OFCnet 2024 Introduction

Cees de Laat, University of Amsterdam, Netherlands
Reza Nejabati, University of Bristol, United Kingdom
Gwen Amice, EXFO, Canada
Andrew Lord, British Telecom, United Kingdom
Workshop

• Started in 2023, OFCnet brings a new opportunity to the exhibition and demonstrates 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 to 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 who work on the mentioned topics to enrich the OFCnet community further and expand the contributing parties. We discuss how this initiative should be developed to ensure OFCnet enriches future community participation.
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Highlights

• We are bringing a live Network on the Exhibit floor;
• With 20 live demonstrations of these 9 are about Quantum Networking
• We are 35 volunteers with international presence.
• We are hosting hands-on live course as well as this workshop.
• We are an Open Network with multiple Industry and Academic researchers.
• Optica gave us great support to Reduce the barrier of live demonstrations and collaboration; OFCNet 2024 represents the culmination of 5 years of effort!
The 2024 Team Edition (35 people)

**OFCnet**
Marc Lyonnais (Chair) Ciena
Jim Stewart (Vice Chair) UETN
Sana Bellamine (Deputy Chair) Will be OFCnet 2025 Chair
Casey Foulds (Program Manager) uTD
Jessica Pagonis Optica Liaison & Biz manager
Randy Giles Optica Scientific Advisor Liaison

**Network Architecture**
Scott Kohlert (Co-Team Lead) Ciena
Mike Blodgett (Co-Team Lead) ESnet

**Logistics**
Akbar Kara (Ciena)
Casey Foulds (uTD)

**OFCnet Workshop, BoF**
Cees de Laat (Team Lead) UVA
Reza Nejabati
Andrew Lord
Gwen Amice (Co-Team Lead), EXFO

**Short Course**
Gwen Amice (EXFO)
Christine Tremblay (ETS)

**Panel Preparation**
Casey Foulds (uTD)

**Network Build and Vendor Reachout**
Management team +
Tunde Sanda CENIC
2 CENIC Engineers
Mike Blodgett Esnet
Jo-Ann Bender (Internet2)
Scotty Stracken (NSHE)
Chris Skaar (University of Illinois)

**Demonstrations organization**
Carl Williams (co-Team lead) CJW Quantum Consulting
Chris Tracy (co-team Lead) Esnet
Sergey Ten or Peter Wigley (Corning)

**Security, Analytics and Measurements:**
JP Velders (UVA) (co-Team lead)
Gwenn Amice EXFO
Gauravdeep Shami Ciena (Data Lake project) (co-Team lead)
Danial Ebling (UETN)
Tom Hutton (SDSC)
Mariam Kiran (ORNL)

**Communications and Signage**
Jennifer Inglisa (Optica) (Team lead)
Beth Harrington (Optica)
Ashley Collier (Optica)
Colleen Morrison (Optica)
Eve Griliches (Cisco)
Dave Brown (Nokia)
Rodney Wilson (Ciena)
OFCnet Exhibiting Companies

Kiosks (we have 11)
• CESNET, z.s.p.o.
• Ciena/FABRIC/SDSC
• F5, Inc.
• ID Quantique (share)
• NEC Laboratories America
• NOKIA (share)
• OFS (share)
• Qunnect Inc.
• StarLight/International Center for Advanced Internet Research Northwestern University
• University of Amsterdam
• University of Bristol (they have 2 kiosks)
• University of Maryland
• Verizon

Booths (we have 6)
• AUREA Technology
• ID Quantique
• IOWN Networking Hub (they have 2 booths)
• NuCrypt, LLC
• QTI SRL
• The University of Texas at Dallas (they have 2 booths)
OFCnet Booth
OFCnet
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OFCNet Workshop Panel

Dr. Duncan Earl
President & Chief Technology Officer
Qubitekk, Inc.

March 2024
1. EPB Quantum Network (deployed/commercial)
2. Center for Quantum Networks (CQN) - Tucson
3. Boston-Area Quantum Network (BARQNET) - Boston
4. MIT Quantum Network Testbed - Boston
5. Chicago Quantum Exchange (CQE) - Chicago
6. Quantum Application Network Testbed for Novel Entanglement Technology (QUANT-NET) - Berkeley
7. MSU Quantum Network – Bozeman
8. AFRL Quantum Network – Rome
9. DC-QNet – Washington, DC
10. Hybrid Quantum Architectures and Networks (HQAN) – Urbana-Champaign
11. Tri-City Quantum Network – Sherbrooke
12. Los Alamos National Lab Quantum Network
OVER THE NEXT 5 YEARS...

- Early network “frameworks” are currently being adopted – winners and losers to follow
- Quantum network components will expand rapidly:
  - Memories
  - Efficient frequency converters
  - Active channel correction
  - Timing and synchronization
  - Network simulators
  - Control and monitoring software
- Lots of industry education coming
  - Fiber optic asset owners are still currently trying to figure out what quantum is and means for their business
  - OFCNet could provide hands-on education and training to industry
  - OFCNet could coordinate network operators and identify best-practices for rest of industry
Thank You

Contact:
Dr. Duncan Earl
e-mail: dearl@qubitekk.com
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Extend Data Center Services Over 400G WAN

Prototype Solution Initial Results:

**Single stream RDMA/RoCE over 400G network at different distance**

(1) CENI Chicago - McLean VA (2) NA-REX Chicago -L.A (3) FABRIC + NA-REX /San Diego Chicago-L.A

SL loopbacks: (1) Rtt 27 ms @ 395G (2) Rtt87 ms @ 388G (3) Rtt 108 ms @ 397G
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Nokia Quantum-Safe Networks
Automated, pre-shared, symmetric key distribution

Nokia 1830 SMS
Classical physics-based key generation

MACsec
OTNsec
7750 1830
7750 1830

© 2024 Nokia
Nokia Quantum-Safe Networks
QKD with automated, pre-shared, symmetric key distribution

• Quantum key generation/distribution
• Quantum key orchestration
• Classical physics-based key generation
OFCnet
QKD hybrid key management demonstration
OFCnet
GRNET QKD-hybrid demonstration facts

- Nokia 1830SMS acts as key orchestrator; both for quantum (thru KMS) and classic keys
- KMS attack simulated by disabling KMS, QKD attack by blocking Q-channel
- Reverts to classic key usage when QK not available
- Key rotations tested at 1, 5, 15, 60 mins
- Quantum key buffers with up to 1K keys, exp in 4 hours
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IDQ’s comprehensive range of Quantum Key Distribution solutions

- Proven and highly reliable technology
- Designed for complex topologies and large-scale deployments
Korean National Convergence Network Project

IDQ and SK Broadband selected for the construction of the first nation-wide QKD network in Korea

2000 kilometers

48 government organizations

Security, stability & efficiency

[ QKD & KMS Network ]
OFCnet 2023 – Joint Ciena>IDQ demo

Diagram showing the setup for the QKD System demo between Ciena and IDQ, including the integration of Waveshaper and QNET Server.
OFCnet 202x – Arising topics on which the OFCnet community can play a role

• Confronting the physical challenges of integrating QKD into classical networks (classical/quantum mix, network topology limits)

• Key management systems (KMS) : scalability, interoperability between vendors

• Ultra-high-rate QKD/Ultra-long-distance QKD : how to integrate the supporting (still maturing) technologies in classical networks?

• The rise of quantum networks that exchange entanglement : totally different that what we have today
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Pioneering Solutions for The Quantum Internet

Mehdi Namazi
Chief Science Officer
Qunnect Brooklyn
What is our end goal?

Practical distribution of useful entanglement over longer (and longer) distances
Our core capabilities

**Generating Entanglement**
- QU-SOURCE
  - Only source on the market that can be used for applications beyond secure communication
  - QU-LOCK
    - High precision reference for stabilizing lasers driving QU-SOURCE
- QU-LAS (available mid 2024)
  - Turnkey laser solution to drive QU-SOURCE

**Preserving Entanglement**
- QU-APC
  - Auto Polarization Compensator
  - Maintains high channel fidelity and network uptime resulting in low QBER (quantum bit error rate)
- QU-VAL (available mid 2024)
  - Validating entanglement for networking protocols

**Storing Entanglement**
- QU-MEM Quantum Memory
  - Providing temporal control to quantum networks
- QU-MEM Broadband (2025)
  - Improved performance specs for optimal interfacing
Ent. Distribution over 34km of NYC’s fibers
In collaboration with: NYU’s CQIP
NIST ↔ JQI (U Maryland)

- ~ 60km aerial fiber (22dB loss @ 1550)
- Recent compensation results over 5 days, 94% avg Fidelity @ 90% uptime.

In collaboration with:
Yicheng Shi, Mheni Merzouki, Abdella Battou, Oliver Slattery, Thomas Gerrits
Demo of the real-time performance of our Qu-APC by stomping the fiber!
From Devices to solutions

World’s first plug and play, automated rack solution for distributing useful entanglement

World’s first atomic-based entanglement source
10 M pairs/s | 95% fidelity | sub-GHz linewidth

World’s fastest polarization compensating device
99% fidelity | <2dB loss | fully automated

Automated inter-node entanglement validation
configurable to user’s requirements

Integrated lasers and telecom wavelength reference

Integrated multichannel TDCs with inter-link ns
Synchronization and multiplexed single photon detectors

Classical network routing and servers for control
and automation
HARDWARE, NOT HYPE
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WDM Entangled Quantum Communications at OFCnet

Jerome Prieur, March 2024, OFCnet San Diego
World-class
Quantum-safe Communications

Entangled Photon Sources  Single Photon Detectors  Time taggers

Visit us booth 1018 at **OFC** on 24-26 March 2024 in San Diego
WDM Entangled Quantum Communications

WDM Entangled Quantum Emitters

WDM Quantum receivers

Secure Key Exchange

Ground Station 1

Ground Station 2

Single Photon Detection
This live demonstration exhibits the capabilities of performing WDM quantum entangled channel distribution using cutting-edge commercially available building blocks from AUREA Technology.
Thank you!

Jerome Prieur, CEO and co-founder
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OFICIAL ETHERNET ALLIANCE PANEL
“LESSONS LEARNED FROM PREPARING INTEROPERABILITY DEMONSTRATIONS…”

DAVID J. RODGERS

24 MARCH 2024
The Ethernet Alliance

A Global Community of End Users, System Vendors, and Component Suppliers

- **Our Mission**
  - **To promote** industry awareness, acceptance and advancement of technology and products based on, or dependent upon, both existing and emerging IEEE 802 Ethernet standards and their management.
  - **To accelerate industry adoption** and remove barriers to market entry by providing a cohesive, market-responsive, industry voice.
  - **Provide resources to establish and demonstrate multi-vendor interoperability.**
The Ethernet Alliance – (if there was only 1 thing)
Investment in Multi-vendor Interoperability

- **Plugfests**
  - High Speed Networking
  - NBASE-T
  - SPE

- **Public Demonstrations**
  - Trade Shows
    - OFC
    - SC
    - ECOC
    - BICSI
Building the Demo requires a TEAM!

- Coordinator/Coach
- On-Field Captains - Tech Leads
- Position Players
- Practice, practice, practice

- Provide resources to enable the success of the demonstration and multi-vendor interoperability.
Chaos becomes Cohesion
Learn More About Ethernet Alliance

Ethernet Alliance:
visit [www.ethernetalliance.org](http://www.ethernetalliance.org);
Follow @EthernetAlliance on Twitter
Join the Ethernet Alliance [LinkedIn group](https://www.linkedin.com);
Visit the Ethernet Alliance [Facebook page](https://www.facebook.com);

PoE Certification Program:
visit [www.ethernetalliance.org/poecert/](http://www.ethernetalliance.org/poecert/)
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How Can OFC, with a Real Life Test-Bed, Accelerate Innovation in the Optical Photonic Networks?

Rump Session

Reza Nejabati, Andrew Lord
Objective

Do we need OFC pop-up style optical network test-bed?

If so, how it should look like?
Rump Session Speakers

• Jorg-Peter Elbers, Adtran, Germany

• Julia Larikova, Infinera, United States

• Dimitra Simeonidou, University of Bristol, United Kingdom

• Prem Kumar, Northwestern University, United States

• Ben Dixon, MIT Lincoln Laboratory, United States
Questions

- Do we require field trial testbeds for scientific and engineering breakthroughs?

- Why can't we rely solely on lab-based test-beds, virtual test-beds, and test-bed emulation?

- Is there a role for a short-term interop / multi-partner PoC, compared to longer-term standards-based trials (e.g. OIF)?

- Is there any role/place for a pop-up short term test-bed?

- What are the essential features of a field trial testbed for future telecom?

- What role do fiber/optical networks play in a holistic telecom network testbed?

- Is OFC a right venue for such a test-bed? Why not MWC..., Where that would be?

- Who are target users?
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Boston Area Quantum Network Testbed Development

P. Ben Dixon – MIT Lincoln Laboratory
Presented at OFC Conference 2024
24 March 2024

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Quantum Memory Module

Quantum Network Testbed Goal

Develop capabilities to incorporate emerging quantum memory technologies into Boston-area fiber testbed

Silicon Vacancy Quantum Memory System

Input Photonic Qubit

Color-center in Resonant Cavity

Interferometric Qubit Capture Heralding System

Quantum Memory Input Requirements for Photonic Qubits

- Timing jitter: <10 ns for low inter-symbol-interference
- Polarization jitter: <0.5 radian for high efficiency
- Optical frequency noise: <1 MHz for low error heralding
- Flux: <10 M photons per sec (-90 dBm) to avoid saturation

Boston-area Quantum Network Testbed

- Two optical fibers from LL to MIT and Harvard
- Dark telecom fiber links
- 50 km optical path length

Testbed Development Effort

- Characterize fiber-induced degradations
- Design fiber compensation system that maintains photonic qubits an operates with -90 dBm noise floor
- Test system by transmitting quantum states across compensated fiber and capturing them in quantum memory
Fiber Channel Characterization

**Timing Drift**
Requirement: <10 ns timing precision

- Maximum optical fiber path length timing drift of 40 ns
- Timing drift highly correlated to ambient temperature
  - 2.6 ns/°C, $R^2 = 0.96$
- Maximum drift rate of 10 ns per hour
- Impact: Minute-class time synchronization needed

**Polarization Drift**
Requirement: <0.5 radian polarization stability

- Polarization drift rate drift correlated to environmental wind speed
  - 1.7 mrad/sec·mph², $R^2 = 0.42$
- Maximum drift rate of 0.5 radians per second
- Impact: Second-class polarization stabilization needed

**Optical Frequency Noise**
Requirement: <1 MHz frequency transfer

- Fiber induced frequency noise consistent with Brownian process
  - Gaussian width $\sigma = 4.6$ kHz
- Transmitted light has frequency broadened by 4.6 kHz
- Impact: No optical frequency stabilization system needed

Fiber-induced degradations characterized, second-class timing synchronization and polarization stabilization needed, optical frequency can be transferred without active fiber stabilization
Integrating Quantum Memories into Quantum Network

Integrated Fiber Compensation System and Qubit Transmitter

- Timing Reference (1550 nm)
  - 1 sec repetition rate
  - 200 nm spectral separation gives high extinction (>100 dB) for low noise floor

- Pol and Freq Reference (1350 nm)
  - 1 sec repetition rate
  - AOM and Mems-based VOA gives 120 dB of extinction for low noise floor

Photonic Qubit (1350 nm)
- Time bin weak coherent state qubits

Transmitter at LL

Testbed Development Effort
- Fiber compensation built and integrated with fiber testbed and quantum memory
- Preliminary data confirmed noise floor operation of system
- Full characterization demonstrates 87% fidelity transfer of transmitted qubit into quantum memory

Transmitter at Harvard

Cross-Fiber Qubit-Memory Interaction

First Light Data

Qubit Measurement Signal (thousands of photons)

Time (msec)

Qubit type 1 stored and measured

Qubit type 2 stored and measured

Qubit Characterization

Testbed Development Effort
- Fiber compensation built and integrated with fiber testbed and quantum memory
- Preliminary data confirmed noise floor operation of system
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The UK’s Joint Open Infrastructure for Networks Research (JOINER)

Dimitra Simeonidou, University of Bristol, UK
1. A UK national testbed with representative heterogeneity, complexity and scale

2. Provides key scientific instrumentation for future networks research

3. Enabling experimental collaboration, introducing new technologies, services and applications resulting from academic and industrial R&D programmes

4. A platform to accelerate TRL advancement of early-stage research and provide credible experimental evidence towards the introduction of new IP and standards

5. A place for hands-on training on telecoms systems and therefore a key contributor to a national (multidisciplinary) skills development pipeline.

6. It will allow to explore new research questions challenging end-to-end assumptions and developing system thinking to Future Networks research:
   - Evaluation of Machine Learning algorithms for large scale networks
   - System-wide energy consumption optimisation in 6G networks
   - Evaluation of end-to-end and multi-layer network security solutions
   - Global automated spectrum management and assignment techniques
Glasgow: RF research and Wireless Networks (UoGlasgow), Scotland 5G Centre

QUBelfast: Signal Processing, Communications Theory, wireless systems simulation and emulation platforms

Cranfield Uni: Satellite and Autonomous Systems

UoBristol: E2E Networks, Convergence, Control, Management, 5G O-RAN testbeds, Digital Twin facilities, Quantum Nets, AI Isambard Supercomputer, International connectivity, FABRIC

UoCambridge: Quantum Comms, III-V Photonics, Optical Wireless, NDFF

UoLeeds: Edge, Cloud, THz, mmWave, immersive and agritech applications

UoSouthampton: New fibre, Optical comms, Wireless & Satellite comms, Silicon Photonics, NDFF

London: Imperial (Cloud, Information Theory, AI/ML), UCL (THz, NDFF), Digital Catapult (SONIC)

UoSouthampton: Quantum Computing, free space optical comms
JOINER Brain: Measurements, Orchestration, Management, AI computation and Digital twin platforms

Labs and/or testbeds in the JOINER NODES

User Equipment

Local Experimenters

User Portal

Multi-access control

Edge Cloud

MEC

Programmable Switching and Routing

Hybrid Private-Public Cloud: Virtual Infra Hosting

Physical Infrastructure: L0, L1, L2, L3 and satellite connectivity

JOINER Fabric
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| 15:30 | End of workshop                                                      | Cees de Laat                                                                      |
How Can OFC, with a Real-Life Test-Bed, Accelerate Innovation in the Optical Photonic Networks?

Prem Kumar
Professor, ECE & Physics
Center for Photonic Communication and Computing
Northwestern University
E-mail: kumarp@northwestern.edu
Illinois Express Quantum Network (IEQNET) – Metropolitan-Scale Experimental Quantum Network

Research team leads:

**Fermilab:** P. Spentzouris (PI), C. Pena, W. Wu, S. Xie
**Argonne:** R. Kettimuthu, J. Chung
**Caltech:** M. Spiropulu, N. Lauk, R. Valivarthi
**Northwestern:** P. Kumar, G. Kanter

The IEQNET collaboration

9/23/2021 | IEQNET Collaboration
IEQNET Topology

IEQNET Physical (proposed)
IEQNET’s Quantum Networking Architecture (three planes)
Orchestration of Entanglement Distribution over a Q-LAN using the IEQNET Controller

Joaquin Chung,1,6 Anirudh Ramesh,1,2 Shariful Islam,1 Gregory S. Kanter,3 Cristián Peña,4 Si Xie,4 Raju Valivarthi,5 Neil Sinclair,5 Panagiotis Spentzouris,4 Maria Spiropulu,5 Prem Kumar,2 and Raj Kettimuthu1

1Argonne National Laboratory, Lemont, IL, USA
2Northwestern University, Evanston, IL, USA
3NuCryp LLC, Park Ridge, IL, USA
4Fermi National Accelerator Laboratory, Batavia, IL, USA
5California Institute of Technology, Pasadena, CA, USA

Legend:
- EPS: Enlarged Photon Source
- SNSPD: Superconducting Nanowire Single Photon Detector
- SDN: Software-defined Networking
- Dark fiber/PP:
- NETCONF communication over IP network

OFC’24 Demo Zone (#M3Z.4, Room 6B)
Monday, 25 March 2024
Quantum Classical Coexistence in the IEQNET

1. Time Synchronization
   1310 nm classical clock light coexisting with 1536 nm photon pairs for picosecond synchronization over 59 km

2. O-band Quantum Networking Beyond Dark Fiber
   Coexistence with milliwatt power C-band classical light over >45 km fiber using O-band quantum entangled photons
Using the optimal quantum channel and narrow spectral-temporal filtering, >95% fidelity to the nearest Bell state is achieved with >18 dBm C-band power.

[2304.09076] Designing Noise-Robust Quantum Networks Coexisting in the Classical Fiber Infrastructure (arxiv.org)
Quantum Teleportation Coexisting with 11 dBm 400 Gbps C-band Signal

4-fold coincidence fringe as Bob rotates his polarization basis for Alice transmitting:

\[ |D\rangle = \frac{1}{\sqrt{2}} (|H\rangle + |V\rangle) \]
\[ |A\rangle = \frac{1}{\sqrt{2}} (|H\rangle - |V\rangle) \]

Fidelities of Bob's qubit to Alice's ideal state, measured via quantum state tomography:

\[ F = \langle \phi_A | \rho_B | \phi_A \rangle \]

Nonclassical limit (F > 66.7%)

Quantum Teleportation Over Optical Fibers Carrying Conventional Classical Communications Traffic

Jordan Thomas\(^1\), Fei Yeh\(^2\), Jim Chen\(^2\), Joe Mambretti\(^2\), Scott Kohlert\(^3\), Gregory Kanter\(^4\), Prem Kumar\(^1\)

\(^1\) Northwestern University, Evanston, USA. \(^2\) International Center for Advanced Internet Research, Chicago, USA. \(^3\) Ciena Corporation, Hanover, USA. \(^4\) NuCrypt LLC, Park Ridge, USA

ECOC 2023
Distribution of Quantum Entanglement through Fiber with Co-Propagating Classical Data


Gregory Kanter  
kanterg@nucrypt.net
Demonstration Objectives

1. Generation of entangled photons (distributed over fiber)
2. Data communication between distant Quantum Nodes
3. Co-Propagation of quantum and classical data
Photon Interference from Independent Sources

Gregory S. Kanter,1,2 Joaquin Chung,2 Cristián Peña,3 Aaron Miller,4 and Prem Kumar,5

- Demonstrate Hong-Ou-Mandel (HOM) Photon Interference
- Two independent sources
  - heralded single photon source
  - sub-photon pulsed coherent source
- Auto-synchronize pulse rate and timing
- Show "HOM dip"
Reflections on the Assigned Questions

- Do we require field trial testbeds for scientific and engineering breakthroughs in telecom networks? Why can't we rely solely on lab-based test-beds, virtual test-beds, and test-bed emulation?

- What are the essential features of a field trial testbed for future telecom?

- What role do fiber/optical networks play in a holistic telecom network testbed?
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6. Jerome Prieur, Aureatechnology  
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| 14:15 | Introduction of the Modified Rump Session approach to engage with industry and academic research labs regarding emerging technologies, research and innovation prototyping to be demonstrated at current and future OFCnet’s. | Reza Nejabati                                    |
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2. Dimitra Simeonidou, University of Bristol, JOINER UK National Test-bed  
3. Prem Kumar, Northwestern University, Illinois Express Quantum Network  
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| 15:30 | End of workshop                                                         | Cees de Laat                                    |
Large scale field testing

Julia Larikova

March 2024, OFC 2024

S1A
Large scale FOAs

- SOP sensing and coherent OTDR
  - Requires access to real life transmission fiber and a LOT of it
  - Long term data collection on different fibers from same cable, same direction
  - Metro behavior vs. ULH
  - Location matters – strong weather (electric storms vs. earthquakes)

- openROADM type of environment
  - openROADM API and MSA is well defined but link control and timing of power control isn’t
  - Lab environment isn’t sufficient to truly test 2-3 vendors of optical line systems when it comes to any kind of interop
  - Need 40+ to 100+ NEs to validate power stability under outrage and power failure conditions
  - Openconfig, IOWN etc – more interop standards to come

- Interoperable OFEC, CFEC and OFEC-PCS formats
  - OIF studies show a huge 4-9dB interop penalties which are poorly understood
  - No studies over real-life CD or PDL
  - No studies over large sample of parts
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What is the role of field trial testbeds in comms R&I?

OFC 2024 – Workshop S1A – Real-life Testbed Innovation
Field trial testbeds – why?

- Demonstration, test and validation in operational environment
- Use of real channel characteristics and their temporal/statistical variations
- Capability to scale up and out (# of nodes & domains, geography)
- Opportunity for ML data generation & test applications

Replacing a lab fiber with a short strand of fiber is not a field trial!
Some good use cases

Optical transmission
• Margin assessment in fiber transmission (esp. under challenging conditions)
• Study of atmospheric turbulences & their compensation (e.g. ground-space links)
• Exploration of joint communication & sensing (fiber network as sensor)
• Stability investigations of quantum key distribution & entanglement schemes

Network control & protocols
• Verification of protocol performance and scalability in operational environment
• Investigation of new network protocols and their interoperability

ML data generation & model tests
• Collection of network performance and fault data sets
• Benchmark of models for performance optimization & trouble shooting
Thank you
joerg-peter.elbers@adtran.com
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