologies are introduced, where photonics and electronics convergence (PEC) is focused. This presentation is in conjunction with Innovative Optical and Wireless Networks (IOWN) program.

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**M3D • 14:00**
Bidirectional 100G-PAM4 Transceiver for 60-km O-Band Transmission, Fabio Bottoni1, Alessandro Cavaciuti1, Dirk Lutz2, ‘Casa Photonics Italy Srl, Italy; ‘Eoptolink, China. We experimentally demonstrate a real-time 100G PAM4 bidirectional optical transceiver suitable for 60km links (ER=4). The transceiver design is based on a O-Band EML, commercial DSP and do not use any kind of optical amplifiers.

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**M3E • 14:00**
304 Channel MicroLED Based CMOS Transceiver IC with Aggregate 1 Tbps and sub-pJ per bit Capability, Barda Pioszki1, Suthin Rangarajan2, Alex Testikov3, Emad Afifi1, Ivan Huang1, Jeff Pepper1, Sarah Zou1, Steve Novak1, Rob Kalman1, Avicinea Tech Corp, USA. 1Tbps 16nm-CMOS transceiver IC with microLED array-based transmitter and hybrid silicon detector array runs at about 1pJ/bit using 304 channels at 3.3Gbps per lane. Initial results are shown for single lane and in various configurations.
OFC 2024 • 24–28 March 2024

14:00–16:00 M3G • Panel: The Road Towards 3.2 Tb/s Intra-Data Center Communications

Organizers
Juthia Basak, Nokia Corp., USA
James Chen, Marvell, USA
Stephan Pachnicke, Christian-Albrechts Universität zu Kiel, Germany

Speakers
Andreas Beckollahme, Arista, USA
Ben Lee, NVDIA, USA
Xiang Liu, Huawei, China
Radha Nagarajan, Marvell Technology, USA
Yawei Yin, Microsoft, USA

The bandwidth demands of hyperscale data center operators have been increasing tremendously over the last years. First prototypes of 1.6 Tb/s (8 channel, 200 Gb/lambda) modules have been demonstrated the last years. First prototypes of 1.6 Tb/s and beyond connectivity, i.e. aiming at 3.2 Tb/s, especially photonic integration.

Topics will include the following questions:

- What are the needs of hyperscale data center operators in cloud and AI infrastructure?
- How much parallelism (number of wave-lengths, spatial channels) do we need?
- What are ultimate and practical limits of symbol and per lambda rates?
- How will nonlinear crosstalk and residual CD be solved?
- What power consumption per module can be handled?

This panel will comprise experts from hyperscalers, switch and module vendors 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 in a controversial panel discussion.

Xiongfeng Ma earned his B.Sc. degree from Peking University in 2003 and a Ph.D. from the University of Toronto in 2008. Currently, he is a Changjiang Distinguished Professor at Tsinghua University and an APS fellow. Xiongfeng’s primary research interest lies in quantum information science, particularly in quantum cryptography, quantum computing, and quantum foundational aspects.

14:00–16:00 M3H • Advancement in Quantum Key Distribution Systems I

Presiders: Tobias Gehring; Technical University of Denmark, Denmark

M3H.1 • 14:00 Top-Scored
Wavelength-Versatile Quantum Key Distribution for Reconfigurable Classical-Quantum Networks, Robert I. Woodward1, Benjamin Griffiths2, Yuan San Lo1, James Dykes2, Andrew Shields1; Toshiba Europe Ltd., UK. We report a high-speed GHz-clocked quantum key distribution (QKD) system, tunable over 65 nm using a novel injection-locked laser design. This paves the way to automatic optimisation of quantum channels in hybrid classical-quantum networks.

M3H.2 • 14:15 Invited Talk
Recent Advances in Measurement-Device-Independent Quantum Key Distribution, Xiongfeng Ma1; Tsinghua Univ., China. Measurement-device-independent quantum key distribution enhances the implementation security. In this tutorial talk, I shall review its security proof and various optical implementations, highlighting the twin-field and mode-pairing schemes that offer quadratic key-rate improvement.

M3I.2 • 14:15 Invited Tutorial
Recalibration Learning: Enabling Universal Transfer of ML Model of Gain and NF for Remote Optically Pumped Amplifiers, Arzum Minakhtsor, Benjamin Piern1, Mazl Le Monnier1, Delphine Rouillan1, Bruno Lavigne1; Alcatel Submarine Networks, France. We demonstrate a novel, physical assumptions-based method—recalibration learning—that transfers Gain and Noise Figure ML models across remote optically pumped amplifiers. Spectral measurements over two justifications on a target device ensure reliable transfer.

M3K.1 • 14:00 Invited Tutorial
Silicon-Organic Hybrid (SOH) Integration - From Lab to Fab, Christian Kooij1, Wolfgang Freude2, Sebastian Randel1, Stefan Bräse1, Peter Erk1, Christian Kooij1, Sebastian Randel1, Stefan Bräse1, Peter Erk1, Cansten Eschenbaumer1,2, Artem Kuzmin1, Adrian Mertens1, Adrian Schwarzenberger1, Hend Khaled, Alexander Kott1, Sida Sana2, Stefan Singer1, Si-IONX, Germany; Karlsruhe Inst. of Technology (KIT), Germany. Silicon-organic hybrid (SOH) integration can complement intrinsically scalable silicon photonic circuits by novel functionalities, obtained through theory-guided material engineering. This presentation will give an overview of our recent progress in exploring the potential of the SOH platform and in bringing the technology from laboratory demonstrations to industrial applications.

M3L.1 • 14:00 Top-Scored
10.9km Hollow Core Double Nested Antiresonant Nodeless Fiber (DNANF) with 0.33dB/km Loss at 850nm, Abubakr Isada Amu1, Muhammad Rosli Bin Abu Hassan1, Yong Chen1, Eric Numkam Fokoua1, Marcelo Alonso1, Hesham Sai1, Francesca Paletti1, David J. Richardson1, Marco Petrovich1; Microsoft Corp, UK. We report a double-nested antiresonant hollow core fiber designed for ~850nm operation. The measured fiber loss is 0.33dB/km at 850nm across a single span of 10.9 km.
M3A • Hybrid Integration and Packaging—Continued

M3A.3 • 14:30  Dust Insensitive, Low Loss, and Low Mating Force Multi-Fiber Expanded Beam Optical Ferrule and Connectors, Changbao Ma1, SM Company, USA. A new multi-fiber, expanded beam optical ferrule, with state-of-the-art IL<0.7 dB (typical 0.34 dB), RL>55 dB for single mode (1310 nm), and IL<0.3 dB (typical 0.14 dB), RL>40 dB for multimode (850 nm), is reported.

M3B • SDM Devices and Mode Manipulation—Continued

M3B.2 • 15:00  Towards Tbps Single-A Intercast by a Multimode Integrated Optical I/O on Silicon for Few-Mode Fibers, Hao Chen1, Wu Zhou1, Yeu Tong2, Microelectronics, The Hong Kong Univ of Science and Technology (Guangzhou), China. A six-channel multimode integrated optical I/O supporting two orthogonal polarizations of $L_P$, $L_{P/2}$, and $L_{P/4}$ modes in a few-mode fiber was experimentally demonstrated, showing chip-to-fiber coupling efficiencies > -6 dB for future Tbps-per-wavelength optical interconnects.

M3C • Quantum Dots Lasers and Comb Generation—Continued

M3C.2 • 14:30  Top-Scored Feedback Tolerant Quantum Dot Lasers Integrated with 300nm Silicon Photonics, Duanni Huang1, Shane Yerkes1, Guan-Lin Su2, Karan Mehta1, Marcus Cramer1, William O’Brien1, Razi Dethghannasiri1, Stan Dobek1, Chelsea Mackos1, Timothy Ward1, Pan Patel1, Ranjeet Kumar1, Songtao Liu1, Xinni Wu1, Xiaoxi Wang1, Junyi Gao1, Mark Isenberg1, Harel Frish2, Hasheng Rong3, 1Intel Corporation, USA. We demonstrate the first quantum dot lasers integrated with 300nm silicon photonics. The measured devices show a linewidth enhancement factor near zero and are resilient to optical feedback up to -16dB of back reflection.

M3C.3 • 14:45  Invited Photonics for Fault-Tolerant Quantum Computing, Mark G. Thompson1, Pennsylvania, USA. Abstract not available.

M3C.4 • 15:00  Low Threshold and 10GClass Narrow Linewidth 1.55 um-Band Quantum Dot Laser Diode on InP(311)B Substrate, Atsushi Matsumoto1, Ryota Yabuki2, Shinya Nakajima1, Toshimasa Umezawa2, 1National Inst of Information & Comm Tech, Japan, 2National Inst of Information & Comm Tech, Japan. We demonstrated low threshold current of 8.8 mA and 15.0 mA in pulsed and CW operation, and the extremely narrow linewidth of 12.2 Hz at room temperature in a fabricated 1.55 µm-band QD-DFB LD.

M3D • Frontiers of Optical Network Architecture Summit—Continued

M3D.2 • 14:40  Invited Next-Generation Optical Devices for Future Network, Hirono Oohashi1, Furukawa Electric Co., LTD, Japan. To achieve the next-generation network architecture, we'll introduce the development of some key optical components, especially light sources and transmission fibers, to expand the possibility of increasing transmission capacity and reducing power consumption.

M3E • Coherent and Direct Detect Datacenter Transmission—Continued

M3E.4 • 15:00  Invited Experimental Demonstration of Amplifier-Less 82Gbaud PAM4 Transmission Over 40 km Using APD at O Band, Haiping Wei1, Kemo Ran2, Kang Ping Zhang3, Alan P. Lau4, Chuan Yang4, Chao Liu5, Hong Kong Polytechnic Univ, China, 1MACOM Technology Inc, China. We experimentally demonstrated an amplifier-less transmission of a record high 82Gbaud PAM4 signal over 40km using O-band APD with a receiver sensitivity of -15.8dBm.

M3F • Radio-Over-Fiber and 6G Access—Continued

M3F.2 • 15:00  Invited VCSEL-Based Optical Wireless Transmission: New Research Prospects, Ernesto Caramella1, Giulio Cassi1, Lorenzo Gill1, 1Scuola Superiore Sant’Anna di Pisa, Italy. The fundamental features of VCSELs make them very suitable for various types of optical wireless communications, especially over short links. We present a range of promising applications for these devices in new OWC areas.

M3F.4 • 15:00  Top-Scored Reconfigurable Photonics and Flexible AI Systems, Gregory Steinbrecher1, 1META Platforms Inc, USA. As AI systems evolve, the distinction between the scale-out network connecting nodes and the scale-up interconnect inside is being lost. How can optical interconnects help best leverage the ever-more-expensive components inside and outside a node?
M3I • Transmission Optimization—Continued

M3I.3 • 14:30 Invited
Optical Network Design with High Symbol Rate Flexible Coherent Transceivers, Thomas Richter1, Steven Searcy2, Philippe Jernve3, Valeria Arlunno1, Simon Tibuleac2, Cisco Systems Inc, USA, 3Adtran Networks North America, USA. We highlight commercial flexible coherent transceivers, including their features and capabilities for optical networks, and present the versatility of a 140-Gb/s transceiver in typical optical link configurations from short reach to subsea.

M3I.4 • 15:00
Monitoring Data Augmentation of Spectral Information Using VAE and GAN for Soft-Failure Identification, Lars E. Kruse1, Sebastian Kuhl1, Annika Dachlan1, Stephan Pichler1, Christian-Albrechts-Universität zu Kiel, Germany. We propose data augmentation of monitoring information using VAE and GAN to reduce the amount of required soft-failure training data. Results show that only 5 samples per failure type are needed for F1-scores above 0.9.

M3J • Hollow-Core Fibers—Continued

M3J.3 • 14:30
Fast, Reliable and Portable Low-Loss Antiresonant Hollow-Core Fiber Fusion Splicing, Tristan Kremp1, Yue Liang2, Alan H. McCurdy3, Shoichi Yoshinaga4, Brian J. Mangan1, OFS Laboratories, LLC, USA. Using a fully automated rotational alignment algorithm and a portable 3-electrode arc-discharging fusion splicer, we achieve median splice losses of 0.13 dB between antiresonant hollow-core fibers within 120 seconds with 100% success rate.

M3J.4 • 14:45 Invited
Non-Destructive Characterization of Hollow Core Fiber, Leonard Budd1, Austin Taranta1, Eric Numkam Fokous2, Francesco Poletti1, Univ. of Southampton, UK. We summarize our recent work developing a technique for accurate and non-destructive measurement of the microstructure geometry of nested and double nested antiresonant fibers. We present results showing microstructure variation along a 2.2 km fiber.

M3K • Emerging Modulator Technologies—Continued

M3K.2 • 14:30
High-Performance Thin-Film Lithium Niobate Mach-Zehnder Modulator on 8-Inch Silicon Substrate, Jingjie Zhou1, Qingsu Cong1, Liming Lu1, Zhihui Yao2, Shiyang Zhu3, Yuxi Wang4, Zhong Li5, Zuowen Fan1, Xianfeng Zeng1, Ting Hu5, Lianxi Jia6; 1School of Microelectronics, Shanghai Univ., China, 2Shanghai Industrial μTechnology Research Inst., China, 3Huawei Inst. of System and Information Technology, Chinese Academy of Sciences, China. We first report the thin-film lithium niobate (TFLN) electro-optic Mach-Zehnder modulator (M2M) on an 8-inch silicon substrate fabricated in the back-end-of-line (BEOL) of CMOS foundry. It operates at 1550 nm with electro-optical response of only 1.5 dB roll-off at 67 GHz.

M3K.3 • 14:45
High Efficiency Single-Sideband Modulator Using Coupled Bragg Grating Resonators on Thin-Film Lithium Niobate, Nuo Chen1, Bo Xiong1, Hengsong Yue1, Kangping Lou1, Tao Chu1; Zhejiang Univ., China. We demonstrate an efficient single-sideband thin-film lithium niobate modulator with periodically cascaded Bragg gratings. The device achieves the highest modulation efficiency that has been reported (0.19 V/cm) with a compact phase-shifter length (542 µm).
Monday, 25 March

ROOM 1A
M3A • Hybrid Integration and Packaging—Continued

ROOM 1B
M3B • SDM Devices and Mode Manipulation—Continued

ROOM 2
M3C • Quantum Dots Lasers and Comb Generation—Continued

ROOM 3
M3D • Frontiers of Optical Network Architecture Summit—Continued

ROOM 6C
M3E • Coherent and Direct Detect Datacenter Transmission—Continued

ROOM 6D
M3F • Radio-Over-Fiber and 6G Access—Continued

ROOM 1A
M3A.3 • 15:15
Ultra-Compact and Ultra-Broadband Mode (De)Multiplexer Using an Asymmetrical Coupler with SWG and Cascaded Tapered Waveguide, Zakriaa Mahammed1, Bruno Paredes2, Mahmoud Rasras3, Electrical and Computer Engineering, New York Univ.-Tandon School of Engineering, USA.

M3B.3 • 15:15
Multi-Dimensional Light Field Manipulation on Diverse Integrated Photonic Platforms, Jian Wang1, Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, China. We review advances in multi-dimensional (frequency, time, complex amplitude, polarization, spatial structure) light field manipulation on diverse integrated photonic platforms (silicon, silica, polymer, III-V, metal, fiber). Silicon photonic integrated circuits, femtosecond laser direct writing 3D photonic chips, InP active photonic integrated devices, and metasurfaces for shaping light are demonstrated. Potential applications and future perspectives are discussed.

ROOM 2
M3C.5 • 15:15
On-Chip InP/InN/GaAs Microcomb Laser, Zhengdong Gao1, Jingwei Ling2, Shixin Xue1, Qili Hu1, Kaibo Zhang1, Osman Javid3, Raymond Lopez-Rios4, Jeremy Staffa1, Qiang Lin1, Univ. of Rochester, USA. We report a chip-scale InP/InN/GaAs laser that directly emits mode-locked microcomb on demand, with spectral bandwidth ~50 nm, individual comb linewidth ~60 Hz, frequency tuning rate > 2.4 x 10^17 Hz/s, and 100% utilization of optical power for comb generation.

M3C.6 • 15:30
Silicon Carbide Soliton Microcomb Generation for Narrow-Grid Optical Communications, Jingwei Li1, Haipeng Zhang2, Ruixuan Wang1, Zhenzheng Jia1, Qing Li1, Carnegie Mellon Univ., USA; CabelLabs, USA. We demonstrate efficient soliton microcomb generation in silicon carbide microresonators with a record-low-on-chip pump power of 6.5 mW. The microcomb exhibits a near 100 GHz free spectral range, enabling its application in optical communications.

M3C.7 • 15:45
6.48 Tb/s Transmissions Using 50 GHz Integrated Lithium Niobate Flat-Top Electro-Optic Combs, Chang Xu1, Yikun Chen1, Kangping Zhong1, Ke Zhang2, Chao Li1, Cheng Wang1, Alan P. Lauer1, 1The Hong Kong Polytechnic Univ., China; 2City Univ. of Hong Kong, Hong Kong. We demonstrate 6.48 Tb/s transmission using 50-GHz integrated lithium niobate flat-top electro-optic (EO) comb over a 53-km field-deployed link and show their flexibility in generating combs with variable frequency spacing and using multiple laser sources.

ROOM 3
M3D.5 • 15:20
More Fiber, Less Equipment, Glenn Wellbrock, Tiejun J. Xia1, Verizon, USA. Fiber will go even deeper into the network, but fewer and smaller boxes will be used as we continue to integrate connectivity with processing. This paper will provide examples at all layers of next-gen networks.

ROOM 6C
M3E.5 • 15:15
Performance Comparison of QD-SOA, QW-SOA, and PDFA for Multi-Tops O-Band WDM Links, Charles Silveira1, Santiago Bernal1, Ramon Gutierrez-Castejon2, Essam Berka2, Zixian Wei3, Janina Rauter4, Sergey V. Poltavtsev5, Alexey E. Gubenko2, Vasilii V. Bel’ky6, Vladimir S. Mikhailov2, Alexey Kosh1, David V. Plata1, McGill Univ., Canada; Innolume GmbH, Germany; FAoptics Inc., USA; Inst. of Engineering, Univ. National Autonoma de Mexico, Mexico. We experimentally compare QD-SOA to QW-SOA, bulk-SOA, and PDFA for coherent and IM/DD in the O-band at 10 km. A 1.152 Tbps/λ WDM coherent transmission is achieved with the QD-SOA.

M3E.6 • 15:30
Ultra-Compact and Ultra-Broadband 25 μm Aperture Waveguide, Raymond Lopez-Rios1, Jeremy Staffa1, Qiang Lin1, Univ. of Rochester, USA.

ROOM 6D
M3F.3 • 15:30
First Demonstration of 4x4 Distributed MIMO Communication with 5GPP-Compliant 5G Smartphone Utilizing SCM/WDM-Based IF-OFDM Link, Shinji Nimura1, Kazuki Tanaka1, Kamya Y. Yazdandoost1, Ryo Inohara2, Masatoshi Suzuki3,4, Takehiro Tsuritani1, KDDI Research, Japan; 2Department of Electronic and Physical Systems, Waseda Univ., Japan. We successfully demonstrated the real-time bi-directional 5G- compliant 4x4 Distributed-MIMO communication for the first time utilizing SCM/WDM-based IF-over-Fiber mobile frankhaul link architecture and commercially available smartphone for realizing future antenna distribution mobile communication systems.

M3F.4 • 15:45
Mitigation of Dispersion-Induced Power Fading in Broadband Intermediate-Frequency-Over-Fiber Transmission Using Space-Time Block Coding, Jinwoo Park1, Jaungmoon Lee1, Inho Ha1, Sang-kook Han1, 1Yonsei Univ., Korea (the Republic of). STBC with optical I-Q modulator for dispersion-induced power fading mitigation is proposed and experimentally demonstrated in broadband IFoF system. 9.5GHz bandwidth IFoF signal transmission with 8.5% EVM in fading-affected band of 50km transmission was demonstrated.
3.2 Tb/s Intra-Data Center

M3G • Panel: The Road Towards 3.2 Tb/s Intra-Data Center Communications—Continued

M3H.3 • 15:15
No-Guard-Band Integration of Digital Coherent CV-QKD System Into 400 Gbit/s 75 GHz Grid DWDM Systems, Tetsuo Kawakami1, NEC Corporation, Japan. We demonstrated no-guard-band integration of a digital coherent Continuous-variable QKD system into OpenZR-compliant DWDM transmission systems. The estimated secret key rate was 19.9 kbit/s over a 75 km EDFA amplified SMF link.

M3H.5 • 15:15
Optical Line Physical Parameters Calibration in Presence of EDFA Total Power Monitors, Giacomo Bonacors1, Yue-Kai Huang1, Andrea D’Amico2, Thomas Ferreira de Lima1, Ezra Ipl2, Vittorio Curri2, Ting Wang2, Koji Asahi3, NEC Laboratories America Inc., USA; Department of Electronics and Telecommunications, Politecnico di Torino, Italy; 1st Networks Solution Division, NEC Corporation, Japan. A method is proposed in order to improve QoT-E by calibrating the physical model parameters of an optical link post-installation, using only total power monitors integrated into the EDFA and an OSA at the receiver.

M3I.5 • 15:15
Spectrum Resolved SNR Monitoring of In-Service Channel, Qingyi Guo1, Xuefeng Tang1, Yang Lan1, Zhiping Jiang1, Huawei Technologies Canada, Canada. We propose and experimentally demonstrate a novel scheme to monitor the spectrum resolved SNR with receiver ADC buffer data. SNR accuracy of 0.2dB can be achieved, and filtering impact can be separated from link noise.

M3J.5 • 15:15
Bend Insensitive Hollow Core DNAF with SMF-Matching Mode Field Diameter and 125µm Outer Diameter for Low Loss Direct Interconnection in Short Reach Applications, Ghaffour A. Amouzad Mahdizadi1, Jaroslav Rzegocki1, Ian Davidson2, Gianluca Guerra3, Gregory T. Jason4, Seyed Mohammad A. Mousavi5, Yong-min Jung3, Austin Taranati4, Kyle Bottrell1, Periklis Petropoulos3, Francesco Poletti4,5, Orteloptics Research Centre, Univ. of Southampton, UK; Microsoft Azure Fiber, UK. We present the first 125µm outer diameter hollow-core fibre with a 10.6µm mode-field diameter allowing direct low-loss splicing to 6502 SMF. We demonstrate O-to-C-band transmission and bend-insensitive single-mode operation, attractive for low-latency sub-1km communications.

M3K.6 • 15:30
Invited talk: Fabrication Methods for Hollow Core Fibres, James M. Stake1, Univ. of Bath, UK. I will present recent work on fabrication techniques for hollow core optical fibres.

M3K.7 • 15:45
110 GHz Plasmonic Lithium Niobate Phase Modulator, Yihan Wang1, Yazhou Zhao1, Xiaoyan Gao1, Qianneng Wang1, Xi Xiao1, Jian Cheng1, Dinghan Gao1, Wentao Gu1, Wenchuan Dong1, Qizhi Yan1, Liao Chen1, Yu Yu1, Chi Zhang1, Xianliang Zhang2, Wuhan National Laboratory for Optoelectronics and School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China; 2National Information Optoelectronics Innovation Center, China. An ultra-compact lithium niobate phase modulator based on the plasmonic slot waveguide is demonstrated with a length of ~16 µm, featuring a bandwidth exceeding 110 GHz and a high-rate operation beyond 90 Gbaud.
M3Z.1 Demonstration of Cooperative Transport Interface Using Open-Source 5G Open-RAN and Virtualised PON Network, Frank Slyne1, Kevin O’ Sullivan2, Merim Dzaficagić3, Bruce Richardson1, Marcin Witaszek1, Brendan Ryan1, Niall Power1, Robin Giller2, Marco Ruffini3, Trinity College Dublin, Ireland; 1Intel Corporation Ireland, Ireland. We demonstrate a real-time, converged 5G-PON through the Cooperative Transport Interface, synchronising 5G and PON DBA upstream schedulers. This innovative approach, implemented using 5G and PON open network implementations, significantly enhances network resource allocation, reducing latency.

M3Z.2 Demonstration of Robust Mobile Free Space Optical System Using High-Speed Beam Tracking and 2D-PDA-Based Spatial-Diversity Reception, Zu-Kai Weng1, Yuki Yoshida1, Toshimasa Yamamoto1, Atsushi Kanno1, Naokatsu Yamamoto1, Tetsuya Kawanishi1, Kouichi Goya1, Toyo Electric Corporation, Japan; 3Na-Toyo Electric Corporation, Japan; 3Na-Kanoo, Japan; 4Fermilab, USA; 5Caltech, USA. We will demonstrate orchestration of entanglement distribution over a quantum local area network (Q-LAN) using a quantum network controller. Our controller enables multiple users to share a Q-LAN composed of commercial equipment for quantum communications.

M3Z.3 Live Demonstration of Autonomous Link-Capacity Adjustment in Optical Metro-Aggregation Networks, Mihail Balanci1, Pooyan Safai1, Behnam Shanaati1, Aydin Jafari1, Johannes Fischer1, Ronald Freund2, Fraunhofer HHI, Germany. We demonstrate a real-time ML-assisted network automation pipeline for dynamic, autonomous link-capacity allocation based on traffic-flow forecasting for optical metro aggregation networks. Its performance is compared to that of a classic, static bandwidth provisioning scheme.

M3Z.4 Orchestration of Entanglement Distribution Over a Q-LAN Using the IEGION Controller, Joosang P. Chung Miranda1, Anrudi Ramesh1, Shariful Islam1, Gregory S. Kanter1, Cristian Pena1, Xi Sui1, Xiangyu Lei1, Marco Ruffini3, Marco Ferrari3, Emilio Paolini2, Robin Giller2. We present a novel quantum-assisted digital signature protocol implementation exploiting Quantum Key Distribution devices and Software Defined Networking (SDN) control. The demonstration shows an innovative practical employment of quantum technology in real-world scenarios.

M3Z.5 Real-Time Demonstration of Anomalous Vibrations Detection in a Metro-Like Environment Using a SOP-Based Algorithm, Saverio Pellegrini1, Leonardo Minelli1, Lorenzo Andrenacci2, Dario Bolognesi3, Gabriele Bosco1, Benjamin Koch2, Reinhold Noël2, Claudio Cagnato1, Stefano Piccialli1, Roberto Gaudio1, Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, Italy; 3NavoSpazioGmbH, Germany; 4CISCO Photonics, Italy. We demonstrate the feasibility of SOP-based anomalous vibrations detection. The proposed demo will engage the audience by showing the time evolution of two proposed metrics, with user-set parameters and different fiber-induced mechanical vibrations.

M3Z.6 Quantum-Assisted Digital Signature in an SDN-Controlled Optical Network, Alessio Giorgetti1, Nicola Andrioli1, Elisabetta Storelli1, Marco Ferrari2, Gennaro Paduano2, Antonino Caccia1, Alberto Tanable1, Rud P. Pagellan2, Ema Paolino2, Giada Saetta1, Marco Burrena1, Alessandro Gagliano1, Paolo Martelli1, Pietro Novello1, Giovanni Schimani1, Alberto Gatta1, Politecnico di Milano - DEIB, Italy; 1IIT, Consiglio Nazionale delle Ricerche - CNR, Italy. We will demonstrate an innovative quantum-assisted digital signature protocol standards.

M3Z.7 Quantum Key Management System with Dynamic Routing for Meshed QKD Networks, Mario Werning1, Jonas Berl1, Ta-bias Feherbergh1, Caran Nilsson1, Helmut Greiser1, Piet Rydholm1, Laurent Schmalfun1, Carmen Mas-Machuca1, 1Adv Network Security GmbH, Germany; 2Chair of Communications Engineering Lab, Karlsruhe Inst. of Technology, Germany; 3Departments of Computer Science and Communications Engineering, TU Darmstadt, Germany. We demonstrate a TAPI-based telemetry streaming framework for automated service provisioning and monitoring in multi-dimensional optical networks. The demo showcases ML-based anomaly detection and network management across domains adhering to recommended YANG and protocol standards.

M3Z.8 Deployment of Secure Machine Learning Pipelines for Near-Real-Time Control of 6G Network Services, Pol Gonzalez1, Adam Zahir1, Chiara Grasselli1, Alejandro Multi1, Milan Grushev1, Sima Barzegar1, Franco Callegati1, Davide Careglio1, Marcelo Zegers1, Luis Velasco1, Universidad Politecnica de Catalunya, Spain; 3CNIT, Italy; 4Fermilab, USA; 5Caltech, USA. We will demonstrate orchestration of ML services is demonstrated. A distributed ledger supports the initial key exchange to establish secure connectivity among the agents in the pipeline.

M3Z.9 TAPI-Based Telemetry Streaming in Multi-Domain Optical Transport Network, Vignesh Karunakaran1,2, Carlos Natali1, Behnam Shanaati1, Piet Lechowicz1, Johannes Fischer2, Achim Autenrieth2, Paolo Monti1, Thomas Bauschert2, Aptron Networks SE, Germany; 2Chair of Communications Networks, TU Darmstadt, Germany. We demonstrate a TAPI-based telemetry streaming framework for automated service provisioning and monitoring in multi-dimensional optical networks. The demo showcases ML-based anomaly detection and network management across domains adhering to recommended YANG and protocol standards.

M3Z.10 Demonstration of a Compositional Learning Framework for Open and Disaggregated Optical Network Control, Huy Q. Tran1, Javier Eraa1, Trung H. Thieu1, Quan Pham Van1, Nakjung Choi1, Dominique Verrecque1, Adlen Ksentini1, Djamel Zeghlache1, 1Nokia Bell Labs, USA; 2Chair of Communication Networks, Technical University of Darmstadt, Germany; 3Department of Electrical Engineering, Chalmers University of Technology, Sweden; 4Fraunhofer HHI, Germany. We introduce an automated Compositional Learning Framework, which can dynamically combine ML models to create a composite ML service. It leverages the ML-OPs principle to streamline data-aware ML workflows. We showcase its applicability in a dynamic Routing Modulation and Spectrum Allocation scenario with the open disaggregated control platform.

M3Z.11 Artificial Intelligence (AI)-Powered Robot for Optical Network Operation Automation, Xiaofan Xu1, Haoshuo Chen1, Michael Scheutzow1, Jesse E. Simsarian1, Roland Ryd1, Qin Qu1, Arney Handel1, Rob Dinoff2, Myaj Szczepanik1, Mikael Mazer1, Lauren Dallachiesa1, Nicolas K. Fontaine1, Jim Sandos2, Mike Coxx2, David Nelson2, 1Nokia Bell Labs, USA. We demonstrate an AI-powered robot for automated service creation. The robot combines a) automated AI-driven network models for service creation and monitoring, b) a network orchestrator deploying secure ML pipelines to support near-real-time control of network services, and c) a decentralized key management system is automatically deployed as VNF. We show that dynamic key re-routing occurs failures in the key distribution layer of meshed QKD-secured OTNs under realistic conditions.

M3Z.12 Distributed Multi-Agent System fed with Telemetry Data for Near-Real-Time Service Operation, Pol Gonzalez1, Faris Alhamed1, Sima Barzegar1, Francesca Paolucci1, Juan José Vegas Olmos1, Marc Ruiz1, Luis Velasco1, Universidad Politecnica de Catalunya, Spain; 3Scuola Superiore Sant’Anna (SSSA), Italy; 4CINT, Italy; 7Demetrix SRL, Italy. We demonstrate an AI-powered robot for automated service creation. The robot combines a) automated AI-driven network models for service creation and monitoring, b) a network orchestrator deploying secure ML pipelines to support near-real-time control of network services, and c) a decentralized key management system is automatically deployed as VNF. We show that dynamic key re-routing occurs failures in the key distribution layer of meshed QKD-secured OTNs under realistic conditions.

M3Z.13 Experimental Demonstration of Optical Encryption Using Quantum Keys: Two Scenarios, Morteza Ahmadian1, Rafael Vicente1, Juan Brito1, Álvaro López-García1, Antonio Pastor1, Jose R. Moccossi1, Joanne Comellas1, Marc Ruiz1, Vicente Martín1, Luis Velasco1, Universidad Politecnica de Catalunya, Spain; 3University of Vigo, Spain; 4Telefónica I+D, Spain. Optical encryption using Quantum keys retrieved from real QKD and QINQ systems will be demonstrated. Retrieved keys are expanded to the required bitrate and then used to encrypt the input bit stream at line speed.
M4A.1 • 16:30
AIM Photonics Design Enablement: a Design-Assembly-Test Platform Advancing the Silicon-Photonics Ecosystem, Amir Dikshit1, Jin Walner2, Mohammad Jobay-er Hossain2, Mohammad Rakib Uddin3, Jarey Mann4, Anthony Aiello5, Lewis G. Carpenter6, Yuka Timalinas7, Colin McDonough7, Gerald Leake Jr.7, Christopher Baicocco7, Christopher Struemer2, Maria Halperin2, Daniel Coleman2, Amir Begovic2, Hao Yang2, Michael Zylstra1, Jerome Jahn1, Jordan Goldstein1, Christopher V. Poulton1, Todd Stievater1, Nathan Tyndall5, Michael Fanto6, USA; 5 Naval Research Laboratory, USA; 6 Air Force Research Laboratory Information Directorate, USA. AIM Photonics design enablement platforms supporting photonic integrated circuit design, interposer-based assembly, and design-for-test for a 300 mm CMOS-compatible silicon-photonics foundry are presented.

M4A.2 • 16:45 • Invited
Optical Interconnects: Path to High Volume Manufacturing, Pooya Tadayon1, Intel, USA. A fundamental challenge to be solved for widespread adoption of copackaging photonics is a high-yielding and low-cost assembly process. In this talk, we will explore recent advances in this area, including Intel’s glass-based optical bridge technology.

M4B • Integrated Devices for Sensing and Metrology
Room 1A
16:30–18:30
Presider: Molly Piels; OpenLight, USA

M4B.1 • 16:30 • Invited
Large-Scale Optical Phased Array Based on a Multi-Layer Silicon-Nitride-on-Silicon Photonic Platform, Liangjun Lu1, Wehan Xu2, Yuyao Guo3, Chuxin Liu4, Jianping Chen5, Linjie Zhou2, Shanghai Jiao Tong Univ., China. We review our recent progress on a chip-scale LiDAR transmitter on a multi-layer Si3N4-on-Si photonic platform. Experimental results show the high optical power budget of the chip and the feasibility for FMCW ranging.

M4B.2 • 16:45 • Invited
Neural Network with Optical Frequency-Coded ReLU, Margareta Vania Stephanie1, Lam Phan1, Alexander Schindler1, Michael Walth1, Tibor Grassier1, Bernhard Schrenk1, 1AIT Austrian Inst. of Technology, Austria; 2TU Wien, Austria. We demonstrate a photonic rectified linear unit (ReLU) function accomplished through frequency-coded neural signals. We show operation of an optical neuron with weighted sum and ReLU activation to perform with a 1% penalty in accuracy.

M4C • Machine Learning and Neural Networks
Room 2
16:30–18:30
Presider: Bill Corcoran; Monash Univ., Australia

M4C.1 • 16:30
Experimental Demonstration of Imperfection-Agnostic Local Learning Rules on Photonic Neural Networks with Mach-Zehnder Interferometric Meshes, Luis Z. El Sraou1, Mehmet Berkay On1, Yun-Jhu Lee2, Mahmoud Abdelghany2, S. J. Ben Yoo3, Univ. of California, Davis, USA. Mach-Zehnder interferometric meshes are attractive for low-loss photonic matrix multiplication but are challenging to program. Using least-squares optimization of directional derivatives, we experimentally demonstrate that desired matrix updates can be implemented agnostic to hardware imperfections.

M4C.2 • 16:45 • Invited
Can the PON Legacy Infrastructure Host Quantum Key Distribution Services?, Paola Parolari1, Alessandro Gasgiana1, Alberto Gatto1, Pierpaolo Both2, Paolo Martelli1, Politecnico di Milano, Italy. The integration of quantum key distribution in the legacy access infrastructure is analyzed considering the optical distribution network characteristics and the coexistence of multiple passive optical network standards providing classical channels, sources of Raman crosstalk.

M4D • Resilience in Access Networks
Room 3
16:30–18:30
Presider: Annunciara Pagano; Telecom Italia, Italy

M4D.1 • 16:30
A Physical-Layer Rogue ONU Identification Method Based on Hardware Finger- print Technology, KaiYu Liu1,2, Deming Liu1,2, Mengfan Cheng1,2, National Engineering Research Center for Next Generation Internet Access System, School of Optical and Electronic Information, Huazhong Univ. of Science and Technology (HUST), China; 3N4-on-Si photonic platform. We propose a method for identifying rogue ONUs based on hardware fingerprint technology. By directly detecting waveform fingerprints, the experimental results show that the average identification accuracy within 16 ONUs can reach 96.74%.

M4D.2 • 16:45
Experimental Demonstration of Imperfection-Agnostic Local Learning Rules on Photonic Neural Networks with Mach-Zehnder Interferometric Meshes, Luis Z. El Sraou1, Mehmet Berkay On1, Yun-Jhu Lee2, Mahmoud Abdelghany2, S. J. Ben Yoo3, Univ. of California, Davis, USA. Mach-Zehnder interferometric meshes are attractive for low-loss photonic matrix multiplication but are challenging to program. Using least-squares optimization of directional derivatives, we experimentally demonstrate that desired matrix updates can be implemented agnostic to hardware imperfections.

M4E • Data Centre and Submarine
Room 6C
16:30–18:30
Presider: Stephan Pachnicke; Christian-Albrechts Universität zu Kiel, Germany

M4E.1 • 16:30 • Invited
AWS Inter-Datacenter Transport Network, Saurabh Kumar1, Amazon Web Services, USA. Abstract not available.

M4E.2 • 16:45
Photonic Layer Encryption in High Speed Optical Communications, Dan Sadot1,2, Eyal Wohlgemuth2, Ido Atta1, Ozael Balasiano1,2, Isaac Jonas1,2, Elimelech Keller1, Ha- mulah Shalom2, Ben Gurion Univ. of the Ne- gev, Israel; 2CyberRidge, Israel. Combining multi-THz optical spectrum spreading, photonic phase encoding, and negative OSNR transmission, forms photonic shield that prevents data recording for offline deciphering. This supports post-quantum security by eliminating raw data availability for quantum computers processing.

M4F • Advanced Optical Communication Technologies
Room 6D
16:30–18:30
Presider: Hai Xu; Marvell Semiconductor Inc., USA

M4F.1 • 16:30 • Invited
Invited Abstract not available.

M4F.2 • 16:45
Can the PON Legacy Infrastructure Host Quantum Key Distribution Services?, Paola Parolari1, Alessandro Gasgiana1, Alberto Gatto1, Pierpaolo Both2, Paolo Martelli1, Politecnico di Milano, Italy. The integration of quantum key distribution in the legacy access infrastructure is analyzed considering the optical distribution network characteristics and the coexistence of multiple passive optical network standards providing classical channels, sources of Raman crosstalk.
Open and disaggregation have grown in popularity and appeal across networking segments, including optical networks, in the past few years. With open and disaggregated networks, operators/vendors can use best-in-class equipment and avoid vendor lock-in, thereby gaining faster innovation, flexibility, and scalability as their network needs grow. Deployment status varies by network segments, working distances, and geographic regions, including data center networks with backbone long-haul and metro, core networks, and customer premises equipment (CPE) in metro and edge layer. Operators/vendors from different geographic regions also have different attitudes and adopt varied approaches.

This summit aims to gather service providers, cloud providers, equipment vendors, and component vendors across the eco-system to share learnings and experiences, highlight innovation, and discuss the future of open and disaggregated optical networking, including software-defined networking (SDN), southbound interfaces, information modeling, interoperable DSP, IP over DWDM, and coherent pluggable transceivers.

Topics to be targeted by this summit include but will not be limited to:

1. In what segments of the network have openness and disaggregation been applied, i.e., long-haul/backbone, metro, or access?
2. What were the anticipated pros and cons of openness and disaggregation? Were those realized in deployment? (e.g., Have the projected cost savings been realized?)
3. Will openness and/or disaggregation help or hinder convergence of different network segments (e.g., metro and long-haul) and layers (IP + optical)?
4. Will nascent interoperable DSP stimulate increased adoption of openness and disaggregation in optical networks?
5. Will openness and disaggregation be a key enabler for IP over WDM?
6. What advances are needed in managing smart coherent pluggables in routers to enable IP over WDM?

Organizers
Raja Ahammad, Cisco Systems Inc, USA
David Neilson, Nokia, USA
Rajneesh Gopalkrishnan, AT&T, USA
Ivan Avendano, Ericsson, Sweden
Vladimir Gundersen, Axa Network, UK
Seongyoung Jang, Ulsan National Institute of Science and Technology, South Korea
Michael Vasilyev, University of Texas at Arlington, USA

Speakers
Tad Hafmeister, Google, USA
Kazuki Kiyota, Furukawa Electric, Japan
Vitaly Mikhalov, OFS, USA
David Neilson, Nokia, USA
Chongjin Xie, Alibaba, China

This panel will address the maturity of the amplifier technologies beyond C- and L-bands, as well as their suitability for hyperscale datacenters and telecom networks of the near future. For the last three decades EDFA has been a key enabler of long-haul communications. As the bandwidth demand keeps growing, opening spectral regions beyond the traditional telecom bands of EDFA becomes important. The importance of amplifier technologies for these regions is further emphasized by the recent advances in hollow core fibers that have low-loss windows much wider than C- and L-bands. In parallel to the telecom market, the hyperscale-datacenter campuses are undergoing a rapid expansion in size and capacity, with ever-increasing intra-datacenter distances and modulation formats complexity. As a result, huge efforts are underway to develop novel optical fiber-based and on-chip amplifiers suitable for such datacenter networks.

Several solutions for amplification outside of the C- and L-bands have been discussed, e.g., SOAs, Bi-, Tm-, and Pr- doped fiber amplifiers, Raman amplifiers, and L-bands have been discussed, e.g., SOAs, Bi-, Tm-, and Pr- doped fiber amplifiers, Raman amplifiers, huge efforts are underway to develop novel optical fiber-based and on-chip amplifiers suitable for such datacenter networks.

Several solutions for amplification outside of the C- and L-bands have been discussed, e.g., SOAs, Bi-, Tm-, and Pr- doped fiber amplifiers, Raman amplifiers, and L- bands have been discussed, e.g., SOAs, Bi-, Tm-, and Pr- doped fiber amplifiers, Raman amplifiers, etc. This panel brings together experts from industry and academia to discuss the advantages and challenges that these solutions face, as well as explore their readiness for the network applications.

Organizers
Lynn Nelson, AT&T USA
Shen Shikui, China Unicom, China
Norman Swenson, Infinera, USA

Presenters
Sebastien Gareau, Ciena, Canada
Steven J. Hand, Infinera, USA
Emerson Moura, Cisco, Brazil
Kirsten Rundberget, AT&T, USA
Chongjin Xie, Alibaba Group, China

M4H.2 • 16:45
Savitzky-Golay-Filter-Based Phase Recovery for CV-QKD.
Elisabeth Llamosa Fiz1, Pol Addin1, Samuel Sarmiento-Hernández1, Jeson Tabares1, Sebastian Etcheyverry1, Luxquanta Technologies SL, Spain.
A Savitzky-Golay filter (SGF) is employed to reduce the excess noise introduced by a pilot-tone-based phase recovery in CV-QKD. Results show an improvement of 29.2% in the secret key rate at 10.9 km when the SGF is used.

Photonic Counting Laser Ranging with Dual-Carb Asynchronous Optical Sampling.
Yun Meng1, Hou-Man Chin 1, Adnan A. Hajomer 1, Michael Vasilyev, University of Texas at Arlington, USA.
We performed the first measurement and recovery of squeezed light using a free-running coherent receiver with a separate laser, 98% of the squeezing was preserved in our method relative to measurements with a shared laser.

Pruning Attention in Transformers for Nonlinear Transmission 16:45
Pruning Attention in Transformers for Nonlinear Transmission.
Behzadeh Behzadeh, NSM, Canada.
We study pruning attention in Transformers for nonlinear transmission. We show the impact of statistical pruning on the performance and complexity of non-linear equalization and compare it with a physics-informed pruning scheme.

M4J.1 • 16:30
Silicon Photonic Four-Channel Dual-Polarization Coherent Receiver Module for FMCW LiDAR Application.
Chongjin Xie, Alibaba, China.
We demonstrate a four-channel dual-polarization FMCW LiDAR receiver module using a silicon photonic coherent receiver chip. The sensitivity of the module is better than -85dBm. The ranging operation within a distance of 81.9m is demonstrated.
Waveguide Raman Sensing for Chemical Detection in Industrial Processes, Doran Sanchez, Christopher Lieutaud, Priscille Bonnassies, Yasmin Ibrahim, Charbel Olmapia, Nabila Ilmatoukene, Jerome Michon; InSpek SAS, France; 1/BD Agrabiotechnologies Industrielles (ABI), CEBB, AgroParisTech, France. Waveguide-enhanced Raman spectroscopy (WERS) is a promising method for detecting chemical and biological compounds with high sensitivity and selectivity on a chip-scale platform, but has so far been limited to demonstrations in research laboratories. We present the implementation of a fibre-coupled WERS sensing system in an industrial bioproduction process.

Proactive Congestion Control Within 1-ms Delay at Mobile Midhaul Utilizing Parallel Traffic Prediction and Fast Switchover of CU and Optical Path, Yuka Okamoto, Hirota, Ujiitake, Kota Asaka, Tatsuya Shimada, Tomoaki Yoshida; NTT Access Network Service Systems Laboratories, NTT Corporation, Japan. We propose a proactive congestion control mechanism that utilizes parallel traffic prediction and fast switchover of the CU and optical path. Our prototype controller can perform these tasks within a 1-ms delay at the MMH.

Novel in-Line Triage Methodology for High-Speed Optical Transceivers in Hyperscale Datacenters, Elaine Chou, Arin Mohan, Chris Berry, Chet Powers, Mario Morales; Meta, USA. A novel in-line triage methodology has been developed by leveraging data collected from optical transceivers and network switches. A success rate of ~88% was achieved by correlating diagnosis from triage to failure analysis from vendors.

Probabilistically Shaped 64-QAM Transmission via Distortion-Aware Phase Retrieval, Han Huang, Haolun Chen, Peiji Song, Cheng Gao, Qi Gao, Ye-tian Huang, Nicolas K. Fontaine, Michael Mazur, Lauren Dallachesa, Roland Ryf, Zhangxuan Li, Yingxiong Song; Shanghai Univ., China; Nokia Bell Labs, USA. We experimentally demonstrate 50-GBaud probabilistically shaped 64-QAM transmission with 5.6-bits/symbol entropy over 80-km SSMF using carrierless intensity-only detection via a distortion-aware phase retrieval receiver, resulting net capacity over 200 Gb/s.

Non-Intrusive DAS Coexisting in Telecom Networks, Jan Krstofer Brenne, Anthony Sladen, Pascal Pecchi, Jan Petter Morten, Julian Pelaez, Joacim Jacobsen, Alain Casais, Philippe Plantady, Jean-Paul Ampuero, Diane Rivet; 1Alcatel Submarine Networks Norway, 2Université Côte d’Azur (IRD), Géoazur, France; 3Xanadu Quantum Technologies, Canada; 4Microsoft Research Center, UK. We experimentally demonstrate a novel method to estimate the carrier frequency offset (CFO) using the eigenvalue and scattering coefficient b in the Nonlinear Fourier Transform, Taisuke Chino, Ta-kei Mazur, Lauren Dallachesa, Roland Ryf, Herve Favelier; 1Alcatel Submarine Networks Norway, 2Université Côte d’Azur (IRD), Géoazur, France; 3Xanadu Quantum Technologies, Canada. Our experiments demonstrate fine CFO estimation below 10 kHz for the proposed method.

Non-Intrusive DAS Coexisting in Telecom Networks, Jan Krstofer Brenne, Anthony Sladen, Pascal Pecchi, Jan Petter Morten, Julian Pelaez, Joacim Jacobsen, Alain Casais, Philippe Plantady, Jean-Paul Ampuero, Diane Rivet; 1Alcatel Submarine Networks Norway, 2Université Côte d’Azur (IRD), Géoazur, France; 3Xanadu Quantum Technologies, Canada. We describe DAS interrogation for non-intrusive coexistence with live C-band WDM channels. The scheme facilitates consistent high sensitivity range >100 km. Surface vessels, seabed fishing gear and earthquakes are localized from the 2Africa network.

We present 56-cm long LPCVD SiN waveguides traversing a full 300mm wafer and biological compounds with high promising method for detecting chemical enhanced Raman spectroscopy (WERS) is a novel reconstructive spectrometer with cascaded nanobeam mirrors. A compact fibre-coupled WERS sensing system in an industrial bioproduction process.
M4H.3 • 17:00
Assessing the Impact of Patterning Effect on Quantum Key Distribution, Tao Wang1, Xin Wang1, Yanwen Zhu1, Sheng Liu1, Jie Zhang1; 1Beijing Univ. of Posts and Telecommunications, China; 2China Mobile Research Inst., China. We assessed the impact of patterning effect on SKR in QKD while considering statistical fluctuations. Through numerical simulations, compared to WCS, HSPS demonstrated superior resistance to patterning effect and can transmit over longer distances.

M4H.4 • 17:15
First Demonstration of a Group-IV Emitter on Photonic BiCMOS Supplying a Quantum Communication Link, Florian Honz1, Michael Hentschel1, Stefan Jesseng1, Jochen Kraft1, Philip Walther1, Bernhard Schrenk2; 1AIT, Austria; 2Faculty of Physics, Vienna Center for Quantum Science and Technology (VCQ), Univ. of Vienna, Austria; 3ams-OSRAM AG, Austria. We implement a silicon-on-insulator light emitter as optical supply for a QKD transmitter and transfer it to an electronic BiCMOS wafer. A secure key is established over short reach in co-existence with shortwave data transmission.

M4I • Panel: Wideband Optical Amplifiers for Datacenters, Hyperscale Networks and Telecom Networks—Continued

M4J • Integrated Optics for Communication and Sensing—Continued

M4K • Nonlinear Transmission—Continued
M4A.4 • 17:30
Toward Large-Scale Nonvolatile Electrical Programmable Photonics with Deterministic Multilevel Operation, Rui Chen1, Krat Tara1, Jayata Dutta1, Minh Hoa1, Justin Sim1, Julian Ye1, Jiaju Zheng1, Zhuan Fang1, Arka Majumdar1; Univ. of Washington, USA. We present a deterministic multilevel scheme by electrically controlling multiple phase-change elements (PCMs) SiSb2, segments through individual PIN heaters. PCMs are integrated on 300-mm silicon photonic fab dies back-end-of-line, promising for fast prototyping and massive production.

M4A.5 • 17:45
Hybrid Integrated Multi-Lane Erbium-Doped S3N4 Waveguide Amplifiers, Zhen Qiu1, Xinrin Xu1, Yiliang Liu2, Martin Hafermann2, Taeong Kim3, Joseph C. Olson1, Ru N. Wang4, Carlton Ronning5, Tobias J. Kippenberg1;1 Swiss Federal Inst. of Technology Lausanne (EPFL), Switzerland; 2Center for Quantum Science and Engineering, Switzerland; 3Inst. of Solid State Physics, Friedrich Schiller Univ. Jena, Germany; 4SPG Group, Applied Materials Inc., USA. We present the integration of four individual erbium-doped waveguide optical amplifiers on a Si3N4 photonic integrated circuit hybrid integrated with a four-lane semiconducting pump laser diode chip. Each amplifier achieves 15 dB on-chip gain.

M4B • Integrated Devices for Sensing and Metrology—Continued

M4C • Machine Learning and Neural Networks—Continued

M4D • Resilience in Access Networks—Continued

M4E • Data Centre and Submarine—Continued

M4F • Advanced Optical Communication Technologies—Continued

M4F.4 • 17:30
First Impact Movement Characterization of Shallow Buried Live Subsea-Cable, Steinar Bjørnstad2,3, Kristina Shizuka Yamase2, Mark Cappuzzo2, Roland Ryf2, Nicolas K. Venkitesh1, Kristina Shizuka Yamase2, Mark Cappuzzo2, Roland Ryf2; 2Simula Research Laboratory, Norway. We review recent advancements in spatial division multiplexing (SDM) towards next generation Pb/s submarine cables, highlighting the transformative impact of these technologies on global communication networks and reporting their novel applications in climate monitoring.

M4F.5 • 17:45
Next Generation SDM Submarine Networks: From Telecom to Climate Change, Olivier Courtois1; 1Alcatel Submarine Networks, France. We review recent advancements in spatial division multiplexing (SDM) towards next generation Pb/s submarine cables, highlighting the transformative impact of these technologies on global communication networks and reporting their novel applications in climate change monitoring.

M4G • Silicon Photonics—Continued

M4H • Integrated Devices for Sensing and Metrology—Continued

M4I • Machine Learning and Neural Networks—Continued

M4J • Resilience in Access Networks—Continued

M4K • Data Centre and Submarine—Continued

M4L • Advanced Optical Communication Technologies—Continued

M4L.4 • 17:30
Opportunities and Challenges of Optical Communications in Autonomous Driving Vehicles, Gordon N. Lui1, Soochow Univ., China. Autonomous driving vehicles require high bandwidth due to the increased sensors and improved architectures. Optical communications provide several advantages over copper cables in intra-vehicle networks, but face many challenges, especially because of the harsh environment.
M4H • Advancement in Quantum Key Distribution Systems II—Continued

M4I • Panel: Wideband Optical Amplifiers for Datacenters, Hyperscale Networks and Telecom Networks—Continued

M4J • Integrated Optics for Communication and Sensing—Continued

M4K • Nonlinear Transmission—Continued

M4H.5 • 17:30 Tutorial
Recent Developments in Quantum Key Distribution, Christoph Marquardt, Max Planck Inst. Science of Light, Germany. I will introduce the principles and requirements of quantum key distribution in realistic scenarios and applications. Furthermore, I will highlight advances and developments in the field in the technical and architectural domain.

Christoph Marquardt owns the Chair of Optical Quantum Technologies at the Friedrich-Alexander-Universität Erlangen-Nürnberg and is the head of the quantum information processing group at the Max Planck Institute for the Science of Light in Erlangen. The topics of his research cover a broad range of quantum optics and quantum information experiments, from nonlinear photonics to satellite-based quantum key distribution. Christoph Marquardt served in advisory groups for the European Union and German government and is a co-founder of the start-up KEEQuant. He is active in several EU and national quantum communication research projects and is taking care of the architecture of the German BMBF Q2Net initiative.

M4J.4 • 17:30 Fabrication-Tolerant High-Speed 5-bit Silicon Optical True Time Delay Line in the O-Band, Ziheng Ni, Yixuan Wang, Liangjun Lu, Yuanbin Liu, Jianping Chen, Linjie Zhou; Shanghai Jiao Tong Univ., China. We demonstrated a high-speed 5-bit silicon optical true time delay line based on fabrication-tolerant electro-optic push-pull optical switches, which shows a lower phase deviation and a lower insertion loss compared with the conventional design.

M4K.4 • 17:30 Improved Physics-Based Raman Amplifier Model in C+L Networks Through Input Parameter Refinement, Yihao Zhang, Xiaomin Liu, Qizhi Qiu, Yichen Liu, Lin Yi, Weisheng Hu, Qunbi Zhuge; Shanghai Jiao Tong Univ., China. We propose an input parameter refinement scheme for the physics-based Raman amplifier model. Experiments over C+L band are conducted. Results show the scheme can lower the physical model’s maximum estimation error by ~2.13 dB.

M4J.5 • 17:45 Power Monitoring and Thermal Crosstalk Compensation for ORR-Based Optical Beamformer, Bin Shi, Ripalpa Stabile, Eduard Tandjioorga; Technische Universiteit Eindhoven, Netherlands. We demonstrate thermal-crosstalk-compensated ORR-based beamformer on InP photonic integrated circuit, through an automatic voltage control method that uses on-chip power monitoring for continuous delay tuning, with <1s reconfiguration time.

M4K.5 • 17:45 Autoencoder Learning of Constellation Shaping Robust to Semiconductor Laser Noise and Nonlinearity in Fiber-THz System, Xiang Liu, Jiao Zhang, Min Zhu, Zhigang Xin, Weidong Tong, Yunxue Wang, Binghong Hua, Yuancheng Cai, Mingzheng Lei, Junjie Ding, Xingyu Chen, Bo Liu; Purple Mountain Laboratories, China; Southeast Univ., China; Nanjing Univ. of Information Science and Technology, China; Fudan Univ., China. We experimentally demonstrate the robustness of autoencoder-based constellation shaping against semiconductor laser noise and nonlinearity. Up to 46% lower BER and 1.5 dB gain are achieved in the fiber-THz system at 320 GHz.
M4A.6 • 18:00  Invited  
Fully Integrated Coherent Lidar Chip, Mehrdi Asghari; SiLiC Technologies, Inc., USA. In this presentation we will report on our latest progress in integrating multiple channels and solid state scanning into a single chip and applications of the technology to different markets from 1m to Km range.

M4B.5 • 18:00  
Wafer-Level Fabrication of Vacuum-Gap Fabry-Pérot Resonators with Quality Factors Exceeding One Billion, Naijun Jin, Yi Fan Li, Dae Young Lee, Hootian Cheng, Charles McLemore, Samuel Halladay, Yizhi Luo, David Mason, Scott Diddams, Franklyn Quinlan, Peter Rakich; Yale Univ., USA; National Inst. of Standards and Technology, USA; Department of Physics, Univ. of Colorado Boulder, USA; Electrical, Computer and Energy Engineering, Univ. of Colorado Boulder, USA. We present a wafer-level fabrication method for high-Q, compact vacuum-gap Fabry-Pérot resonators, with quality factors surpassing one billion at 1560 nm, these resonators are well-suited in a range of applications as frequency references.

M4B.6 • 18:15  
Co-Packaged Micro Reference Cavity with Photonic Integrated Circuits, Hootian Cheng, Naijun Jin, Zhaowei Dai, Chao Xiang, Joel Guo, Yishaou Zhou, Scott Diddams; Franklyn Quinlan, John Bowers, Owen Miller, Peter Rakich; Yale Univ., USA; Department of Electrical and Computer Engineering, Univ. of California, Santa Barbara, USA; National Inst. of Standards and Technology, USA; Department of Physics, Univ. of Colorado Boulder, USA. A compact co-packaged micro Fabry-Pérot reference cavity integrated with photonic circuits achieves a redirected signal, 14.2 dB back-reflection suppression, and 79.5% cavity mode matching efficiency.

M4E.6 • 18:15  
Delay-Minimized Distributed Sequence Routing for Satellite Optical Networks, Qiancheng Zhao, Ruijie Zhu, Yudong Zhang, Wenchao Zhang, Chao Xi, Bo Yang; Zhengzhou Univ., China; Space Star Technology CO., LTD, China. A sequence routing algorithm based geographical information is proposed to reduce delay in satellite optical networks. The simulation results show that compared with the static topological routing algorithm, the average delay is reduced by 30%.

19:00–21:00  Student Party, Coin-Op Gaslamp
M4G • ONS: Open and Disaggregated Optical Networking: Where We’ve Been and What’s Coming Next—Continued

M4H • Advancement in Quantum Key Distribution Systems II—Continued

M4I • Panel: Wideband Optical Amplifiers for Datacenters, Hyperscale Networks and Telecom Networks—Continued

M4J • Integrated Optics for Communication and Sensing—Continued

M4K • Nonlinear Transmission—Continued

M4J.6 • 18:00
W-Band Wireless Transmission Based on 98 GHz Packaged Silicon Photonics Optical Clock Generator, Antonio Malacarne1, Alberto Montanaro1, Fawad Ahmad1, Gaurav Pandey1, Antonio D’Errico1, Marco Romagnoli1, Antonella Bogani1, Claudio Forzani2; Photonics Networks and Technologies National Laboratory, CNIT, Italy; TeCIP, Sant’Anna School of Advanced Studies, Italy; Ericsson Research, Italy. A fully packaged CMOS-compatible photonic integrated frequency-tunable optical clock synthesizer is used for 93 GHz wireless transmission of complex modulation formats up to 4 Gb/s data rate, with noise performance suitable for upcoming 6G networks.

M4K.6 • 18:00
Fast and Accurate DNN-Based Approach in Maximizing Ultra-Wideband Fiber-Optic Systems Throughput, Zelin Gan1, Mykyta Shevchenko2, Sam Nallapurema Herzberg1, Seb Savory1; Univ. of Cambridge, UK; Univ. College London, UK. We present a fast and accurate physical layer model assisted by a neural network to maximize the throughput for ultra-wideband systems. The proposed approach significantly saves computation time and keeps the same precision.

M4J.7 • 18:15
Beamforming Demonstration of Hybrid Photonic Integrated Circuit Based on a Blass Matrix for Radar Receivers, Federico Camponeschi1, Valentina Gemmati1, Filippo Scotti1, Luca Rinaldi1, Ahmad Mohammad1, Chris Roelofzen1, Paolo Ghelfi1, Scuola Superiore Sant’Anna, Italy; CNIT, Italy; LioniX, Netherlands. This paper reports the first-ever beamforming demonstration of a hybrid photonic integrated circuit operating as an optical Blass-matrix architecture for a Scan-on-Receive synthetic aperture radar intended for Earth observation from space.

M4K.7 • 18:15
1200-km Transmission of 4096-ary Eigenvalue-Modulated Signal Using a Neural Network-Based Demodulator and SD-FEC, Ryotaro Harada1, Tsuyoshi Yoshida2, Daisuke Hisano1, Akihiro Maruta1, Ken Mishina1; Osaka Univ., Japan; Mitsubishi Electric Corporation, Japan. We experimentally demonstrate the transmission of a 4096-ary eigenvalue-modulated signal using a neural network-based demodulator and SD-FEC. The experimental results indicate a successful operation with an error-free transmission through a 1200-km optical fiber line.

19:00–21:00  Student Party, Coin-Op Gaslamp
Tu1A • Plenary Session

Presider: Jiajia Chen; TikTok, USA; Johannes Fischer; Fraunhofer Heinrich-Hertz Inst., Germany; Tetsuya Hayashi; Sumitomo Electric, Japan

Tu1A.1 • 08:30 (Plenary)

How 6G Will Impact Networking, Anita Döhler¹; 'NGMN Alliance, Germany. This presentation explores NGMN's pivotal role in advancing the Mobile Industry towards next-generation networks, encompassing Operator led requirements on 6G, sustainability, and cloud-native. With a prerequisite to deliver new use cases that create value and exceptional end-user experiences this presentation looks at trade-offs that will need to be made, for example energy consumption versus bit rates and identifies the critical role optical communications will play in enabling these Operator led requirements, for example disaggregation, resilience and energy efficiency.

Tu1A.2 • 09:00 (Plenary)

Networking Alchemy: Transforming Science Through Connectivity, Inder Monga¹; ‘Berkeley Lab, USA. Scientists are driven to answer some of the world’s most fundamental questions – from the origin of the universe to the future of humanity and our biosphere. Answers lie hidden in the deluge of data being gathered 24/7 from experiments, observations, and simulations. Energy Sciences Network (ESnet), the Department of Energy’s data circulatory system, seeks to harness and accelerate the creativity of vital research collaborations while pushing the boundaries of networking in experimenting with what a quantum computing network might look like. This talk will describe global-scale science and its workflows, innovations being explored to meet its rapidly evolving needs, and the engineering behind the science networks of today and the future.

Tu1A.3 • 09:30 (Plenary)

Emerging Fiber Technologies for Future Optical Networks About the Speaker, David J. Richardson¹; ‘Microsoft, USA. Major advances have been made in recent years on the development of radically new transmission fibers offering improved optical properties and systems performance relative to conventional single mode fiber technology, with some of the most promising, including hollow core fiber, now deployed in the field. I review progress in these emerging technologies and discuss where they are likely to prove most disruptive and impactful in future optical networks.

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

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

10:00–16:45  Career Zone, Exhibit Hall B1

10:30–12:00  The Art of Writing the Perfect OFC Paper, 6A

12:00–14:00  Awards Ceremony and Luncheon, Upper Level, Ballroom 20

OFC 2024 • 24–28 March 2024
Room 1A

14:00-16:00
Tu2A • Optical Transmission Techniques
Presider: Antonio Tartaglia; Ericsson, Italy
Tu2A.1 • 14:00 “Tight Sync” in Precision Time Protocol (PTP), Requirements and Impact at Optical Component Level, Stefano Ruffini; Shane McKeown; Calnex Solutions, UK. Accurate time sync is required by various applications (e.g. 5G). This talk will go through the challenges in distributing accurate timing, including the impact to performance from some optical technologies, and options to verify performance of optical modules.

Tu2B • Nonlinear Photonic Devices and Material Platforms
Presider: Kazuhiro Ikeda; AIST, Japan
Tu2B.1 • 14:00 Subwavelength Photonic Structures for Nonlinear Optical Functionalities, Paulo Nuño Ruano1, Jianhao Zhang†, David González-Andrade1, Hiba El Bouil Ferhati†, Thi Thuy Dinh Dinh1, David Medina Querol†, Pavel Chichkov1, Delphine Marron-Morin1, Eric Cassan1, Laurent Vivien1, Norberto Daniel Lanzarotti-Kimura1, Carlos A. Alonso Ramos1,2; CN-CNRS, France; CN-CNRS, Canada. Periodic subwavelength patterning of silicon enables the control of nonlinear effects with unprecedented flexibility. Here, we will present our most recent results on nonlinear supercontinuum generation and nonlinear Brillouin interactions in subwavelength silicon waveguides.

Room 1B

14:00-16:00
Tu2C • Quantum Components and Quantum PICs
Presider: Cheryl Sarace-Agaskar; MIT Lincoln Lab, USA
Tu2C.1 • 14:00 An Integrated Photonic-Electronic Quantum Coherent Receiver for Sub- shot-Loss Noise-Limited Optical Links, Volkan Gurses1, Debjit Sarkar†, Samantha David1, Ali Hajime1; Electrical Engineering, California Inst. of Technology, USA; Physics, California Inst. of Technology, USA. We demonstrate an integrated quantum-limited coherent receiver with co-packaged silicon photonic and electronics. The fully integrated receiver has 2.57 GHz bandwidth, 14.5 dB shot noise clearance, 587 kW/m² knee power, and 2.7 × 0.8 mm² footprint. With this system, we measure squeezed vacuum showing 0.156 ± 0.039 dB sub-shot-noise-level sensitivity.

Room 2

14:00-16:00
Tu2D • High Speed Transmitters
Presider: Yuichi Tohmori; Tsurugi Photonics Foundation, Japan
Tu2D.1 • 14:00 Top-Scored Demonstration of 155 Gbaud PAM4 and PAM4 EML with Narrow High-Mesa EA Modulator for 400 Gbps per Lane Transmission, Asami Uchiyama1, Shinya Okuda1, Toshiyuki Tsuji1, Yohei Hokama1, Mizuki Shirao1, Kenichi Abe1, Takeshi Yamatoya1, Yasuhito Yamauchi1, Mitsubishi Electric Corporation, Japan. We experimentally demonstrated 400 Gbps per-lane EML with narrow high-mesa EA modulator. TDECO less than 3.3 dB at 310 Gbps (155 Gbaud PAM4) and clear eye diagram at 450 Gbps (155 Gbaud PAM6) were achieved.

Room 3

14:00-16:00
Tu2E • Advanced Optical Fibers
Presider: Takashi Matsu; NTT Corporation, Japan
Tu2E.1 • 14:00 Top-Scored Record Low Loss Optical Fiber with 0.137 dB/km, Shin Sato1, Yuki Kawaguchi1, Hirotake Sakuma1, Tetsuya Haruna1, Takemi Hasegawa1, Sumitomo Electric Industries, Ltd., Japan. We have achieved low loss record of 0.137 dB/km at 1566 nm wavelength and 0.1406 dB/km at 1550 nm on a Ge-free silica-core fiber that has been achieved by the further reduction of fictive temperature.

Room 6C

14:00-16:00
Tu2F • Moore’s Law: A Photonics Perspective for the Next Decade
Presider: Paul Gunning; British Telecommunications, UK
Tu2F.1 • 14:00 Keeping up with Moore’s Law, Andreas Bechtolsheim1, Ananta Networks, Inc., USA. This presentation discusses how Photonics can keep up with Moore’s law given that the dimensions of Photonics devices for generating, propagating and modulating light do not benefit from the ever shrinking feature sizes of advanced process technologies.
As for the next generation of MCF-SDM systems and on the availability of suitable components. The choices that are made will determine the direction of the development of future optical fiber networks.

The panelists will discuss the pros and cons of both approaches utilizing single-core and multi-core fibers and optical-fiber communications.

Tu2H • Panel: Beyond Two-Core Fibers: Single-Core vs Multi-Core Amplifiers in Long-Haul SDM Links

Organizers
Victor Kopp, Chiral Photonics, USA
Atsushi Nakamura, NTT, Japan
Bera Falsiditof, OFS Fotel Denmark I/S, Denmark
Masato Tanaka, Sumitomo Electric Industries Ltd, Japan

Speakers
Dan Neugrosh, Chiral Photonics, USA
Philipe Ferrer, Meta, USA
Massimiliano Salsi, Google, USA
Philippe Perrier, NEC, Japan
Furukawa, Japan

Massimo Salsi, Google, USA
Meta, USA
Philippe Perrier, NEC, Japan
Furukawa, Japan

Tu2H.1 • 14:00 Tutorial Probabilistic Shaping for Nonlinearity Mitigation, Lutz Lampe1, Univ. of British Columbia, Canada. In its broad application, signal shaping can serve as a method for mitigating nonlinearity in optical fiber communication, complementing established techniques for nonlinearity compensation. We will explore recent findings on widely used probabilistic constellation shaping aimed at minimizing nonlinear effects.

Lutz Lampe is a Professor in the Department of Electrical and Computer Engineering at the University of British Columbia, Canada. His research focuses on signal design, detection and estimation, and employing learning-from-data methods in communications.

EDFAs for the next generation of MCF-SDM can be implemented in single-core and multi-core fibers (MCFs). The former typically requires a pair of fan-in/out devices and consists of conventional single-core EDFAs and related components. The latter utilizes multi-core components such as MC EDFs, MC-WDM couplers, MC-GFFs, and MC-isolators. Which approach will be adopted depends on the transmission scheme of MCF systems and on the availability of suitable components. The choices that are made will determine the direction of the development of future optical fiber networks.

The panelists will discuss the pros and cons of both approaches utilizing single-core and multi-core amplifiers from different perspectives and will provide insight into future MCF networks.

Topics will include the following:

- Unidirectional MCF transmission vs. bidirectional MCF transmission
- Single-core amplifier vs. multi-core amplifier
- Core-pumped amplifier vs. cladding-pumped amplifier
Tuesday, 26 March

Tu2A • Optical Transmission Techniques—Continued

Tu2B • Nonlinear Photonic Devices and Material Platforms—Continued

Tu2C • Quantum Components and Quantum PICs—Continued

Tu2D • High Speed Transmitters—Continued

Tu2E • Advanced Optical Fibers—Continued

Tu2F • Moore’s Law: A Photons Perspective for the Next Decade—Continued

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**Tu2A.2 • 15:00**

**Optical and THz Broadband Integrated Circuits for Mode-Dependent Free-Space Communications**

Alan E. Willner 
Univ. of Southern California, USA.

Integrated circuits may be an important role in future mode-dependent free-space communications. This presentation will describe broadband optical and THz structures that can generate data-carrying beams on unique spatial modes. One example is tunable pixel-array-based metasurfaces.

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**Tu2B.3 • 14:45**

**Foundry Compatible, Efficient Wafer-Scale Manufacturing of Ultra-Low Loss, High-Density SiN Photonic Integrated Circuits**

Xin Xu 
Rui N. Wang, Yong Liu, Johann Riemenberger, Zheru Qiu, Tobias J. Kippenberg, Ecole Polytechnique Federale de Lausanne, Switzerland.

We demonstrate ultra-low propagation loss, lithographic precision, and wafer-scale manufacturability for high-density SiN photonic integrated circuits using an efficient DUV-based subtractive approach. We show a propagation loss as low as 1.4 dB/m at 1.55 μm.

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**Tu2B.4 • 14:50**

**Multi-Channel System with High-Performance Fractal Superconducting Nanowire Single-Photon Detectors**

Tao Li, Zifan Hao, Kai Zou, Yun Meng, Thomas Descamps, Adnan Iovani, Val Zwoller, Xiaolong Hu, Fan Jin, UNI, China; Royal Inst. of Technology (KTH), Sweden.

We report on an eight-channel fractal SNPSD system in the wavelength range of 940 nm with minimal polarization sensitivity. The best channel exhibits 96% system detection efficiency and 19 cps dark-count rate.

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**Tu2C.4 • 14:45**

**A Co-Planar Stripline Mach-Zehnder Modulator Enabling 160 Gbd PAM-4 on an Indium Phosphide Platform**

Jesús A. Hiller, Qian Hu, Heoshuo Chen, Arezoo Moghaddam, Luc Augustin, Michael Wale, Kevin Williams, Weiming Yao, Eindhoven University of Technology, Netherlands; Nokia Bell Labs, USA; SMART Photonics, Netherlands; Infineon Optics B.V., Netherlands; Department of Electronic and Electrical Engineering, University College London, UK.

Large signal measurements are undertaken on electro-optic Mach-Zehnder modulators using a co-planar-stripline design, realized for the first time on a generic InP platform, demonstrating a 320 Gbps line rate with a bit error rate of 1.62×10^-3.

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**Tu2D.4 • 14:45**

**Advances in Photonic Integration for Quantum Communications**

Taoqiang Paraiso 
Tokai University, Japan; UK.

We review recent progress in the development of photonic integrated circuits for high speed, real-time quantum random number generation and quantum key distribution.

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**Tu2E.4 • 14:50**

**Advanced Optical Transmitters**

Hua Chuan Xie 
Mayank Raj, Anish Joshi, Eindhoven University of Technology, Netherlands; 2Royal Inst. of Technology, Sweden.

We present a 64 Gb/s NRZ O-band ring modulator with 3.2 THz FSR for DWDM Applications, Chuan Xie, Mayank Raj, Anish Joshi, Zakir T. Nag, Advanced Micro Devices (AMD), USA. We demonstrate the highest BW/FSR product O-band Si microring modulator to date. The device achieves 3.2 THz FSR, 41 GHz BW, 44 pm/√m modulation efficiency, and operates at 64 Gb/s NRZ.

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**Tu2F.4 • 15:00**

**Record Length of 2000km Weakly-Coupled 7-Core MCF Produced From a Single Large-Scale MCF Preform**

Tobias Tiest, Michael Loretz, Jang-Won Lee, Maximilian Schmidt, Jimmy E. Beavers, Evan Green, Nicolay L. Andersen, Andreas C. Samson, Frederik N. Andersen, Sarah Cawlina, Kai Habel, Giulin Ma, Martin Boettcher, Stefan Amezcua, Rebecca K. Hillier, Amezcua, Tokyo University, Japan; 2Royal Inst. of Technology, Sweden; 3Fraunhofer-Institut für Nachrichtentechnik HHI, Germany.

We present the design and fabrication of more than 2000 km of MCF drawn from a single large-scale MCF preform. The fiber was fabricated without any online fiber breaks and exhibits excellent geometrical conformity.

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**Tu2F.3 • 14:40**

**Breaking Down the Interconnect Bottleneck - a Third Dimension**

Rebecca K. Schaefer 
Lightmatter, USA.

A paradigm shift in packaging that replaces silicon substrates with a programmable silicon photonic interposer enabling the scale up and out required by the AI/ML network topologies of new data centers.
Tu2H.2 • 15:00
In-Service Transmitter Calibration via Offloaded 4×2 WL MIMO Equalizer with Compensating IQ Imbalance, Masaki Sato,1, Hidemi Noguchi1, Jun’ichi Abe1, Emmanuel Le Taillandier de Gabory1; 1NEC Corporation, Japan.
In-service Tx-IQ imbalance calibration estimated with 4×2 MIMO equalizer for 96-Gbaud PM-PCS-64QAM was demonstrated over 120 km SMF. Q penalties of 0.1 dB with 2 ps IQ skew and ±2.5 dB IQ peaking error were achieved.

Tu2H.3 • 14:45
High-Efficiency ISAC to Enable Sub-Meter Level Vibration Sensing for Coherent Fiber Networks, Jinghuan Wang1, Liwang Lu2, Li Wang1, Yaxi Yan1, Alan P. Lau1, Chao Lu1; 1The Hong Kong Polytechnic Univ., Hong Kong; 2Zhejiang Normal Univ., China. We demonstrate 0.5 m resolution vibration sensing and 60 Gbaud 16-QAM data transmission with negligible crosstalk over 10 km fiber using a new integrated communication and distributed acoustic sensing scheme with shared spectrum and transmitter.

Tu2J.3 • 14:45
Top-Scored «
Anomaly Detection and Localization in Optical Networks Using Vision Transformer and SOP Monitoring, Khouloud Abdeli1, Matteo Lonardi1, Jurgen Gripp1, Diego Correa1, Samuel Olsson2, Fabien Boitier1, Patricia Layec1; 1Nokia Bell Lab, Germany; 2Nokia, USA. We introduce an innovative vision transformer approach to identify and precisely locate high-risk events, including fiber cut precursors, in state-of-polarization derived spectrograms. Our method achieves impressive 97% diagnostic accuracy and precise temporal localization (6-ms RMSE).

Tu2J.4 • 15:00 ★
Optical Beam Steerable and Beam Divisible of Non-Orthogonal Multiple Access (NOMA) Signal with Low-Density Parity-Check (LDPC) for Multi-User Optical Wireless Communication System, Yin-He Jian1, Chih-Chun Wang1, Jian-Wen Chen1, Tsu-Chieh Wei1, Chi-Wai Chow1, Chien-Hung Yeh1; 1National Yang Ming Chiao Tung Univ., Taiwan; 2Feng Chia Univ., Taiwan.
We propose a spatial-light-modulator (SLM)-enabled optical beam steerable and beam divisible optical-wireless-communication (OWC) using orthogonal-frequency-division-multiplexing non-orthogonal-multiple-access (OFDM-NOMA) and low-density-parity-check (LDPC). Three-layer successive-interference-cancellation (SIC) is experimentally demonstrated.

Tu2K.4 • 14:45
Optical Beam Steerable and Beam Divisible of Non-Orthogonal Multiple Access (NOMA) Signal with Low-Density Parity-Check (LDPC) for Multi-User Optical Wireless Communication System, Yin-He Jian1, Chih-Chun Wang1, Jian-Wen Chen1, Tsu-Chieh Wei1, Chi-Wai Chow1, Chien-Hung Yeh1; 1National Yang Ming Chiao Tung Univ., Taiwan; 2Feng Chia Univ., Taiwan.
We propose a spatial-light-modulator (SLM)-enabled optical beam steerable and beam divisible optical-wireless-communication (OWC) using orthogonal-frequency-division-multiplexing non-orthogonal-multiple-access (OFDM-NOMA) and low-density-parity-check (LDPC). Three-layer successive-interference-cancellation (SIC) is experimentally demonstrated.

Tu2K.5 • 15:00
30 Gbit/s Visible Light Communication System with Optimized Color Temperature, Pedro Loureiro1, Fernando P. Guimarães1, Gil Fernandes2, Sandra Correia, Mafra André2, Paulo Monteiro1; 1Instituto de Telecomunicações, Portugal; 2CICECO, Portugal.
We jointly optimize the bit rate and correlated color temperature (CCT) of a diffuse light RGB-VLC system using laser diodes. Bit rates of 27-33 Gbit/s and CCT of 2500-6500K are experimentally demonstrated, respecting the lighting recommendations for a set of potential application scenarios.
Tu2A • Optical Transmission Techniques—Continued

Tu2A.3 • 15:30
Liquid Cooling for Optical Networking Equipment, Behzad Mohajer1, Peter Ajersch1, Michael Bishop1, Simon Shearman1, Peter Saturley1, Marko Nicolici1; 1Ciena, Canada. This article provides insights into a successful upgrade of an air-cooled coherent metro router into a Hybrid Liquid/Air-cooled system. Additionally, an innovative solution is presented for integrating liquid-cooling into the body of pluggable optical modules.

Tu2A.5 • 15:15
Low-Loss and Thermal-Stable Ta2O5 Photonic Platform with Low-Temperature Process, Zhaoting Geng1, Wieren Cheng1, Zhenyu Liu1, Mingjian You1, Xiaokai Yu1, Penghong Wu1, Ning Ding1, Xingyu Tang1, Yihan Liu1, Li Shen1, Qianchong Zhao1; 1Southern Univ. of Science and Technology, China; 2Huzhou Univ. of Science and Technology, China. We demonstrate a Ta2O5 photonic platform with a propagation loss of 0.5dB/cm and a thermo-optic coefficient of 2.3×10⁻⁶/K at 1550 nm. The process temperature is below 350°C, friendly to integration with other optoelectronic components.

Tu2B • Nonlinear Photonic Devices and Material Platforms—Continued

Tu2B.6 • 15:30
Monolithically Integrated Magneto-Optical Isolators, Circulators and Phase Shifters on SiN Photonics, Lei Bi1, Wei Yan1, Xucang Yang1, Zixuan Wei1, Di Wu1, Zijian Zhang1, Xiaoyi Song1; 1Univ of Electronic Sci & Tech of China, China. We report monolithically integrated magneto-optical isolators, circulators on SiN with 30 dB isolation ratio, -28 dB cross-talk, 54 nm 20 dB isolation bandwidth, and 2.7 dB insertion loss. Compact magneto-optical phase-shifter arrays with $V_p L=0.3$ Vcm were also developed, allowing the development of MGHz speed optical phased arrays on SiN.

Tu2C • Quantum Components and Quantum PICs—Continued

Tu2C.6 • 15:30
Invited
Ultra-low-Loss Silicon Nitride Integrated Circuits for Nonlinear and Quantum Photonics, Junqiu Liu1; 1Univ of Science and Technology of China, China. Abstract not available.

Tu2D • High Speed Transmitters—Continued

Tu2D.6 • 15:30
Invited
High Speed InP Modulator for Beyond 200 Gb/s, Yoshihiro Ogiso1, Josuke Otsuki1, Kenta Sugiura1, Yusuke Saito1, Mitsuteru Ishikawa1; 1NTT Device Innovation Center, Japan. We developed a next-generation InP twin-IQ modulator PIC for beyond 200-Gb/s operations. A 3-dB electro-optic bandwidth of the modulator exceeds 100 GHz while maintaining a half-wave voltage of 1.5 V and total on-chip optical insertion loss of less than 3.5 dB.

Tu2E • Advanced Optical Fibers—Continued

Tu2E.5 • 15:15
Invited
Optofluidic Microstructured Fibers: a Nanoparticle Tracking Analysis Platform for Understanding Nanoscale Objects Such As SARS-CoV-2, Markus Schmidt1; 1Leibniz-Institut für Photonsiche Tech, Germany. Understanding nanoscale processes at the single-species level is highly relevant for many areas. Here, we will present the details of fiber-assisted nanoparticle tracking analysis and show various experimental results relying on microstructured fibers.

Tu2F • Moore’s Law: A Photonics Perspective for the Next Decade—Continued

Tu2F.5 • 15:20
Invited
The Path for Scaling Photonic Integrated Circuits, Anna Tauke-Pedretti1; 1DARPA, USA. Computing, sensing and data transmission architectures all benefit from larger and more complex photonic circuits. A perspective on how these circuits could scale by overcoming unique technological challenges of photonics will be presented.
Continued in Long-Haul SDM Links—

vs Multi-Core Amplifiers

Core Fibers: Single-Core

Tu2G • Panel: Beyond Two-Core Fibers: Single-Core vs Multi-Core Amplifiers in Long-Haul SDM Links—Continued

Tu2H • Transceiver and Transmission Impairments Mitigation—Continued

Tu2I • Panel: Can New Access Technology and Architectures Support the Beyond 5G Network Vision—Continued

Tu2J • Fiber Sensing Applications I—Continued

Tu2K • Indoor Optical Wireless Communication—Continued

Tu2H.3 • 15:15

Transmitter Impairment Mitigation by 8×2 Widely Linear MIMO Equalizer with Improved Frequency Offset Tolerance, Xiang Li1, Xuemeng Hu1, Zengpeng Gong1, Pengpeng Wei1, Fan Shi1, Xiao Xiao1, Tianye Huang1, 1China Univ. of Geosciences, China; 2Zhongnian Sulan (Wuhan) Science and Technology Co., Ltd, China. Transmitter impairment mitigation for 450Gbaud DP-8QAM with 8×2 WL MIMO equalizer embedding CW-DA-WL phase estimator is demonstrated. Q penalty less than 0.5-dB with 8-ps IQ skew and 2.5-dB power imbalance are achieved with improved tolerance to frequency offset.

Tu2H.4 • 15:30

Distortion Characterization and Performance Estimation of Time-Interleaved DAC and ADC Based on the Measurement of Nonlinear Noise Spectrum, Tong Ye1, Tao 1; Huang 1; Tong Ye1, 1China Univ. of Geosciences, China; 2Fujitsu R&D Center, China; 3GlobalConnect, Norway; 4Simula Research Laboratory, Norway. A short aerial cable span on a high-voltage line is used to monitor wind-induced stress on the cable infrastructure. Span-by-span localized early warnings may be issued based on the state of polarization transients.

Tu2H.5 • 15:15

Local Wind Impact Sensing Using State of Polarization Measurement on a Live Short-Haul Aerial Fiber Cable, Kristina Shizuka Yamase Skarvng1, 1Optical Communications Technology, Japan; 2Toyo Electric Co., Ltd, Japan. We demonstrate the detection and localization of the perturbations induced by a jackhammer and an excavator over a buried fiber cable from an operational optical network thanks to high sensitivity Multiple-Input-Multiple-Output digital fiber sensing.

Tu2J.5 • 15:15

40-Gbit/s Mobile FSO with High-Speed Beam Stabilizer and 2D-PDA-Based Diversity Receiver for Support Robots, Zu-Kai Weng1, Yuki Yoshida1, Tashimasa Umezawa1, Abdelmoula Bekkal1, Michika- zu Hattori1, Atsushi Matsumoto1, Atsushi Kanno1, 1NTNU, Norway; 2Tampnet, Norway; 3GlobalConnect, Norway; 4Simula Research Laboratory, Norway. A short aerial cable span on a high-voltage line is used to monitor wind-induced stress on the cable infrastructure. Span-by-span localized early warnings may be issued based on the state of polarization transients.

Tu2K.6 • 15:15

40-Gbit/s Mobile FSO with High-Speed Beam Stabilizer and 2D-PDA-Based Diversity Receiver for Support Robots, Zu-Kai Weng1, Yuki Yoshida1, Tashimasa Umezawa1, Abdelmoula Bekkal1, Michika- zu Hattori1, Atsushi Matsumoto1, Atsushi Kanno1, 1NTNU, Norway; 2Tampnet, Norway; 3GlobalConnect, Norway; 4Simula Research Laboratory, Norway. A short aerial cable span on a high-voltage line is used to monitor wind-induced stress on the cable infrastructure. Span-by-span localized early warnings may be issued based on the state of polarization transients.
Tu2A • Optical Transmission Techniques—Continued

Tu2B • Nonlinear Photonic Devices and Material Platforms—Continued

Tu2C • Quantum Components and Quantum PICs—Continued

Tu2D • High Speed Transmitters—Continued

Tu2E • Advanced Optical Fibers—Continued

Tu2F • Moore’s Law: A Photonics Perspective for the Next Decade—Continued

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<td>Tu2C.4 • 15:45</td>
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<td>Spectrally Sliced Optical Arbitrary Waveform Measurement (OAWM) Using a Photonic Multi-Chip Receiver Assembly, Dengyang Fang1, Daniel Drayss1, Yung Chen1, Matthias Lauermann1, Huatfa Peng1, Grigory Lyashov1, Alexander Quint1, Luca Valenzano1, Sebastian Randell1, Thomas Zwick1, Wolfgang Freude1, Tobias J. Kippberberg1, Christian Koos1; Karlsruhe Institute of Technology (KIT), Germany; Vanguard Automation GmbH, Germany; Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland. We demonstrate the first spectrally sliced OAWM receiver assembly that combines slicing filters and optical receivers in a hybrid multi-chip module. We prove the viability of the device by receiving a wavelength-division-multiplexed signal over a bandwidth of 320 GHz.</td>
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<td>Power Resilient, Air-Gap Multi-Core Fiber with &gt;20 W Fiber Fuse Propagation Threshold per Core, Aditi Mehta1, Kazunori Mukasa1, Takeshi Takagi1, Motoaba Masuda1, Yaxian Liu1, Kjeld Dalgaard1, Karsten Rettwitt1, Michael Gall1, Lei K. Chen1, Leif K. Oxenløwe1, Toshio Morioka1; Japanese National Institute of Technology, Denmark; Telecommunications &amp; Energy Laboratories, Furukawa Electric, Japan. We measured fiber fuse properties of FMFs, coupled/uncoupled MCFs, and novel air-gap MCFs. We found that air-gap MCFs have fiber fuse propagation threshold of more than 20 W owing to efficient heat diffusion into air.</td>
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Tu2H.5 • 15:45
Frequency-Band Analysis of Equalization-Enhanced Phase Noise Jointly with DSP Impact, Celestino S. Martins1, Abel Lorences-Riesgo1, Sami Mumtaz1, Triung-Hien Nguyen1, Abir Hraghi1, Zihang Wu1, Yann Frigac, Gabriel Charlet1, Yu Zhao1; Huawei Technologies France, France. The fundamental of equalization-enhanced phase noise (EEPN) jointly with the DSP impact is investigated, using an approach based on frequency-band segmentation of the frequency-noise (FN) spectrum. This approach enables to study the EEPN penalty of different FN spectral regions and correlated with its bursty nature.

Tu2J.7 • 15:45
Field Test of Communication Cable for Environmental Monitoring, Chuanbiao Zhang1, Xiongyan Tang1, Guangquan Wang1, Shiku Shen1, He Zhang1, Yanbiao Chang1, Junzhong Cao1; China Unicom Research Inst., China; 2China Unicom Tianjin Branch, China. A routing section of the communication cable in the live network is used, combined with distributed optical fiber sensing equipment, for long-term monitoring, and through data recording, to achieve a variety of dynamic event response analysis.

Tu2K.8 • 15:45
Wavelength-Multiplexed Beam Steering in Fiber and Visible Light Communication Integrated Indoor Access Network, Wenqing Niu1, Fujie Li1, Zengyi Xu1, Chao Shen1, Ziwei Li1, Jianyang Shi1, Junwen Zhang1, Nan Chi1; Fudan Univ., China. We propose a wavelength-multiplexed fiber and VLC integrated access network. Neural networks with a generator-model structure are employed for single-hologram-based wavelength-multiplexed beam steering. A 2λ transmission with overall data rate of 4.02 Gbps is demonstrated.
Advancement in CPO and Ecosystem, Tu3A.1 • 16:30–18:30
Presider: Janet Chen, Meta, USA

Room 2
16:30–18:30
Tu3C • Quantum Information Generation, Distribution and Processing
Presider: Eleni Diamanti, CNRS, France

Highly Pure 4-Qubit States Fully Integrated in a Programmable Silicon-Photonic Chip, Jong-Moo Lee1, Jiho Park2, Jeongho Bang3, Young-Ik Sohn3, Alessio Baldaza4, Matteo Sanna5, Stefano Azzini6, Lorenzo Pavesi7, ETRI, Korea (the Republic of)8, KAIST, Korea (the Republic of)9, Univ. of Trento10, Italy; We demonstrate 98% Hong-Ou-Mandel (HOM) visibility, 82% Greenberger-Horne-Zeilinger (GHZ) fidelity, and Bell’s inequality violations by 4-photon coincident measurements using a silicon-photonic chip including photon-pair sources, filters, and linear-optic gates.

Ultra-Fast Ge-on-Si Photodetectors, Stefan Lischke1, Daniel Stecker2, Anna Pezze2, Jesse Morgan2, Andreas Beiling2, Lars Zimmermann2, ETRI, Korea (the Republic of); Technology / Process Integration, IHP - Leibniz Inst. for High Performance Microelectronics, Germany; Department of Electrical and Computer Engineering, Univ. of Virginia, USA; FG Silizium-Photonik, Technische Universität Berlin, Germany; Technology / Si Photonics, IHP - Leibniz Inst. for High Performance Microelectronics, Germany; Germany; A Ge-fin photodetector in which un-doped germanium is laterally sandwiched between complementary in-situ-doped silicon is demonstrated, allowing for unprecedented 3-dB bandwidths up to 265 GHz. Here, we review our work on ultra-fast Ge photodiodes.

Room 3
16:30–18:30
Tu3D • High Speed Photodetectors
Presider: Patrick Runge, Fraunhofer HHF, Germany

Room 6C
16:30–18:30
Tu3E • High Bit Rate High Capacity Transmission
Presider: Helmut Gniesser, Adva Optical Networking GmbH, Germany

Real-Time Transmission of 34.9 Tb/s with 1-Tb/s Channels Over 4800 GHz-Wide C-Band Along 1000 km of G654E Fiber, Bruno Lavigne1, Thierry Zami1, Julien David2, Stephan Wesser2, Lut Raddatz2, Florian Pulka3, Mael Lernvall1, Tétecs1, Nikos Pleros1, Aristoteleo Panepistimio Thessalonikis, Greece. We discuss our work in optics informed photonic neural networks, an architectural framework bridging the idiosyncrasy of integrated photonic architectures with a set of Deep Learning algorithms, towards harnessing the full potential of light-based accelerators.

Room 6D
16:30–18:30
Tu3F • Optical Neural Networks
Presider: Mahdi Nikdast, Colorado State Univ., USA

Optics-Informed Neural Networks: Bridging Deep Learning with Photonic Accelerators, Miltiadis Moralis-Pegios1, Apostolos Tsakyridis2, Christos Pappas3, Theodoros Moschos4, George Giamougianni3, Stefanos Kovalos1, Ioannis Roumpas1, Manos Kirtas1, Nikolaos Passalis2, Anastasios Tefas1, Nikos Pleros1, Aristoteleo Panepistimio Thessalonikis, Greece. We discuss our work in optics informed photonic neural networks, an architectural framework bridging the idiosyncrasy of integrated photonic architectures with a set of Deep Learning algorithms, towards harnessing the full potential of light-based accelerators.
The rapid evolution of artificial intelligence (AI) and machine learning (ML) has led to the development of increasingly complex AI/ML systems. These clusters are composed of interconnected nodes working collaboratively to process vast amounts of data and perform intricate computations. This panel will explore the strategies and technologies that enable seamless communication and cooperation within these clusters, with an emphasis on low latency and power efficiency. Bringing together experts from academia and industry, the panel will delve into the challenges and solutions associated with creating robust, high-performance interconnections that optimize performance and efficiency of AI/ML systems.

Tu3H.1 • 16:30 ★ Top-Scored
5G Burst-Mode Receiver Using Monolithic SOA-UTC and Burst-Mode TiA
Laurens Breyné1, Christophe Caillé1, Thibaut Gurné1, Jean-François Paret2, Michael Straub1, Gertjan Coudyzer1, Karim Mechkazi1, Michel Verplaetse1, ‘Nokia Bell Labs, Belgium; ‘II-VI Labs, France; ‘Nokia Bell Labs, Germany; ‘IMEC Ghent Univ., Belgium. We demonstrate a 55G-PON upstream SOA-UTC based receiver integrated with a BM-TIA, without optical filtering. The OMMA sensitivity is -24.3 dBm. We achieve a 38 % reduction in processing time with no penalty in sampling phase tolerance.

Tu3H.2 • 16:45
Semi-Analytical Methodology for Advanced Filter Design in Chirped-Managed Lasers, Raza Mirani3, Md Samiul Alam1, Arif Shahtani1, Pasquale Ricciardi2, David V. Plant1; McGill Univ., Canada; ‘Fonex Data Systems, Canada. We introduce a novel semi-analytical method for the deterministic design of advanced optical filters in chirped-managed lasers (CMLs), enhancing transmission reach for access networks. This approach can be applied to any baud rate of NRZ and PAM-4, overcoming previous trial-and-error methods.

Tu3I.1 • 16:30 ★ Top-Scored
Real-Time Demonstration of Softwareized Low-Complexity Timing Recovery by CMA Filter Interpolation for Baud-Rate Sampling DSP, Takahiro Suzuki1, Sang-Yuep Kim2, Jun-ichi Kani1, Tomoaki Yoshida3, ‘NTT Corporation, Japan. This paper proposes a low-complexity timing recovery method and demonstrates the real-time softwareization of a baud-rate sampling DSP suite. It achieves a 38 % reduction in processing time with no penalty in sampling phase tolerance.

Tu3I.2 • 16:45 Tutorial
Disaggregation and Virtualization for Future Access and Metro Networks, Jun-ichi Kani1, ‘NTT Access Service Systems Laboratories, NTT Corporation, Japan. Future access and metro networks are expected to support advanced broadband services and evolving mobile xhaul in a flexible manner. This presentation reviews progress and challenges on disaggregation and virtualization technologies to meet this expectation.

Tu3J.1 • 16:30 ★ Top-Scored
Continuous Distributed Phase and Polarization Monitoring of Trans-Atlantic Submarine Fiber Optic Cable, Mikel Mazur1, Nicolas K. Fontaine1, Megan Kelleher1, Valery Kamalov2, Roland Ryf2, Lauren Dalichaach1, Haozhou Chen1, David Neilson2, Franklyn Guinan1, ‘Nokia Bell Labs, USA; ‘Physics, Univ. of Colorado Boulder, USA; ‘National Inst. of Standards and Technology, USA; ‘Valery Kamalov LLC, USA. We demonstrate unprecedented 2nm bandwidth AE source-enabled digital-signal-processing (DSP) based receiver integration with a BM-TIA, without optical filtering. The OMMA sensitivity is -24.3 dBm. We achieve a 38 % reduction in processing time with no penalty in sampling phase tolerance.
Tu3A.2 • 17:00 Top-Scored
1.6 Tbps (224 Gbps/λ) Silicon Photonic Engine Fabricated with Advanced Electronic-Photonic FOWLP for Co-Packaged Optics and Linear Drive Applications, Xin Li1, Sajay B. Gaurukutty2, Jiao Wu3, Teck Guan Lim3, Pengfei Guo3, Jaye C. Davies3, Edward Sing Chee Koh4, Lau Boon Long5, Ming Ching Jong6, Chao Li7, Patrick Lo8, Surya Bhattacharya9, Tzun-Yang Lio9, 1Rain Tree Photonics Pte Ltd, Singapore; 2Inst. of Microelectronics, A*STAR, Singapore; 3Advanced Micro Foundry, Singapore. A 1.6 Tbps (8-channel 224 Gbps/λ) Silicon Photonic Engine, fabricated using advanced electronic-photonic FOWLP, is successfully demonstrated for the first time, enabling low-cost, volume-manufacturable and highly scalable terabit photonic engines for CPO and LPO.

Tu3B.2 • 17:00 A Roadmap Towards Entanglement Distribution Over Useful Telecom Distances, Vatsal Sinavast1, Natalia Herrera Valencia1, Will McCutcheon1, Sorech Ledummongkot1, Sebastian Designolle1, Roop Ueo1, Nicolas Brunner2, Mehul Malik3, 1Henst-Watt Univ., Edinburgh, UK; 2Univ of Geneva, Switzerland. I review progress on the distribution of photonic entanglement under extreme conditions of noise and loss, enabled by high-dimensionally entangled quantum states of light.

Tu3C.3 • 17:15 Invited Optics Qualification in Data Centers: Navigating Reliability Challenges and Implementing Solutions, Vincent Zeng4, 1Meta Platforms Inc, USA. Worldwide demands for faster, secure data transmission including AI/ML have led to significant optical interconnect demands. The reliability and quality control in building block process remain increased challenges that engineering and manufacturing alike must address.

Tu3C.2 • 17:00 High Speed Photodecorators—Continued
DC–226 GHz Well-Impedance-Matched High-Speed Photoreceiver for Multi-Band Signal Detection, Toshimasa Umezawa1, Pham T. Dat1, Yuki Yoshida1, Shinya Nakajima1, Atsushi Matsumoto1, Kouchi Akahane1, Atsushi Kanno1, Naokatsu Yamamoto1; 2National Inst of Information & Comm Tech, Japan; 3NTT Network Innovation Laboratories, Japan. Ultra-wideband wavelength-division-multiplexed (WDM) transmission is an essential technology to achieve >100-Tbs single-mode-fiber (SMF) capacity. This paper overviews the status of high-capacity SMF transmission and provides our research results using high-symbol-rate coherent channels under a triple-band WDM configuration.

Tu3D.3 • 17:15 Plasmonically Enhanced Optical Accelerator for Nonlinear Signal Processing Based on Artificial Neural Networks, Tobias Blatter1, Amame Zure2, Yaniv Horst3, Christoph Papp4, George Gaugarnac5, Apostolos Tsakyridis6, Manuel Kohl1, Miladis Mora1-Pegor6, Nikos Pleros2, Juerg Leuthold1; 1ETH Zurich, Switzerland; 2Zurich Institute of Technology, Switzerland; 3Aristotle Univ. of Thessaloniki, Greece. We reconstructed a 48 Gbit/s nonlinearly distorted optical signal using an artificial neural network (ANN). The digital ANN execution exceeded traditional nonlinear equalizers, while its analog acceleration using plasmonic-organic-hybrid modulators surpassed conventional digital linear equalizers.
Tu3H.3 • 17:00
Multi-Channel Coherent Optical System Based on a High Power Fabry-Perot QW Laser Diode, Shalmoli Ghosh1, Maurice O’Sullivan1, Charles Laperle1, Rongqing Hui1, ‘Univ. of Kansas, USA; ‘Ciena Corporation, Canada. We demonstrate 20-channel coherent transmission using a high-power single-section QW FP-laser diode over 78.3 km single mode fiber. The system capability can reach > 4Tb/s with a single laser in the transmitter using polarizations multiplexing.

Tu3H.4 • 17:15
EML-Based Coherent Receiver for Low CSPR Single-Sideband Transmission Enabled by Injection Locking, Siyu Luo1, Zhenguan Li1, Yingxiong Song1; ‘Shanghai Univ., China. We propose a novel single-sideband self-coherent detection scheme employing an EML-based receiver and demonstrate a 6.5-dB sensitivity improvement compared with Kramers-Kronig receiver for the SSB 16-QAM signal transmission over 40-km SSMF.

Tu3J.3 • 17:00
Field Implementation of Fiber Cable Monitoring for Mesh Networks with Optimized Multi-Channel Sensor Placement, Philip N. Ji1, Zilong Ye1,2; ‘NEC Laboratories America Inc., USA; ‘California State Univ. Los Angeles, USA; ‘Verizon Corporation, USA; ‘Transport Network Department, NEC Corporation, Japan. We develop a heuristic solution to effectively optimize the placement of multi-channel distributed fiber optic sensors in mesh optical fiber cable networks. The solution has been implemented in a field network to provide continuous monitoring.

Tu3J.4 • 17:15
Optical Fiber Sensing Network Control Plane Enabled by a Novel Sub-μs Response Time Fiber Sensing Control Device, Mijail Szczerban1, Mikael Mazur1, Lauren Dallachiesa1, Haik Mardoyan1; ‘Nokia Bell Labs, USA. We propose and implement a novel fiber sensing control device and sensing control plane that controls backscatter and polarization-based fiber sensing. We experimentally demonstrate in a fiber network that this device achieves sub-μs response time.

Tu3K.3 • 17:00
1.92-Tb/s CPRI-Equivalent Rate Direct Detection Transmission Based on ANN Pre-Equalization for Digital-Analog Radio-Over-Fiber Mobile Fronthaul, Junhao Zhao1, An Yan1, Guoqiang Li1, Zhongya Li1, Wangwei Shen1, Yongzhu Hu1; ‘Fudan Univ., China. We experimentally demonstrate a 1.92-Tb/s CPRI-equivalent data-rate supporting 1024-QAM OFDM signal in a direct-detection-based digital-analog radio-over-fiber mobile-fronthaul link using ANN for signal pre-equalizations. Performances of pre-equalizers or post-equalizers based on different methods are also studied.

Tu3K.4 • 17:15
W-Band Photonics-Aided ISAC Wireless System Sharing OFDM Signal as Communication and Sensing, Jiaxuan Liu1, Jianjun Yu1,2, Xianming Zhao1, Chengshen Bian1, Xiongwai Yang1, Long Zhang1, Wenzhong He1, Jiqing Long1, Yao Zhang1, Yu Zhang1, Zhou Ju1, Xinyi Wang1, Wenzhong He1, Kaihui Wang1, Feng Zhao1; ‘Fudan Univ., China; ‘Purple Mountain Laboratories, China; ‘China Harbin Inst. of Technology, China; ‘School of Electronic Engineering, Xian Univ. of Posts and Telecommunications, China. We experimentally demonstrate the dual functionality of OFDM signals for both communication and sensing. Photonics-aided ISAC system in W-band achieves range-Doppler imaging with 0.0102m resolution and data rate of 48.04 Gbit/s over wireless link.
Tuesday, 26 March

Tu3A • CPO and Ecosystem—Continued

We present a collective PIC ecosystems. The collaboration among imec, Flexi Electronics Technology of THU, and many other institutions has shown that integrated photonic circuits for quantum computing will be presented. Integrated photonic modules, e.g. for processors and memories, have stringent demand for schemes such as photonic I/O and ion traps.

Tu3B • 6G and Emerging Applications—Continued

Collective Die-to-Wafer Bonding Enabling Low-Loss Evanescent Coupling for Optically Interconnected System-on-Wafer, Pengfei Xu1, Junwen He1, Koen Kennes1, Anton Divoretski1, Armita Podpoo1, Guy Lapage1, Neen Gohshani1, Rafal Magdziak1, Swetanshu Biplu1, Dieter Bode1, Peter Verheyen1, Maumita Chakrabarti1, Dimitrios Velmis1, Andy Miller1, Yoojin Ban1, Filippo Ferraro1, Joris Van Campenhout1; imec, Belgium. We present a collective PIC die-to-wafer dielectric bonding process, enabling SiN waveguide-based die-to-wafer evanescent couplers with insertion losses of 0.36 ±0.18dB at 1310nm wavelengths, paving the way to optically interconnected 300mm wafer-scale multi-chip compute systems.

Tu3C • Quantum Information Generation, Distribution and Processing—Continued

Remote Entanglement of Quantum Memories Over a Metropolitan Network, Daniel R. Assumpção1, Can Kou1, Aazza Suleymazade1, Yan-Cheng Wei1, Pieter-Jan Stas1, Yang-Lu Zhou1, Bartheolomeus Machielse2,1, Erik Knall1, Madison Sutula1, Gеfеn Baranes1,1, Neil Sinclair1, Chawing De-Eknamkul2, David Levonian2,1, Marco Lenc2,1, Mikhail Lukin1,1, Harvard Univ., USA, 2AWS Center for Quantum Networking, USA, “Massachusetts Inst. of Technology, USA. We generate remote entanglement between spatially separate color-center based quantum nodes at rates up to 1 Hz. In addition, we demonstrate remote entanglement across a deployed 35km long fiber loop in the Boston urban area.

Tu3D • High Speed Photodetectors—Continued

Invited: Ultra-Wide Bandwidth and High Saturating Power Uni-Traveling Carrier Photodiodes, Bingxiang1, Xu1, Yanjun Tan1, Changcheng Sun1, Zhihao Hao1, Jian Wang1, Lai Wang1, Yanzhe Han1, Honghao Li1, Lin Gai1, Yi Luo2,1, Tsinghua Univ., China; “Institut of Flexible Electronics Technology of THU, China. In this talk, we present our recent work on ultra-wide bandwidth (>100 GHz) uni-traveling-carrier photodetectors with high saturation power, by optimizing the photogenerated carrier transport and taking advantage of the inductive gain peaking effect.

Tu3E • High Bit Rate High Capacity Transmission—Continued

High-Capacity and High-Spectral Efficiency Transmission Systems for 1.6 Tbit/s and Beyond, Fabio Pittalà1, Keysight Technologies Deutschland GmbH, Germany. Challenges and trends to achieve high-capacity and high-spectral efficiency transmission systems for different fiber-optic applications are discussed focusing on 1.6 Tbit/s/cable. Recent research results, industry status and standardization progress of coherent optical interfaces are also reviewed.

Tu3F • Optical Neural Networks—Continued

Demonstration of Neural Heterogeneity with Programmable Brain-Inspired Optoelectronic Spiking Neurons, Yun-Jhu Lee1, Mehmet Berkay On1, Luis E. Souu1, Li Zhang1, Mahmoud Abdellghany1, S. J. Ben Yoo1, “Univ. of California, Davis, USA. Neural heterogeneity enables spiking neural networks to implement complex functions with fewer neurons. We designed, simulated, and demonstrated programmable optoelectronic spiking neurons that can achieve multiple neuron characteristics based on external tuning voltages.

Tu3A.4 • 17:45

Collective Die-to-Wafer Bonding Enabling Low-Loss Evanescent Coupling for Optically Interconnected System-on-Wafer, Pengfei Xu1, Junwen He1, Koen Kennes1, Anton Divoretski1, Armita Podpoo1, Guy Lapage1, Neen Gohshani1, Rafal Magdziak1, Swetanshu Biplu1, Dieter Bode1, Peter Verheyen1, Maumita Chakrabarti1, Dimitrios Velmis1, Andy Miller1, Yoojin Ban1, Filippo Ferraro1, Joris Van Campenhout1; imec, Belgium. We present a collective PIC die-to-wafer dielectric bonding process, enabling SiN waveguide-based die-to-wafer evanescent couplers with insertion losses of 0.36 ±0.18dB at 1310nm wavelengths, paving the way to optically interconnected 300mm wafer-scale multi-chip compute systems.

Tu3B.4 • 17:30

Invited: Programmable Packet-Optical Networks Using Data Processing Units (DPUs) with Embedded GPU, Piero Castoldi1,2, Rana Abu Bakar1, Andrea Sgambelluri1,2, Juan José Vegas Olmo1, Francesco Paolucci1, Filippo Cugini1; “Scuola Superiore Sant Anna di Pisa, Italy; “NVIDIA, Denmark; “CIT, Italy. Data Processing Units (DPUs) with embedded GPU have the potential to revolutionize optical networks functionalities at the edge. Use cases are presented for optical data monitoring with local AI processing, 5G acceleration, and embedded security.

Tu3C.4 • 17:30

Top-Scored: Remote Entanglement of Quantum Memories Over a Metropolitan Network, Daniel R. Assumpção1, Can Kou1, Aazza Suleymazade1, Yan-Cheng Wei1, Pieter-Jan Stas1, Yang-Lu Zhou1, Bartheolomeus Machielse2,1, Erik Knall1, Madison Sutula1, Gefеn Baranes1,1, Neil Sinclair1, Chawing De-Eknamkul2, David Levonian2,1, Marco Lenc2,1, Mikhail Lukin1,1, Harvard Univ., USA, 2AWS Center for Quantum Networking, USA, “Massachusetts Inst. of Technology, USA. We generate remote entanglement between spatially separate color-center based quantum nodes at rates up to 1 Hz. In addition, we demonstrate remote entanglement across a deployed 35km long fiber loop in the Boston urban area.

Tu3D.4 • 17:30

Invited: Ultra-Wide Bandwidth and High Saturating Power Uni-Traveling Carrier Photodiodes, Bingxiang1, Xu1, Yanjun Tan1, Changcheng Sun1, Zhihao Hao1, Jian Wang1, Lai Wang1, Yanzhe Han1, Honghao Li1, Lin Gai1, Yi Luo2,1, Tsinghua Univ., China; “Institut of Flexible Electronics Technology of THU, China. In this talk, we present our recent work on ultra-wide bandwidth (>100 GHz) uni-traveling-carrier photodetectors with high saturation power, by optimizing the photogenerated carrier transport and taking advantage of the inductive gain peaking effect.

Tu3E.4 • 17:30

Invited: High-Capacity and High-Spectral Efficiency Transmission Systems for 1.6 Tbit/s and Beyond, Fabio Pittalà1, Keysight Technologies Deutschland GmbH, Germany. Challenges and trends to achieve high-capacity and high-spectral efficiency transmission systems for different fiber-optic applications are discussed focusing on 1.6 Tbit/s/cable. Recent research results, industry status and standardization progress of coherent optical interfaces are also reviewed.

Tu3F.4 • 17:30

Invited: Optical Neural Networks with Tensor Compression and Photonic Memory, Xian Xiao1, Stanley Cheung1, Bassem Tsouss1, Thomas Van Vaerenbergh1, Geza Kurczveil2, Raymond Beausoleil1, Hewlett Packard Enterprise, USA. This paper introduces our recent efforts on scalable, energy-efficient, and low-latency tensorized optical neural networks, including design considerations, options for wavelength-parallel photonic tensor cores, and photonic memory for non-volatile tuning.
Tu3H.5 • 17:30
Throughput Maximisation in Ultra-Wideband Hybrid-Amplified Links, Henrique Buglia¹, Éric Silletens¹, Lidia Galdino¹, Robert Killey¹, Polina Bayvel¹; ¹Univ. College London, UK; ²Coming, UK. A semi-analytical, real-time nonlinear-interference model including ASE noise in hybrid-amplified links is introduced. Combined with particle-swarm optimisation, the capacity of a hybrid-amplified 10.5-Tb/s 117×57-km link was maximised, increasing throughput by 12% versus an EDFAs-only configuration.

Tu3H.6 • 17:45
C-Band Net 1.8 Tbps (240Gb/s/λ × 8λ) DWDM IM/DD Transmission Over 1.4km AR-HCF with Linear FFE Only, Chao Li¹, Zichen Liu¹, Yizhi Sun², Shoufei Gao³, Qibing Wang⁴, Hui Chen⁵, Siyu Jin⁵, Ming Luo⁵, Xu Zhang⁵, Chao Yang⁵, Yingying Wang⁵, Wei Ding⁵, Lei Wang⁵, Xi Xiao⁵, Zhixue He⁵, Shaohua Yu⁵; ¹Peng Cheng Laboratory, China; ²Jinan Univ., China; ³China Information and Communication Technologies Corporation, China. Record net 1.8Tbps IM/DD optical interconnect supported by 8λ dense wavelength division multiplexing technique in C-band over wide-band low dispersion anti-resonant hollow-core fibre (AR-HCF) is experimentally demonstrated under 6.7% HD-FEC limit with linear FFE only.

Tu3J.5 • 17:30
Remote Sensing with High Spatial Resolution, André Sandmann¹, Florian Azendorf², Michael Eiselt¹; ¹Adtran Networks SE, Germany; ²Distributed fiber sensing based on correlation-aided phase-sensitive optical time domain reflectometry is presented. The focus is on correlation as an enabler for high spatial resolution. Results from different applications are presented.

Tu3K.5 • 17:30
Invited
Sigma-Delta Radio Over Fiber, Guy Torfs¹, Achim Vandierendonck¹, Fatemeh Zardost¹, Caro Meyerson¹, Xin Wang¹, Haolin Li²; ¹IDLab, Ghent Univ.-imec, Belgium; ²R&D, iCana, Belgium. Sigma-delta modulation can encapsulate an analog radio signal in a digital bit stream enabling low-cost synchronous radio-over-fiber links. This paper covers both direct modulated links and links with external up-conversion for use in fronthaul connections.
Room 1B

Tu3B • 6G and Emerging Applications—Continued

Tu3C • Quantum Information Generation, Distribution and Processing—Continued

Room 2

Tu3D • High Speed Photodetectors—Continued

Room 3

Tu3E • High Bit Rate High Capacity Transmission—Continued

Room 6C

Tu3F • Optical Neural Networks—Continued

Tuesday, 26 March

Tu3B.5 • 18:00 Availability-Guaranteed Differentiated Provisioning in Integrated Satellite-Terrestrial Optical Networks, Lu Zhang1,2, Xin Li1, Massimo Tomatore3, Jingjie Xin1, Shangqiu Huang1, Beijing Univ. of Post and Telecomm, China; 2Department of Electronics Information and Bioengineering, Politecnico di Milano, Italy. This paper investigates differentiated provisioning in integrated satellite-terrestrial optical networks. Two connection availability models are developed considering network dynamic nature. Two availability-guaranteed differentiated provisioning algorithms are proposed. Their effectiveness is verified by numerical results.

Tu3D.5 • 18:00 Type-II GaInAsSb/InP Modified Uni-Traveling Carrier Photodiodes Under Zero-Bias Operation, Raghunath Chaudhary1, Akshay Abhayani2, Sara Hamzelou1, Martin Lech1, Olivier Ostdiell1, Colombie Boilenguet1, ETH Zurich, Switzerland; 2Millimeter-Wave Electronics Laboratory, D-ITET, ETH Zurich, Switzerland. We report the first bias-free performance of Type-II modified GaInAsSb/InP UTC-PD for high-bandwidth and high-power applications. The UTC-PD achieves zero-bias bandwidth of 60 GHz and high output power of -11 dBm at 100 GHz.

Tu3E.5 • 18:00 Single-Fiber Bidirectional Transmission Using 400G Coherent Digital Subcarrier Transceivers, Pablo Torres-Ferrara1, Jacqueline Smet1, Thomas Duthie2, Emanuele E. Virgilio3, Vittoria Cumi3, Roberto Gaudino3, Chris R. Fludger1, Antonio Napoli1, Infinera, Germany; 2Infinera, Germany; 3Politecnico di Torino, Italy. We experimentally evaluate the Rayleigh Back-Scattering power penalty in a single-fiber single-wavelength bidirectional link using coherent digital subcarrier-based transceivers and verify a theoretical model in this scenario. A negligible penalty is achieved by using subcarrier-interleaving.

Tu3F.6 • 18:15 Inference and Training in Deep Learning Using a Symmetric Optical Crossbar Array, Rui Tang1, Shuhei Ohno1, Ken Tanizawa1, Kazuhiro Ikeda1, Makoto Okano1, Kasidit Toprasertpong1, Shinichi Takagi1, Mitsuru Takenaka1, NTT Network Innovation Laboratories, Japan; 2Tamagawa Univ., Japan; 3National Inst. of Advanced Industrial Science and Technology, Japan. We propose and demonstrate a symmetric optical crossbar array based on microscopic resonators (MRRs) to accelerate both the inference and training in deep learning, experimentally achieving a 93.3% classification accuracy in an inference task.
Tu3I • Disaggregated and Software Defined Access Networks—Continued

Tu3I.5 • 18:15
MAC-Assisted DSP Architecture for 50G TDM-PON Pitstream Triple-Rate Reception, Nannan Zhang1, Junwei Li1, Lirong Qin2, Weisheng Hu1, Guangying Yang1, Qunbi Zhuge1, Xiansong Fang2, Chenbo Zhang2, Yicheng Xu1, Xiangnan Zhao3, Miao Yu2, Leiya Hu1, Xiaopeng Xie2, Fan Zhang2, Weisheng Hu1, Jiang 1, Tao Zhang2, Qingpeng Liu2, Hami ng Qin1, Hao Li1, ‘Huawei Technologies Co., Ltd, China. We propose a MAC-assisted DSP for tri-rate upstream reception of 50G PON, which greatly reduces preamble time and achieves requirements of power budget C+ class for BTB and 25km transmission.

Tu3I.7 • 18:15
Highly Sensitive Co-Trench Detection of Optical Fibers by Correlation Analysis with Field Test, Jiaxuan Lin1, Zhengping Jiang2, Tao Zhang2, Qingpeng Liu2, Haomiao Chou3, David Neilson1, Jochen Schröder1, Per Larsson-Edefors1, Magnus Karlsson1, ‘Nokia Bell Labs, USA; 2Sunet, Sweden; 3Computer Science and Engineering, Chalmers Univ. of Technology, Sweden. We monitor a 524km live network link using an FPGA-based sensing-capable transceiver prototype during a human-caused cable break. Polarization data uncovers minute-level potential warning precursors directly preceding the break, offering real-time sensing based outage mitigation prospects.

Tu3J • Fiber Sensing

Tu3J.6 • 18:00
Real-Time Monitoring of Cable Break in a Live Network Using a Coherent Transceiver Prototype, Mikael Mazur1, Dennis Wallberg1, Laurent Gallaischa1, Erik Börjeson1, Roland Ryf1, Magnus Bergroth1, Börje Josefsson1, Nicolas K. Fontaine1, Haoshuo Chen1, David Neilson1, Jochen Schröder1, Per Larsson-Edefors1, Magnus Karlsson1, ‘Nokia Bell Labs, USA; 2Sunet, Sweden; 3Computer Science and Engineering, Chalmers Univ. of Technology, Sweden. We monitor a 524km live network link using an FPGA-based sensing-capable transceiver prototype during a human-caused cable break. Polarization data uncovers minute-level potential warning precursors directly preceding the break, offering real-time sensing based outage mitigation prospects.

Tu3K • High Capacity Radio-over-Fiber Communication—Continued

Tu3K.6 • 18:00
Analog RoF Fronthaul Carrying 27.6-Tb/s CPRI-Equivalent Rate and 512-QAM with Sideband Modulation for IQ Imbalance Separation and Bi-Directional Transmission, Xiyao Zhu1, Xiansong Fang1, Chenbo Zhang1, Yicheng Xu1, Qunbi Zhuge1, Xiaoqing Xie2, Weisheng Hu1, Fan Zhang1, ‘Shanghai Jiao Tong Univ., China; 2Peking Univ., China. We leverage sideband modulation-based bidirectional scheme to separate the transmitterside IQ imbalance and boost the SNR to 30.8dB. We experimentally demonstrate high-capacity coherent analog RoF fronthaul achieving 27.6Tb/s(=12×2.089Tb/s) CPRI-equivalent rate and 512-QAM over 10-km SMF.

Tu3K.7 • 18:15
Fading-Free Integrated Digital and Analog RoF Fronthaul Based on Dual-Drive MZM and Chip Multiplexing, Xiyao Zhu1, Xiansong Fang1, Chenbo Zhang1, Yicheng Xu1, Guangying Yang1, Qunbi Zhuge1, Xiaoqing Xie1, Fan Zhang1, Weisheng Hu1, ‘Shanghai Jiao Tong Univ., China; 2Peking Univ., China. We propose fiber dispersion fading-free integrated digital and analog radio-over-fiber fronthaul based on dual-drive MZM and chip multiplexing. Single-wavelength co-transmission of 64-Gb/s PAM-4 and 6×1-GHz 64-QAM millimeter-wave signals is experimentally demonstrated over 10-km SMF.

Tu3L • Edge Technologies for Tu3G • Panel: Cutting-Edge Technologies for Interconnecting AI/ML Clusters—Continued

Tu3L.7 • 18:00
Parameter Estimation of Semi-Conductor Optical Amplifier Booster Based on Digital Signal Processing, Tanek Eldahrawy1, Abir Hraghi1, Abel Lorences-Riesgo1, Trung-Hien Nguyen1, Isaf Demirtzioglu1, Loig Godard1, Hartmut Hafermann1, Naya El Dahldhi1, Yu Zhao1, Yann Frigui1, Gabriel Charlet1, ‘Huawei technologies France, France. We propose a method for SOA characterization using conventional coherent transmission signals, including dual-polarization signals. Using 16QAM signals, we demonstrate that this method can be applied for several baudrates and wavelengths.

Tu3M • Parameter Estimation of Semi-Conductor Optical Amplifier Booster Based on Digital Signal Processing, Tanek Eldahrawy1, Abir Hraghi1, Abel Lorences-Riesgo1, Trung-Hien Nguyen1, Isaf Demirtzioglu1, Loig Godard1, Hartmut Hafermann1, Naya El Dahldhi1, Yu Zhao1, Yann Frigui1, Gabriel Charlet1, ‘Huawei technologies France, France. We propose a method for SOA characterization using conventional coherent transmission signals, including dual-polarization signals. Using 16QAM signals, we demonstrate that this method can be applied for several baudrates and wavelengths.

Tu3N • Parameter Estimation of Semi-Conductor Optical Amplifier Booster Based on Digital Signal Processing, Tanek Eldahrawy1, Abir Hraghi1, Abel Lorences-Riesgo1, Trung-Hien Nguyen1, Isaf Demirtzioglu1, Loig Godard1, Hartmut Hafermann1, Naya El Dahldhi1, Yu Zhao1, Yann Frigui1, Gabriel Charlet1, ‘Huawei technologies France, France. We propose a method for SOA characterization using conventional coherent transmission signals, including dual-polarization signals. Using 16QAM signals, we demonstrate that this method can be applied for several baudrates and wavelengths.
W1A.1 • 08:00
Integrated Filters for Band-Unaware Multi-Band CDC-ROADM
Presider: Milos Popovic; Boston Univ., USA

W1A.2 • 08:15
Estimation and Localization of DGD Distributed Over Multi-Span Optical Link by Correlation Template Method
Ramon Casellas is serving as a Research Director at CTTC. His research interests include network control and management and has co-authored over 5 book chapters and over 300 papers, contributing to standardization and Open Source. He has been OFC program chair, general chair, short course instructor and IEEE/Optica JOCN editor.

W1B.1 • 08:00
On the Accuracy of Power Profile Estimation Using MMSE or Deconvoluted Correlation-Based Profiles
Ali A. May, Fabien Boitier, Ana Che Reniego, Patricia Layec, Nokia Bell Labs France, France. We evaluate the accuracy of the deconvolution of the longitudinal power profile computed using correlation-based method. We show that we obtain a similar accuracy to the MMSE approach in different cases.

W1B.2 • 08:15
Low-Complexity 4D+D MIMO Equalizer Enabling 2.6-Tb/s/λ SDM Signal Reception Over Dynamic Four-Coupled-Core Cabled Transmission Line
Akira Kawae, Kohki Shibahara, Masanori Nakamura, Takayuki Kobayashi, Takeshi Morimoto, Ryota Imada, Takayoshi Mori, Yutaka Yamada, Kazuhide Nakamura, Yutaka Miyamoto; NTT Network Innovation Laboratories, Japan; NTT Access Network Service Systems Laboratories, Japan. We propose a transceiver-impairment-tolerant 4D+D multiple-input/multiple-output equalizer with significantly reduced computational overhead and improved tracking performance for spatial-division-multiplexed receivers and demonstrated it in a 100-Gbaud transmission over a cabled four-coupled-core transmission line with MHz-class fluctuation.

W1C.1 • 08:00
SDN Control of Multi-Band Over SDM Optical Networks with Physical Layer Impairments
Ramon Casellas, Ricardo Martinez, Raul Muñoz, Ricardo Vilalta; CTTC, Spain. This tutorial aims at presenting key aspects in the design and development of a PL-aware SDN control plane for Multi-Band over SDM disaggregated optical networks, including hierarchical arrangements with externalized path computation.

W1C.2 • 08:15
Top-Scored
Computing with Degenerate Optical Parametric Oscillators Networks
Hirotaka Takesue, Tatsuhito Inagaki, Kensuke Inaba, Takuya Kita, Yasuhiro Yamada, Kinya Yamaizumi, Toshimori Honjo; NTT Basic Research Laboratories, Japan. We report on the recent progress of a coherent in-line processing, which simulates the Ising model using a network of degenerate optical parametric oscillators (DOPO). We also describe a spiking neural network realized with DOPOs.

W1D.1 • 08:00
Invited
Yb-Doped Fibers for kW-Class Fiber Lasers
Andrew Rosales-Garcia, Jeffrey Nichols, Rasmus Vincentz Skougaard Jensen, Paul Kratzenk, Jose Pinto, Simona Ovtar, Miranda Mirovic, Kaspar Ingles, Bent Edvold, Simon Christensen, David DiGiovanni, Bera Palsdottir; OFS Fiber LLC, USA; OFS Fiber Denmark Aps, Denmark. We demonstrate a TMI-free 5.2 kW single-mode output from a fiber amplifier using Yb 20400 fibers with reduced core thermo-optic coefficient. The TMI threshold is increased by 50% compared to that of commercial Ybdoped fibers.

W1E.1 • 08:00
Top-Scored
205.7Tb/s Weakly-Coupled 2-Mode 7-Core Transmission Over 1170-km FM-MCF Only Using 2x2 MIMO-DSP, Gang Zhao, Yu Yang, Honglin Ji, Shuang Liu, Chengbin Long, Yuyang Gao; Peking Univ., China; 2Peng Cheng Laboratory, China; Yangtze Optical Fibre and Cable Joint Stock Limited Company (YDFC), China. We demonstrate the first long-haul weakly-coupled FM-MCF transmission adopting non-degenerate LP1_1 and LP0_1 modes in a 6-UP mode 7-core fiber. 205.7Tb/s throughput over 1170 km transmission with DP-QPSK modulation is achieved only utilizing 2x2 MIMO-DSP.
Emerging photonic technologies promise to revolutionize different aspects of future datacenters and HPC systems. However, new photonic components are best not treated as simple drop-in replacements of their electronic counterparts. Instead, we should consider new capabilities enabled by photonics. This panel will discuss the impact of emerging photonics as well as system architecture to discuss potential connections between chiplets towards modular systems or high-bandwidth connections. This enables time-multiplexed closed-loop control of programmable silicon photonic meshes with a reduced number of electrical interconnections.

Organizers
Liam Barry, Dublin City University, Ireland
George Michalogiannakis, Lawrence Berkeley National Laboratory, USA

Speakers
Nicola Calabretta, Eindhoven University of Technology, Netherlands
Larry Dennis, NVIDIA, USA
Marco Fiorentino, Hewlett Packard Enterprise, USA
David Lazovsky, Celestial AI, USA

W1G • Panel: Next Generation Disaggregated Data Centers Using Future Chip to System Photonic Technologies

08:00–10:00
W1H • Short-Reach Transmission
Presider: Masanori Nakamura; NTT Network Innovation Laboratories, Japan

W1H.1 • 08:00
A Novel Machine Learning-Based Equalizer for a Downstream 100G PAM-4 PON
Chen Shao1, Elias Gavoulidou2, Shi Li1, Jiali Lei1, Tobias Keller1, Michael Faerber1, Andre Richter1, Karlruhe Inst. of Technology, Germany

W1H.2 • 08:15
Multiplication-Free Equalization Schemes for 244-Gbps PAM-4 Transmission
Fei Xie1, Xiaoqian Huang1, Shuangyu Liu1, Du Tang1, Zhengkang Wang1, Yaojun Qiao1, Beijing Univ. of Posts and Telecom, China

W1H.3 • 08:30
A tightly-coupled LiNbO3/III-V hybrid photonic transmitter for 56-Gbps PAM-4 transmission
Patrick Runge1, Tobias Keller1, Christian Schönharting1, Michael Faerber1, Andre Richter1, Karlruhe Inst. of Technology, Germany

W1H.4 • 08:45
Breaking the Interconnection Limit by Integrating CMOS Electronics on PICs, Franco Zanetto1, Monica Cricco2, Andrea I. Martinez1, Fabio Toso1, Francesco Marchetti1, Andrea Melloni1, Giorgio Ferrai1, Marco Sampaio1, Politecnico di Milano, Italy.

W1H.5 • 09:00
Breaking the Interconnection Limit by Integrating CMOS Electronics on PICs, Franco Zanetto1, Monica Cricco2, Andrea I. Martinez1, Fabio Toso1, Francesco Marchetti1, Andrea Melloni1, Giorgio Ferrai1, Marco Sampaio1, Politecnico di Milano, Italy.

W1H.6 • 09:15
Breaking the Interconnection Limit by Integrating CMOS Electronics on PICs, Franco Zanetto1, Monica Cricco2, Andrea I. Martinez1, Fabio Toso1, Francesco Marchetti1, Andrea Melloni1, Giorgio Ferrai1, Marco Sampaio1, Politecnico di Milano, Italy.

W1H.7 • 09:30
Breaking the Interconnection Limit by Integrating CMOS Electronics on PICs, Franco Zanetto1, Monica Cricco2, Andrea I. Martinez1, Fabio Toso1, Francesco Marchetti1, Andrea Melloni1, Giorgio Ferrai1, Marco Sampaio1, Politecnico di Milano, Italy.

W1H.8 • 09:45
Breaking the Interconnection Limit by Integrating CMOS Electronics on PICs, Franco Zanetto1, Monica Cricco2, Andrea I. Martinez1, Fabio Toso1, Francesco Marchetti1, Andrea Melloni1, Giorgio Ferrai1, Marco Sampaio1, Politecnico di Milano, Italy.

W1H.9 • 10:00
Breaking the Interconnection Limit by Integrating CMOS Electronics on PICs, Franco Zanetto1, Monica Cricco2, Andrea I. Martinez1, Fabio Toso1, Francesco Marchetti1, Andrea Melloni1, Giorgio Ferrai1, Marco Sampaio1, Politecnico di Milano, Italy.

08:00–10:00
W1I • Panel: Photonic Components for In-Physics Computing

Presider: Chathurika Ranaweera; Deakin Univ., Australia

W1I.1 • 08:00
Experimental Demonstration of In-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

W1I.2 • 08:15
W1I.3 • 08:30
W1I.4 • 08:45
W1I.5 • 09:00
W1I.6 • 09:15
W1I.7 • 09:30
W1I.8 • 09:45
W1I.9 • 10:00

W1J • Access, Metro and Mobile Convergence

Presider: Patrick Lo; Advanced Micro Foundry Pte Ltd, Singapore

W1J.1 • 08:00
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

W1J.2 • 08:15
Wideband Tunable Laser Based on Thin-Film Lithium Niobate / III-V Hybrid Integration, Wang Shuan1, Qi Wang1, Rui Ma1, Zhongjin Liu1, Xirun Cai1, Sun Yat-sen Univ., China.

W1J.3 • 08:30
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

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Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

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W1J.8 • 09:45
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

W1J.9 • 10:00
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

08:00–10:00
W1K • Photonic Integration and Integrated Receivers

Presider: Patrick Lo; Advanced Micro Foundry Pte Ltd, Singapore

W1K.1 • 08:00
Breaking the Interconnection Limit by Integrating CMOS Electronics on PICs, Francesco Zanetto1, Monica Cricco2, Andrea I. Martinez1, Fabio Toso1, Francesco Marchetti1, Andrea Melloni1, Giorgio Ferrai1, Marco Sampaio1, Politecnico di Milano, Italy.

W1K.2 • 08:15
Wideband Tunable Laser Based on Thin-Film Lithium Niobate / III-V Hybrid Integration, Wang Shuan1, Qi Wang1, Rui Ma1, Zhongjin Liu1, Xirun Cai1, Sun Yat-sen Univ., China.

W1K.3 • 08:30
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

W1K.4 • 08:45
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

W1K.5 • 09:00
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Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

W1K.7 • 09:30
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

W1K.8 • 09:45
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.

W1K.9 • 10:00
Experimental Demonstration of in-Field 400G Coherent Metro-Access Convergence, Giuseppe Rizzelli Martella1, Maria Cristina Casasco1, Arranchara Paganò1, Valter Ferrera1, Roberto Gaudino1, Politecnico di Torino, Italy; Fondazione LINKS, Italy; TIM, Italy.
We propose a small-footprint 32×100 GHz filter. This 6-channel silicon tunable ring-filter for THz, and the first silicon ring-based WDM-(5.85 mW/π) for silicon rings with FSR≥3.2 best of our knowledge, this paper has Continued

Continued

We develop a ROADM using an 8-channel compact cascaded AWGs. This method in which an arrayed waveguide area serves as an evaluation metric and report a 170-nm-wide and highly rectangular waveband MUX/DEMUX filter using compact cascaded AWGs.

We experimentally demonstrate the fiber-longitudinal power profile estimation (PPE) methods, which estimate optical power along a fiber-optic link at a coherent receiver. We highlight key experiments demonstrating the extreme performance of PPE and its feasibility in operational use.

We experimentally show how pump wavelength would affect the static gain curve variation. The theoretical model is explored to interpret the experimental observations.

A 16 m High Bismuth-Doped Fiber Amplifier provides 47.9 dB gain in E+S-band, which captures power scaling trends and performance impact of time-dependent drift. For a system with 28-GBd subcarriers, an equalizer for 8×8 is 5.3 times larger than for 2×2.

Site Dependent Pumping Effect in Super L-Band EDFA, Liwan Wang1, Saber Jalili1, Jean-Claude Roussel1, Alan Elshad1, Guy Legaye1, Chiara Marchese1, Hakim Kobbi1, Rafal Magdziak1, Jeroen De Coster1, Neha Singh1, Marko Ersek Filipic1, Kristof Croux1, Dimitrios Velenis1, Maumita Chakrabarti1, Peter De Heyn1, Peter Verheyen1, Philippe Abi1, Filippo Ferraroni1, Yoonan Ban1, Josip Van Campenhout1, imec, Belgium. To the best of our knowledge, this paper has achieved the lowest thermal tuning power (5.85 mW) for silicon rings with FSR=3.2 THz, and the first silicon ring-based WDM-32×100 GHz filter.
**Room 7**

**W1H • Short-Reach Transmission—Continued**

**W1H.3 • 08:30** Single-Mode Coherent Transmission Over Universal Fiber for Data Center Interconnects, Fabio A. Barbona, Marek Radighe, Samuel Leonard, Ming-Jun Li, Filipe Ferreira, Univ. College London, UK; Univ. of Campinas, Brazil; Corning Incorporated, USA. We demonstrate DP-16-QAM up to 42 Gbaud over 50 km of universal fiber, meeting current OCI requirements while allowing SDM upgrades. Multipath interference is analyzed experimentally using mandrel wrapping and matched by split-step simulation.

**W1H.4 • 08:45** Nonlinear Vector Autoregressor Equalization for PAM-4 Micro-Ring Modulator-Based Short-Reach Transmission, Yeheni Ognachuk, Deming Kong, Darko Zibić, Francesco D. Ross, Technical Univ. of Denmark, Denmark. We experimentally demonstrate a nonlinear vector autoregressor equalizer for 40 and 50 GBaud PAM-4 transmission with microring modulators and show that it outperforms both Volterra and reservoir computing-based equalizers in 82B and 2 km scenarios.

**W1H.5 • 09:00** CD-Aware OCT Precoding for C-Band 100-Gb/s IM/DD OFDM Transmission Over 50-km SSMF, Junwei Zhang1, Li-wang Lu2, Heyun Tan1, Kangping Zhong1, Alan P Lau1, Chao Fei3, Xiaojian Hong3, 1Univ. of Campinas, Brazil; 2Univ. of Cal., USA; 3Technische Univ. Dresden, Germany. We propose a novel CD-aware orthogonal-circulant-matrix-transform (OCT) precoding scheme. Compared to CD-aware subcarrier loading (DFT precoding), the proposed scheme outperforms conventional schemes and improves the capacity by >20% (>12%) compared to CD-aware subcarrier loading (DFT precoding).

**W1I • Panel: Photonic Components for In-Physics Computing—Continued**

**W1I.4 • 08:45** Port-Agnostic Path Establishment with Point-to-Multipoint Control of Remote User Terminals for Metro/Access-Integrated All-Photonics Network, Ryo Igarashi1, Shin Kaneko1, Yasutaka Kimura2, Naotaka Shibata3, Takahiro Suzuki4, Masamichi Fujiwara1, Jun-ichi Kanai, Tomoaki Yoshida1; NTT Corporation, Japan. We propose a port-agnostic initial-connection sequence allowing simultaneous connection of multiple user terminals (UTs), and demonstrate end-to-end wavelength-path and fiber-path establishment for DWDM and non-DWDM UTs through point-to-multipoint-type remote UT control in Metro/Access-Integrated All-Photonics Network.

**W1J • Access, Metro and Mobile Convergence—Continued**

**W1J.3 • 08:45** Wideband FTTR PON Integrating Optical Wireless Access, Bernd Schrenk1, AIT Austrian Inst. of Technology, Austria; 2Technical Univ. of Denmark, Denmark. We demonstrate DP-16-QAM transmission over installed fiber, meeting current DCI requirements while allowing SDM upgrades. Multipath interference is analyzed experimentally using mandrel wrapping and matched by split-step simulation.

**W1J.4 • 09:00** Wideband FTTR PON Integrating Optical Wireless Access, Bernd Schrenk1, AIT Austrian Inst. of Technology, Austria; 2Technical Univ. of Denmark, Denmark. We demonstrate DP-16-QAM transmission over installed fiber, meeting current DCI requirements while allowing SDM upgrades. Multipath interference is analyzed experimentally using mandrel wrapping and matched by split-step simulation.

**W1K • Photonic Integration and Integrated Receivers—Continued**

**W1K.3 • 08:30** Heterogeneously-Integrated Self-Injection Locked Lasers on Thin Film Lithium Niobate, Mingxiao Li1, Chao Xiang2, Jonathan Peters1, Joel Guo1, Theodore Monot2, Shixin Xue3, Mario Dumont1, Jeremy Staffa1, Quang Le3, John Bowers1; Univ. of Rochester, USA; Univ. of California, Santa Barbara, USA. We demonstrate a heterogeneously integrated self-injection locked lithium niobate laser via direct bonding. The single mode lasing power is as high as 16 mW with a side mode suppression ratio over 50 dB.

**W1K.4 • 08:45** A Cost-Efficient 1.28 Tb/s DWDM Receiver Using All-Si Double Microring Avalanche Photodiodes, Yiwei Peng1, Yuan Xuan1, Wayne Sorn2, Stanley Cheung2, M. Thomas Parsons2, Keren Bergman2, Xscape Photonics, USA; 2Electrical Engineering, Columbia Univ., USA. We demonstrate a novel 8-channel all-Si double-MRR RX with record-high 1.28 Tb/s aggregated data rate and ultra-low -50 dB crosstalk, which can compete with the commercial RXs and promises ~40% chip cost saving.
Room 1A • Integrated Filters for Communication Systems—Continued

Room 1B • Monitoring and Sensing—Continued

Room 2 • Network Control and Orchestration—Continued

Room 3 • Doped Fiber Amplifiers and High Power Laser—Continued

Room 4C • Digital Subsystems for SDM and SCM Transmissions—Continued

Room 6D • Optical Computing and Memory—Continued

W1A.5 • 09:15
Monolithic Silicon Photonic Few-Mode Waveguide with Satellite Structures for Athermal Spectral Filtering, Ryotaro Konoke1, Takayuki Kurosu1, Guangwei Cong1, Keijiro Suzuki1, Kazuhiro Ikeda1, Shu Tamaki1,2, AIST, Japan. We propose a fully CMOS-compatible few-mode waveguide with “satellite” structures that exhibits thermally anomalous modal phase difference, and demonstrate the condition for athermal operation of spectral filtering from 20 to 50 °C.

W1B.5 • 09:15
State-of-Polarization Monitoring Employing Optical Supervisory Channel Enabling Instantaneous Fluctuation Detection and Localization, Yuuseki Sasaki1, Masaki Sato1, Hidemi Noguchi1, Kohe Hosokawa1, Advanced Network Research Laboratories, NEC corporation, Japan. We demonstrate a state of polarization monitoring system employing an optical supervisory channel that can detect even short fluctuations of 10 ns with precise localization in the experiment over an FPGA.

W1C.3 • 09:15
Privacy Preserving Digital Twin Knowledge Sharing for Multi-Domain Network Works, Marc Ruiz1, Luis Velasco2, Universitat Politècnica de Catalunya, Spain. Knowledge sharing techniques among OCATA optical layer digital twin instances are proposed for multi-domain scenarios. Intra-domain model transformations are performed to guarantee privacy of intrinsic domain topology. Remarkable accuracy to estimate multi-domain lightpaths QoS is shown.

W1D.5 • 09:15
Gain Optimization of Er-Doped Fibers Doped with Er:BaF, Nanoparticles, Jennifer Campbell1, Mary Ann Cahoon1, Michael Gachuch1, Michael Norlander1, Thomas Hawkins1, John Ballato2, Peter Dragic1, ULiC, USA; Clemson Univ., USA. An Er:BaF nanoparticle doped silica fiber (EDF) heavily doped with erbium exhibits mitigated quenching effects and possesses a high quantum efficiency (976 nm pump). Investigations herein suggest the erbium concentration is scalable to 1 WfL.

W1E.7 • 09:30
A Low Complexity Coherent 16x400 Gbit/s 45C-16QAM DSCM System with Precise Transceiver IQ Skew Compensation and Simplified Equalization, Wei Wang1, Dongdong Zou1, Zhengpeng Wu1, Xingwen Yi1, Wei Sun1, Fan Li1, Zhadi Li1, Sun Yan-Sen Univ., China; R & D Department, Hengtong Optic-electric Co., Ltd., China. A low complexity coherent 16x400 Gbit/s 45C-16QAM DSCM system with 50Gbaud 45C-16QAM DSCM signal is experimentally demonstrated, enabled by a low latency baseband transceiver IQ skew estimation method and simplified equalizer embedded phase tracking.

W1F.6 • 09:45
Frequency-Comb-Enabled Photonic RF Memory for Multi-False-Target Radar Compound Jamming, Kai Xi1, Xinghan Li1, Hongyu Li1, Mengfang Cheng1, Qi Yang1, Ming Tang1, Deming Liu1, Lei Deng1, Wuhan National Laboratory for Optoelectronics and School of Optical and Electronic Information, Huazhong Univ of Science and Technology, China. We report the first all-optical multi false-target radar jamming scheme using frequency-comb-enabled photonic RF memory. More than 10 false targets with range-velocity deceptions are demonstrated, with storage time exceeding 840μs and signal frequency exceeding 16GHz.
W1H.6 • 09:15 Simultaneous IM/DD Data Transmission and High-Rate Secret Key Distribution Over a Single C-Band Channel, Michal Jauchura1, Jakub Szlachetka1, Mateusz Kucharczyk4, Marcin Jarzyna1, Piotr Kolendowski1, Jaroslaw P. Turkiewicz1, Konrad Baraszek1; 1Univ. of Warsaw, Poland; 2Nicolaus Copernicus Univ., Poland; 3Warsaw Univ. of Technology, Poland. We demonstrate hierarchical multiscale PAM-4 transmission combining 500 Mbps data transfer with optical-layer cryptographic key distribution at rates 23.76 Mbps and 6.20 Mbps secure against passive eavesdropper advantage 0 dB and 6 dB respectively.

W1J.5 • 09:15 Invited Optical Transport Networks Converging Edge Compute and Central Cloud: an Enabler for 6G Services, Anna Tzanakaki1, Markos Anastasopoulos1; 1National and Kapodistrian Univ. of Athens, Greece. The paper positions the role of optical transport networks in converging edge and central cloud compute resources adopting an intent-based approach suitable for 6G systems. System level evaluations are performed over an experimental 5G testbed.

W1K.6 • 09:15 Invited InP-Based Optical Devices Integrated on Silicon Photonic Circuits, Takuya Okiyama1,2, Naoki Fujinawa1,2, Naoko Inoue1,2, Takuo Hiratani1,2, Takehiko Kikuchi1,2, Takuya Mitarai1,2, Munetaka Kurokawa1,2, Toshihide Takao3,4, Hajime Tanaka1,2, Hideki Fujikata1,2, Tohru Watanabe3,4, Tomohiro Nishiyama1,2, Hideki Yagi1,2; 1Photonics Electron Devices Research Institute, Japan; 2Sumitomo Electric Industries Ltd, Japan; 3Tokyo Inst. of Technology, Japan. We review our III-V/Si hybrid integration platform using chip-on-wafer direct bonding technique and the performance of hybrid lasers with InP-based gain regions on Si photonic circuits.

W1J.6 • 09:45 Large-Scale Network Field Trial Demonstrating the Evolution of 10G EPON to 50G PON Using Two-Generation Multi-PON Modules, Dezhi Zhang1, Jialiang Jin1, Jianglong Wang1, Dekun Lu2, Derek Nesset3; 1China Telecom Research Inst., State Key Laboratory of Optical Fiber and Cable Manufacture Technology, China; 2China Telecom Corporation Limited, China; 3Optical Research Department, Huawei Technologies Co., Ltd, China; 4Ipswich Research Centre, Huawei Technologies, UK. We report the first large-scale network field trial demonstrating the evolution of 10G EPON to 50G PON using a newly two-generation multi-PON module, which validates the sustainable evolution for mass 10G EPON networks.

W1K.6 • 09:15 Invited InP-Based Optical Devices Integrated on Silicon Photonic Circuits, Takuya Okiyama1,2, Naoki Fujinawa1,2, Naoko Inoue1,2, Takuo Hiratani1,2, Takehiko Kikuchi1,2, Takuya Mitarai1,2, Munetaka Kurokawa1,2, Toshihide Takao3,4, Hajime Tanaka1,2, Hideki Fujikata1,2, Tohru Watanabe3,4, Tomohiro Nishiyama1,2, Hideki Yagi1,2; 1Photonics Electron Devices Research Institute, Japan; 2Sumitomo Electric Industries Ltd, Japan; 3Tokyo Inst. of Technology, Japan. We review our III-V/Si hybrid integration platform using chip-on-wafer direct bonding technique and the performance of hybrid lasers with InP-based gain regions on Si photonic circuits.

W1K.7 • 09:05 128 Gb/s Coherent Receiver Engine with Flat Frequency Response, Jonas Glass1, Alexander Schindler2, Hendrik Boerma1, Thanh T. Tran1, Felix Garzer1, Duy P. Nguyen1, Billy Allen1, Patrick Rune2, Martin Schell1,2, Fraunhofer HHI, Germany; 1Technical Univ. Berlin, Germany; 2MACOM Technology Solutions, USA. We demonstrate a high responsivity intradyne coherent receiver engine with 80 GHz bandwidth. A co-design of the InP waveguide integrated coherent photodetector and the dual linear SiGe transimpedance amplifier results in a flat frequency response. A system evaluation at 128 Gb/s shows the capability for QPSK and 16QAM.
W2A.1 Improving FFE Performance by an Error Decorrelation Algorithm, Nebosja Stefanovic, Tom Jonas Wetlin, Lin You, Maxim Kuschnrner, Taha Rahman, Stefano Calabrò, Huawei Technologies Co Ltd, Germany. Two error decorrelation algorithms with negligible complexity and latency are developed to improve noise statistics after feed-forward equalizers. Performance improvement is demonstrated in simulations and experiments.

W2A.2 Wavelength-Stable Transmitter at ONU by Using Burst SOA for Coherent TDM-PON, Acai Tan1, Zhenguan Li1, Siyu Luo1, Zheng Xin1, Qinyao Yang1, Yingxiong Song1, Shanghai Univ., China. We propose and experimentally demonstrate a wavelength-stable upstream transmission system for coherent TDM-PON by using a burst-mode SOA at the ONU, which is capable of supporting more than 512 ONU’s with high performance and reliability.

W2A.3 Optical Single-Sideband (SSB) Conversion Technique Using Phase Modulator for High-Speed Short-Reach IM/DD PAM Signaling, Nobuhiko Kikuchi1, Rui Hrai2, Takahisa Tanimura3, Hitachi Ltd, Japan. We propose novel SSB-free SSB conversion technique of high-speed SSB signals by phase modulation and show improvement of CD tolerance of MZ and EML transmitter by >6 and >7.6 times in 40-GB PAM transmission experiments.

W2A.4 Long-Distance Quantum Key Distribution System Based on a PIC-Based Interferometer, Giulia Guardi1, Dominico Ribezzo2, Tommaso Occhipinti2, Alessandro Zavatta1, Davide Bacco1, Department of Physics, University of Florence, Italy. We demonstrate 100-km free-space long-haul QKD with efficient BB84 protocol implementing a photonic integrated Mach-Zehnder interferometer in the receiver. Our solution outperforms fiber-based devices, covering up to 45 km and achieving a 220% higher key rate per link by 10 dB.

W2A.5 3D Freeform Millimeter-Wave and THz Structures Based on Multi-Photon Lithography, Pascal Maier1, Alexander Kotz2, Joachim Heibecker3, Qiaoqiang Zhang4, Christian Benz5, Marius Kretschmann6, Tobias Harter7, Sebastian Rendle8, Ulrich Lemmer9, Wolfgang Freude10, Thomas Zwick11, Christian Koos12, Institute of Photonics and Quantum Electronics (IPQ), Karlsruhe Institute of Technology (KIT), Germany. We present the fabrication of 3D millimeter-wave and THz structures that overcome the limitations of conventional planar architectures. We demonstrate THz probes, suspended antennas, and ultra broadband chip-chip interconnects offering bandwidths in excess of 0.4 THz.

W2A.6 100 Gbps PAM4 VCSel-Based Transmission Over Meter-Scale Flexible Multimode Polymer Waveguides for Board-Level Optical Interconnections Application, Xu Lin1, Lin Ma2, Ying Shi1, Qianqian Wu3, Motoya Kaneta4, Zuyuan He5, Shanghai Jiao Tong University, China; Sumitomo Bakelite Co., Ltd, Japan. We demonstrate 100 Gbps PAM4 VCSel-based transmission over 12-channel interconnected meter-scale flexible multimode polymer waveguides with a bandwidth-length product greater than 56 GHz/mm at a wavelength of 850 nm for board-level optical interconnections application.

W2A.7 A Grating Coupler with High Coupling Efficiency and Large Bandwidth for Silicon-on-Insulator Technology, Christian Schweikert1, Simon Na2, Niklas Hopperl1, Wolfgang Vogel1, Manfred Berroth1, Georg Rademacher1, University of Stuttgart, Germany. Conventional grating couplers show a tradeoff between low-loss and broad bandwidth operation. By using the interference of counter-propagating waves, we demonstrate a grating coupler design with a simultaneous coupling efficiency of 8 dB and bandwidth of 77 nm.

W2A.8 Low-Divergent 940-nm Photonic-Crystal Surface Emitting Laser for Short-Reach Free-Space Data Link, Hsin-Hsen Cheng1, Po-Lun Chen1, Jen-Wen Lin1, Yu-Heng Hong1, Shih-Chen Chen1, Shu-Wei Chang2, Chao-Hsin Wu3, Hao-Chung Kuo4, Atsushi Matsumoto5, Tsuchi1, Shih-Chen2, Chung-Ru Liu1, National Inst. of Information and Communications Technology, Japan. We theoretically and experimentally demonstrate how the detection of capabilities of the inner code in an experimental rate-adaptive concatenated FEC scheme can be employed to reduce the computational complexity of the nonlinearity compensation block. Total complexity savings between 17% and 95% are reported depending on the target operating point.

W2A.9 Importance of the Contentionless OXC Property for WDM Networks Handling the Fastest Optical Channels, Thierry Zam1, Nokia Corporation, France. This paper explains why the contentionless property becomes more than only “nice to have” in the add/drop stages of wavelength-routing OXCs with fewer channels in the T-band as channel symbol rate starts significantly grows.

W2A.10 A Low-Cost Network Architecture Enabled by SOA-Based Filter-Less OADMs and Digital Subcarrier Multiplexing, Carla Castro1, Shyamnath A. Narasimha2, Domenico Ribezzo3, Tommaso Occhipinti5, 1CTTC, Spain; 2Eviden, 3Q.ANT GmbH, Germany; 2Inst. of Microstructure Technology (IMT), Karlsruhe Institute of Technology (KIT), Germany. We propose an architecture based on semiconductor optical amplifiers, our point-to-multipoint scheme can cover distances of up to 350 km with OSNR margins > 9.3 dB in typical ITU-T hose networks.

W2A.11 Single Wavelength Laser-to-CAN Integrated with One-Chip Wavelength Locker, Junichi Suzuki, Ki-yotomo Hasegawa1, Kei Masuyama1, Nobuo Ohashi2, Mitsubishi Electric, Japan. A 4.4-mm TCO-6 CAN packaged light source module integrated with one-chip wavelength locker has been fabricated with a frequency shift <±1.1 GHz, small enough to achieve wavelength locking with a compact package for short-reach coherent communication.

W2A.12 Experimental Demonstration of Error Detection Driven Nonlinearity Compensation for Optical Fiber Communication Systems, Metod P. Ylenkov1, Edson P. da Silva1, Sören Forchhammer1, 1Department of Photonics and Electrical Engineering, Technical Univ. of Denmark, Denmark; 2Department of Electrical Engineering, Federal Univ. of Campina Grande, Brazil. We demonstrate how the error-detecting capabilities of the inner code in an experimental rate-adaptive concatenated FEC scheme can be employed to reduce the computational complexity of the nonlinearity compensation block. Total complexity savings between 17% and 95% are reported depending on the target operating point.

W2A.13 Importance of the Contentionless OXC Property for WDM Networks Handling the Fastest Optical Channels, Thierry Zam1, Nokia Corporation, France. This paper explains why the contentionless property becomes more than only “nice to have” in the add/drop stages of wavelength-routing OXCs with fewer channels in the T-band as channel symbol rate starts significantly grows.

W2A.14 A Low-Cost Network Architecture Enabled by SOA-Based Filter-Less OADMs and Digital Subcarrier Multiplexing, Carla Castro1, Shyamnath A. Narasimha2, Domenico Ribezzo3, Tommaso Occhipinti5, 1CTTC, Spain; 2Eviden, 3Q.ANT GmbH, Germany; 2Inst. of Microstructure Technology (IMT), Karlsruhe Institute of Technology (KIT), Germany. We propose an architecture based on semiconductor optical amplifiers, our point-to-multipoint scheme can cover distances of up to 350 km with OSNR margins > 9.3 dB in typical ITU-T hose networks.

W2A.15 Energy-Efficient Spiking Neural Network Equalization for IM/DD Systems with Optimized Neural Encoding, Alexander von Bank1, Eike-Manuel Edelmann1, Laurent Schmalen1, 1KIT CEL, Germany. We propose an energy-efficient equalizer for IM/DD systems based on spiking neural networks. We optimize a neural spike encoding that boosts the equalizer's performance while decreasing energy consumption.

W2A.16 Providing Anomalous Behaviour Profiling by Extending SmartNIC Transceiver Support in Packet-Optical Networks, Ricardo Vilhita1, Johannes szczesny2, Javier Vilchez1, Luís Gifs1, Carlos Manso1, José Luis Cerdeira-Riera, 1Faculdade de Engenharia, Universidade do Porto, Portugal; 2Eviden, Spain. We present a use case for providing anomalous behaviour profiling support using the proposed extensions.

W2A.17 Flexible Optical Metro-Access Networks Leveraging SOA-Based OADM Nodes and DSCM with Power Loading, Zhouyi Hu1, Shiyu Xia2, Henrikre F. Santana1, Manjin Rombouts3, Bin Shi4, Nicola Calabretta1, 1Department of Electrical Engineering, Eindhoven Univ. of Technology, Netherlands. We demonstrate a flexible metro-access network exploiting SOA-based OADM nodes and digital subcarrier multiplexing with power loading. Results show that at least 4 nodes can be supported for 40-Gb/s transmission with bandwidth allocation on demand.

W2A.18 Multi-Section Partially-Corrugated Grating DFB Lasers for Achieving High Power, Low Noise, and Narrow Linewidth, Siti Sulikhah1, Kryzhan. Anel Malica Da Cruz1, San-Lang Lee1, Chang G. Yu2, Jang F. Jang3, Hung P. Shiao2, Chao-Hsin Wu3, Haing-Chun Yang4, National Taiwan Univ. of Science and Technology, Taiwan. A novel DFB laser structure with multi-section partially-corrugated gratings (PCG) is demonstrated with enhanced output power, reduced noise, and reduced linewidth, resulting from the equalized photon density in the laser cavity by the partitioned partial gratings.

W2A.19 Machine Learning-Driven Low-Complexity Optical Power Optimization for Point-to-Point Links, Isia Asensio1, Matteo Lernardi1, Petro Ramantarins2, Ele Awwad1, Ekhtire Iuroizki3, Stefan Cleomenis3, Paolo Sera1, Chiara Lasagri1, Sebastien Bigo2, Pa- tricia Leyco3, Nokia Bell Labs, France; Telecom Paris, France; Univ. of Parma, Italy. We propose a strategy to dynamically adjust transmitted power solely based on the analysis of performance fluctuations due to polarization-dependent loss. We show that our method converges faster to optimum compared to a standard approach.

Exhibit Hall B1

10:30–12:30
W2A • Posters Session I, In Person
Those of optical connectors are achieved in the rotation of a ferrule holding a fiber bundle. Excellent demonstrate an opto-mechanical switch based on a 0.18 Hamming distance from the destined PUF. In the worst-case scenario, our device exhibits at least integrated with perforated microring resonators. In addition, Corning Inc., USA.

We demonstrate a novel silicon-...lithography, Colorado State University, USA; ‘Electrical Engineering, Columbia University, USA; ‘Information Directorate, Air Force Research Laboratory, USA. We demonstrate a vertical-junction microlens modulator with interleaved RF contacts and doped-silicon heater. We measure a resonance ER=36.8 dB, FSR=27.15 nm, and open eye diagrams at 32 Gb/s NRZ with 800 mV peak-to-peak driving signal.

Photonic Phynically Unclonable Functions Using Ridge-Coupled Directional-Couplers, Mohammad-Amin Mahdian, Ebadollah Taheri, Kaveh Has...Kermani, ‘Xcape Photonics, USA; ‘Electrical Engineering, Columbia University, USA; ‘Information Directorate, Air Force Research Laboratory, USA. We demonstrate a vertical-junction microlens modulator with interleaved RF contacts and doped-silicon heater. We measure a resonance ER=36.8 dB, FSR=27.15 nm, and open eye diagrams at 32 Gb/s NRZ with 800 mV peak-to-peak driving signal.

Broadband Transmission Opto-Mechanical Switch Based on Cylindrical Ferrule-Fiber Switching, Using Fiber Bundle Inserted in Ferrule, Chisato Fukai, Takeo Uematsu, Ryo Koyama, Kiyotaka Ogawa, Yuko Ohmori, and Masahiro Tsuchiya. We demonstrate an opto-mechanical switch based on a ferrule holding a fiber bundle. Excellent low-loss optical couplers, compatible with those of optical connectors are achieved in the telecommunication wavelength bands.

Verification of the Physical Modelling Approach of Spectral Hole Burning in EDFA Based on Erbium Doped Fiber, Abhishek Suriya, Hongyao Chua, Patrick Lo, Joyce Gordon, Leif Johansson, Milan Masanovic. We experimentally demonstrate an ultra-efficient vertical-junction microdisk circuit, utilizing 3µm-thick ridge waveguide having low propagation dependence. The multiplexer achieves low loss (2.8dB) and low PDL (0.085dB) across the C-band. Output modes are coupled to rectangular core fiber.

Experimental Analysis of Receiver Failure for 19-Core Randomly Coupled Core Fibre Transmission, Mervin van den Hout, Ruby S. Ospina, Ruben Santos, Dino Mazar, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit, Wouter van der Horst, Aharon Novik, Benno Bode, Hidde spirit.
Wednesday, 23 March

**OFC 2024** • 24–28 March 2024

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**W2B.1**
Optimization of Channel Powers, Raman Pumps and EDFA in the Wideband Fiber Optic Transmission Systems, Yicheng Wang, Yuxia Li, Jingyu Zhao, Wujie Xing, Kun Wang, Jinping Luo, Wenwu Ma, Jian Fan, Shoucheng Li, and Yifei Li

**W2B.2**
Topological Rotation-Symmetric-Based Wave-length Allocation for Entanglement Distribution Networks, Xujun Liu, Yuanyuan Luo, Jiaming Li, Xingjie Zhou, Zhong Chen, Xiaoyang Li, and Guanghong K. Zhang

**W2B.3**
Modeling and Experimental Evaluation of End-to-End Delay Jitter for Cross-Domain Interconnection in SD-SONET, Peter Zhang, Guochu Shou, Junli Xue, and Jian Fan, Beijing Univ. of Posts and Telecommunications, China; **W2B.4**
Beijing Univ. of Posts and Telecommunications, China; We establish a relationship model of end-to-end delay jitter with time synchronization for TSN cross-domain interconnection. Experiments demonstrate that the delay jitter of 2000mm/250ps with 0.3 us time error is less than 1 μs.

**W2B.5**
Photonic Counting Single-Point 3D Imaging Using a Multimode Fiber-Coupled Fractal SNSPD, Kai Zou, Yun Meng, Zifan Hao, Xiaolong Hu, 1Beijing Univ. of Posts and Telecommunications, China; 2Huazhong Univ. of Science and Technology, China; We demonstrate photonic-counting single-point 3D imaging using a multimode fiber-coupled fractal SNSPD and showcase 32×32×32-point imaging with reflectance and depth contrasts at the wavelengths of 1580 nm.

**W2B.6**
A Low Complexity 64GAM-Based Probabilistically Shaped OFDM for W-Band RoF System, Long Zhang, Kahi Wu, Jun Liu, Xiaoyuan Li, Zhaolin Chen, Chen Wang, Yang Chen, Hanyi Su, Xingzhi Li, Zhiwu Shen, and Zhiqiang Wang, 1Wuhan National Laboratory for Optoelectronic Devices, China; 2State Key Laboratory of Optical Communication Technologies and Networks, China; We propose and experimentally demonstrated a low-complexity photonic shaping (PS) 64GAM-OFDM in a W-band RoF system using envelope detection. After 45 km SSMF and 4-m wireless transmission, 28.13 Gb/s PAM-64GAM-OFDM signals transmission is achieved.

**W2B.7**
CPR-Equalized Data Rate of 3.12 Tbps 16384QAM DSM 300GHz Terahertz Wave Signals Over Hollow-Core Fiber, Xiangwei Tang, Junfan Ju, Weiping Li, Chen Wang, Wen Zhou, Kahi Wang, Chengzhen Bian, YI Wei, Mingxu Wang, Quanzhang Ying, Wu Bi, Luxi Yan, Zhaoyun Zhu, Junjie Ding, Jiao Zhang, Min Zhu, Jianguo Yu, Feng Zhao, Fudan Univ., China; 2Harbin Inst. of Technology, China, 3Nanjing Univ. of Information Science & Technology, China; We report the first demonstration of Ge-on-Si APD for +20 ps/nm and -28 ps/nm at 1270 and 1370 nm, with an on-chip loss of 49dB, showing a broadband dispersion compensation capability.

**W2B.8**
In-Service Simultaneous Monitoring of Transceiver and Channel Impairments in DCSM Systems Without Post-processing, Ziquan Yan, Wenleng Wang, Changcheng You, Heng Zhang, Yufan Yang, Qun Zhang, Siyu Gong, Jianwei Tang, 1Beijing Univ. of Posts and Telecommunications, China; 2China United Network Communications Group Co., Ltd., China; We experimentally demonstrate ultra-large capacity hybrid fiber and THz-Wave wireless transmission over 2-km hollow-core fiber and 2-m wireless distance based on 80 GHz DWM and DCM, achieving CPR-Flat equalization up to 3.12 Tbps.

**W2B.9**
Data Labeling Using Unsupervised Cascaded Pre-trained with Fused Multi-Port Data for Optical Transmission Systems, Jia Li Zhu, Yuan Cao, Jian Li, Xingyu Bian, 1Beijing Univ. of Posts and Telecommunications, China; 2Huazhong Univ. of Science and Technology, China; We propose an unsupervised cascaded pre-training data labeling method that considers the intrinsic correlation of unlabelled data, and verifies the scheme validity in real multi-port data from optical networks.

**W2B.10**
Wide-Angle Vertical Coupling Gratings Enabled Different Baud-Rate PAM-4 Signal Recognition, Kai Zhang, Yuan Yu, Yao Li, Mi Zhang, 1Beijing University of Posts and Telecommunications, China; 2Harbin Institute of Technology, China; We propose a reinforcement-learning-optimized nonlinear physical dfferential receiver architecture using cascaded OAM-mode and LP-mode conversion with Gaussian noise removal. The PSNR and SMM of the converted mode reach 27.94 dB and 0.838, respectively.

**W2B.11**
High-Performance Chiral Mode Switching Device at 2 pmW Bandwidth Using Photonic Crystal Waveguide, Kang Li, Heye Feng, Swei Wang, Lin Chen, Jian Wang, 1Wuhan National Laboratory for Optoelectronic Devices, China; We experimentally demonstrate a silicon chiral mode switching device by dynamically creating an exceptional point at 2 pmW bandwidth, with high purities (>95%) for both TE and TM modes in a broad bandwidth (85 nm).

**W2B.12**
Experimental Demonstration of 51.2 Ts/s Self-Homodyne Coherent Interconnections on a 3D PAM-64QAM Chip Inspiring Coherent Technology Transfer to Centimeter-Scale Ultra-Short-Reach Applications, Jie Zhang, 1Huazhong Univ. of Science and Technology, China; 2Optics Valley Laboratory, China; 3Haiense Broadband Inc., USA; 4Haiense Broadband Multimedia Technologies Co., Ltd., China; We demonstrated a record net 51.2 Ts/s (800Gbps PDM-64QAM x 54 Channels) ultrafast laser inscribed 3D photonic chip interconnects based on self-homodyne coherent detection, showing the feasibility of coherent technology transfer to ultra-short-reach applications.

**W2B.13**
Direct Radio Frequency Modulation of Quantum Cascade Lasers for mid-IR Applications, Grzegorz Dudzik, Wojciech Fraczek, Piotr Jaworski, Karol Krakowiak, Krysztof Abrasinski, 1Wroclaw University of Science and Technology, Poland; We present a QCL-based integrated laser module operating in the mid-IR range, with a high signal-to-noise ratio, 7.5 GHz and a miniaturized, fully electronic module for spectroscopic signal retrieval.

**W2B.14**
Denoising in Mode Conversion by Utilizing Diffractive Deep Neural Networks Optimized with Reinforcement Learning, Zheng Li, Weibo Zhang, Yang Wang, Guanjun Peng, Zongze Li, Xiaoyan Zhou, 1Huazhong University of Science and Technology, China; We report the first demonstration of Ge-on-si APD for 1550 nm wavelength photodetector at the cryogenic temperature of -80°C, with an In=0.369 μA, R=8.44 AW and V=1840 at I=−20.8 V.

**W2B.15**
Different Baud-Rate PAM-4 Signal Recognition, Pei Zhang1 , Guochu Shou 1 , Junli Xue 2; 1Beijing Univ. of Posts and Telecommunications, China; 2Huazhong Univ. of Science and Technology, China; We propose a reinforcement-learning-optimized nonlinear physical differential receiver architecture using cascaded OAM-mode and LP-mode conversion with Gaussian noise removal. The PSNR and SMM of the converted mode reach 27.94 dB and 0.838, respectively.

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**ePoster Gallery**

**W2B 10:30–12:30**

**W2B Posts Session II, Remote**

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**W2B.19**
Mode Division Multiplexed Coherent Optical Transmission in Time Domain by Using Higher-Order Hermite-Gaussian Pulses, Masataka Nakazawa, Masato Yoshida, Toshiki Hiroaka, International Research Inst. for Disaster Science, Tohoku Univ., Japan; We propose a new mode-division-multiplexing (MDM) technique in time domain using higher-order Hermite-Gaussian pulses. 32-QAM, 450-km MDM transmission was successfully demonstrated with HG, HG2, HG4, and HG8 pulses, where the time domain orthogonality was used for demultiplexing.

**W2B.20**
Integrated Silicon Photonics Transmitter and Receiver Array Modules Enabling 1 Tbps Interboard Optical Interconnection Over 8-Channel Polymer Optical Waveguide, Chao Yang, Chao Li, Dagao Chen, Ming Liu, Ying Zhu, Zhiwei He, Xu Liu, Lin Ma, Xi Xiao; 1China Information Communication Technologies Group Corporation, China; 2China Post-Telecommunications Laboratory, China; 3National Information Optoelectronics Innovation Center, China; 4Shanghai Jiaotong Univ., China; 1-Tbps FS-PAM-4 interboard optical interconnection using integrated SiP transmitter and receiver array module over an 8-channel polymer optical waveguide is proposed and experimentally demonstrated, achieving a low-cost and high-speed solution for short-range optical interconnects.

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**W2B.21**
High Sampling Rate Arbitrary Waveform Generator in the Polarimetric Synthetic Dimension, Yiran Yao, 1Hong Kong University of Science and Technology, Hong Kong; We propose a high sampling rate arbitrary waveform generated in the polarimetric synthetic dimension for optoelectronic systems. A triangular, rectangular, and sawtooth waveform at a sampling rate of 80 GSa/s are experimentally generated.

**W2B.22**
New GAWBS Noise Interacting with Longitudinally Propagating Acoustic Waves in Few-Mode Fibers, Masato Yoshida, Takahiro Ishii, Shohe Bepu, 1Kansei Kasa, Toshiki Hiroaka, Masataka Nakazawa, 2Tohoku University; We report the first demonstration of GAWBS noise characteristics in few-mode fibers from different LP modes through long-distance propagating acoustic waves.
W2B.23 Accelerated Distributed Deep Learning with a Fast Reconfigurable Optical Network, Wenhe Li, Gang Qiao, Jie Luo, Mingqing Zuo, Yuyang Gao, Xiaoxuan Gao, Rentao Gu, Yue- jiao Li, Jun Bai, Yuefeng Ji, Beijing Univ. of Posts and Telecommunications, China. We propose a fast-reconfigurable and scalable optical network architecture, which employs a flow-based transit scheduling scheme to accelerate data parallelism in distributed deep learning. Experimental results demonstrate that the 4-node prototype achieves training times comparable to those of ideal electrical switching.

W2B.24 Fast Online Optimization of Multi-Pump Raman Amplifiers for Field Deployment in Multi-Band Optical Networks, Xiaoguang Xue, 60+60 km Weakly-Coupled MDM-WDM Transmission with Coherent Detection, Xiaoyuan Gao, Ren Tao, Peiheng Zhang, 1, George N. Rouskas, 2, Inst. of Computing Technology, CAS, China; 1Inst. of Intel- ligent and Computing Technology, Sichuan, CAS, China; 2Department of Computer Science, North Carolina State Univ., USA. We propose a fast-reconfigurable and scalable optical network architecture, which employs a flow-based transit scheduling scheme to accelerate data parallelism in distributed deep learning. Experimental results demonstrate that the 4-node prototype achieves training times comparable to those of ideal electrical switching.

W2B.25 Chirp Dispersion Interaction-Enabled Uneven Optical-PAM-4 Based on Dual-Drive MZM for 5.9-DB SNR Gain in Digital RF Frontof with Quantizer Compatibility, Yimin Hu, Yi Xiao Zhu, Guangyang Yang, Zhiheng Zhang, Lina Man, Ziyu Chen, Weisheng Hu, 1Shanghai Jiao Tong Univ., China. We theoretically model and explain the dispersion-induced eye closure/open in dual-drive MDM-based system and leverage the effect for uneven optical-PAM-4 digital radio-over-fiber fronthaul. We evaluated two quadrants and 5.9-DB SNR gain is experimentally achieved.


11:45–13:45 Challenges and Solutions for Realizing Quantum Fiber-Based Networks, Room 3
Wednesday, 27 March

**Room 1A**

14:00–16:00
**W3A • Transmitters and Receivers**

Presider: Frank Chang; Source Photonics, USA

**Room 1B**

14:00–16:00
**W3B • Optical Signal Processing**

Presider: Xiaoke Yi; Univ. of Sydney, Australia

**Room 2**

14:00–16:00
**W3C • Network Planning and Operation**

Presider: Yvan Pointurier; Huawei, France

**Room 3**

14:00–16:00
**W3D • Laser Stabilization and Comb Sources**

Presider: Vladimir Gordienko, ADVA, Germany

**Room 6C**

14:00–16:00
**W3E • Embracing Fiber Sensing: What’s the “Killer App” for Large-Scale Deployments?**

Presider: Sander Jansen, Corning Inc, UK

**Room 6D**

14:00–16:00
**W3F • Submarine Long-Haul and Repaterless Transmission**

Presider: Sergei Makovejs, Alcatel Submarine Networks (ASN), France.

**W3A.1 • 14:00**

**Invited**

**Top-Scored**

Net+1.8 Tbps/A Transmission Enabled by C+L-Band InP-Based Coherent Driver Modulator, Josuke Ozaki1, Yoshihiro Ogiso1, Hiroshi Yamazaki1, Masanori Nakamura1, Kenta Sugura1, Katsuya Nagashima1, Yasuaki Hashamura1, Nabihiro Nuniyama1, Katsuaki Miyamoto1, Mitsutaka Ishikawa1; NTT Innovative Devices, Japan; NTT Network Innovation Laboratories, Nippon Telegraph and Telephone Corporation, Japan; Fukuoka Electric Co., Ltd., Japan; “NTT Device Innovation Center, Nippon Telegraph and Telephone Corporation, Japan. Using a newly developed InP-based C+L-band supported coherent driver modulator with an electro-optic 3-dB bandwidth above 90 GHz, an 80 km transmission with a net bit rate of 1.8 Tbps/A in the C+L band was successfully demonstrated.

**W3A.2 • 14:15**

**Top-Scored**

Integrated Coherent Transmit-Receive Optical Sub-Assembly (IC-TROSA) for 140 Gbps Applications, Eftymios Rouvalis1, Patrick Domburg1, Jörg Honecker1, Jens Stephan1, Christopher Harbs1, Johann Henkel1, Ulrich Tedeschi1, Andreas Varon1, Sebastian Wissig1, Georg Clarici1, Matthias Berger1, Coherent, Germany. We report on a high output power (>0 dBm), integrated coherent transmit-receive optical sub-assembly (IC-TROSA) integrating all electro-optical and control functions for single-carrier, coherent transmission up to 800 Gbps.

**W3B.1 • 14:00**

**Invited**

**Top-Scored**

Cascadability of PPLN-based Inter-Band Wavelength Conversion for Band-Switchable Multi-Band Optical Cross-Connect, Haruka Minami1, Takatumi Fukatani1, Masahide Nakazawa1, Takeshi Seki1, Shinspei Shimizu1, Takayuki Kobayashi1, Takushi Kazama1, Koji Ebizui1, Takeshi Umeaki1, Rie Hayashi1, Takashi Kuwahara1; NTT Corporation, Japan. A band-switchable multi-band optical cross-connect can contribute flexible operation of future multi-band networks. We review an experimental demonstration for cascadability of PPLN-based inter-band wavelength converters with a view to incorporating them into the optical cross-connect.

**W3B.2 • 14:15**

**Invited**

**Top-Scored**

Networking Benefits of Coherent Pluggable Optics, João Pedro Ribeiro1, Infinera Unipessoal Lda, Portugal; Instituto de Telecomunicações, IRT, Portugal. This paper overviews the range of applications of coherent pluggable optics. Selected simulation results highlight how deploying devices that feature both high-performance and digital subcarrier multiplexing is a key enabler of cost-effective network solutions.

**W3C.1 • 14:00**

**Invited**

Iso Channel Symbol Rate Faster Than 200 Gbaud the Panacea for WDM Transparent Meshed Networks?, Thierry Zami1, Nicola Rossi1, Bruno Lavigne1; Noka Corporation, France. In the context of transparent meshed WDM networks, we illustrate and explain why very large channel symbol rate (288 Gbaud) can adversely reduce the total network capacity, whilst still improving global expenditures per Gbit.

**W3C.2 • 14:15**

**Invited**

**Top-Scored**

Low-Complexity Experimental Model for Submarine Link Performance Prediction, Juliana Tiburcio de Araujo1, Alexis Carbo Meseguer1, Jean-Christophe Antona1; Alcatel Submarine Networks (ASN), France. We propose a low-complexity experimental model that predicts the OSNR of submarine links, considering both EDFA homogeneous and inhomogeneous responses. We tested it with random input pre-emphases, obtaining a mean RMSE of 0.29 dB after 24 spans when trained with simple single-span datasets.

**W3D.1 • 14:00**

**Invited**

Environmentally Stable Ultra-Low Noise Self-Injection Locked Semiconductor Lasers, Andrey B. Matsko1; JPL, Caltech, USA. Self-injection locking (SIL) of semiconductor lasers by means of monolithic optical cavities allows generation of high spectral purity and high stability optical signals under varying environmental conditions. We review recent advances in the field and focus at the SIL by means of monolithic Fabry-Perot resonators.

**W3D.2 • 14:15**

**Invited**

Low-Complexity Experimental Model for Submarine Link Performance Prediction, Juliana Tiburcio de Araujo1, Alexis Carbo Meseguer1, Jean-Christophe Antona1; Alcatel Submarine Networks (ASN), France. We propose a low-complexity experimental model that predicts the OSNR of submarine links, considering both EDFA homogeneous and inhomogeneous responses. We tested it with random input pre-emphases, obtaining a mean RMSE of 0.29 dB after 24 spans when trained with simple single-span datasets.

**W3E.1 • 14:00 Introduction**

**W3E.2 • 14:15**

**Invited**

**Top-Scored**

Subcarrier-Enabled Record Field Trial Demonstration in a Dispersion Uncompensated Ultra-Long Transpacific Cable, Sunmu Q. Edrissi1, Siddharth Varughese1, Dominic Lavery1, Pierre Mert1, Han Sun1; Advanced Optical Engineering, Infinera Corporation, USA; Advanced Optical Engineering, Infinera Canada Inc, Canada. A record real-time transmission is demonstrated over an 18,008 km dispersion uncompensated subsea cable, enabled by subcarrier-based EEPN mitigation and FEC. Numerical analysis supports the field trial’s real-time measurements, quantifying the benefit of subcarrier modulation.
We show successful demonstration of emerging 400G high power ZR+ optics in IP over WDM applications investigating its performance in key network scenarios with end-to-end 400GE traffic and streaming telemetry for performance monitoring.

We present the large-scale, production deployment of reconfigurable Lightwave Fabrics (LWF) for Machine Learning (ML) supercomputers. These fabrics consist of a custom developed optical circuit switch (OCS), circulators, and WDM transceiver technologies. The use of a LWF dramatically enhances the current generation 4096 tensor processing unit (TPU) system in both availability (up to 3x) as well as performance (up to 3.3x) with modest power and cost increases (1% and 6%, respectively).

This joint panel session will outline the landscape of optics for space communications today and in the future. Panelists will discuss their work in devices and systems to bring together the broader picture on how current technology is driving applications in space optical communications and quantum networks.

We report an overview of photonic integrated circuits for generating, processing accumulated knowledge on the state of light (qubit and qudit) in the context of quantum communications and quantum networks.

QoT Estimation for Large-Scale Mixed-Rate Disaggregated Metro DCI Networks by Artificial Neural Networks, Yan He1, Kaushik Chandramouli2, Zha Z. Qun3, Sai Chen1, Lian Dau1, Changjin Xie2, Chao Lu1, Alan P. Lau1;1 The Hong Kong Polytechnic University, Hong Kong, China; 2Alibaba Cloud, Alibaba Group, Beijing, China; 3Alibaba Cloud, Alibaba Group, New York, USA. We proposed an artificial neural network (ANN)-based QoT estimator for large-scale mixed-rate disaggregated metro DCI networks with an estimation error standard deviation of 0.3 dB, outperforming analytical-based methods with vendor-specific transponder SNR characterization.

End-to-End 400GE Traffic, Yu Rong Zhou1, John Keens 2, Martyn Allen1; 1 BT Group plc, UK; 2Cisco Systems Inc, USA. We show successful demonstration of 400G high power ZR+ optics in IP over WDM applications investigating its performance in key network scenarios with end-to-end 400GE traffic and streaming telemetry for performance monitoring.

Coherent LWFs for ML Supercomputers, Ryohi Urata1; 1Google LLC, USA. We present the large-scale, production deployment of reconfigurable Lightwave Fabrics (LWF) for Machine Learning (ML) supercomputers. These fabrics consist of a custom developed optical circuit switch (OCS), circulators, and WDM transceiver technologies. The use of a LWF dramatically enhances the current generation 4096 tensor processing unit (TPU) system in both availability (up to 3x) as well as performance (up to 3.3x) with modest power and cost increases (1% and 6%, respectively).

Field Transmission Performance of Few-Mode Fibers and Multicore Fibers, Cristian Antonelli1; 1Universita degli Studi dell’Aquila, Italy. This presentation reviews accumulated knowledge on the performance of field-deployed fibers for spatially multiplexed transmission. These are multi-core and few-mode fibers deployed in the Italian city of L’Aquila as part of the INCIPICT testbed for space-division multiplexing.

Field Transmission Performance of Few-Mode Fibers and Multicore Fibers, Cristian Antonelli1; 1Universita degli Studi dell’Aquila, Italy. This presentation reviews accumulated knowledge on the performance of field-deployed fibers for spatially multiplexed transmission. These are multi-core and few-mode fibers deployed in the Italian city of L’Aquila as part of the INCIPICT testbed for space-division multiplexing.
W3A • Transmitters and Receivers—Continued

W3B • Optical Signal Processing—Continued

W3C • Network Planning and Operation—Continued

W3D • Laser Stabilization and Comb Sources—Continued

W3E • Embracing Fiber Sensing: What’s the “Killer App” for Large-Scale Deployments? I—Continued

W3F • Submarine Long-Haul and Repellerless Transmission—Continued

W3A.3 • 14:30
Fully Integrated Silicon Photonic High-Speed Transmitter with Ring-Assisted Mach-Zehnder Modulator, Xinmin Wu, Xi Xiao, Xiaming Zhang, Huazhong Univ. of Science and Techn, China. We report a fully integrated transmitter which includes a DFB laser and a push-pull drive ring-assisted Mach-Zehnder modulator. We demonstrate 224Gb/s PM-4 transmission with 1.8Vppd differential driving swing and transmitter penalty (TDECC) of 1.25dB.

W3B.2 • 14:30
Over 3 THz Real-Time Optical Vector Oscilloscope, Liu Li, Yuchong Cai, Chi Zhang, Xi Xiao, Xinmin Zhang, Huazhong Univ. of Science and Techn, China. We propose a real-time optical vector oscilloscope to obtain full-field information with over 3-THz acquisition bandwidth. The experiments demonstrate 80 gigabits/s OOK and BPSK signals, and 2×160 gigabits/s QPSK wavelength-division-multiplexed signals are simultaneously observed.

W3C.3 • 14:45
Universal Optical Logic Gates on a Programmable Silicon Photonic Platform, Farnidh Ashram, Nokia Bell Labs, USA. We propose and demonstrate the implementation of NOT, OR/AND, and AND/NAND logic gates compatible with integrated photonics. Using a programmable photonic platform consisting of a Mach-Zehnder interferometer mesh, universal logic gates are experimentally demonstrated.

W3B.4 • 15:00
Integrated Non-Sliced OAWM Engine Enabling 320 GHz Photonic-Electronic Analog-to-Digital Conversion, Daniel Drayss, Dangrong Fang, Alexander Quent, Luca Valenzano, Matthias Lauermann, Grigory Liachev, Yung Chen, Huanfa Peng, Sebastien Rangel, Thomas Zweck, Wolfgang Freude, Tobias J. Kippenberg, Christian Koos, KIT, Germany; EPFL, Switzerland; Vanguard Automation, Germany. We demonstrate an optically and electrically packaged silicon photonic receiver system for non-sliced optical arbitrary waveform measurement (OAWM). The OAWM engine is used for high-speed data transmission and for photonic-electronic analog-to-digital conversion at bandwidths of up to 320 GHz.

W3C.4 • 15:00
Identification of Optical Links with Heterogenous Fiber Types in a Production Network, Emmanuel Seve, Sebastien Bigo, Patroca Layet, Nokia Bell Labs France, France. We develop a technique to identify fiber types within heterogeneous networks links using correlation between lightpath accumulated dispersions. We successfully identified fiber types from real data issued from a continental-size production network running live.

W3D.2 • 14:30
Frequency Modulated Integrated 780 nm Brillouin Laser with 24 Hz Fundamental and 14 kHz Integral Linewidths and 22 kHz Modulation Bandwidth, Andrei Isichenko, Nitesh Chauhan, Jia-wei Wang, Mark W. Harrington, Kaikai Liu, Daniel Blumenthal, U. Santa Barbara, USA. We demonstrate a frequency modulated 780 nm Brillouin laser pumped by a semiconductor laser. We achieve a 1.4 kHz 1/16th linewidth and 24 Hz fundamental linewidth and a 22 kHz modulation bandwidth.

W3E.4 • 14:45
Monolithically Integrated Comb Lasers on Silicon for Optical I/O, Ting Wang1, Institute of Physics, Chinese Academy of Sciences, China. Significant HPC and AI development enable the rising demand of chip-to-chip optical I/O. Monolithically integrated multi-wavelength lasers on silicon integrated with micro-ring modulators are capable of increasing data transmission bandwidth among XPUFs, FPGAs and ASICs. Multi-terabit optical data transmission with on-board optics shall lead to next generation high-performance computing.

W3F.3 • 14:30
Tailoring Transceiver Designs for Subsea, Siddharth Varughese1, Domanic Lavrey1, Pierre Merc2, Infineon Corporation, USA. Unique challenges that subsea cables introduce which influence optical transceiver design are described. DSP algorithms that address these challenges are discussed and the use of subsea transceivers for seismic sensing is also introduced.

W3A.1 • 14:30
Existing and Emerging Market Opportunities for Distributed Fiber Optic Sensing, Paul R. Dickinson1,2, Dura-Line, USA; Fiber Optic Sensing Association, USA. Through Broadcom and Datacom, optical fibers provide an ever-increasing mesh spanning the globe. In this presentation we’ll discuss multi-use trends where distributed fiber optic sensing, using existing fibers, now provides novel capabilities for multiple market applications.
Interoperable Coherent WDM Interfaces at 400G and 800G, Erwan Pincon, Olivier Renaud, Orange Innovation, France. 400G and 800G coherent WDM interfaces were recently standardized by MSA and standardization forums to enable interoperable operation across DCI, metro/regional, and IP/WDM networks of transceivers from various vendors with OUIs of different suppliers. OpenROADM is elaborating for the first time a probabilistic constellation shaping specification that addresses this need at 800G.

High-Density Optical I/O for ML/AI Applications, Peter J. Winzer, Nubis Communications, USA. We discuss optical interconnect solutions optimized for machine-learning clusters. Key performance criteria include ultra-high I/O density, low-power, low-latency, and linear-drive operation to natively replace copper interconnects.

U-Band Transmission Characteristics Over Standard Cladding Step-Index 4-Core Fiber Link, Takashi Matsumi, Taiji Sakamoto, Masaki Wada, Kazuhide Nakajima, NTT Corporation, Japan. We revealed that crosstalk influence in unpeered counter-propagating multi-core fiber link could be minimized at optimum gain and position of remote-optically pumped amplifier (ROPA). 1.5-times longer unpeered link was obtained by implementing isolators with ROPA.

Design Guideline for Unpeered Counter-Propagating Multi-Core Fiber Link, Takashi Matsumi, Taiji Sakamoto, Masaki Wada, Kazuhide Nakajima, NTT Corporation, Japan. We developed multiple-core filters (MCFs) with more than 30 cores and conducted transmission tests. Currently, we aim to commercialize four-core MCFs with a standard cladding diameter by conducting trials using MCF cables, and related technologies.

Development of Four-Core MCFs with Standard Cladding Diameter from High-Core-Count MCFs, Kazuhiko Aikawa, Takuya Oda, Sho Takei, Kohei Ozaki, Maju Isaka, Katsuhisa Takenaga, Akito Nishimura, Kento Itoh, Fujikura Ltd., Japan. We developed multiple-core filters (MCFs) with more than 30 cores and conducted transmission tests. Currently, we aim to commercialize four-core MCFs with a standard cladding diameter by conducting trials using MCF cables, and related technologies.

High-Density Optical I/O for ML/AI Applications, Peter J. Winzer, Nubis Communications, USA. We discuss optical interconnect solutions optimized for machine-learning clusters. Key performance criteria include ultra-high I/O density, low-power, low-latency, and linear-drive operation to natively replace copper interconnects.

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Ultra-Thin Bottom-Emission VCSEL-Based Optoelectronic Flexible Printed Circuit Module for High-Speed Transmission, Zuhai Khan1, Cheng-Yu Hong2, Ming-Chie Hsieh3, Chun-I Wu4, Long-Yi Lin5, Chun-Chih Chen6, David Cheng7, Flexium Interconnect Inc., Taiwan; 2Quantum Inc., Taiwan. Innovative integration of back emission VCSEL-based optoelectronic module with optical waveguide achieves remarkable 50Gbps PAM4 optical and 25Gbps NRZ electrical transmission speeds. An ultrathin USB3.2 type C optoelectronic module with 0.2mm thickness has been realized.

A 4×112Gbps Compact Polarization-Insensitive Silicon Photonic WDM Receiver, Jintao Xue1,2, Jinyi Wu1,3, Chao Cheng1,3, Kang Li1,2, Guofeng Yan1, Kangrui Wang1,2, Jiayuan Guo1,2, Hong Kong; 2PengCheng Lab, China. We present a two-section ring filters and bidirectional photodiodes is demonstrated. A polarization-dependent loss of 0.45dB is achieved.

Heterogeneous Integrated Fiber-Chip System Enabling 192-Channel and 20-Tb/s Multi-Dimensional Optical Signal Transmission and Processing, Kang Li1, Guofeng Yan2, Kangrui Wang1, Chengkun Cai1, Min Yang1, Qijie Xie2, Quanying Wen1, Guoquan Tian2, Weike Zhao3, Yingqing Peng1, Yaosheng Shi1, Daowin Dai1, Jian Wang1, Wuhan National Laboratory for Optoelect; China, 2State Key Laboratory for Modern Optical Instrumentation, Center for Optical & Electromagnetic Research, College of Optical Science and Engineering, International Research Center for Advanced Photonics, China. We demonstrate a heterogeneous integrated multi-dimensional fiber-chip system using few-mode fiber and 2D/3D integrated chips. By carrying a 56 Gbaud QPSK signal, the system with 192 mode/polarization/wavelength channels implements 20-Tb/s optical signal transmission and processing.

Using P2MP Transceivers as Regenerators in Disaggregated and Multi-Rate Regional Optical Networks, Ashwin Gumaste1,2, Joao Pedro1,2, Antonio Napoli1,2, Sai Bhyn1, Walid Wakim1,3, Infinera Corporation, USA. We investigate the role of point-to-multipoint (P2MP) transceivers as regenerators in multi-rate regional optical networks. By smart placement of P2MP devices, we are able to reduce transceiver count by 29% and free up spectral resources.
W3J.4 • 15:15
First Demonstration of Net-1.6-Tbps 4A-WDM in 150-GHz Grid IM/DD Transmission with a Single DAC/Channel and Advanced DSP for Intra-Datacenter Interconnects, An Yan1, Guoqiang Li1, Sahe Xing1, Yonghu Hu1, Wangwei Shen1, Zwei Li1, Chao Shen1, Jianyang Shi1, Xi Xiao1, Zhiyuan He1, Nan Chi1, Junwen Zhang1, ‘Fudan Univ., China; ‘National Information Optoelectronics Innovation Center, CICT, China; ‘Peng Cheng Laboratory, China. For the first time, we experimentally demonstrate net-400-Gbs/s/lane 150-GHz-spaced 4A-WDM transmission over 0.5-km SSMF in C-band for intra-datacenter interconnects based on 128-Gbaud probabilistically shaped PAM-20, using a single DAC per channel and driver-free, high-bandwidth TFUN modulators.

W3J.5 • 15:30
Dispersion-Unmanaged Transmission of 144-Gb/s PAM-8 and 110-Gb/s PAM-6 Signals Over 10/20-km SSMF for DML-Based IM-DD Optics at C Band, Qi Wu2,1, Zhaopeng Xu2, Yixiao Zhu2, Yixiao Zhu1, Honglin Ji2, Yu Yang2, Junpeng Li2, Honglin Ji2, Gang Qiao1, Shangcheng Wang1, Lulu Liu1, Zhiyuan He1, Jinlong Wei1, Qunbi Zhuge1, Weisheng Hu1; 1Shanghai Jiao Tong Univ., China; 2Peng Cheng Laboratory, China. We experimentally demonstrate record net 134.6-Gb/s PAM-8 and 102.8-Gb/s PAM-6 signals transmission over 10/20-km SSMF using a 20-GHz commercial C-band DML without dispersion management, using joint sparse Volterra nonlinear equalization and noise whitening DSP techniques.

W3J.6 • 15:45
8×462Gb/s Transmission with Symmetric Carrier-Assisted Differential Detection Using Delay-Unknown Field Recovery, Yixiao Zhu1, Xiansong Fang1, Guangying Yang1, Qunbi Zhuge1, Weisheng Hu1, Fan Zhang1; Shanghai Jiao Tong Univ, China; ‘Peking Univ., China. We implement symmetric carrier-assisted differential detection receiver as an LO-free alternative to single-polarization coherent receiver. Using 2×1 MIMO equalizer-based optical field recovery and SSB1 cancellation, 3.7 Tb/s (8×462Gb/s) PS-64-QAM signals are transmitted over 25-km SSMF for data-center-interconnects.

W3K.5 • 15:20 • Invited-Integrated Quantum Photonics/Foundry Talk, Segolene Olivier1; ‘CEA-Leti, France. Abstract not available.
Wednesday, 27 March

OFC 2024 • 24–28 March 2024

Room 1A

16:30–18:30
W4A • THz Processing and Communications

W4A.1 • 16:30
616Gbit/s Single-Line Rate Fiber-THz Fiber Seamlessly Transmitted Under Cascading MIMO Equalization

W4A.2 • 16:45
Flexible Capacity Wireless Communication in THz-Band with Michelson Interferometer-Based THz-Wave Filter

W4A.3 • 17:00
Phonotonic Frequency Hopping Driven by a High-Speed Wavelength Tunable Laser for Secure Terahertz-Wave Communication

Room 1B

16:30–18:30
W4B • FSO for Turbulent and Underwater Channels

W4B.1 • 16:30
Water-to-Air PAM4 Optical Camera Communication Using Short Long-Term Memory Neural Network (LSTM-NN)

W4B.2 • 16:45
Seeing Through Wave—Real-Time Beam Tracking via a ResNet-Based Model in Water-air OWC Systems

W4B.3 • 17:00
Experimental Demonstration of 14.5 Gbps Turbulence-Resilient Visible Laser Communication with Vector Beams Based on LiNbO3 External Modulation

Room 2

16:30–18:30
W4C • Coding and Modulation

W4C.1 • 16:30
Flexible Prototyping of CC/DWM with On-Line Configurable Probabilistic Distribution Based on Parallel Arithmetic Coding

W4C.2 • 16:45
Generalized Staircase Codes with Arbitrarily Bit Degree

W4C.3 • 17:00
Low-Complexity SD-FEC Based on Channel-Polarized Multistage Codes for Data Center Networks

Room 3

16:30–18:30
W4D • Amplifier Architecture for Data Transmission

W4D.1 • 16:30
C+L Band Transmission Under Bidirectionally Pumped Distributed Raman Amplifier Utilizing Semiconductor Incoherent Pumps

W4D.2 • 16:45
1200km Coherent O-Band Transmission Using In-Line BDFAs and Standard Single-Mode Fibre

W4D.3 • 17:00
U-Band WDM Transmission Over 90-km Deployed Fiber-Optic Cable Leveraged by 5+14-CN-Band WDM Channels

Room 6C

16:30–18:30
W4E • Embracing Fiber Sensing: What’s the “Killer App”? for Large-Scale Deployments? I

W4E.1 • 16:30
The ”Killer App” Is That the Fiber Already Exists!

W4E.2 • 17:00
Progression from Discrete Fiber Bragg Grating Sensors to Distributed Optical Fiber Sensing in the Railway Industry

Room 6D

16:30–18:30
W4F • Optical Architectures and Subsystems for Accelerating ML/AI Applications

W4F.1 • 16:30
Optical Architecture and Interconnection for Datacenter Networking and Machine Learning

W4F.2 • 17:00
Invited Tutorial

Hong Liu is an Engineering Fellow at Google’s Machine Learning, Systems, and Cloud AI team, where she is involved in the roadmap, architecture, and photonics innovation for Google’s datacenter networks and machine learning. She received her Ph.D. in electrical engineering from Stanford University, and is an Optica Fellow.
Room 7
16:30–18:30
W4I • AI-Based Automation
Presider: Konstantinos (Kostas) Christodouloupolou; Univ. of Athens, Greece

W4I.1 • 16:30
Experimental Demonstration of Automated ML Service Provisioning for VNT Configuration in SDM Networks, Hanyu Gao; Xiaokang Chen; Wenbang Zheng, Aioue Wang; Jingshun Pan; Xiaoliang Chen; Zhaohui Li; Sun Yat-sen Univ., China. We demonstrate automated ML service provisioning for VNT configuration over a 7-core fiber SDM testbed. Results show below 3-second VNT configuration time and provisioning of GoT estimators with >90% accuracy using <100 samples.

W4I.2 • 16:45
A 100 W Output Power Coherent Transmission Link for Future High Data Rate Earth-to-Satellite Communication, Yannick Hornat; Laurent Kulmer; Tobias Blatter; Joel Winger; Vincent Billault; Guénolé Darré; Jérôme Boudrennen; Arnaud Bignon; Anaelle Maho; Matthew Welch; Stefan M. Koepfli; Juerg Leuthold; IEF ETHZ, Switzerland; Thales Research and Technology, France; Thales Alenia Space, UK. An optical coherent transmission link with 100Watt output power is tested for satellite communications. Modulation formats are tested for transmission of the highest data-rates despite of nonlinear amplifier impairments across a linear, low-SNR free-space link.

W4I.3 • 17:00
Connecting the Switch to the Fiber: the Energy Efficiency Challenge, Davide Tonietto; Huawei Technologies Canada, Canada. The pressure for energy efficiency in AI and distributed computing systems has put in sharp focus ASIC to fiber efficiency as an area needing improvement. What is the origin of the problem and the possible solutions?

W4I.4 • 17:45
Multi-Core Fiber Backscattered Crosstalk Statistical Distribution Model, Aramaz Zakharian; Ming-Jun Li; Coming Inc, USA. Inter-core crosstalk statistical distribution due to Rayleigh backscattering is analysed for bi-directional transmission in multi-core fibers. The counter-propagating crosstalk distribution is shown to be consistent with a chi-squared statistics with eight degrees of freedom.

Room 9
16:30–18:30
W4K • Multi-Core Fiber Characterization and Connection
Presider: Tristan Kremp; OFS Fitel LLC, USA

W4K.1 • 16:30
Universal and Fault-tolerant Photonic Quantum Computing, Blair Morrison, Xanadu, Canada. Xanadu is developing a universal and fault-tolerant quantum computer using photonic QXP qubits. We will discuss this hardware architecture and the current state of progress towards reaching this goal.

W4K.2 • 16:55
Scalable Microwave-to-Optical Transducers for Quantum Computing and Networking, Chi Xiong; IBM TJ Watson Research Center, USA. Microwave-to-optics quantum transducers are an essential component for scaling superconducting quantum processors and building heterogeneous quantum network. This talk reviews the challenges and progresses in making quantum transducers and discusses IBM’s electro-optic transducer approach.
Room 1A
W4A • THz Processing and Communications—Continued

Room 1B
W4B • FSO for Turbulent and Underwater Channels—Continued

Room 2
W4C • Coding and Modulation—Continued

Room 3
W4D • Amplifier Architecture for Data Transmission—Continued

Room 6C
W4E • Embracing Fiber Sensing: What's the “Killer App” for Large-Scale Deployments? II—Continued

Room 6D
W4F • Optical Architectures and Subsystems for Accelerating ML/AI Applications—Continued

W4A.4 • 17:15
Digital Coherent Receiver Based Optical Performance Monitoring Technology and its Application to Photonics Tomography, Shoichiro Oda1, Ryu Shinzaki1, Motoniko Eto1, Kazuyuki Tajima1, Kyousuke Sone1, Setsuo Yoshida1, Inwoong Kim2, Olga Vassil’eva3, Paparo Palacharli3, Takeshi Hashida1;1Fujitsu Ltd, Japan; 2Fujitsu Network Communications, Inc, USA. Digital coherent receiver-based fiber-longitudinal power profile estimation (PPE) over multiple spans is presented. We then review three specific examples of applications of photonics tomography based on PPE and discuss the comparison between hardware and software implementation.

W4A.4 • 17:15
Experimental Demonstration of an 8-Gbit/s QPSK Coherent Underwater Wireless Optical Communication Link Under Scattering Conditions, Yuixiang Duan1, Hubin Zhou1, Zile Jiang1, Muralekshin Ramakrishna2, Xinzhao Su1, Wing Ko1, Yue Zuo1, Hongkun Lian1, Zixun Zhao2, Ruoyu Zeng2, Yingying Wang2, Moshe Tizi1, Alan E. Willner1;1Univ. of Southern California, USA, 2School of Electrical Engineering, Tel Aviv Univ., Israel. We experimentally demonstrate an 8-Gbit/s QPSK coherent underwater wireless optical communication link under scattering conditions at 532 nm. We achieve BER below 20% FEC limit under attenuation length up to 6.5 km and the corresponding receiver sensitivity is -29.8 dBm.

W4B.5 • 17:30
Broadband Single Flat Narrow Beam Shaped Time-Domain Adaptive Modulation for Underwater Transmission with Wavelength Characteristics in Blue-Green WDM System, Takahiro Kodama1, Fumiya Kobori1, Ayumu Kariya1, Keita Tanaka1, Kichiro Kuwahara1, Kaga Univ, Japan. We experimentally demonstrated that time-domain adaptive modulation per wavelength optimizes the underwater transmission capacity of a broad-spectrum WDM-TDHP comprising 450 nm and 520 nm wavelengths, shaped into a flat-narrow beam using a Galileoscope-type beam shaper.

W4C.5 • 17:30
Compensation of FEC Induced Distribution Distortion Based on Distribution Detuning in a 36-Tb/s (4x500-Gb/s) 2100-km Polar Coded PS-64QAM System, Xiaohuo Ju1, Jun Li1, Jingwei Song1, Ming Luo1, Chao Yang1, Qingyu He1, Ku Zhang1, Daigo Chen1, Hongguang Zhang1, Xi Xiao1, Xiaobing Hong1, Hongxiang Guo1, Zhisheng Yang1, Jingfan GUI1, Jian Wu1;1State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ of Posts & Telecom, China; 2China Information and Communication Technologies Group Corporation, China; 3National Information Optoelectronics Innovation Centre, China; 4Information and Communication Technologies Group Corporation, China. In this paper, a detuned distribution enabled polar coded probabilistic shaped 64-QAM is proposed and experimentally investigated over a 36-Tb/s (4x500-Gb/s) 2100-km transmission system at the spectral efficiency of 8-bit/s/Hz.
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<td>W4G • Space Communication—Continued</td>
<td>W4H • Datacom Modulation and Linear Transceivers—Continued</td>
<td>W4I • AI-Based Automation—Continued</td>
<td>W4J • Multi-Core Fiber Characterization and Connection—Continued</td>
<td>W4K • PICs for Quantum Communication and Quantum Computing: Challenges and Opportunities II—Continued</td>
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**W4G.3 • 17:15**
Range and Velocity Measurement with a Bi-Static LiDAR System Based on Optical Phased Array
- Wei Lan Xu
- Xianyi Cao
- Qi Qi Yuan
- Chuxin Liu
- Yuxiao Guo
- Liangjun Li
- Kan Wu
- Jianping Chen
- Linjie Zhou
- Shanghai Jiao Tong University, China
- Intelligent Optoelectronics, China

**W4H.3 • 17:15**
Extending the OCATA Digital Twin for Optical Connections Based on Digital Subcarrier Multiplexing
- Mariano Davile
- Diogo Goncalo Sequiera
- Marc Ruiz
- Nelson Cortes
- Carlos Castro
- Antonio Napoli
- Joao Pedro
- Luis Velasco
- Universidad Politecnica de Catalunya, Spain
- Infinita Unipessoal Ltd, Portugal
- Telefónica, Germany
- Instituto de Telecomunicaciones, Portugal

**W4I.3 • 17:15**
Single-End Crosstalk Measurement Method for Multi-Core Fibers Using Continuous Light Source
- Kei Yamaguchi
- Ayumi Inoue
- Takahiro Kikuchi
- Takoji Nagashima
- Hidesha Tazawa
- Tetsuya Hayashi

**W4J.3 • 17:15**
Single-End Crosstalk Measurement Method for Multi-Core Fibers Using Continuous Light Source
- Yuto Yamaguchi
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- Luis Velasco
- Universidad Politecnica de Catalunya, Spain
- Instituto de Telecomunicaciones, Portugal

**W4K.3 • 17:20**
Commercialising QRNGs—From Lab to Product
- Wenmiao Yu
- Quantum Dice, UK
- Quantum Random Number Generators are commonly researched in academia. Given their benefits for applications from encryption to simulations, why are QRNGs not more widely used? This talk discusses the challenges and potential within QRNG commercialisation.
Wednesday, 27 March

**W4A • THz Processing and Communications—Continued**

W4A.5 • 17:45 Invited

Broadband InGaAs MHEMT THz Transmitters and Receivers, John Laurenz, Fabian Thieme, Arndt Leuther, Axel Tesmann; †Fraunhofer IAF, Germany. We describe THz amplifier and front-end modules that have been developed based on an InGaAs metamorphic HEMT (mHEMT) technology for THz-wireless communication applications around 300 GHz, covering the frequency range between 270 and 330 GHz and enabling record output-power levels above 10 dBm. Furthermore, we report on the development of state-of-the-art distributed mHEMT circuits with absolute bandwidths in excess of 300 GHz as building block of next-generation ultra-broadband THz front ends.

**W4B • FSO for Turbulent and Underwater Channels—Continued**

W4B.6 • 17:45 Experimental Demonstration of Underwater Optical Ranging with Enhanced Accuracy Under Scattering Conditions Using Multiple Bessel Modes, Zile Jiang, Muralekshman Ramakrishnan, Huibin Zhou, Xinchu Su, Youxiang Duan, Hao Song, Ruoyu Zeng, Yingning Wang, Robert Book, Moshe Tur, Alan E. Willner; †Department of Electrical Engineering, Univ. of Southern California, USA; ‡R-Dex Systems, Inc., USA; §School of Electrical Engineering, Tel Aviv Univ., Israel. †Domestic Dept. of Physics & Astronomy, Univ. of Southern California, USA. We demonstrate a structured-beam-based underwater optical ranging system through scattering, and we utilize multiple (>2) Bessel modes for accuracy enhancement. The average error decreases from ~16 mm to ~3 mm when the number of modes increases from 2 to 8.

**W4C • Coding and Modulation—Continued**

W4C.6 • 17:45 Low-Complexity Non-Binary Forward Error Correction for Lattice-Based 4D Constellations, Sebastian Stern, Mahmoud Sallam, Robert F. Fischer; †Inst. of Communications Engineering, Ulm Univ., Germany. Low-complexity non-binary LDPC decoding is studied for a 512-ary lattice-based 4D Welti constellation. In an 800ZR scenario, more than 1 dB SNR gain is obtained over DP-16QAM and binary FEC at fixed symbol rate.

**W4D • Amplifier Architecture for Data Transmission—Continued**

W4D.6 • 17:45 Optimization of Iterative Chase Soft Decoder Based on Cross Entropy Minimization, Takahiro Suzuki, Yutaka Morikawa, Masayuki Tohyama, Shinya Sugiura; †NTT, Japan; ‡Univ. of Tokyo, Japan. We propose a scheme to optimize the parameters of iterative Chase decoder. Minimizing the cross entropy loss of the final stage Chase decoder output in the form of log-likelihood ratio improves turbo product code performance.

**W4E • Embracing Fiber Sensing: What’s the “Killer App” for Large-Scale Deployments? II—Continued**

W4E.4 • 18:00 Invited

Fiber Sensing Use Cases and Applications for an Electric Utility, Michael Morgan; †Exelon, USA. Abstract not available.

**W4F • Optical Architectures and Subsystems for Accelerating ML/AI Applications—Continued**

W4F.4 • 18:00

Assessment of an O-Band 4x4 InP Monolithic Photonic Switch at 100 Gbit/s PAM-4, Marin Rombouts, Aref Rasoulzadeh Zali, Stefanos Andreou, Luc Augustin, Nicola Calabretta; †Technische Universität Eindhoven, Netherlands; ‡Smart Photonics, Netherlands. We assess the performance of an O-band integrated optical 4x4 switch using the broadcast and select architecture with 100 Gbit/s PAM-4 signals. We measured a power penalty of <1 dB at the FEC-limit for multiple optical paths.

**W4F.5 • 17:45**

A Tale for Many: Integrated Control Mechanism of Optical Circuit Switching for Data Center and Distributed Deep Learning System, Cen Wang, Yuta Wakisawa, Noboru Yoshikane, Takehiro Tsutsumi; †KDDI Research, Japan. We propose an integrated control mechanism of optical circuit switching for both general data center traffic and deep distributed learning applications. Semi-physical evaluations show a relative throughput of 1.27 and a 6.18× speedup in a 256-block network constructed by MEMS-based optical switches.
through a 100-Gbps FSO experiment.

We propose a circularly-polarized system using a partial Stokes-vector receiver (SVR) that enables polarization rotation-independent coherent signal reception. The (SVR) that enables polarization rotation-independent coherent signal reception.

We demonstrate a 300-Gbit/s PAM8 modulation using a 55-GHz bandwidth silicon-microring modulator (SiMM) with a driving voltage of 1.8-Vpp. To achieve high-order PAM8 modulation, long-short-term memory (LSTM) and deep-neural-network (DNN) are used for regression and classification respectively.

We investigate the origin of large PMD variations shows how the agent uses a trained reinforcement learning agent. Our analysis over the three RMSA environment variations shows how the agent uses the input information, increasing our understanding of its learned policy.

We present a self-written waveguide approach for efficient optical interconnects in multi-core fiber systems. This cost-effective and flexible method enables enhanced coupling between two four-core fibers, achieving 0.47 dB coupling loss and -29.61 dB crosstalk.

We demonstrate a 300-Gbit/s PAM8 modulation using a 55-GHz bandwidth silicon-microring modulator (SiMM) with a driving voltage of 1.8-Vpp. To achieve high-order PAM8 modulation, long-short-term memory (LSTM) and deep-neural-network (DNN) are used for regression and classification respectively.
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07:30–08:00 Coffee Break, Upper Level Corridors

08:00–10:00
Th1A • Programmable Circuits/Switches and Control Technologies
Presider: Keita Yamaguchi; NTT Corporation, Japan

Th1A.1 • 08:00
NEO-PGA: Nonvolatile Electro-Optically Programmable Gate Array, Arka Majumdar, Univ. of Washington, USA. In this talk, I will discuss different phase change materials that can be used in conjunction with silicon and silicon nitride photonics, to create reconfigurable optical switches for visible and infrared wavelengths.

08:00–10:00
Th1B • Datacom: VCSELs, Multi-Lambda Sources, Spatial Multiplexing
Presider: Thomas Greer; NVIDIA, USA

Th1B.1 • 08:00
Multi-Wavelength Sources for in Package Optics, Matthew N. Syvás, Radek Roucka, Raval Maran, Nandita Aggarwal, Chen Li, Fernando Luna, Sally El-Henawy, Frey John, Ken Wang, Li-fan Yang, Mark Wade, Chen Sun; Ayar Labs, USA. Ayar Labs 8 wavelength, 64 carrier, CW-WDM MSA compliant SuperNova optical source is presented supporting >8 Tbps from a CMOS die.

08:00–10:00
Th1C • Wireless and Access Quantum Networks
Presider: Rui Wang; University of Bristol, UK

Th1C.1 • 08:00
High-Rate Quantum Access Network Using Coherent States, Yan Pan, Tingting Bian, Li Ma, Heng Wang, Jiai Dou, Yun Shaol, Yasdi Pi, Ting Ye, Jie Yang, Yang Li, Wei Huang, Song Yu, Yicheng Zhang; Bingjie Xu; Science and Technology on Communication Security Laboratory, Inst. of Southwestern Communication, China; State Key Laboratory of Information Photonics and Optical Communications, School of Electronic Engineering, China. A quantum access network with Mbps level key rate and simple structure compatible with classical network facilities is reported, where the average secret key rate per user can reach 4.24 Mbps at 30 km.

08:00–10:00
Th1D • Integrated Nonlinear-Optical Devices and Amplifiers
Presider: Vladimir Gordienko; Aston Univ., UK

Th1D.1 • 08:00
Invited
Erbium-Doped Si$_3$N$_4$ Photonic Integrated Circuits and Wafer-Scale Fabrication to Include our Recent Progress, Yang Liu; ‘Ecole Polytechnique Federale de Lausanne, Switzerland. We present the recent progress on Erbium-doped Si$_3$N$_4$ photonic integrated circuits-based devices including high-power amplifiers and hertz-line-width lasers, and the fabrication via wafer-scale processes.

08:00–10:00
Th1E • Advanced PON Technology
Presider: Jim Zou; Adtran, Germany

Th1E.1 • 08:00
400 Gbit/s Dual-Wavelength and Dual-Polarization IM-DD TDM-PON with 34 dB Power Budget, Dana van Veen; Robert Borkowski; Koeninavan Vijayan; Amikumar Mahadevan; Vincent Houtsma; Nokia Corporation, USA. We demonstrate a 400G dual-wavelength dual-polarization IM-DD TDM-PON based on optical diubinary modulation with 34 dB back-to-back optical power budget. After 20 km of SSMF we find an optical path penalty below 1 dB.

08:00–10:00
Th1F • Optical Methods and Sensing
Presider: Bill Corcoran; Monash University, Australia

Th1F.1 • 08:00
Top-Scored
Free-Space Optical Receiver with Real-Time Self-Configuration Using a Fully Integrated CMOS Controller, Emanuele Sacchi; Alessandro Andronico; SeyedMohammad SeyediNavaeh; Francesco Zanetti; Andrea Malloni; Marco Sampietro; Giorgio Ferrai; Politecnico di Milano, Italy. We present a CMOS chip for closed-loop control of integrated photonic processors, able to configure 8 interferometers in 20ms while consuming 80mW. The chip autonomously mitigates the effect of atmospheric turbulence in free-space receivers.

08:00–10:15
Th1A • Programmable Circuits/Switches and Control Technologies

Th1A.2 • 08:15
The Opportunities and Challenges of Euro-QCI, Felix Wissel; Deutsche Telekom AG Laboratories, Germany. EuroQCI, the European Quantum Communication Infrastructure, is one of the most ambitious security initiatives in Europe. We will present the current status and discuss challenges and opportunities.
Thursday, 28 March
OFC 2024 •  24–28 March 2024
Show Floor  
Programming
Room 6F Room 7 Room 8Room 6E

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

08:00–10:00  Th1G • Open Line Systems and Digital Twins
Presider: Shikui Shen; China Unicom, China

Th1G.1 • 08:00 Characterizing Fiber Nonlinearity with Deployed Equipment in Optical Line Systems, Yinqing Pei1, Alex W. MacKay2, Mehrnoosh Boroojerdi3, Jean-Luc Archambault1, David W. Boetjes1; 1Ciena, Canada. We introduce the first measurement procedure to characterize fiber nonlinear parameters of all fibers in an optical network using widely deployed network equipment which does not rely on modem measurements or external instrumentation.

Th1G.2 • 08:15 All-Optical GOSNR Estimation on an Open Line System Using Polarization-Resolved Optical Spectrum Analysis, Gang He1, Steven Searcy2, Sorn Tsubokaze1; 1EXFO Inc, Canada; 2Adtran, USA. We introduce an all-optical method for estimating linear and nonlinear noise using an unmodulated laser source and varied state of polarization optical spectrum analyzer, then experimentally validate the technique against the conventional transceiver-based GOSNR approach.

08:00–10:00  Th1H • MMF Based Transmission
Presider: Lidia Galdino; Corning Inc., UK

Th1H.1 • 08:00 5.27 Peta-bit/s Weakly-Coupled SDM-WDM Transmission Over 55-km 10-Mode 7-Core Fiber for SDM-Priority Scheme, Gang Gao1,2, Yu Yang1, Honglin Ji1, Yiyang Gao1, Mingjing Zhu1, Chengbin Long1, Jianu Zhang1, Jinyi Yu1, Zhaoqing Xu1, Shangzheng Wang1, Lulu Liu1, Qi Wu1, Lei Shen1; 1Beijing Univ., China; 2OFDC, China. We propose an SDM-priority SDM-WDM transmission scheme with simplified optical transceiver structure, for which a record throughput of 5.27 peta-bit/s transmission over 55-km weakly-coupled 10-mode 7-core fiber is experimentally demonstrated with up to 4×4 MIMO-DSP.

Th1H.2 • 08:15 102-Tbit/s C-Band WDM-MDM-PDM Transmission Over 1000-km FMF Enabled by Advanced Block-Wise MIMO-FD-DFE, Chen Wang1, Bohan Sang1, Kailui Wang1, Junjie Ding1, Wen Zhou1, Xianming Zhao1, Bing He1, Weihang Chen1, Xiangjun Xie1, Bo Li1, Lei Shen1, Jianjun Yu2, Fudan Univ., China; 2Harbin Inst. of Technology, China; 3ZTE corporation, China; 4Yangtze Optical Fiber and Cable, China; 5Beijing Univ. of Posts and Telecommunications, China. A high-performance block-wise MIMO-FD-DFE is proposed and experimentally verified in an 80-channel MDM system at the C-band for ISI compensation, which extends the transmission distance by over 33.33% at 20% SD-FEC threshold.

08:00–10:00  Th1I • Next Generation ROADMs, Multiband and SDM Networking
Presider: Jesse Simsarian; Nokia Bell Labs, USA

Th1I.1 • 08:00 Invited Enabling Technologies for Scalable ROADMs, Peter Roorda1, Brian Smith1, Paul Colbourne1, Sheldon McLaughlin1, Martin Matthews1; 1Lumentum Operations LLC, Canada. Continued ROADM capacity scaling will require WSS devices in quad and octal configurations, with higher port counts, that operate across wider bands (C and L). Introduction of hybrid fiber/wavelength switching architectures for multi-rail will follow.

Th1I.2 • 08:15 Invited O-Band Coherent Links for Intra-Data Center Applications, Aaron Maharry1; 1Lucidean, Inc., USA. We present recent advances in O-band coherent links for intra-data center applications. Offloading functions traditionally performed by coherent digital signal processing (DSP) into the optical domain is the path to low-power and low-cost coherent links.

08:00–10:00  Th1J • Short-Reach Transmission Systems
Presider: Ming-Fang Huang; NEC Laboratory America Inc., USA

Th1J.1 • 08:00 Invited O-Band Coherent Links for Intra-Data Center Applications, Aaron Maharry1; 1Lucidean, Inc., USA. We present recent advances in O-band coherent links for intra-data center applications. Offloading functions traditionally performed by coherent digital signal processing (DSP) into the optical domain is the path to low-power and low-cost coherent links.
We propose and demonstrate the optical inversion process using a silicon photonic interferometer mesh in a feedback loop, without any optical-to-electronic conversions inside the inversion process.
A Joint Mode Permutation Architecture for 10-Mode-Multiplexed Long-Haul Transmissions, Xoaohuan Liu1, Wang Yanzhi2, Qushi Huang2, Dechao Zhang2, Xutao Wang2, Qiang Guo2, Zhiqiang Yang2, Yaping Liu2, Rui Zhou2, Wei Sun2, Mingqiang Zhu2, Min Yan2, Zherhua Liu3, Xiangyu Zhang2, Zhanhua Huang2, Dong Wang2, Xinrui Xiao2, Lim Zhang4, Jiangsu Alpha Optic-electric Technology Co., Ltd., China; 2Department of Fundamental Network Technology, China Mobile Research Inst., China; 3B&P Laboratory, Huawei Technologies Co., Ltd., China; 4Peng Cheng Laboratory, China; 5Key Laboratory of Opto-electronics Technologies and Devices, School of Precision Instruments and Opto-electronics Engineering, Tianjin Univ., China. We propose a joint mode permutation architecture for 10-mode transmission. Compared with cyclic mode-group permutation, the required equalizer window is further reduced by 30.7%, while the transmission reach is extended to 2000 km.

Throughput Increase in Multi-Fiber Networks Using Partial Lane-Change Capabilities, Oleg Karandrin1, Francesco Musumeci1, Yvan Pointurier2, Massimo Tomatore1, Politecnico di Milano, Italy; 2Huawei Technologies, Paris Research Center, France. Effective application of lane change in multi-fiber (MF) networks is hindered by limitations in WSS-size in ROADMs. We present a simple LLR-calculation method which modifies the LLR distribution using hard-decision equalizer with an adaptive removal of intensity fluctuations, MPI tolerance is increased by 2 and 10 dB, respectively.

A study of multipath-interference reduction techniques for 56Gbd and 92Gbd PAM-4. By extending the equalizer and with an adaptive removal of intensity fluctuations, MPI tolerance is increased by 2 and 10 dB, respectively.

An experimental study of multipath-interference reduction techniques for 56Gbd and 92Gbd PAM-4. By extending the equalizer and with an adaptive removal of intensity fluctuations, MPI tolerance is increased by 2 and 10 dB, respectively.

MIMO-LMS achieves 25% reach improvement compared to traditional MIMO-LMS.
Room 1A  •  Programmable Circuits/Switches and Control Technologies—Continued

**Th1A.4 • 09:00**
Reinforced Q-Learning Enabled Automatic Blind Working Wavelength Alignment Against Wide Input-Wavelength Shifts and Temperature Variations for Silicon Photonic Vernier Filter Rings, Guangwei Cong1, Ryo Tanaka2, Kajiro Suzuki1, Noritsugu Yamamoto1, T. K. Y. Liu2, Yuki Maegami1, Moritomi Ohno1, Kazuhiro Ikeda1, Shu Namiki1, Koji Yamada1, AIST (Natl Inst of Adv Indus Sci&Tech), Japan. We experimentally demonstrate long-time (~10 hours) continuous full-C-band automatic working wavelength alignment for silicon photonic cascaded-ring vernier filters against wide input-wavelength and temperature changes using reinforced Q-learning method, without pre-building look-up table and temperature monitor.

**Th1A.5 • 09:15**
A Scalable, High-Speed Optical Rotary Switch, Max Mellette1, Ilya Agurev1, Alex Forencich1, Spencer Chang2, George Papagiannis3, Joseph Ford1,1v, Focus Networks, USA,1UC San Diego, USA. Rotary optical switching enables low-loss microsecond-scale reconfiguration between pre-programmed interconnects with thousands of ports, supporting high-bandwidth and low-latency Rotated datacenter architectures. We describe a 7 µs 128 x 128 port rotary switch with 4-dB fiber-to-fiber insertion loss and a 1-dB spectral bandwidth of 120 nm.

Room 1B  •  Datacom: VCSELs, Multi-Lambda Sources, Spatial Multiplexing—Continued

**Th1B.4 • 09:00**
Invited
Multimode Links Based on High-Speed VCSELs for Cost-Effective Data Center Connectivity, Yipul Bhat1, Coherent Corp, USA. Low cost and low power consumption of multimode links are the result of a design effort to optimize specifications for short reach applications. We will review 800G link budget, 3.2T MCPO, and 1:1 spacing.

**Th1B.5 • 09:15**
Co-Propagation of Classical and Continuous-Variable QKD Signals Over a Turbulent Optical Channel—With a Real-Time QKD Receiver, João R Frazão1,2, Vincent van Velthoven1,2, Menno van Hoult1,2, Aaron Mejia1,2, Tom Bradley1, Chigo M. Okonkwo1,2, High-capacity Optical Transmission Laboratory, Univ. of Technology Eindhoven, Netherlands;1CLiQ Technologies, Netherlands. We demonstrate classical and quantum signal co-propagation over a turbulent free-space optical channel with 3–910⁻³ throughput and record 2.7 Mbit/s secret-key rate. Our real-time GPU-based receiver assessed quantum signal integrity under different turbulence scenarios for the first time.

Room 2  •  Wireless and Access Quantum Networks—Continued

**Th1C.4 • 09:00**
Adaptive Recombination for Experimental Continuous-Variable Quantum Key Distribution Over a Turbulent Free-Space Optical Channel, Kadir Gurus1, João R Frazão1,2, Vincent van Velthoven1,2, Menno van Hoult1,2, Aaron Mejia1,2, Tom Bradley1, Chigo M. Okonkwo1,2, High-capacity Optical Transmission Laboratory, Univ. of Technology Eindhoven, Netherlands;1CLiQ Technologies, Netherlands. We experimentally demonstrate adaptive recombination for continuous-variable quantum key distribution over a turbulent free-space optical channel. Additionally, we propose a method for optimising the recombination efficiency, increasing secret key rates by up to 8.1%.

Room 3  •  Integrated Nonlinear-Optical Devices and Amplifiers—Continued

**Th1D.4 • 09:00**
Top-Scored
Integrated Optical Parametric Amplifier with Record Gain, Junjie Xiao1, Xi Xie1, Junqing Liu1,2, Zhen Sun1,2, Sun Yest 1 Un., China. We report an innovative phase-sensitive optical amplification using GeSiS microresonators, obtaining 31.5 dB gain with 8.5 mW CW-pump power in phase-insensitive mode, a 4.95 dB additional gain and 18.9 dB extinction ratio in phase-sensitive mode.

Room 6C  •  Advanced PON Technology—Continued

**Th1E.4 • 09:00**
1.024-Tbit/s C-SDM Coherent PON Over 10-km Weakly-Coupled MCF, Luxiao Zhang1, Lin Sun2, Rendong Xu1, Junjie Xiong1, Lin Ma1, Bin Chen1, Jun Li1, Yi Cai1, Gangxiang Shen1, Gordon Ning Liu1,2, So aorhaw Univ, China; Zhejiang Univ, China;1Shanghai Jiao Tong Univ, China;2Heifei Univ of Technology, China. 1.024-Tbit/s C-SDM coherent PON is experimentally demonstrated based on weakly-coupled MCFs and Walsh code assignment. Space-time coding is utilized for balancing the inconsistency of the reception performances of CDM-assigned ONUs.

Room 6D  •  Optical Methods and Sensing—Continued

**Th1F.4 • 09:00**
Cryptographic Key Generation Using Conventional Single-Mode Fiber and an Optical Time Domain Reflectometer, Yuto Sagae1, Atsushi Nakamura1, Takayoshiishi1, Yuzuru Nakajima1, NTT Japan. Generation of cryptographic key is demonstrated by conventional equipment for an optical network. Random bit sequences obtained from an optical time domain reflectometry of a single-mode fiber satisfies a quality of randomness as cryptographic keys.

**Th1F.5 • 09:15**
Demonstration of on-Chip Optical Frequency Comb Generation and Optical Injection Locking, Ellutikes Andrianopoulos1, NikoLaos K. Lytras1, Tianwen Qian2, Milan Deumer3, Georgios Megias1, Gartt Schwanke1, Durkasa Gugat1, Paras Gourares1, Zherun Tegegne3, Ben Schuler4, Muhsan Ali5, Bradley Snyder5, Simon Nellen6, Cristo Takos2, David De Felipe2, Maria Massaouti3, Guillermo Carpintero5, Mahadevan1, Pat Iannone1, Dora van Veen1,5Universidad Carlos III de Madrid, Spain. We experimentally demonstrate for the first time a photonic integrated circuit comprising an optical frequency comb generation unit and an optical injection locking unit, as part of a fully packaged photonic wireless sub-THz receiver module.
Th1G • Open Line Systems and Digital Twins—Continued

Th1G.4 • 09:00
GPT-Enabled Digital Twin Assistant for Multi-Task Cooperative Management in Autonomous Optical Network, Yao Zhang1, Min Zhang1, Yuchen Song1, Xiaotian Jiang1, Yidi Wang1, Shikui Shen2, Danshi Wang1, Beijing Univ. of Posts and Telecommunications, China; 1China Unicom Research Inst., China. A GPT-enabled digital twin (DT) assistant is implemented with the capabilities of intention understanding, analysis, reasoning, and complex multi-task collaboration, which integrate DT technologies to enhance the automated operation, monitoring, control, and upgrade of optical networks.

Th1G.5 • 09:15
Auto-DTWave: Digital Twin-Aided Autonomous Optical Network Operation with Continuous Wavelength Loading, Xiaomin Liu1, Qizhi Qiu1, Yihao Zhang1, Meng Ca1, Yichen Liu1, Lilin Yi1, Weisheng Hu1, Qunbi Zhuge1, Shanghai Jiao Tong Univ., China. We develop joint online digital twin (DT) construction and amplifier configuration with continuous wavelength loading in a commercial testbed. The DT achieves an RMSE of 0.37dB, assisting near-optimal amplifier configuration with <0.1dB average Q-factor deviation.

Th1H • MMF Based Transmission—Continued

Th1H.5 • 09:00
Mechanism and First Experimental Demonstration of ILMD-Induced Reduction of Intramodal Cross-Phase Modulation in Weakly-Coupled PMF Transmission, Mingqing Zuo1, Gang Qiao2,3, Yu Yang1, Chengbin Long2, Dawei Ge4, Dong Wang5, Yunbo Li5, Zhangyuan Chen6, Dechao Zhang7, Han Li7, Juhao Li7, China Mobile Research Inst., China; 1Peking Univ., China; 2Peng Cheng Laboratory, China. We for the first time experimentally analyze the interaction between intramodal XPM and ILMD effects in weakly-coupled PMF, and prove that the ILMD could be a major factor for effectively reducing the intramodal XPM impairments.

Th1H.6 • 09:15
Effect of Modal Dispersion on the Nonlinear Interference Noise in SDM Transmissions, Chiara Lasagni1, Paolo Serena1, Alberto Boroni1, Antonio Mecozzi1, Cristian Antonelli2, Università degli studi di Parma, Italy; 1Università degli studi dell’Aquila, Italy. We review the effects of spatial mode dispersion and differential mode group delay on the nonlinear interference noise in space-division multiplexed systems based on few-mode fibers with weak linear coupling between mode groups.

Th1I • Next Generation ROADMs, Multiband and SDM Networking—Continued

Th1I.4 • 09:00 Invited
Control of Packet Over Multi-Granular Optical Networks Combining Wavelength, Waveband and Spatial Switching for 6G Transport, Raul Munoz1, Varsha Lohani1, Ramon Casellas1, Ricardo Martinez1, Richard Vilalta1, CICTC, Spain. This paper presents an end-to-end transport SDN control system for packet (IP) and multi-granular (WDM/WBDM/SDM) optical networks for 6G transport. The dynamic routing and resource assignment combining wavelength, waveband, and spatial resources is also addressed.

Th1J • Short-Reach Transmission Systems—Continued

Th1J.4 • 09:00
Adaptive and DSP-Compatible Optical Multipath Interference Mitigation Scheme for 60Gbps PAM8-CRAN, Rui Xue1, Di Che1, Xi Chen1, Huazhong Univ. of Science and Tech, China. We propose an adaptive DSP-compatible time-varying multipath interference noise mitigation algorithm based on probability distribution over 15.5km SSMF at 56/60Gbps PAM4/8. The signal-to-interference ratio tolerance improvement of 3dB PAM8 shows its potentiality for high-order PAM.

Th1J.5 • 09:15
An Optimization Method for Probabilistic Constellation Shaping in Peak-Power Constraint Systems in the Presence of Peak Enhancement Effects, Basak Ozaydin1, Di Che1, Xi Chen1, Nokia Bell Labs, USA. We propose a generic method to optimize the probabilistic distributions for a peak-power constraint system with arbitrary peak enhancement effects. The technique is useful for developing flexible-rate optical transceivers in links without optical amplifiers.
Low-Crosstalk 8×8 Silicon Photonic Switch Fabric with Dual-Stage MZI Cells, Peng Bao1, Chunhui Yao1, Giuseppe Talli2, Maxim Kuschnerov3, Richard V. Fenty4, Qixiang Cheng1; 1Univ. of Cambridge, UK; 2Huawei Technologies Duesseldolf GmbH, Germany. We demonstrate a strictly non-blocking 8×8 silicon photonic switch fabric with centrally placed dual-stage MZI cells that effectively suppress first-order crosstalk. This thermally actuated device exhibits on-chip loss of <5dB and low-crosstalk of <-40dB.

Room 1A • Programmable Circuits/Switches and Control Technologies—Continued

Room 1B • Datacom: VCSELs, Multi-Lambda Sources, Spatial Multiplexing—Continued

Room 2 • Wireless and Access Quantum Networks—Continued

Room 3 • Integrated Nonlinear-Optical Devices and Amplifiers—Continued

Room 6C • Advanced PON Technology—Continued

Room 6D • Optical Methods and Sensing—Continued
The Evolution of Open and Disaggregated Optical Networks: From Open Line System to Open Box System, Sai Chen1, Weitang Zheng1, Liang Dou1, Huan Zhang1, Zhao Sun1, Lei Wang1, Fan Gao1, Boyuan Yan1, Zha Z. Qun1, Chongxin Xie1; Alibaba Cloud, China. Optical networks have been evolving from proprietary and close systems to open line systems, and further to open box systems. Technologies that enabled the evolution are reviewed and discussed.

For the first time, we demonstrate a 10-mode transmission over 2320 km at 15-Gbaud, greatly extending the record reach by 1000 km. We develop and experimentally verify the rules for identifying superior mode-permutation strategies.

We compare the potential of four multi-band transmission systems leveraging optimized Raman amplification. Simulation results highlight that complementing a SuperC+L-band system with the S-band outperforms using the E-band or interleaving data-channels and Raman pumps.

We verify that frequency-resolved SNR is crucial to approach the capacity of a discrete-multitone system with entropy loading (EL), and propose several methods to reduce the complexity of EL while keeping the SNR information to minimize the rate penalty.

We show that solving interrelated inverse differential equations can address pre-tilt power optimization, resulting in a few-second-computed optimal power for each span and boosting average channel generalized signal-to-the-noise ratio (GSNR) by up to 0.5 dB.

10:00–16:00 Exhibition and Show Floor Programs, Exhibit Hall

10:00–15:45 Career Zone, Exhibit Hall B1

10:30–12:30 Th2A • Posters Session III, In-Person, Exhibit Hall B1

Lunch Break (on own; concessions available in Exhibit Hall)
This page contains information related to OFC 2024, a conference or technical event. The text is a mix of titles, authors, and abstracts, likely related to topics such as optical fiber technology, networking, and quantum key distribution. The page appears to be part of a program or proceedings document, and the content is technical in nature.
Demonstrate a room-temperature LWIR FSO link with 1K Gb/s Single-Channel LWIR Data Transmission. We use the transmitter constellation closure (TCC) for accurate quality assessment beyond 400G coherent transmitters, and show its tolerance to inter-symbol interference and phase noise with and without probability constellation shaping (PCS).

Sub-1 dB Loss SiN-to-Polywaveguide Coupling: an Enabler for Co-Packed Optics, Jef Van Ash, Jeroen Missinne, Junwen He, Pengfei Xu, Amita Podguy, Gou Lepage, Negin Gohari, Rafal Magdab, Huseyn Sar, Hakim Kabbiri, Swetanshu Bispu, Dieter Bode, Yoojin Ban, Filippo Ferraro, Jo-ri Van Campenhout, Geert Van Steenberge, Ghent Univ., Belgium; Optical IO, imec, Belgium. We report the design, fabrication and characterization of a broadband silicon nitride to polymer waveguide adiabatic coupling interface with sub-1 dB loss around 1310 nm, enabling a sub-2 dB chip-to-chip and chip-to-fiber coupling loss.

Performance Evaluation and Optimization of LDPC FEC for 100 Gbps Coherent Passive Optical Networks, Qun Zhang, Haipeng Zhang, Shengyu Fang, Shuyue Zhang, Xingyi Jiang, KDDI, Japan. We experimentally demonstrate a compact silicon-based photonic phase-tunable IF signal generator, meeting the 3GPP error vector magnitude (EVM) and achieving 6 dB optical signal-to-noise ratio gain.

Capacity Optimization Strategies in an Unrepeated System, Hans Bissessur, Alexis Busson, Daryna Kravchenko, Fabien Boitier, Petros Ramantanis, Ghaya Rekaya, Joana Girard-Jollet, Jean-Christophe Antona, Alexis Carbo Meseguer, IMT Atlantique, France. We investigate highly dispersed QPSK signals, observing good agreement with the eGm model.

Reduced-Complexity Frequency Interleaved DAC for High-Speed Optical Communications, Juan I. Bonetti, Mario Hueda, Fundacion Fulgor, Argentina; Digital Communications Research Laboratory, FCCEyF, UNIC, Argentina. We propose a new architecture of frequency-interleaved DACs for the all-electronic generation of high-bandwidth signals. We demonstrate significant robustness in both DSP complexity and PAIM, along with a simplified analog circuit design.

Estimation of Energy Storage Status in Power Supply System Using Power Over Fiber for Outdoor Environment, Tomohiro Kawanou, Ryo Koyama, Akihiro Kurosawa, Takui Uematsu, Chisato Fukui, Hiroyuki Watanabe, Ikuzo Oguchi, NT Corporation, Japan. We demonstrate that our model for estimating power charging regimes of the power supply system combining Power over Fiber and an energy storage is very accurate as it accounts for the temperature dependence.

Neural Network Model of a Second Stage L-Band Amplifier Using Experimental Training Sets, Hamed Rabbanii, Kaboko Jean-Jacques Monga, Sophie La Rochelle, Leslie Rusch, Laval Univ., Canada. Using experimental measurements with high-power input signals, we train a neural network model of the second stage of an L-band amplifier with the model, we jointly optimize amplifier gain and noise figure (alternatively gain flatness).

Integrated Coherent Optical Fiber Communication System with Discrete-Time Analog Transmission, Hengyu Huang, Yu Zheng, Ming Chen, Wei Zhang, Yue Guo, Kun Xu, Beijing Univ. of Posts & Telecomm., China. We propose and experimentally demonstrate an integrated coherent optical fiber communication system based on discrete-time analog transmission (DTAT-IDCF). The experimental results indicate that DTAT-IDCF exhibits better performance and achieves 6 dB optical signal-to-noise ratio gain.

Integrated Coherent Optical Fiber Communication System with Discrete-Time Analog Transmission, Hengyu Huang, Yu Zheng, Ming Chen, Wei Zhang, Yue Guo, Kun Xu, Beijing Univ. of Posts & Telecomm., China. We propose and experimentally demonstrate an integrated coherent optical fiber communication system based on discrete-time analog transmission (DTAT-IDCF). The experimental results indicate that DTAT-IDCF exhibits better performance and achieves 6 dB optical signal-to-noise ratio gain.
Room 1B
14:00–16:00
ThB 1 • Practical Security Demonstration
Presider: Andrew Lord; BT, UK

ThB 1 • 14:00
Secure FSO Transmission with Quantum Deliberate Signal Randomization Using All Optical Technology
Fog Conditions, Fumio Futami, Ken Tanazawa, Kentaro Kato, Yuichiro Harra, Michikazu Hattori, Abdelmoulla Bekkali, Yukihiko Sugai, Tamagawa Univ., Japan; TCTO Electric Corporation, Japan. Security-enhanced 10Gbit/s DP PSK Y-00 cipher transmission is demonstrated with deliberate signal randomization driven by quantum random number generator in free space in dense fog. High security and transmission performance are achieved over the entire transmission system.

Room 2
14:00–16:00
Th2C 1 • 14:00
Free Space Communication Enabled by Directly Modulated Quantum Cascade Laser, Xiaodan Fang, Richard Schatz, Mahdieh Johanjani, Hanza Deli, Laureline Durupt, Gregory Mason, Djamel Gacem, Rafael Fuerta, Thomas Bonazzi, Lu Zhang, Sansa Spolitis, Yan-ting Sun, Vajaceslav Babrov, Xiaomin Yuan, Angela Vasenell, Carlo Sirton, Osaki Ozolins, Kungliga Tekniska Hogskolan, Sweden; Inst. of Telecommunications, Riga Technical Univ., Latvia; Laboratoire de Physique de l’ENS, Département de Physique, École Normale Supérieure, Université PSL, Sorbonne Université, Université Paris Cité, CNRS, France. ‘Kinesis Research, Ericsson, Sweden; College of Information Science and Electrical Engineering, Zhejiang Univ., China; Zhejiang Lab, China; RISE Research Inst. of Sweden AB, Sweden. We summarize our recent experimental studies of free-space communications enabled by directly modulated quantum cascade lasers at both MWIR and LWIR regions. Different detector types with various characteristics are compared.

Th2C 2 • 14:15
Experimental Demonstration of an Efficient Correlation Attack Method in 300km QAM/QNSC Transmission, Minhua Zhang, Tzyy Li, Kongming Zhu, Shuang Wei, Yang Li, Zhao Yongli, Jie Zhang, Beijing Univ. of Posts and Telecomm., China. We propose an efficient correlation attack based on low-order modulation to recover the seeds keys in QNSC. Experiment results prove its high success possibility and low computational complexity in 300km QAM QNSC transmission.

Room 3
14:00–16:00
Th3C 1 • 14:00
Free Space Communication Enabled by Directly Modulated Quantum Cascade Laser, Xiaodan Fang, Richard Schatz, Mahdieh Johanjani, Hanza Deli, Laureline Durupt, Gregory Mason, Djamel Gacem, Rafael Fuerta, Thomas Bonazzi, Lu Zhang, Sansa Spolitis, Yan-ting Sun, Vajaceslav Babrov, Xiaomin Yuan, Angela Vasenell, Carlo Sirton, Osaki Ozolins, Kungliga Tekniska Hogskolan, Sweden; Inst. of Telecommunications, Riga Technical Univ., Latvia; Laboratoire de Physique de l’ENS, Département de Physique, École Normale Supérieure, Université PSL, Sorbonne Université, Université Paris Cité, CNRS, France. ‘Kinesis Research, Ericsson, Sweden; College of Information Science and Electrical Engineering, Zhejiang Univ., China; Zhejiang Lab, China; RISE Research Inst. of Sweden AB, Sweden. We summarize our recent experimental studies of free-space communications enabled by directly modulated quantum cascade lasers at both MWIR and LWIR regions. Different detector types with various characteristics are compared.

Th3C 2 • 14:30
Large-Core Optics for Simplified Short-Range FSO Links, Florian Honol, Bernhard Schrenk, AIT, Austria. We evaluate large-core FSO links where excellent coupling pairs with bandwidth fading due to multi-mode propagation. The 10-Gb/s link is set for 100-μm double-clad fibers is mitigated by spectral launch tuning, resulting 84% of single-clad 25-Gb/s link capacity.

Th3C 3 • 14:40
Hybrid Photonic Integrated Circuits for Quantum Communications, Moritz Kleiner, Martin Kresse, Sarah Simon, Maximilian Ott, Jairod Reck, Clausper Keuler, Lara Mihov, Madeleine Wiegels, Tianwen Qian, Philipp Winkler, David De Felipe, Cristian Zorawski, Norbert Keil, Martin Schell, ‘Photonics Components, Fraunhofer Heinrich Hertz Inst., Germany. Hybrid photonic integration is promising for the miniaturization of quantum communication setups. We discuss current integration approaches and present hybrid PICs for the generation of polarization-based quantum states and photon pairs in the PolyBoard platform.

Room 4C
14:00–16:00
Th4E 1 • 14:00
Top-Scored Transformation Using All Optical Technology, Pham Tien Dat, Kuya Yamaguchi, Shingo Takano, Shatoro Hirata, Junichiro Ichikawa, Ryo Shimizu, Keizo Inagaki, Iao Mochihashi, Yuki Yoshida, Atsush Kanno, Naokatsu Yamamoto, Kosuchi Akahane, ‘NIC T Network System Research Inst., Japan; Suntimoto Osaka Cement Co., Ltd., Japan. A direct reception of a sub-THz signal and its conversion to the microwave band is demonstrated using an all-optical receiver and photonic downconversion technology. An 80-Gb/s OFDM signal was transmitted over a converged fiber-sub-THz fiber system at 151.5 GHz.

Th4E 2 • 14:15
40-GHz Bandwidth Envelope Detector Used in 0.3-THz IM/DD System for 4096-QAM DMS Signal Transmission, Kiyoko Long, Jingwen Tan, Jiangyun Yu, Xuejun Liu, Xiongwei Yang, Yi Wei, Kahi Wang, Wen Zhou, Xiongming Zhao, Junye Ding, Jiao Zhang, Min Zhu, Jianguo Yu, Feng Zhao, Fudan Univ., China; ‘Purple Mountain Laboratories, China; X’ian Univ. of Posts and Telecommunications, China; Beijing Univ. of Posts and Telecommunications, China; China Nabil Inst. of Technology, China. We experimentally demonstrate a photodiodes-aided THz IM/DD transmission system using a large-bandwidth envelope detector and delta-sigma reference. The proposed system can support 4096-QAM DMS modulation and simple and low-cost receiver architecture.

Th4E 3 • 14:30
Optical Frequency Division on SiN-Based Platform for Low-Noise MmWave Generation, Sungwook Suh, Shunan Sun, Bei Chen, Weng Wang, Kaikai Liu, Jiawei Wang, Wuxuan Liu, Mandana Jahanbogri, Zijiao Yang, Paul Morton, Karl Nelson, Daniel Blumenthal, Yu Yi, ‘Department of Electrical and Computer Engineering, Uni. of Virginia, USA; ‘Department of Electrical and Computer Engineering, Uni. of California Santa Barbara, USA; ‘Department of Physics, Uni. of Virginia, USA; ‘Morton Photonics, USA; ‘Honeywell International, USA. We demonstrate integrated optical frequency division using SiN-based reference cavity and micromach, achieving a 36 dB phase noise reduction with 100 GHz carrier frequency, phase noise reaches -115 dBc/Hz at 10 kHz offset.
### Room 6E

**14:00 – 16:00**

**Th3G • Optical Computing and Accelerators**

Presider: Nikos Pleros; Aristoteleio Panepistimio Thessalonikis, Greece

**Th3G.1 • 14:00**

A TeraFLOP Photonic Matrix Multiplier Using Time-Space-Wavelength Multiplexed AWGR-Based Architectures, Christos Pappas1, Theodoros Mouschos1, Mitkadis Moralis-Pegios1, George Giamougiannis1, Apostolos Tsalynidis1, Manos Kirtas1, Nikolaos Pasalidis1, Anastasios Tefas1, Nikos Pleros1; Aristotle Univ. of Thessaloniki, Greece. We demonstrate experimentally a novel 8×8 AWGR-based photonic matrix multiplier that enables simultaneously time-, wavelength- and space-division multiplexed computing with a computational power of 1.28 TeraFLOP.

**Th3G.2 • 14:15**

Multi-Transverse Mode Multiply-and-Accumulate Operation Toward Advancement of Photonic Accelerators, Seyed Mohammad Raza Salee Ardestani1, Kaveh Hasan Rabbardar Mogaver1; Odile Liboren-Ladouceur1, McGill Univ, Canada. We demonstrate a novel mode-division-multiplexing subsystem achieving four output power levels using two single-bit rings on two TE modes for photonic accelerators. The photodetector combines the energy of two TE modes without requiring coherent summation.

**Th3G.3 • 14:30**

Optical Computing and Linear Optics, Dirk R. Engebretson2; Massachusetts Inst. of Technology, USA. Abstract not available.

### Room 6F

**14:00 – 16:00**

**Th3H • Photonics Manufacturing Technologies**

Presider: Sagi Mathai; Hewlett Packard Labs, USA

**Th3H.1 • 14:00**

Progress Towards Low Loss Waveguides in Si/ SiN Integrated Photonics Platforms, Nicholas Fahringer1,2, Sisi K. Bini1,2, Cung Tran1,2, Yukta Timalinsa1, Lewis G. Carpenter1,2, Michael Zynda1, Hao Yang1, Christopher Baocchi1,2, Gerald Leake1,2, Christopher V. Poulton1,2, David Harame1,2; Research Foundation for The State Univ. of New York, USA; AIM Photonics, USA; Analog Photonics, USA. We present low-loss waveguide development on an active silicon photonics platform. Supported by AIM Photonics, the APSUNY component library provides seamless access to a full suite of devices compatible with this new process technology.

**Th3H.2 • 14:30**

Latest Progress and Challenges in 300mm Monolithic Silicon Photonics Manufacturing, Takako Hirokawa1, Kahseeh Bi1, Ken Giewont1, Marios Kirtas1, Nikolaos Pasalidis1, Globalfoundries Inc, USA. In this paper we discuss the latest developments in the Globalfoundries FotoniX™ program, including enhancements in device performance, packaging, PDK compact models, and in-house test capabilities.

### Room 7

**14:00 – 16:00**

**Th3I • Survivability and Fault Management**

Presider: Zuqing Zhu; Univ of Science and Technology of China, China

**Th3I.1 • 14:00**

Scalable Optical Network Fault Management with Decentralized Graph Learning, Junlin Lin1, Xiaoxiang Chen2, Zhenlin Ouyang1, Chen1, Hanyu Gao1, Xiaoliang Kang1, Zhaohui Li1; SUN Yat-sen Univ., China. We propose a decentralized graph learning framework for scaling cognitive fault management in optical networks. Results show the proposed design achieves >96% fault identification and localization accuracy.

**Th3I.2 • 14:15**

Optical Network Anomaly Detection and Localization Based on Forward Transmission Sensing and Route Optimization, Philip N. Ji1, Zilong Ye1,2, Edefors1, Keren Liu1; Chalmers Univ. of Technology, Sweden. While ML algorithms can learn and adapt to channel characteristics, implementation of ML-based DSP hardware is challenging. We demonstrate a real-time implementation of a model-based ML equalizer that compensates for non-linear and time-varying channel.

**Th3J • Machine Learning DSP**

Presider: Gabriele Ligi; Eindhoven Univ. of Technology (TUe), Netherlands

**Th3J.1 • 14:00**

Real-Time Implementation of Machine-Learning DSP, Erik Börjeson1, Christian Häger1, Per Larsson-Edelers1, Karen Liu1; Chalmers Univ. of Technology, Sweden. We present an IM/DD experimental transmission, results show up to 99.5% multiplications are reduced.

**Th3J.2 • 14:30**

Non-Uniform Quantization and RUM for Optimizing Implementation of Real-Time FIR Equalization in Short-Reach Optical Links, Bahan Sang1, Kaihui Wang1, Luhan Jiang1, Chen Wang1, Yikai Wang1, Jiaxuan Liu2, Long Zhang1, Jingtao Ge1, Wen Zhou1, Jianjun Yu1; Globalfoundries Inc, USA. We propose a new quantization scheme and rotation-based mechanism for low-complexity equalization. It’s verified in DDMS for 92-Gbaud 10km offline and 14.7456-Gbaud 25-km FPGA-based real-time PAM4 IM/DD experimental transmission, results show up to 99.5% multiplications are reduced.

### Room 8

**14:00 – 16:00**

**Th3K • Machine Learning DSP**

Presider: Alessandro Sforna; Eindhoven Univ. of Technology, Netherlands

**Th3K.1 • 14:00**

An Ecosystem Perspective on Scaling Integrated Photonics for the AI Revolution, 15:00–16:00, Theater I
**Room 1B**

**Th3B • Practical Security Demonstration—Continued**

**Room 2**

**Th3C • Free Space Optical Communication—Continued**

**Room 3**

**Th3D • Photonic Integration for Novel Applications—Continued**

**Room 6C**

**Th3E • MCF Based Transmission—Continued**

**Room 6D**

**Th3F • Sub-THz and mm-wave Signal Processing—Continued**

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**Th3B.4 • 14:45**

Field Trial of Quantum-Secure IPSec Tunnels with Chip-Based QKD, Philip Sibson1, Jake Kennard2, Thomas Crabtree2, Paul Wright1, Catherine White1, Emilio Hughes-Salas1, Andrew Lord1, Gert Grammel2, William Mead3, Melchior Aelmans3, Radko Radev1, Steven Jacques1, BT, UK; KETS Quantum, UK; Juniper Networks, USA. We report a field trial of chip-based IPSec over 28.5km of deployed G.652 fibre, integrated using RFC 8784 with Juniper routers, with concurrent IPSec tunnels consuming independent keys. This illustrates practical quantum-resistant transport layer communication.

**Th3C.3 • 14:45**

Experimental Demonstration of Fidelity Enhancement for Chaotic Signals in Free-Space Turbulent Channels Utilizing Vector Optical Field Manipulation, Xiangang Luo1, Yun Zhang1, Mengjie Zhou3, Jiazheng Ding1, Minbo Fu1, Kun Qiu1, Ning Jiang1; CAS Inst. of Optics and Electronics, China; School of Information and Communication Engineering, Univ. of Electronic Science and Technology of China, China; Chengdu Institute of Optics and Electronics, China. We experimentally demonstrate fidelity enhancement in transmitting chaotic signals through an indoor simulated kilometer-scale turbulence channel using vector optical field manipulation, which results in a 30% fidelity improvement relative to Gaussian beams under stronger turbulence.

**Th3D.5 • 15:00**

Quantum-Safe 10 Gbps Site-to-Site IPSec VPN Tunnel Over 46 km Deployed Fibre, Obada Ala1, Albert Huang1, Huan Luo1, Omar Amer1, Marco Pistoia2, Charles Lim3; Global Technology Applied Research, JP Morgan Chase, Singapore; Global Technology Applied Research, JP Morgan Chase, USA. We successfully demonstrated a 10 Gbps IPSec-secured IPSec VPN tunnel between two JPMorgan Chase datacenters in a metro network over 46 km of deployed telecom fiber with over 168 hours of continuous operation.

**Th3C.4 • 15:00**

100m Free-Space Over 10Gbps Visible Light Laser Communication Using Gallium-Nitride Blue LD and Huffman-Coded Dyadic Probabilistic Shaping, Zengxi Xu1, Yuning Zhou1, Zhiyan Liu1, Jiancai Nai1, Chi1; Fudan Univ, China; Pekinghong Laboratory, China. In this experiment, we achieved over 10Gbps transmission rate in a 100m free-space visible light laser communication system. Huffman-coding QAM provides probabilistic shaping effects and improves the system’s working range and robustness against turbulence.

**Th3D.3 • 15:00**

Plasmonic-on-Chip Antenna Enabling Fully Passive sub-THz-to-Optical Receiver for Future RoF Systems, Hanle ib1, Tobias Blatter1, Laurenza Kulmer1, Michael Baumann1, Saimin Turk1, Yanik Horst1, Stefan M. Koepf1, Boris Vukovic1, Jasmin Smajic1, Jürg Leuthold1; ETH Zurich, Switzerland. We demonstrate a fully-passive on-chip antenna integrated plasmonic modulator receiver with a built-in field enhancement of 10 000 around 235GHz making RF electronics redundant. Transmission of up to 800bit/s in a wireless sub-THz link is shown.

**Th3E.5 • 15:00**

Tailoring Large Scale Manufacturing of MCF to High-Capacity Subsea Systems, Kevin W. Bennett1; Combining Research & Development Corp, USA. Multicore fiber (MCF) targeted for use in subsea systems is under active development. There are many variables and constraints which must be considered in the design, fabrication, and deployment of this new type of fiber to enable its success. This talk will expand upon the details and performance achieved to date by subsea fiber manufacturers through the lens of manufacturing suitability.

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**Th3B.5 • 15:00**

Solar-Blind QKD Over Simplified Short-Range FSO Link, Florian Harz1, Michael Hentschel1, Philip Walter1, Hannes Huber1, Bernhard Schrenk1; AT, Austria; 2Faculty of Physics, Vienna Center for Quantum Science and Technology (VCQ), Univ. of Vienna, Austria. We demonstrate QKD and data communication over an out-door free-space link with a large-core fiber substitutes active alignment. We further prove E-band QKD as stable and robust under full daylight, despite the loss of spatial filtering.

**Th3C.5 • 15:15**

Tailoring Rate and Latency of Free Space Optical Systems to Turbulence Conditions with Probabilistic Constellation Shaping and Data Interleaving, Rajiv Boddada1, Amrinnosh Ghassemi2, Sébastien Bigo3, Samar Rabeh1, Guillaume Dovi1, Sylvain Almog3,1, HaiK Mardoyan4, Jerome Renaudier3, Nokia Bell Labs France, France; Imagine Optics, France. We show up to 250 Gbit/s per carrier transmission is achievable with digital coherent technologies at 65GHz link-loss. We jointly optimize symbol-rate, probabilistic shaping and interleaving while replicating strong turbulence conditions.

**Th3D.4 • 15:15**

Space Qualifying Photonic Modulator Circuits, Tingyi Gu1, Dun Mao2, Lory Chang1, Hwee Sook Lee2, Anthony Vu1, Michael Kranak1, Pa Dong1, Department of Electrical and Computer Engineering, Univ. of Delaware, USA; 2Coherent, USA; 3Lasers and Electro-Optics Branch, NASA Goddard Space Flight Center, USA; 4Relative Dynamics, USA. Here we performed space experiments of photonic integrated circuits, revealing the critical roles of energized charged particles. The year-long cosmic radiation does not change carrier mobility but reduces free carrier lifetime, resulting in unchanged electro-optic modulation efficiency and well-expanded optoelectronic bandwidth.

**Th3F.5 • 15:15**

Applications of Multicore-Fiber Nonuniformly-Spaced Delay Lines in Microwave Photonics, Mario A. González Pérez1, Elham Nazemosadat1, Ivana Gasulla Mestre2; 1TEAM Research Inst., Univeritat Politècnica de València, Spain; 2CNRS, France. We experimentally demonstrate a flat-top broadband microwave filter and a fractional Hilbert transformer in a multicore fiber. Both applications operate based on nonuniformly-spaced delay lines, providing equivalent negative tap coefficients by adjusting their time delays.
Mitigating Substrate Leakage Loss on a Monolithic SiP Platform: Experimental Demonstration of Hybrid Si-SiN Waveguides for O-Band Datcom, Yusheng Bian1, GlobalFoundries, USA. We introduce the concept of hybrid Si-SiN waveguides to mitigate substrate leakage on a monolithic SiP platform. Experimental data indicates an ~80% reduction in TM-waveguide loss (resulting in ~0.3 dB/cm-attenuation) and a 9-fold TM-bend loss reduction.

High Performance Silicon Nitride Passive Optical Components on Monolithic Silicon Photonics Platform, Sujith Chandran1, Yusheng Bian1, GlobalFoundries, USA. We demonstrate low-loss silicon nitride passive optical components including straight and bend waveguides, 1×2MMI, 2×2MMI, directional-coupler and waveguide crossings on a monolithic silicon photonics platform. Hardware performance statistics substantiate the mass manufacturability of the building-blocks.

Spatio-Temporal Failure Prediction Using LSTGM for Optical Networks, Cheng Xing1, Chunyu Zhang1, Yu Wang1, Jiayin Zhan1, Min Zhang1, Danshi Wang1, 1State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, China; 2National Key Laboratory of Science and Technology on Communication Network Security, Beijing, China; 3National Information Opticalelectronics Innovation Centre, China. A Latent Spatio-Temporal Graph Model is proposed for failure prediction in optical networks, which can effectively learn both spatial and temporal distribution of real equipment performance data and achieve F1-score up to 0.9745.

Fully-Blind Neural Network Based Equalization for Severe Nonlinear Distortions in 112 Gbit/s Passive Optical Networks, Vincent Launger1, Patrick Matalla1, Jonas Ney1, Norbert Wehn2, Sebastian Rendel2, Laurent Schmalen3, 1CELE, Karlsruhe Inst. of Technology, Germany, 2IPQ, Karlsruhe Inst. of Technology, Germany; 3RPTU Kaiserslautern-Landau, Germany. We demonstrate and evaluate a fully-blind digital signal processing (DSP) chain for 1000 passive optical networks (PONs), and analyze different equalizer topologies based on neural networks with low hardware complexity.
Thursday, 28 March

**Room 3**

**Th3C • Free Space Optical Communication—Continued**

Th3C.6 • 15:30
Reliability Enhancement in FSO Communications Using FMF Assisted by Subcarrier Multiplexing, Manuel José M. de Freitas¹, Marco A. Fernandes⁴, Vitor Correia¹, Paulo Monteiro¹, Fernando P. Guimarães¹, Gil Fernandes¹, Universidade de Aveiro, Portugal; Instituto de Telecomunicações, Portugal. We exploit the frequency diversity offered by digital subcarrier-multiplexing to overcome the coherent combining challenge associated with the use of FMF in FSO systems. Experimental validation at 200 Gbps in an atmospheric chamber reveals reliability gains of >20% compared with an equivalent single-mode coupling system.

Th3C.7 • 15:45
Eye-Safe Terabit-Class WDM Optical Wireless: How Many Channels are Enough?, Marco A. Fernandes¹, Gil Fernandes¹, Bruno T. Brandão¹, Manuél José M. de Freitas¹, Norcin Kael, Alina Tomeeva¹, Bas v. Velsen¹, John Red¹, Danielle Rateri¹, Paulo Monteiro¹, Fernando P. Guimarães¹; Instituto De Telecomunicações, Portugal; Aircision, Netherlands. On the path towards Terabit-class optical wireless, the use of WDM technology poses many practical questions. Supported by a 1.8 km field-trial, and multiplexing up to 16×200G channels, we expose the tradeoffs between capacity and reliability depending on the channel count, optical pre-amplification architecture and coding requirements.

**Th3D • Photonic Integration for Novel Applications—Continued**

Th3D.6 • 15:30
High Temperature and Large Bandwidth Blue InGaN/GaN Micro-LEDs, Daniel Rogers¹, Haotian Xue¹, Fred Kish¹, Bardia Pezeshki¹, Alex Tselikov², Jonathan Wierer¹; North Carolina State Univ., USA; Alcance Tech, USA. InGaN/GaN micro-light-emitting diodes with the highest bandwidths at very high temperatures (3.2 GHz at 290°C) are demonstrated. Differential carrier lifetime analysis is undertaken to understand recombination-related effects on the modulation response.

**Room 1B**

**Th3B • Practical Security Demonstration—Continued**

**Room 2**

**Th3C • Free Space Optical Communication—Continued**

Th3C.6 • 15:30
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**Th3D • Photonic Integration for Novel Applications—Continued**

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**Room 6C**

**Th3E • MCF Based Transmission—Continued**

Th3E.5 • 15:30
Narrowband Noise Filtering of Arbitrary Waveforms by Reversible in-Fiber Temporal Talbot Sampling, Majid Goodarzi¹, Manuel P. Fernandez², Xinyi Zhu¹; Instituto Balseiro (UNCuyo-CNEA) & CONICET, Argentina. We effectively employ temporal Talbot effects to filter narrowband optical noise beyond optical bandpass filter capabilities in MHz-bandwidth temporal waveforms and random data signals, recovering buried optical signals and enhancing optical signal-to-noise ratio.

**Room 6D**

**Th3F • Sub-THz and mm-wave Signal Processing—Continued**

Th3F.5 • 15:30
Ultra-Large Key Space Multi-Dimensional Masking Encryption System for DSM-Based D-Band Wireless Fronthaul, Tianqi Zheng¹, Kainu Wang¹, Xiangwei Yang¹, Quotong Zhang¹, Weiping Li¹, Yi Wei¹, Feng Wang¹, Xianming Zhao¹, Feng Zhao¹, Jianjun Yu¹; Fudan Univ., China; The Inst. of Future Information Technology, Harbin Inst. of Technology, China; School of Automation X’an Univ. of Posts and Telecommunications, China. We implement a multi-dimensional masking encryption scheme with an ultra-large key space of 10 143 in a photonics-aided millimeter radio-over-fiber (ROF) system. The equivalent 1.67GBaud encrypted-4096QAM signal is successfully transmitted and decrypted over a 4.6-km wireless link in the DSM-based D-band wireless fronthaul system.
**Th3G • Optical Computing and Accelerators—Continued**

**Th3H • Photonics Manufacturing Technologies—Continued**

**Th3H.5 • 15:30**

Low-Temperature and Hydrogen-Free Silicon Dioxide Cladding for Next-Generation Integrated Photonics, Zhihan Li1,2, Zhou Gu1,2, Xu N. Wang3, Xinru Ji1,2, Marta Divall1, Anat Siddharth1,2, Tobias J. Kippenberg1,2, 1École Polytechnique Fédérale de Lausanne, Switzerland; 2Center for Quantum Science and Engineering, EPFL, Switzerland; 3Luxel Intelligence SA, Switzerland. We demonstrate a process for hydrogen-free low-loss silicon oxide films deposited using SiCl4 and O2 as precursors. A wide low-loss window from 1260 nm to 1625 nm is achieved at deposition temperature of 300 °C.

**Th3H.6 • 15:45**

Arbitrary Mode Size Conversion with 3D-Nano-printed Couplers: a Generic Coupling Strategy, Huiyu Huang1, Zhihan Shi1, Giuseppe Talli1, Maxim Kuschnerov1, Richard V. Penty1, Qixiang Cheng1, 1University of Cambridge, UK; 2Huawei Technologies Duesseldorf GmbH, European Research Center, Germany. We present a solution for efficient off-chip coupling with no requirement of on-chip mode engineering and additional manufacturing processes. A 10.4µm to 4µm fiber-to-chip mode-field-dimension conversion is demonstrated with ~2dB loss across >100nm wavelength range.

**Th3I • Survivability and Fault Management—Continued**

**Th3I.7 • 15:30**

DC-Carrier Cooperation for Rapid Restoration Against PNE-Node Failure in Optical Networks, Subrata Bora1, Sifat Ferdousi1, Sugeng Xu2, Yusuke Hirota3, Massimo Tomatore1, Yoshinari Awayi1, Biswanath Mukherjee1,3, 1University of California Davis, USA; 2National Inst. of Information and Communications Technology, Japan; 3Politecnico di Milano, Italy; 4Soochow Univ., China. We propose a rapid restoration strategy against PNE-node failure during post-disaster cooperation among DC providers and optical-network carriers. Our strategy reduces disruption and improves DC-service restoration by 35% in 20% less time compared to baseline.

**Th3I.8 • 15:45**

Disaggregated Confidentiality-Preserving Scheme for Fault Detection in Optical Networks, Rafael F. Sales1, Andrei N. Ribeiro1, Moses F. Silva1, Fabricio R. Lobato1, Andrea Spambelli1, Luca Valcarenghi3, João W. Costa1, 1Universidade Federal do Pará, Brazil; 2Los Alamos National Laboratory, USA; 3Scuola Superiore Sant’Anna, Italy. We propose a confidentiality-preserving approach based on distributed principal component analysis (PCA) and telemetry data scrambling to detect hard-failures in optical networks. Experiments in a real optical testbed show the suitability of the proposed disaggregated solution.

**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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