ECOC 2009
Vienna ▪ ▪ ▪ Austria

35th European Conference on Optical Communication

Final Program

September 20 - 24, 2009, Austria Center Vienna, Austria

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Welcome to ECOC 2009!

Welcome to Vienna and to the European Conference on Optical Communication!

The European Conference on Optical Communication (ECOC), the largest conference on optical communications in Europe, and one of the largest and most prestigious events in this field in the world, is now in its 35th edition, reflecting the stability and the attractiveness of this conference as one of the world's major forums for discussion of the most recent advances in research, development, and industrial applications of optical communication technologies and optical networks.

ECOC travels from one European center to another each year and is now visiting Vienna, Austria, for the first time. The conference is held at the Austria Center Vienna, Austria's largest conference center and among the most modern ones in Europe, located next to the United Nations Vienna Headquarters in the most modern part of the city. The center can be reached within a few minutes by metro from the historical Vienna city center.

The last conference, ECOC 2008 in Brussels, was again a great success and ECOC 2009 will accelerate this momentum. Three world-renown plenary speakers, as well as a broad selection of distinguished invited and tutorial talks will survey the field and give in-depth analyses of the impact of photonic technologies on present and future optical communication networks. Some of the hottest topics in optical communications will also be covered in a series of dedicated symposia and Sunday workshops.

Despite the recent economic downturn, the number of paper submissions at this year's ECOC was less than 10% off last year's ECOC and close to the number of 2007. Out of 712 submitted technical papers, 228 were accepted for oral presentation and 145 will be presented during a poster session. With its high technical quality, ECOC continues to bring together professionals in the area of opto-electronic devices, optical transport networks and access technologies all the way to future optical routing architectures and quantum information applications. Most of the major international telecommunication service providers and optical network system vendors are represented at ECOC each year. As a not-for-profit conference, ECOC focuses on the dissemination of new research results, the education of engineering and business leaders, and the exposition of cutting-edge optical fiber communication and networking products.

The city of Vienna, the former capital of one of Europe's most influential monarchies, is known for its superb music and splendid architecture, both classical and modern. It represents an ideal link between history and tradition on the one hand, and modern intellectual curiosity in the arts and sciences on the other hand. Whether you enjoy immortal waltzes, the exciting tension between imperial and modern architecture, or the vibrant life style of a twenty-first century metropolis, Vienna will certainly exceed your expectations. We encourage you to explore Vienna's cultural treasures in addition to enjoying the technical conference and exhibition.

We wish you a highly successful technical conference and a great time immersed in Viennese culture.

Walter Goldenits

Herwig Kogelnik

Walter Leeb

Peter Winzer

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ECOC 2009 Paper Topics

1) Fibres, Fibre Devices, and Amplifiers

This area focuses on optical fibres, their fabrication and characterization, the physics of light propagation in optical fibres, fibre amplifiers and lasers, as well as fibre-based devices for communication and sensor applications.

- Optical fibre design and fabrication
- Splices, connectors, and fibre coupling
- Fibre characterization and measurement techniques
- Fibre-based dispersion compensation
- Specialty optical fibres
- Highly nonlinear fibres
- Microstructure and photonic bandgap fibres
- Fibre-based devices (e.g., gratings, interferometers, sensors)
- Fibres for switching and nonlinear optical processing
- Propagation effects in fibres (including slow light)
- Nonlinear and polarization effects in fibres
- Raman, Brillouin, and parametric processes
- Optical fibre amplifiers
- Fibre lasers
- Supercontinuum sources
- Optical meta-materials

2) Waveguide and Optoelectronic Devices

This area focuses on the fabrication, performance testing, and reliability of devices and compo-nents used to generate, amplify, detect, switch, or process optical signals. Technologies include planar-waveguides, bulk-optics, and photonic bandgap structures based on various material systems.

- Optoelectronic devices: fabrication, integration, packaging, testing, and reliability
- Waveguide materials and fabrication
- Silicon Photonics
- Polymer waveguides
- Lithium Niobate devices
- Photonic bandgap devices
- MEMS-based devices
- Planar lightwave circuits (PLCs)
- Rare-earth doped waveguide amplifiers
- Semiconductor optical amplifiers
- Laser sources, detectors, and modulators
- Wavelength monitoring and wavelength locking devices
- Non-linear devices, regenerators, wavelength converters, and switches
- Dispersion compensation devices
- Polarization control and monitoring devices
- Optical performance monitoring devices
- Fixed or tunable filters and gain equalizers
- Reconfigurable Add Drop Multiplexer (ROADM) technologies
- On-chip optical communications
- Terahertz technologies
- Plasmonics

3) Subsystems and Network Elements for Optical Networks

This area focuses on the modelling, design, and implementation of optical, optoelectronic, or electrical subsystems and network elements for fixed or adaptive impairment mitigation, per-formance monitoring, add-drop multiplexing, and optical packet processing.

- Transmitter and receiver subsystems subsystems for direct detection and for coherent systems
- Multiplexing and demultiplexing subsystems
- Modulation and demodulation subsystems for single-carrier and multi-tone formats
- Optical and electronic signal processing and impairment mitigation techniques
- Subsystems for the emulation and compensation of linear and nonlinear impairments
- Coherent detection subsystems and algorithms
- Clock and data recovery
- Analogue-to-digital and digital-to-analogue conversion
- Forward error correction (FEC) techniques
- Performance estimation and performance monitoring techniques
- Performance of network nodes, of their technology and their design
- Subsystem aspects of reconfigurable add-drop multiplexers
- Optical regeneration and wavelength conversion subsystems
- Optical delays, optical buffering, bit-, and label-processing subsystems
- Chip-to-chip and optical backplane communication subsystems

4) Transmission Systems

This area focuses on the modelling, design, and implementation of optical fibre or freespace transmission links, highlighting system-level applications of subsystems and networking elements as well as system-level implications of physical impairments and impairment mitigation techniques. It further covers applications of quantum information technologies.

- WDM transmission system design, modelling, and experiments
- High-speed optical transmission systems
- Free-space optical communication systems
- Impact of fibre non-linearity on transport system performance
- System aspects of static and dynamic polarization effects (PDL, PMD)
- Implications of modulation formats, subcarrier multiplexing, and OFDM on system performance
- Implications of coherent detection on system performance
- System implications of digital signal processing and forward error correction (FEC)
- Transmission aspects of WDM system upgrades and mixed bit rate systems
- Application of optical and electronic fixed and adaptive impairment compensation schemes
- Transmission aspects in multimode fibre systems
- Quantum communication, quantum information, and quantum cryptography

ECOC 2009 Paper Topics

5) Backbone and Core Networks

This area focuses on the modelling, design, architecture, and scaling of optical WDM and packet-based backbone and metro-core networks, including control and management functions and protocols as well as the application of optical communication technologies in core networks. It also covers aspects of successful commercial deployments and transport field trials.

- Optical backbone and metro-core networks: Architecture, design, performance, control, and management
- Architectures of backbone and metro-core switches and routers
- Backbone network reliability and availability
- Protection and restoration
- Cross layer optimized network design
- IP-over-optical networks and architectures
- Optimization of converged optical network infrastructures
- Optical networking in the future Internet
- Optical packet/burst/flow switching networks
- Algorithms and protocols (e.g., routing, wavelength assignment, grooming)
- Architectures and solutions for content distribution applications (e.g., video)
- Support for end-to-end optical services across different network segments and width different QoS requirements
- Switching, protocols, and standards related topics for 100G Ethernet
- Backbone and metro-core network demonstrations and field trials
- Interoperability demonstrations
- Optical networks integrating grid computing and storage services
- Energy efficiency and power consumption of optical networks
- Techno-economic comparison between different backbone and metro-core network architectures and technologies

6) Access Networks and LAN

This area focuses on networking aspects of broadband optical access and local-area networks. It covers FTTx, passive optical networks, radio-over-fiber systems, hybrid wireless/optical solutions, and in-building networks. It also comprises successful commercial mass deployments, field trials, and applications of optical communication technologies in public, private and enterprise networks.

- Optical access systems: Architecture, design, performance, control, and management
- Optical access network experiments
- Access network demonstrations and field trials
- Access networks for commercial deployment
- Local area networks (LANs) at 10G and beyond
- Rack-to-rack optical communications
- Optical networks for automotive applications
- Optics in storage area networks (SANs)
- Multimode and plastic optical fibre systems
- Optical Ethernet access networks
- Fiber to the X (FTTx)
- Passive optical networks (PONs)
- Hybrid wireless-optical access networks
- Microwave photonics
- Analogue optical systems
- Multiple access techniques (e.g., code-division multiple access (CDMA))
- Interoperability demonstrations
- Access system reliability, availability, and security
- Techno-economic comparison between different access network architectures and technologies

Room: Hall E1

WS1: DSP & FEC: Towards the Shannon Limit

Chair: Dirk van den Borne, Nokia Siemens Networks, Germany; Takashi Mizuochi, Mitsubishi Electric Corporation, Japan
Contact: dirk.vandenborne@nsn.com

♦ With the recent advances in digital signal processing (DSP), coherent detection is currently living its second life in the world of fiber-optics. First generation transponders using coherent detection are coming to the market, and a significant amount of research is being invested in this area. With the rise of digital signal processing as an integral part of optical communication systems, most of the complexity is shifted from the optical/analogue to the electrical/digital domain. This will fundamentally change the way we should design our systems.
At the same time, new generations of WDM systems continue to increase the maximum capacity; either by reducing channel spacing or by increasing bit rates. This requires the use of state-of-the-art forward error correction (FEC) coding and de-coding in order to improve system margins and realize transmission over long-haul distances. In next-generation optical transmission systems, the design of DSP algorithms and FEC coding & decoding will most likely require a combined approach. This will give rise to a new level of complexity in algorithm design and implementation challenges that will be a major challenge for both industry and the research community.
In this workshop we will discuss DSP algorithms, FEC coding & decoding, as well as their mutual interaction in high-capacity long-haul optical transmission systems. The workshop will specifically address the implementation challenges that arise in such complex mixed-signal chip designs.

Part 1: Digital signal processing

The Digital Coherent Revolution
Seb Savory, University College London, U.K.
♦ The combination of digital signal processing and coherent detection is causing a revolution in optical transmission systems. We will briefly chart this revolution while outlining the salient features of a digital coherent transmission system before discussing the future challenges.

Frequency Domain Equalization without Guard Interval for High-speed Transmission.
Yutaka Miyamoto, NTT Network Innovation Laboratories, Japan
♦ Advantages of frequency domain equalization (FDE) are described for high-speed transmission at the channel rate over 100Gbit/s. We proposed and demonstrate novel FDE scheme without guard interval in high-capacity long-haul DWDM experiment.

Title TBD
Hiroshi Onaka, Fujitsu, Japan

Coherent Optical Systems - High-End or Commodity?
Bernhard Spinnler, Nokia Siemens Networks, Germany
♦ Will coherent receivers have replaced noncoherent systems in optical transmission in a few years? An attempt at future prospects.

Part 2: Forward error correction

Shannon Limits for Optical Communication
Gerhard Kramer, University of Southern California, U.S.A.
♦ Information theory gives the maximal rates for reliable communication for point-to-point and multi-point-to-multi-point channels. In this talk, we view an optical fiber network with K wavelength-division-multiplexing channels as a K-user interference network, and we review some old and new advances in coding for such channels. The question arises: can the sophisticated coding methods be implemented in optical networks?

Implementation of hard-decision FEC for next-generation 40G/100G transmission
Frank Chang, Vitesse, U.S.A.
♦ This talk will discuss the CI-BCH eFEC approach, providing an update on the latest 40G lab results, as well as to suggest options and theoretical performance capabilities of higher overhead ratios and stronger polynomials based on continuously interleaving method.

Reality check: Implementation of Soft-Decision FEC in a DSP LSI
Takashi Sugihara, Mitsubishi Electric Corporation, Japan
♦ Can we implement a soft-decision FEC having a net coding gain of >10dB?
What are the problems we should solve; e.g. LSI partitioning, multi-lane distribution, and metric generation. We will take a reality check and discuss issues of implementation.

Iterative Equalisation and Forward Error Correction (FEC)
Ralph Urbansky, University of Kaiserslautern, Germany
♦ Combining FEC coding and Viterbi-based equalisation allows to reduce considerably the influences of PMD, CD, system non-linearity and noise. Further improvements close to the channel capacity limit are achievable by iterative equalisation and FEC decoding, so-called turbo equalisation. These concepts can also be applied to coherent and OFDM fibre-optical systems.

Part 3: Challenges of high-speed mix-signal design

Hardware requirements for coherent systems beyond 100G
Timo Pfau, Alcatel-Lucent, U.S.A.
♦ In this talk the different options to realize a system supporting 400Gb/s are reviewed. Different modulation formats are compared in terms of reach and required hardware performance, and a possible implementation with today's state-of-the-art DSP is evaluated.

Reality check: challenges of mixed-signal VLSI design for high-speed optical communications
Ian Dedic, Fujitsu MicroElectronics, U.K.
♦ This talk will describe some of the problems encountered in actually realising such devices which may come as unpleasant surprises, rather than the more obvious -- and expected -- difficulties such as designing high-speed CMOS circuits.

System level trade-offs in the design of a coherent receiver
Chris Fludger, CoreOptics, Germany
♦ Advanced signal processing techniques that were previously only possible in low-speed radio transmission are now available for high data rate lightwave communications. Linear and non-linear distortion compensation can be effectively implemented using highly parallel architectures in low-cost CMOS signal processors. We discuss the design trade-offs of coherent receivers for 40 and 100G transmission.

Future perspectives of pure CMOS technology for coherent receivers
Bruce Beggs, Nortel Networks, Canada
♦ This presentation will review the CMOS technology roadmap and application to high bit-rate coherent optical systems. Challenges include design of higher-speed analog transducers (ADC & PLL), implementation of efficient DSP and FEC algorithms at realizable complexity/power levels, plus monolithic packaging in an ASIC.

13:00 - 14:30 Lunch break

Room: Hall E2

WS2: New Directions in Fiber Technology

Chair: Robert Lingle, Jr., OFS; David Richardson, University of Southampton
Contact: rlingle@ofsoptics.com

♦ As new fabrication technologies and optical materials have been introduced over the years, appealing estimates have been made for the ultimate limits of fiber properties such as attenuation, non-linearity (both min and max), micro- and macrobending losses, control of dispersion and slope, and birefringence. New technologies discussed in past years include non-silica materials, the application of high order modes, use of air holes as a design feature, as well as advances in solid fiber design.

This workshop will focus on
1) identifying where advancing the limits on fiber performance seems most useful for key applications and
2) understanding the current view of the theoretical and practical limits for realizing such improvements, with a view toward physical intuition. The workshop will focus on cabled fibers intended for DWDM transmission.

Key Topics to be Addressed
1. What is the long term benefit of reducing loss and increasing effective area?
2. Are there other breakthrough ideas to increase the capacity of fibers?
3. What are the fundamental and practical limits to fiber loss reduction?
4. What is the optimum strategy for reducing final, deployed cable loss?
5. How resistant can a fiber be made to cable effects?
6. What are the limits, fundamental and practical, to increasing effective area?
7. Is ultra large area fiber contradictory to minimum loss in cable?
8. What are the design tradeoffs in air core fiber?
9. Are current limits to air core fiber fundamental or potentially solvable?

What would be useful?

Impact of fiber properties on the capacity of optical networks.
Rene Essiambre, Alcatel-Lucent

Field fiber Challenges
Glenn Wellbrock, Verizon Labs

Carrier perspective
T. Sakamoto, NTT

What might be possible?
Prospects for low loss fiber
Scott Bickham, Corning

Coffee break at 11:15

Prospect for large effective area
Robert Lingle, Jr., OFS

Reducing cable loss effects
Pierre Sillard, Draka

Space Division/Mode multiplexing using multicore fiber.
Prof. Kokubun, Yokohama National University

Design trade-offs in air core bandgap fibers for telecoms applications
Francesco Polletti, Southampton

Loss mechanisms in hollow-core fibers
Jens K. Lyngso, NKT Photonics

Moderate Wrap-Up Discussion

13:00 - 14:30 Lunch break

Room: Hall F1

WS3: Optics in Computing - How much is not enough?

Chair: Keren Bergman, Columbia University; S. J. Ben Yoo, UC Davis
Contact:bergman@ee.columbia.edu, yoo@ece.ucdavis.edu

♦ What will be the role of photonics in future Computing? The phenomenal advances in computing technology over the past two decades were enabled by Dennard scaling, whereby the power efficiency, performance, and cost-effectiveness of silicon technology tracked Moore's Law improvements in integrating more devices on each chip. However, the electronic device feature sizes are rapidly approaching the atomic scale, and the 'power wall' has put future growth of the computing industry in jeopardy. Multicore has provided a temporary respite from stagnation of CPU clock frequencies, but creates daunting challenges to programmability, and drives today's system architectures towards extreme levels of unbalanced communication-to-computation ratios! It is
expected that computer chips in 2020 may contain 1000 cores with ultra high-density nanoscale devices exceeding 10 TeraFlops in performance. A 10 Teraflop chip would require an interconnect bandwidth of 100 Tb/s for a balanced architecture. This is twenty times larger than the average 5 Tb/s Internet traffic in the U.S. today!
Photonic interconnects offer a disruptive technology solution that fundamentally changes the computing architectural design considerations towards a new generation of extremely energy-efficient and balanced computing systems. Today's optical interconnects already exist in board-to-board, and rack-to-rack communications. What is next? Will it penetrate into inter-chip and intra-chip communications? How will optical reconfiguration help computing? What will computing look like twenty years from now? This workshop will discuss the role of optics in computing of the future.

Opportunities and stumbleblocks for optics in servers
Ronald Luijten, IBM Zurich Research Laboratory, Switzerland
♦ The successful commercial deployment of optical technology inside servers has not happened yet. Using an example of how optical technology could address one of the key current challenges called the memory wall, I will show which obstacles this technology must overcome from a technical and ecosystem point of view to be selected.

Optics and the Exascale Datacenter
Moray McLaren, HP Laboratory, Bristol
♦ Optical technologies are the key to delivery the higher bandwidth and lower power interconnect required for future high performance computer systems. However to exploit the full promise of the technology we need to re-evaluate computer architectures to exploit the capabilities of optical interconnect.

Bonded photonic structure incorporated into a chip
Keishi Ohashi, Masafumi Nakada, MIRAI-Selete and NEC Corporation; Takahiro Nakamura, NEC Corporation
♦ One of the merits to introduce optical interconnects is to eliminate repeaters in electrical interconnects. The transition point from electrical to optical should be determined to achieve the highest cost performance. Several bonding structures of optical interconnection layers with LSI chips will be reviewed and discussed in the session.

Nano-scale silicon photonics for energy efficient interconnection networking in Exascale systems
Keren Bergman, Columbia University, New York, USA
♦ As chip multiprocessors scale to increasing numbers of cores and commensurate on-chip computational power, the gap between the available off-chip bandwidth that is required to appropriately feed the processors continues to widen under current memory access architectures. We examine how silicon nano-photonics offers significant benefits to problems related to off-chip signaling in three key areas of communications distance, bitrate transparency, and bandwidth density.

A photonic architecture for high-speed interconnects
H.J.S. Dorren, Technical University Eindhoven, the Netherlands
♦ A photonic packet based Clos-architecture is investigated for board-to-board or rack-to-rack interconnects where low latency is key issue. It is shown that this architectures is scalable to a large number of nodes, and is capable to resolve packet contention in the wavelength domain at the expense of low latency and packet loss. Sub-systems and devices that support such architecture are presented.

Room: Hall F1

WS3: Optics in Computing - How much is not enough? Continued

Active Photonic Routing for Computer Interconnects
Ian White, Cambridge University, UK
♦ Computing power is growing rapidly and placing more rigorous demands on low cost transmission technologies for short distance links. In recent years, however, a range of photonic technologies have been studied not only to allow high speed point-to-point links, but also to form networks within computers. Such technologies have grown to accommodate both routing and switching functionality. In this paper, we will present recent studies of components and subsystems which have been developed specifically to enable routing and switching. In terms of routing, we will review the performance of a high capacity backplane able to provide Tb/s aggregate shuffle routing and be directly integrated with active components on a printed circuit board. We will then extend the presentation to describe recent work on forming active optical crosspoint switches which have both uncooled performance and also high port count.

Electro-optical packaging trends for computing applications
Bert Offrein, IBM Zurich Research Laboratory, Switzerland
♦ New intra-system interconnect technologies will be required to continue the performance scaling of computing systems. Optical interconnects offers several advantages compared to established electrical links such as a higher bandwidth density and power efficiency. Challenges, options and trends for the assembly of intra-system optical links will be reviewed and discussed.

Semiconductor Nanowire Heteroepitaxy on Arbitrary Substrates for Optoelectronic Devices and Massively Parallel Interconnects
M. Saif Islam, Logeeswaran VJ, Ramin Banan Sadeghian, Sonia Grego, Linjie Zhou and S. J. Ben Yoo, Department of Electrical & Computer Engineering, University of California, Davis, USA
♦ This talk will present an overview of semiconductor nano-heteroepitaxy for massively parallel interconnects and mass-manufacturable integration of nanowires in devices and systems. A novel method for integration of devices based on transferring semiconductor nanowires from the growth substrates to flexible and non-crystalline target surfaces for low cost, highly efficient and high-speed optoelectronics ad interconnects will also be presented.

Optical RAM: A Solution Path to True Optical Packet Switching
Ken-ichi Kitayama, Osaka University, Japan
♦ Progresses of a government-supported R&D program, aiming at all-optical RAM buffer will be presented. Focuses are on nano-structured optical bit memory for RAM, the optical interfaces such as serial/parallel converter and optical addressor as well as architecture design of optical packet switch with small-size buffers and the performance evaluation.

"Macrochip" Computer Systems Enabled by Silicon Photonic Interconnects
John E. Cunningham, Sun Microsystems, USA
♦ We present a new computing system that leverages the bandwidth, density, and latency advantages of silicon photonic interconnects to enable highly compact but scaleable supercomputer systems. Our optically enabled "macrochip" is a set of contiguous, optically-interconnected chips enabled by wavelength-division multiplexed (WDM) based silicon photonics and Optical Proximity Communications. However, a macrochip requires advancement in the state of the art in optical device technology as well as new approaches to chip packaging that we discuss.

Room: Hall G

WS4: How much Energy Efficiency Can we Achieve in Next Generation Core Networks and Switches?

Chairs: Marina Thottan, Alcatel-Lucent; Dirk Breuer, DT
Contact: marinat@alcatel-lucent.com; D.Breuer@telekom.de

♦ This workshop aims to address a wide range of issues that affect the energy efficiency and scalability of core networks and switches. The impact of core network traffic trends (the increasing prevalence of real time interactive applications and the use of cache based network services) on energy consumption and their impact on network and switch architectures will be discussed. These trends will be understood in the context of what is possible today in terms of scaling electronic routers both in terms of capacity as well as power consumption / dissipation. The application of optical technologies to circumvent power issues as well as the possibility of optical networks assuming additional core network functionality will be explored. The goal is generate an exciting debate among service providers, content providers, vendors (both optical and IP) as well as chip suppliers regarding the evolution of the next generation core network.

Energy-related Aspects in Backbone Networks.
Christoph Lange, Deutsche Telekom
♦ The Internet traffic growth leads to a rising energy consumption of backbone networks. The layer 3 backbone network equipment consumes significantly more energy than the associated optical transport network. Appropriate systems, components and network architectures have to be implemented in order to design reliable and energy efficient backbone networks.

Rationalizing Core Transport Network Evolution
Vishnu Shukla, Verizon

N.N.
Pete Magill, AT&T

Scalability issues of the new Photonic backbone of Telecom Italia
Marco Schiano, Telecom Italia

N.N.
Vijay Gill, Google

Scaling Networks considering Power Trends
Oliver Tamm, Alcatel-Lucent
♦ This talk will provide a view into technology evolution issues of networking systems versus capacity trends including power profiling of networking functions and will explore options to address network scaling.

ICT Networking Energy Footprint and Opportunities
Loukas Paraschis, Cisco
♦ The global energy consumption of the ICT networks has remained relatively small (2-3%) despite the significant global IP traffic growth (> 50% CAGR), but it has been growing primarily due to growth in the access networks, and the data-center computationally-intensive applications. Therefore, IC and optical technology and architectural advancements are needed to contain its energy footprint. At the same time, "smart" networking promises significant (> 10%) improvements in the overall energy consumption, primarily from advancements in "smart-grid" power distribution, transportation, and buildings.

N.N.
David Welch, Infinera
♦ The amount of electrical power consumed by Information and Communication Technology (ICT) systems is increasing dramatically. Modern photonic integrated circuits (PICs), which integrate multiple optical subsystems on a single chip, greatly reduce the power consumption, heat generation, and space requirements for optical transport equipment not only on a nodal basis but on a network basis, thereby yielding significant OpEx and CapEx savings. Our presentation will explore the parameters driving power consumption and related costs in optical networks and will outline how photonic integration can reduce overall power consumption while reducing the space requirements for optical networking equipment.

Towards a scalable and flat IP core network
Thomas Thiemer, Nokia Siemens Networks
♦ The mismatch between traffic growth and router technology improvements will force architectural changes in larger IP backbones. Flat core architectures and other changes help to improve scaling and optimise capex as well as opex (power consumption).

Hybrid Optoelectronic Router
Ryohei Urata, NTT Photonics
♦ An optimum combination of optical and electrical technologies will be critical for realizing a packet-switched network. At NTT, we are currently developing a hybrid optoelectronic router that combines all-optical and optoelectronic devices with CMOS electronics to effectively reduce power consumption, size, and latency of the node while at the same time, maintaining the ability to support various IP-related services. In this presentation, we will describe the router and its key optical/optoelectronic devices which allow the label processing, switching, and buffering of high-speed asynchronous arbitrary-length optical packets.

N.N.
Andreas Brandt, Fujitsu

Development Challenges of Energy-Efficient Core Network
Alex Vukovic, CRC Canada
♦ Energy consumption model of core network is developed. Model identifies the most critical network functionalities from an energy-use standpoint. It sheds a light on potential developments which could lead towards scalable and more energy efficient core networks based on reduced power consumption and innovative network architectures.

13:00 - 14:30 Lunch break

Room: Hall E1

WS5: 100 Gb/s - How, Where, When?

Chair: Jörg-Peter Elbers, ADVA AG Optical Networking; Glenn Wellbrock, Verizon Business
Contact: jelbers@advaoptical.com, glenn.wellbrock@verizon.com

♦ With bandwidth demand continuing to grow, operators, system vendors and component manufacturers are preparing themselves for the move to 100Gb/s. How, where and when this move will happen is subject of a lively debate. This workshop will report on the latest status of relevant IEEE, ITU and OIF standards and bring people from industry and academia together sharing their views.

- Which technologies will be used & which optical performance can be expected?
- In which network area will 100 Gb/s first be introduced?
- When is the 100 Gb/s introduction likely to happen?
- Which will be the market drivers for 100 Gb/s rollout?

These are the questions to which this workshop wants to stimulate answers and discussions.

Market overview and Outlook for 100G
Dana A. Cooperson, Ovum RHK
♦ This talk will provide a look at the commercial status and prognosis for 100G. Topics will include market linkages between 40G and 100G; client vs. network interfaces; deployment drivers and impediments; and outlook going forward.

100G as infrastructure - A carrier's view
Yutaka Miyamoto, NTT Innovation Labs
♦ This talk focuses on the long-haul network serving as an infrastructure for a carrier's operation, and introduces the carrier's view on the requirements of 100G transport. Technical aspects will be discussed along with a realistic roadmap and some gaps in the requirements.

100G in Data-center Interconnects: When, Where?
Bikash Koley, Google
♦ This presentation focuses on the trade-offs associated with choices of various optical interconnect speeds and technologies to build data-center interconnect architectures. Such interconnects can be very short-distance or may span large geographical distance connecting several data-centers. The sweet-spot for application of 100G technology in such applications is presented.

Long-haul 100G transmission: the system vendor challenge
Dirk van den Borne, Nokia Siemens
♦ A 100G ecosystem is rapidly taking shape within the telecommunication industry, and this provides both challenges and opportunities to everybody. In this talk we will discuss the 100G challenge from a system vendor perspective: what does it take to turn promising transmission research on 100G into a cost-effective commercially feasible product.

100G in router networks: Opportunities and Challenges, Risks and Rewards
Luc Ceuppens, Juniper
♦ This presentation will discuss the initial 100GE applications targeted by service providers. We will also look at the challenges of being first to market with a 100GE interface and the technology trade-offs that need to be made. We will also evaluate the critical success factor for early adoption and continued successful ramp-up.

Cost and Performance Optimization of 100Gb/s DWDM Line Side Modules
Ross Saunders, Opnext
♦ Coherent and next-generation FEC technology will deliver 100Gb/s DWDM performance that meets key carrier requirements. The quantum leap in performance does not come without significant increases to the photonic/electronic design complexity. This talk will discuss how we can attack the cost side of the ledger, without sacrificing performance gain.

100G Client Interfaces
Chris Cole, Finisar
♦ The presentation will describe 100G Client Interface applications, specifically 1) intra-rack card interconnect, 2) inter-rack card interconnect, 3) data center switch to switch interconnect, 4) central office router to router/transport interconnect, 5) metro router to router interconnect. Technologies and architectures for these interfaces as well as relevant standards will be explained.

Room: Hall E2

WS6: Installing Fibre in the Access Network: Experiences and Remaining Challenges

Chair: Hartwig Tauber, FTTH-Council Europe; Russell Davey, British Telecom
Contact: russell.davey@bt.com

♦ Optical access is now being deployed around the world. Despite lots of work on standardisation of the network equipment , there are a range of different technologies being deployed : point-to-point, active Ethernet, GPON, GE-PON, FTTCab/FTTNode, HFC. It seems there is currently no one right answer. While most ECOC presentations on the topics focus on the network equipment, the cost of installing the fibre infrastructure is actually the dominant cost. In this workshop companies from around the world will describe their optical access deployments with a focus on the following questions:

1) How do they install the fibre infrastructure into the access network?
2) Why have they chosen the particular network technology (point-to-point, PON etc)?
3) What technology do they use for in-home network?

14:30: Japanese FTTH deployment and experiences for more than 10 million subscribers
Masahito Arii, NTT

14:50: Verizon's FTTP deployment
Glenn Wellbrock, Verizon

15:10: Experiences and considerations on fibre installation and fibre managing challenges in the access network
Erik Weis, DT

15:30: Point-to-point optical access deployment - 1
Martin Bruckner and Peter Höbarth: FTTH-network St. Martin - Großschönau

15:50: Coffee Break

16:05: Point-to-point optical access deployment - 2
Frans-Anton Vermaast, i-nec

16:25: Use of POF in home network
Olaf Ziemann, POFAC, University of Applied Sciences Nürnberg

14:45: The role of blown fibre technology in the access network
Jason Pedder, OFS

17:05: Discussion and panel: "What are the key areas for improvement in the future to allow optical access to be deployed to everyone?"

17:30: End of the workshop

18:00 - 20:00 Get Together Reception (Lobby ACV)

Room: Hall F1

WS7: Monolithic and Hybrid Photonic Integrated Transceivers for Advanced Modulation Formats

Chair: Chris Doerr, Alcatel-Lucent; Yoshinori Hibino from NTT
Contact: crdoerr@alcatel-lucent.com

♦ Advanced modulation formats are a powerful means for squeezing more information into a given bandwidth for transmission through optical fiber. In turn, photonic integrated circuits are a powerful means for realizing transmitters and receivers for advanced modulation formats. This workshop will explore various integration approaches, both monolithic and hybrid, and the many possible material platforms, including glasses, group III-V materials, group IV materials, and lithium niobate.
We will dig down to the bones and sinews of these approaches, exposing their strengths and weaknesses, answering questions such as which technologies may have the lowest cost? Which may consume the lowest power? Which may have the smallest footprint? Which are likely to be stepping stones and which are likely to last?

Digital coherent technologies
Andreas Leven, Bell Labs., ALU

100G transceiver technologies
Jin Hong, Opnext

Standard actives in OIF
Matt Traverso, Opnext

Advanced modulation formats
T. Kawanishi, NICT

PLC-based integrated devices for advanced modulation formats
Y. Inoue, NTT Photonics Labs

Monolithic devices for advanced modulation formats
Chris Doerr, Bell Labs., ALU

PIC technologies for advanced modulation formats
David Welch, Infinera

High speed detectors
A. Umbach, U2t

InP-based modulator technologies
M. Kikuchi, NTT Photonics Labs

InP agile transmitters and receivers
Ben Yoo, U. C. Davis

PLC-based hybrid integration devices
Tony Ticknor, Neophotonics

Duobinary transceivers
Robert Blum, JDSU

Room: Hall G

WS8: Multi-Layer Dynamic Transport Networks Enabling Rich Bandwidth Services

Chair: Vishnu Shukla, Verizon; Hans-Martin Foisel, Deutsche Telekom
Contact: vishnu.shukla@verizon.com , H.Foisel@telekom.de

♦ Dynamic transport networks, based on ASON-GMPLS control planes, are being deployed in carrier networks to meet growing data and video bandwidth needs efficiently and economi-cally. NG transport network integrating optical and layer 2 protocols are becoming available from system providers. Seamless interworking of control planes of multi-layer transport networks will be critical to support end to end provisioning.
This workshop will provide an overview of multi-layer control plane protocols, technologies and evaluations in progress at various labs. Examples of technologies such as Layer 1 (OTN) and Layer 2 (PBB-TE, MPLS-TP) next generation networks will be considered in detail. Also included will be insights into the work conducted by the OIF (Optical Internetworking Forum) to enable end to end, dynamically provisioned carrier-grade broadband services.

14:30 Introduction and Overview of OIF Interoperability Activities
Hans-Martin Foisel, Deutsche Telekom , Germany

14:55 Packet Transport: EVPL over Layer1 Transport Technologies
Yoshiaki Sone, NTT, Japan

15:20 Packet Transport: EVPL over MPLS-based Transport Technologies
Roberto Sabella, Ericsson, Italy

15:45 - 16:15 Coffee break

16:15 Packet Transport:EVPL over PBB-TE Transport Technologies
Gint Atkinson, Ciena, USA

16:40 Application of OIF UNI 2.0 to new Transport Network Technologies
Vishnu Shukla, Verizon, USA

17:05 Multi-Domain Restoration
Gert Grammel, Alcatel-Lucent, Germany

17:30 End

18:00 - 20:00 Get Together Reception (Lobby ACV)

Room: Hall F2

WS9: Quantum Information Technologies

Chairs: Thomas Jennewein, University of Waterloo, Canada; Paul Toliver, Telcordia Technologies, USA
Contact: thomas.jennewein@univie.ac.at; ptoliver@research.telcordia.com

♦ Quantum cryptography, or actually quantum key distribution (QKD), is the most mature application of the quantum information technologies. The first practical protocol, called BB84, was invented in 1984 and the key exchange between distant users is safeguarded by transmitting single quanta. Since then there have been many theoretical and experimental advances of QKD protocols, and the first commercial systems are already on the market. However, quantum cryptography presently faces challenges before it can achieve widespread deployment.

1) There are the technological questions, such as how to extend distances beyond metro-scale reach as well as determining which physical implementation might provide the best performance.

2) There are the questions on the commercial side, such as identifying possible markets for quantum technologies and specifying the relevant performance criteria that might be required by IT-security markets.

This workshop will foster discussions on these questions. Several keynote speakers coming from diverse areas will each briefly present their individual viewpoints, plus additional time will be reserved for questions and discussions. By bringing together relevant institutions from Industry and Academia, we plan to gain unique perspectives on future directions for QKD and its application to securing real-world networks.

Introduction to QKD
Organizers
We will briefly present the history and background of quantum key distribution (QKD), and highlight the most important developments it has seen. This will provide a baseline for the state-of-the-art achievements presented in this workshop.

Quantum Key Distribution over Telecom Networks
Hugo Zbinden, University Genve
♦ QKD has been demonstrated over up to 250 km of ultra low loss (dark) fibre in the lab. Here, we discuss the combination of the quantum channel and data traffic using a single fibre and WDM. Recent experimental results with a commercial QKD and encryption system are presented.

Practical Megabits/s Quantum Key Distribution
Z. L. Yuan, A. R Dixon, J. F. Dynes, A. W. Sharpe, A. J. Shields, Toshiba Labs
♦ We show that InGaAs/InP avalanche photodiodes (APDs) offer a practical and cost-effective solution to high speed single photon detection in high-bit-rate quantum key distribution. Operated with a circuit that compares the output with that in the preceding period, InGaAs APDs allow high count rate (500 MHz), efficient (10-25%), low-noise (10-6-10-5 per gate) single photon detection with a repetition rate exceeding 1 GHz. Applied to quantum key distribution, the secure bit rate has exceeded 1 Mb/s for a 20km fibre link and remained at 10 kb/s for 100km. The same device has also been applied to an ultra-long distance (200km) entanglement distribution. Our results pave the way towards a high bit-rate quantum key distribution network at low cost.

Optical Networking for Quantum Key Distribution and Quantum Communications
Thomas Chapuran, Telcordia
♦ Optical-layer networking can significantly extend the applicability of quantum communications by moving beyond dedicated point-to-point optical links, and by sharing fiber with conventional traffic. We demonstrate many of the fundamental capabilities needed, and describe an architecture with the flexibility and scalability likely to be critical for widespread deployment of quantum applications.

Title: TbA
Christian Illmer, ADVA Optical
♦ The presentation will cover the question of commercial and technical requirements a sellable QKD solution would have to fulfill in order to integrate with a WDM system. Starting with the enterprise application environment the author will try to highlight important aspects like power budget, size, relative costs, OA&M interfaces, etc.

Does QKD fit to the WDM world?
Misha Brodsky, AT&T
♦ I will start by discussing feasible multi-user QKD architectures. Then by examining the specifications of existing telecom components I'll touch upon some limitations that WDM environment imposes on quantum key distribution systems. As few examples, we will consider the coincidence rates of photon pairs separated by a wavelength selective switch in various WSS configurations.

A possible role of QKD in photonic networks
Akihisa Tomita, ERATO-SORST, JST
♦ The attacks on photonic networks may not be limited to the secrecy of the messages carried by the network.
The talk will consider potential attacks to the photonic networks, and show possible solutions offered by QKD.
Research issues on combining QKD with the photonic networks will also be discussed.

A quantum of security
Werner Stein, Inforserve GmbH
♦ We will have a look at the commercial status regarding the use of quantum effects in computer technologies. Topics will include quantum computing, quantum key distribution and quantum key generation, coming from theory to real live applications. We will discuss existing and future easy ready to use solutions for service providers.

QKD in ETSI
Gaby Lenhart, ETSI, the European Telecommunication Standards Instite
♦ ETSI, the European Telecommunication Standards Institute, is the home of the QKD ISG, where ETSI Group Specifications describing quantum cryptography for ICT networks are developed. This standardization group brings together experts from industry, research and academia from different continents, who are specifying all relevant issues of QKD networks, such as use cases, security requirements and proofs, components, interfaces,etc.

Open discussion - Future developments of quantum technologies
Organizers
The final minutes of the workshop will be dedicated to an open discussion concerning the future develepments of quantum technolgies, such as its markets, technology and acceptance. We will pose a series of open and challenging questions to all participants in the workshop, also with a strong invitation to the audience to bring in questions and join the discussions.

18:00 - 20:00 Get Together Reception (Lobby ACV)

The Rise of Exaflood Optics"

George Gilder, *President of Gilder Publishing, LLC, Chair of George Gilder/Forbes Telecosm Conference*

Abstract

Optics is now in its exaflood stage: with hundreds of exabytes of data swarming around worldwide webs of glass and light. An exabyte is 10 to the 18th, a billion gigabytes, a million billion big books of text or fifty thousand textual Libraries of Congress, enough to satisfy the reading needs of the world's population for a century. Or one exabyte is just a hundred million high definition movies, hardly enough to satisfy a million teenagers for a year. For the past two decades has raged a war between the rise of Exaflood optics with its video tides and the persistence of a communications infrastructure based on vocal and textual trickles. The trickleware has all gone mobile and wireless. Today the planetary utility of optical glass increasingly carries high definition images, virtual worlds, games, and telephonic telepresence, in a global sensorium, pushing the system toward the Zettabyte era of 10 to 21st. This requires a new optical architecture. It's first manifestations are inclement and cloudy for the industry. Most optics companies are following an uncreative, modular strategy, fitting components into existing systems. The real opportunity in optics is to create entirely new systems that adapt to a new age of optical entanglement appropriate to the age of telepresence. Don't solve problems, pursue opportunities.

Biography

George Gilder is the founder and president of Gilder Publishing, a technology research and consulting company specializing in telecom and semiconductors. A consultant to America's leading technologists in business and academia for nearly three decades, he offers expertise in fiber-optic, wireless, networking, and semiconductor technologies, including network processors, memory chips, FPGAs, ASICs, imagers, WDM, CDMA, Wi-Fi, WiMax, fab equipment and processes, media processors, analog and mixed-signal chips, data and storage centers, and user interface technology.
Gilder also hosts the Gilder Telecosm Forum, an online community where hundreds of investors, entrepreneurs, engineers and money managers gather daily to share investment advice and debate technology, investing, economics, politics and finance.

A graduate of Harvard University, Gilder co-authored The Party That Lost Its Head, and served as a speechwriter for Nelson Rockefeller, George Romney, and Richard Nixon. In the 1970s, Gilder began an excursion into the causes of poverty, resulting in his books Men and Marriage (1972); Visible Man (1978); and Wealth and Poverty (1981). His later investigation into wealth creation led to a deeper examination of the lives of entrepreneurs, culminating in The Spirit of Enterprise (1986) and Microcosm (1989). A subsequent book, Life After Television, was a prelude to his book on the future of telecommunications, Telecosm (2000).

In his latest book, The Silicon Eye (2005), Gilder shares his inside knowledge of Silicon Valley and illustrates how the unpredictable mix of genius, drive, and luck that can turn a startup into a Fortune 500 company.

The Coming Capacity Crunch

Andrew Chraplyvy, *Bell Labs, Alcatel-Lucent*

Abstract

Over the past 20 years, principally enabled by wavelength-division multiplexing (WDM), fiber-optic transport capacities have been growing exponentially. As a result of world-wide R&D in the optical communications field, the capacity per fiber has increased at a rate of 100 every 10 years reaching 32 Terabits/ second in recent research demonstrations and several Terabits/ second in commercial systems. Associated with this remarkable growth was an important reduction in the cost per transmitted bit and also in the power consumption per bit.

Because the transmission capacity of optical fibers was seemingly limitless, the unabated exponential growth of demand was viewed as lucrative business opportunities by carriers, service providers, and equipment manufacturers alike. However recent information-theoretic studies have concluded that the capacity of conventional fiber optic systems is not as limitless as had been thought, and in fact that the "end" could be in sight. Scientists and engineers are now struggling to squeeze the last few doublings of capacity out of optical fibers using a variety of techniques, in particular by implementing complex modulation formats. But what then?

Biography

Andrew Chraplyvy received the B.A. degree in physics from Washington University in St. Louis, and the MS and PhD degrees in physics from Cornell University. He is Optical Transport Networks Research Vice President at Bell Labs, Alcatel-Lucent. Dr. Chraplyvy is a Bell Labs Fellow, a member of the National Academy of Engineering, a Fellow of the Optical Society of America, and a Fellow of the IEEE.

Quantum Information: The next frontier

Prof. Anton Zeilinger, *Vienna University*

Abstract

For a long time the conceptually challenging predictions of quantum physics for individual experiments have been the issue of such bizarre discussions as Schrödinger's cat gedanken experiment.

There, quantum superposition would imply the co-existence of the states of a live cat and a dead cat, quantum randomness would imply the fundamental unpredictability of the results of an observation of the cat's real and factual properties, and entanglement means that the state of the cat, dead or alive, is entangled with the state of an radioactive atom.

Interestingly these same concepts, randomness, superposition, and entanglement, have become cornerstone concepts in a new quantum information technology. The most important applications are quantum cryptography, quantum computation, and quantum teleportation.

Quantum cryptography permits the encoding of confidential information in a way that its security against eavesdropping is guaranteed by the laws of physics. A quantum computer would be able to operate in a quantum superposition of many different states thus enabling exponential speedup for some problems. Quantum teleportation allows transferring directly the quantum state of an individual system onto a distant one thus providing an ideal way for quantum computers to communicate with each other.

Biography

In the 1970s, Anton Zeilinger started his work on the foundations of quantum mechanics in Vienna with neutron interferometry. These experiments included confirmation of such phenomena as the sign change of a neutron's quantum state upon rotation, precision tests of the linearity of the Schrödinger equation, and many other fundamental tests.
Going beyond single-particle phenomena, Zeilinger became interested in quantum entanglement, where his most significant contribution is the discovery of what is today called "GHZ states" and their experimental realization. These were the first instances of multi-particle entanglement ever investigated. Such states have become essential in fundamental tests of quantum mechanics and in quantum information science.
Since then, Zeilinger has performed many experiments with entangled photons, including quantum teleportation, quantum cryptography, all-optical one-way quantum computation and a number of quantum gates.
In single-particle interference, he has performed a number of experiments in atom interferometry and in quantum interference of large molecules, like C60 and C70. These included very detailed studies of quantum decoherence.

The most important stages in the career of Anton Zeilinger include the Technical University of Vienna, M.I.T., the Technical University of Munich, the University of Innsbruck, the Collége de France, the University of Vienna and the Austrian Academy of Sciences. He is currently Professor of Physics at the University of Vienna and Scientific Director at the Institute for Quantum Optics and Quantum Information IQOQI of the Austrian Academy of Sciences.

Monday September 21, 14:00 - 15:00

Tutorial: FTTH Deployments Options and Economic Challenges

David Payne, University of Swansea, United Kingdom

Abstract

Fibre to the premises has been studied for over three decades but only in the last few years have the beginnings of significant deployments occurred. The major deployments have been in Japan and Korea where IEEE EPON has dominated. In the US ITU BPON and now GPON dominate. In Europe several technologies have been used for a range of relatively small deployments (compared to Japan and Korea). FTTCabinet is an expedient option but is this just delaying full FTTP? R&D is being focussed on static WDM PON but is this best use of the precious wavelength domain? FTTP has the potential for very high bit rate service delivery driving huge bandwidth into the network but is such growth economically viable? Power consumption and carbon footprint are hot topics what are the green solutions? This tutorial will address these questions and look at the architectural options for a viable FTTP future.

Biography

Dave joined BT labs in 1978 working on single-mode fibre splicing and connectors, development of fused fibre couplers and FTTP.
Dave wrote the first internal paper on shared access networks in 1983. He co-invented TPON the first Passive Optical Network, then moved to amplified PONs culminating in 1991 in an experimental 50 million way split, 500km range PON carrying 16 x 2.5Gb/s wavelengths.
In the latter 1990's he moved into business and traffic modelling examining the drivers and economic justification for large-scale deployment of FTTP.
From 1999 Dave led BT's optical research activities and was awarded the Martlesham Medal for his contribution to optical access networks in 2005.
From 2007 he was "Principle Consultant on Optical Networks" working on extended reach PONs for very low cost FTTP solutions.
In September 2007 he took early retirement from BT and is now with the Institute of Advanced Telecommunications at Swansea University.

Monday September 21, 16:15 - 17:15

Tutorial:
Fundamentals of Coding and Modulation

Gerhard Kramer, University of Southern California, USA

Abstract

This tutorial provides an introduction to coding and modulation from a communications engineer's point of view. The tutorial reviews information-theoretic concepts such as channels, channel capacity, modulation sets for Gaussian-noise channels, and spectral efficiency. Coding-theoretic concepts are treated next, including linear block codes, low-density parity-check codes, and hard and soft-decision decoding. The focus is on broad insight rather than detailed design. The tutorial concludes by showing how this insight was recently applied to determine a lower bound estimate on optical fiber capacity.

Biography

Gerhard Kramer received the B.Sc. and M.Sc. degrees in Electrical Engineering from the University of Manitoba, MB, Canada in 1991 and 1992, respectively, and the Dr. sc. techn. (Doktor der technischen Wissenschaften) degree from the ETH Zurich, Switzerland, in 1998. From July 1998 to March 2000, he was with Endora Tech AG, Basel, Switzerland, as a communications engineering consultant. From May 2000 to December 2008 he was with the Math Center at Bell Labs, Murray Hill, NJ. Since January 2009, he has been with the University of Southern California (USC), Los Angeles, CA, where he is a Professor of Electrical Engineering. His research has been focused on information theory, communications theory, coding and modulation, iterative decoding, and cooperative communications.

Tuesday, September 22, 09:15 -10:15

Tutorial: Nanophotonics: Dressed Photon Technology for Innovative Optical Devices, Fabrications and Systems

Motoichi Ohtsu, The University of Tokyo, Japan

Abstract

This tutorial reviews recent progress in nanophotonics, a novel optical technology proposed in 1993 by the author. Nanophotonics utilizes the local interaction between nanometric particles via optical near fields. The optical near fields are the elementary surface excitations on nanometric particles, that is, dressed photons that carry the material excitation. The principles of device operation are reviewed considering the excitation energy transfer via the optical near-field interaction and subsequent relaxation. The operations of logic gates, an optical nano-fountain, a nano-coupler, a pulse generator, a nonadiabatic light emitter, etc. are described as well as their single photon emission and extremely low power consumption capability. Experimental results using quantum dos at the room temperature are described. Using a systems-perspective approach, the principles of content-addressable memory for optical router, a multilayer memory retrieval system, etc. are demonstrated. Application to nonadiabatic lithography, etching, etc. are also reviewed.

Biography

Motoichi Ohtsu received the Dr. E. degree from the Tokyo Institute of Technology in 1978. From 1986 to 1987, he joined the Crawford Hill Laboratory, AT&T Bell Laboratories. In 1991, he became a Professor at the Tokyo Institute of Technology. In 2004, he moved to the University of Tokyo as a professor, and was appointed the director of the Nanophotonics Research Center. He has been the leader of national projects on nanophotonics. He has written over 420 papers and received 87 patents. He is the author, co-author, and editor of 51 books. In 2000, he was the President of the IEEE/LEOS Japan Chapter. He was an executive director of the Japan Society of Applied Physics. His main field of interests are the nanophotonics and dressed photon technology. He has been awarded 14 prizes including the Japan Royal Medal with a Purple Ribbon from the Japanese Government in 2004.

Tuesday, September 22, 14:30 - 15:30

Tutorial: Core Photonic Networks - Where Are Things Heading?

Peter D Magill, AT&T Labs - Research, USA; Robert Doverspike, AT&T Labs - Research, USA

Abstract

Telecommunications carriers are under great economic pressure to keep their core networks cost effective. To address that, they need to keep reducing the cost-per-bit in the core IP routers and switches as well as the optical transport network which interconnects them. We will discuss the resulting desires for the transport technologies and temper those with Capacity Crunch issues. We will then explore alternate network architectures to better utilize the transport resources. These will include consideration of the pros and cons of a sub-wavelength grooming layer between the Layer 2/3 routers and Layer 1 transport. We will then describe ways to make the "ROADM" layer truly reconfigurable (remotely reconfigurable) and its value.

Biography

Peter Magill received his B.S. in Physics from the University of Dayton, Ohio in 1979 and his Ph.D. in Physics from the Massachusetts Institute of Technology in 1987. He joined AT&T Bell Labs a month later; working at the Crawford Hill Lab on the characterization of advanced lasers, optical access networks and data-over-cable access protocols. He then went with Lucent Technologies as it was spun out of AT&T in 1996, to head their access research department. He managed the R&D of passive optical network (PON) systems and cable modem headend equipment. In 2000 he returned to AT&T and is now Executive Director, Optical Systems Research in Middletown, NJ concerned with advancing fiber communication technologies for the entire network (inter-city, metro and access) including 100 Gb/s transmission systems and dynamic wavelength networks. Since 2007 he has also been working on assessing, with a goal of reducing, AT&T's electricity consumption

Tuesday, September 22, 16:45 - 17:45

Tutorial: Optical Signal Processing: The Roadmap towards High-speed Optical Packet/Burst Switching

Masash Usami
KDDI Corporation, Japan

Daniel J. Blumenthal
UCSB, USA

Abstract

The current explosion in capacity of optical systems and data storage, processing and routing has created a major problem with scaling traditional electronic-only systems in terms of power and footprint. During the last decade there has been significant progress in optical burst and packet switching. In this tutorial we will cover the fundamentals and basic approaches, techniques and underlying technologies for optical packet and optical burst switching. An overview of the latest in state of the art in systems and devices as well as demonstrators in the US and JAPAN will be covered.

Biography

Daniel J. Blumenthal is a Professor in the Department of ECE at UCSB. He is Director of the LASOR project, funded by the DARPA/MTO, and serves on the NLR Board of Directors and the Internet2 Architecture Advisory Council. He is co-founder of Calient Networks and Packet Photonics, LLC, has co-authored over 300 papers, one book and holds 7 patents. Dr. Blumenthal is Fellow of the IEEE and OSA and is recipient of a PECASE award, a NSF Young Investigator award and an ONR Young Investigator Program award. He has served as an Associate and Guest Editor for numerous IEEE Journals and has as General Chair and on TPC for conferences including OFC, ECOC, CLEO and Sigcomm.

Masashi Usami joined KDDI Research and Development Laboratories in 1985 and had worked in the area of opto-electronic devices such as 1.5 um DFB lasers for long haul fiber-optic communications. Since 1990, he had been developed highly reliable and high power InGaAs/GaAs pump lasers for low noise EDFAs and involved in the R&D program toward optical amplifier undersea cable systems, especially ultra-high capacity advanced WDM systems, which include Japan-US Cable Network, PC-1, and TAT-14. From 2000, he had been engaged in the research and development of future all-optical networks and components, such as ROADM, optical regeneration, and wavelength conversion technologies and their various applications. Since 2007, he has been in charge of technology strategy for KDDI headquaters, which cover from telecommunication infrastructures (fixed and mobile) to ICT services.

Wednesday, September 23, 09:00 - 10:00

Tutorial: Coherent Receivers: Principles and Real-Time Implementations

Andreas Leven, Alcatel-Lucent, Germany

Abstract

"High-speed digital signal processing has enabled implementation of coherent optical receivers at GBit/s speed. Besides reviewing fundamental principles of DSP-based coherent receivers, we will focus on practical implementation issues of the actual processing algorithm in digital circuitry. Andreas Leven received his Ph.D. (Dr.-Ing.) degree from Karlsruhe University, Germany, in 2000. From 1997 to 2000 he was at Fraunhofer Institute of Applied Solid State Physics, Freiburg, Germany. In 2000, he joined Bell Laboratories, Murray Hill, NJ, were he worked on high speed optical receivers and broadband optical digital-to analog converters. His current work is focused on digital signal processing for high-speed coherent receivers. Since 2008, he is on leave with Optical Networking Division, Alcatel-Lucent, Nuremberg, Germany.

Biography

Andreas Leven received his Ph.D. (Dr.-Ing.) degree from Karlsruhe University, Germany, in 2000. From 1997 to 2000 he was at Fraunhofer Institute of Applied Solid State Physics, Freiburg, Germany. In 2000, he joined Bell Laboratories, Murray Hill, NJ, were he worked on high speed optical receivers and broadband optical digital-to analog converters. His current work is focused on digital signal processing for high-speed coherent receivers. Since 2008, he is on leave with Optical Networking Division, Alcatel-Lucent, Nuremberg, Germany.

Wednesday, September 23, 11:15 - 12:15

Tutorial: Structured Light with Optical Fibers: Beams that Can Do What Gaussians Cannot

Siddharth Ramachandran, Technical University of Denmark, Denmark

Abstract

When we think of light propagating in a fibre, we think of a beam that looks like a spot (that is Gaussian- or Bell-shaped). However, many of properties of light are dramatically altered if one were able to generate and stably propagate beams that are higher-order, spatially variant mode-solutions of a fibre. For instance, certain non-uniform polarisation distributions of light, when focussed, result in beams that carry no energy along the optic axis. Alternatively, beams with Bessel-functional profiles can navigate around dark objects in free space. This talk will introduce the physics of such interesting beam shapes. We will illustrate their utility, both from the standpoint of using them to propagate signals in fibres, for telecom and fibre-laser applications, as well as for exploiting their free-space characteristics, in quantum systems, sensors and biomedical applications.

Biography

Dr Siddharth Ramachandran obtained his Ph.D. in Electrical Engineering from the University of Illinois, in 1998. Thereafter, he joined Bell Laboratories, as a Member of Technical Staff, and continued with its spin-off, OFS Laboratories. In 2003, he was named a Distinguished Member of Technical Staff of OFS Labs. In 2009, he moved from industry to academics, and is currently a Professor at the Technical University of Denmark.
Dr. Ramachandran's research focuses on the optical physics of guided waves, with applications to telecom, biomedical imaging, lasers and sensors. He has authored over 125 refereed journal and conference publications, more than 20 invited talks and papers, 2 book-chapters, over 30 patent applications, and is the editor of a Springer-Verlag book on "Fiber-based dispersion compensation." Dr. Ramachandran is a topical editor for Optics Letters and has served on numerous conference and grant-review committees.
Dr. Ramachandran is a member of OSA and IEEE-LEOS.

Wednesday, September 23, 14:30 - 15:30

Tutorial: High-Speed InP and Silicon Transceivers for Terabit Transport Networks

Christopher R Doerr, Bell Labs, Alcatel-Lucent, USA

Abstract

This tutorial will cover group III-V and group IV photonic integrated circuits (PICs) for transmitting and receiving optical signals in fiber-optic networks. We include such topics as quadrature phase-shift keying, polarization division multiplexing, multi-wavelength transmitters and receivers, and coherent reception.

Biography

Christopher R. Doerr earned a B.S. in aeronautical/astronautical engineering and a B.S., M.S., and Ph.D. (1995) in electrical engineering, all from the Massachusetts Institute of Technology (MIT). He attended MIT on an Air Force ROTC scholarship and earned his pilot wings at Williams AFB, Arizona, in 1991. His Ph.D. thesis, on constructing a fiber-optic gyroscope with noise below the quantum limit, was supervised by Prof. Hermann Haus. Since coming to Bell Labs in 1995, Doerr's research has focused on integrated devices for optical communication. He was promoted to Distinguished Member of Technical Staff in 2000, received the OSA Engineering Excellence Award in 2002, and became an IEEE Fellow in 2006 and an OSA Fellow in 2009. Doerr was Editor-in-Chief of IEEE Photonics Technology Letters from 2006-2008 and is currently an Associate Editor for the Journal of Lightwave Technology. He is married to Neriko Musha and has two children, Hanako and Joe.

Thursday, September 24, 09:00 - 10:00

Tutorial: Free-space Laser Communications: Global Communications and Beyond

David Caplan, MIT Lincoln Laboratory, USA;
Mark Stevens, MIT Lincoln Laboratory, USA;
Bryan Robinson, MIT Lincoln Laboratory, USA

Abstract

Just as optical communications has become the dominant means of transporting information at high-rates through long-distance guided channels, it shows great promise to provide power-efficient wide-band capacity in the future free-space networks where RF technologies are presently the incumbent. Free-space laser communications has potential to surround the planet with flexible and agile high-speed connectivity that can extend to interplanetary distances. For these applications, power-efficient transceiver designs are essential for cost-effective implementation. State-of-the-art designs can leverage advances in optical technology that have led to fiber-optic networks with multiple Tbit/s capacities. While spectral efficiency is a key design parameter in the telecommunications industry, the many THz of excess channel bandwidth in the optical regime can be utilized to improve receiver sensitivities where photon efficiency is a design driver. This tutorial will discuss state-of-the-art optical transmitter and receiver designs that are particularly well-suited for photon-starved links in intersatellite and deep-space applications.

Biography

David Caplan has been a member of the Optical Communication Technology group at MIT Lincoln Laboratory for more than 10 years. During that time he has been engaged in research, design, and development of high-sensitivity lasercom systems and related technologies, with an emphasis on photon- and power-efficient transmitter and receiver design. He led the development of transmitter systems for the GeoLITE mission, the world's first successful high-rate space-based laser communications system. His pioneering work on high-sensitivity multi-rate lasercom transceivers has been incorporated in NASA's deep-space interplanetary laser communication initiatives including the Mars and ongoing Lunar Laser Communication Demonstration programs. Among numerous publications are nine issued or pending patents and a recent book chapter on laser communication transmitter and receiver design. David received a B.S. degree in electrical engineering from Tufts University, and M.S. and Ph.D. degrees from Northwestern University in the fields of quantum optics and communications.

Area 1: Fibres, Fibre Devices, and Amplifiers

Supercontinuum Generation by Higher-Order Mode Excitation in a Photonic Crystal Fibre
Vittorio Degiorgio, Università di Pavia

All-Glass Micro-Structured Optical Fibers
Liang Dong, IMRA America Inc.

Ultrafast Nonlinear Optics on a Chalcogenide Chip
Benjamin Eggleton, University of Sydney

Large Mode Area Chirally-Coupled Core Fibers for High Power Fiber Lasers
Almantas Galvanauskas, University of Michigan

Fiber-Based Nonlinear Processing of Optical Signals
Robert M. Jopson, Alcatel-Lucent, Holmdel

Multimaterial Multifunctional Fiber Devices
Fabien Sorin, MIT

Area 2: Waveguide and Optoelectronic Devices

III-V-Based Photonic Crystal Technology for Integrated All-Optical Processing
Alfredo De Rossi, Thales Res. & Techn.

Multi wavelength amplification and signal processing in InP based quantum dash semiconductor optical amplifiers
Gadi Eisenstein, Technion, Haifa

Electrically Driven Single Photon Sources - Status and Challenges
Alfred Forchel, Universitaet Wuerzburg

Silicon Organic Hybrid - A Platform for Ultrafast Optics
Jürg Leuthold, University of Karlsruhe

Heterogeneously Integrated SOI/Compound Semiconductor Photonic Circuits
Dries Van Thourhout, Ghent University

Nonlinear Functions and Quantum Entanglement Generation Using Silicon Photonic Wire Waveguides
Koji Yamada, NTT Labs

1.55 µm InP-based Short-Cavity-VCSELs with Enhanced Modulation-Bandwidths of 15 GHz
Michael Mueller, Walter Schottky Institut, Technische Univeristät München

64QAM Modulator with a Hybrid Configuration of Silica PLCs and LiNbO3 Phase Modulators for 100-Gb/s Applications
Hiroshi Yamazaki, Takashi Yamada, Takashi Goh, Yohei Sakamaki, Akimasa Kaneko, NTT Photonics Laboratories, Japan

Novel Optical 90-deg Hybrid with Low Wavelength Sensitive Power Balance and Phase Deviation over 94-nm-wide Spectral Range
Seokhwan Jeong; Ken Morito; Fujitsu limited, Japan

Area 3: Subsystems and Network Elements for Optical Networks

Optical Monitoring for Intelligent Networks
Trevor Anderson, Monitoring Division Inc.

Terabit-on-Chip: Enabling Ultra-high Capacity Photonic Networks
Efstratios Kehayas, National Techn. University of Athens

Ultrafast All-Optical Analog-to-Digital Conversion using Fiber Nonlinearity
Ken-Ichi Kitayama, Osaka University

Digital Modulation Challenges for High-Capacity Optical Transport Network with 100G Channels and Beyond
Yutaka Miyamoto, NTT Labs

Complexity of Algorithms for Digital Coherent Receivers
Bernhard Spinnler, Nokia Siemens Networks

Transparent Nodes. Yes, but to what Extent?
Thierry Zami, Alcatel-Lucent, France

Area 4: Transmission Systems

Modeling of Signal-Noise Interactions in Nonlinear Fiber Transmission with Different Modulation Formats
Alberto Bononi, Università di Parma

Modulation Formats for Ultra-Long-Haul Undersea Transmission
Jin-Xing Cai, Tyco Telecommunications

The SECOQC Quantum Key Distribution Network in Vienna
Momtchil Peev, Austrian Research Centers

High Spectral Efficiency Phase and Quadrature Amplitude Modulation for Optical Fiber Transmission: Configurations, Trends and Reach
Matthias Seimetz, Fraunhofer-Institute for Telecommunications, HHI

Coherent OFDM Transmission with High Spectral Efficiency
Hidenori Takahashi, KDDI R&D Labs

Coherent Detection & Digital Signal Processing: Realizing the Challenge of Long-haul 100G Transmission
Dirk Van den Borne, Nokia Siemens Networks

Area 5: Backbone and Core Networks

CARRIOCAS Project: An Experimental High Bit Rate Optical Network for Computing-Intensive Scientific and Industrial Applications
Olivier Audouin, Alcatel-Lucent, France

Optical Technologies can Improve the Energy Efficiency of Networks
Fabio Neri, Politecnico di Torino

Dynamic Resilient IP/Optical Networks: DARPA CORONET Program
Ann Von Lehmen, Telcordia Technologies

Demonstration of 100 Tbit/s Scale Multiple Granularity OXC Architecture
Kazushige Yonenaga, NTT Laboratories

A Unified Architecture for Cross Layer Design in the Future Optical Internet
Ilia Baldine, Renaissance Computing Institute

Building globally distributed Warehouse Sized Computers
Vijay Gill, Google Inc.

Multi-Vendor Interoperability Demonstration of Wavelength Switched Optical Network (WSON) with GMPLS Lambda-Label Extension
Shuichi Okamoto, Takehiro Tsuritani, Munefumi Tsurusawa, KDDI R&D Laboratories, Inc.; Sota Yoshida; Teruko Fujii, Kazuo Kubo, Shoichiro Seno, Mitsubishi Electric Corporation; Itaru Nishioka, Masahiro Sakauchi, Soichiro Araki, NEC Corporation, Japan

1 Tb/s Optical Path Aggregation with Spectrum-Sliced Elastic Optical Path Network SLICE
Bartlomiej Kozicki, Hidehiko Takara, Yukio Tsukishima, Toshihide Yoshimatsu, Takayuki Kobayashi, Kazushige Yonenaga, Masahiko Jinno, NTT Network Innovation Laboratories, Japan

Area 6: "Access Networks and LAN"

Evolution of Optical Component Technologies for Access and Metro Networks
Andy Carter, Oclaro

High Speed Optical Transmission over Plastic Optical Fibers
Roberto Gaudino, Politecnico di Torino

Evolution of Optical Access Network Technologies in Radio Systems
Yukio Horiuchi, KDDI R&D Labs

Radio over Fibre Networks: Advances and Challenges
John Mitchell, University College London

Optics in Supercomputers
Bert Offrein, IBM Research, Zurich Res. Labs.

Evolution of Burst Mode Receivers
Xing-Zhi Qiu, Ghent University - IMEC

Next Generation Optical Access: 1 Gbit/s for Everyone
Harald Rohde, Nokia Siemens Networks

Monday, September 21, 2009 - Time: 14:00-18:00

Room: Hall I

1. InP and Si integrated photonics: competition or symbiosis

Chairs: Joe Campbell, University of Virginia; Roel Baets; Laurent Fulbert; Lorenzo Pavesi

♦ It has been a long-time goal of photonics to develop integrated circuits that parallel, to some extent, the successes of Si CMOS integrated circuits. Fundamental limitations as well as materials issues and market factors have slowed the emergence of photonic circuits with multiple functionalities and high component counts.

Recently, however, there have been significant breakthroughs in both InP- and Si-based platforms. Heterogeneous combinations of these technologies have also shown promise. This has been driven by numerous factors including Internet data demands, the push for higher performance and, simultaneously, lower cost, and the maturation of sophisticated design and fabrication technologies. This symposium will review the state of the art in this field and project evolutionary paths. The issue of whether the two primary materials approaches will compete or merge will also be addressed

Tuesday, September 22, 2009 - Time: 14:30-18:30

Room H

2. Real-time digital signal processing for optical transceivers

Chairs: Seb Savory, University College London; John Sitch, Nortel Networks

♦ The symposium will focus on real-time implementation of digital signal processing (DSP) from 10Gbit/s to 100GbE data rates, with the first session of the symposium focusing on the technology for real-time implementation, and the second session focusing on applications of DSP. In order to apply DSP at 10Gbit/s and beyond in CMOS, a highly parallel architecture is required, which in turn presents challenges for implementation. Nevertheless DSP has become a disruptive technology for optical transceivers due to advancements in microelectronics. While the DSP may be realized using a custom application specific integrated circuit (ASIC), much of the focus of the symposium will be on field programmable gate arrays (FPGA), since their processing power is now approaching that required for prototyping of architectures and algorithms.

The FPGA market is dominated by two manufacturers, Xilinx and Altera, and therefore in order to contrast the salient features the symposium will feature a case study of implementing framing and FEC for 100GbE systems using the two platforms, which will conclude the technology half of the symposium. In the second half of the symposium four applications of high speed DSP will be considered, for both conventional direct detection systems as well as next generation digital coherent communication systems.

Tuesday, September 22, 2009 - Time: 14:30-18:30

Room I

3. Next generation optical access technologies

Chairs: Russell Davey, British Telecom; Tom Pearsall, EPIC

♦ GPON and GE-PON and point-to-point fibre are now being deployed and can deliver ~100 Mbit/s to end users. In parallel next generation technologies are being developed such as 10 Gbit/s PONs and WDM-PONs. Unless the industry identifies a killer application causing end-users to pay extra revenue for bandwidths higher than can be delivered today, then the cost of future optical access technologies must be comparable to the technologies available today. This is a significant challenge and should be a major focus for the optical research community. This symposium will:

- Discuss drivers for next generation optical access technology
- Compare capability, cost and power consumption of candidate next generation PON architectures (10Gbit/s PON, WDM-PON etc.) versus each other and versus GPON/GE-PON and point-to-point Discuss enabling optical component technology for next generation optical access with a focus on cost reduction.

Wednesday, September 23, 2009 - Time: 09:00-13:00

Room I

4. Dynamic Multi-Layer Mesh Network ... Why, How, and When?

Chairs: Sander Jansen, Nokia Siemens Networks; Yvan Pointurier, Athens Information Technology (AIT); Brandon Collings, JDSU

♦ The ever-increasing demand for increased capacity and level of service at a lower cost are key drivers fueling the evolution of core optical networks from statically provisioned optical links interconnected with electronic switching and regeneration to more complex and flexible, optically switched mesh topologies with dynamic provisioning. The major advantages of these flexible networks include prompt and efficient system deployment and commissioning, removal of expensive and inflexible optical-electrical-optical equipment, and rapid wavelength and service provisioning. This evolution from point-to-point links to reconfigurable optical networks is enabled by many technologies, such as physical layer photonic cross connects to the control and management techniques such as GMPLS and multi-layer network design. This symposium will give an overview of the implementations, challenges and benefits of current and next generation dynamic multilayer optical mesh networks. Major network operators will detail their motivation to transition to dynamic multi-layer mesh networks and comment on the timeframe for such transitions. Component suppliers and network designers will describe current and future implementations and capabilities of these networks.

Thursday, September 24, 2009 - Time: 11:15-13:00

Room F2

5. Optical Space Communications

Chairs: Josep-Maria Perdigues, European Space Agency (ESA); Zoran Sodnik, European Space Agency (ESA)

♦ Optical technologies will play a key role in future space communication systems. This symposium will present the status of some of the latest technology developments in Europe (ESA), United States (NASA) and Japan (NICT) both in the areas of Free Space Optical Communications (e.g., second generation of optical communications terminals for optical inter-satellite links with increased data transmission rate and reduced mass, size and power consumption; the new European DRS system; the new Japanese DRS system, etc.) and for on-board Satellite Communications (e.g., on-board digital and analog communications; optical signal processing, etc.). The symposium will conclude with a panel discussion about future developments, in-orbit demonstrations, potential operational services

Thursday, September 24, 2009 Time: 09:00-13:00

Room I

6. Subsea Communications: Recent advances and Future Prospects

Chairs: Stuart Walker, Univ. Essex; Vincent Letellier, Alcatel-Lucent; Andrew Lord, British Telecom; Joerg Schwartz, Xtera Communications

♦ Growth in Internet traffic is one of the many factors driving bandwidth consumption in present-day networks. As migration to fibre-to-the-home gathers pace internationally to accommodate customer requirements, it is essential that global network capacity meets the demand. Whilst deployment of new submarine cable systems is a welcome feature in the 2009 scenario; economic considerations make the upgrade of existing routes an attractive proposition. Advanced modulation formats, such as RZ-DPSK offer a means of extending route length or upgrade from legacy 2.5 and 10Gbps date-rates. However, terrestrial links are moving towards 40 Gbps with 100 Gbps Ethernet being widely discussed. Such upgrades present major challenges for existing submarine routes whilst new-builds are attractive with possible lower equipment costs overall. On the fibre side, dispersion slope-matched fibre is now used for trans-oceanic systems to overcome the chromatic dispersion limitations of non-zero dispersion shifted fibre. However, polarization-mode dispersion and nonlinear penalties still impose severe limitations on transoceanic links at 40 Gbps and above.

What does the future hold? Is electronic dispersion compensation the complete answer? Are sophisticated signalling constellations a way forward? The symposium speakers are well-placed to give their take on future directions. A concluding panel session will invite audience involvement in this important arena.

Monday, September 21 · 09:30 - 12:30

Room: Hall A

Welcome and Plenary Session

9:30 **Welcome Greetings**
Walter Goldenits Telekom Austria AG, Austria; Herwig Kogelnik Bell Labs, Alcatel-Lucent, USA

9:45 **1.0.1**
The Rise of Exaflood Optics
George Gilder Forbes Telecosm Conference, USA
♦ Optics is now in its exaflood stage: with hundreds of exabytes of data swarming around worldwide webs of glass and light. An exabyte is 10 to the 18th, a billion gigabytes, a million billion big books of text or fifty thousand textual Libraries of Congress, enough to satisfy the reading needs of the world's population for a century. Or one exabyte is just a hundred million high definition movies, hardly enough to satisfy a million teenagers for a year. For the past two decades has raged a war between the rise of Exaflood optics with its video tides and the persistence of a communications infrastructure based on vocal and textual trickles. The trickleware has all gone mobile and wireless. Today the planetary utility of optical glass increasingly carries high definition images, virtual worlds, games, and telephonic telepresence, in a global sensorium, pushing the system toward the Zettabyte era of 10 to 21st. This requires a new optical architecture. It's first manifestations are inclement and cloudy for the industry. Most optics companies are following an uncreative, modular strategy, fitting components into existing systems. The real opportunity in optics is to create entirely new systems that adapt to a new age of optical entanglement appropriate to the age of telepresence. Don't solve problems, pursue opportunities.

10:40 **1.0.2**
The Coming Capacity Crunch
Andrew Chraplyvy Bell Labs, Alcatel-Lucent, USA
♦ Over the past 20 years, principally enabled by wavelength-division multiplexing WDM), fiber-optic transport capacities have been growing exponentially. As a result of world-wide R&D in the optical communications field, the capacity per fiber has increased at a rate of 100 every 10 years reaching 32 Terabits/second in recent research demonstrations and several Terabits/second in commercial systems. Associated with this remarkable growth was an important reduction in the cost per transmitted bit and also in the power consumption per bit. Because the transmission capacity of optical fibers was seemingly limitless, the unabated exponential growth of demand was viewed as lucrative business opportunities by carriers, service providers, and equipment manufacturers alike. However recent information-theoretic studies have concluded that the capacity of conventional fiber optic systems is not as limitless as had been thought, and in fact that the "end" could be in sight. Scientists and engineers are now struggling to squeeze the last few doublings of capacity out of optical fibers using a variety of techniques, in particular by implementing complex modulation formats. But what then?

11:35 **1.0.3**
Quantum Information: The Next Frontier
Anton Zeilinger Institute for Quantum Optics and Quantum Information, Austria
♦ For a long time the conceptually challenging predictions of quantum physics for individual experiments have been the issue of such bizarre discussions as Schrödinger's cat gedanken experiment. There, quantum superposition would imply the co-existence of the states of a live cat and a dead cat, quantum randomness would imply the fundamental unpredictability of the results of an observation of the cat's real and factual properties, and entanglement means that the state of the cat, dead or alive, is entangled with the state of an radioactive atom. Interestingly these same concepts, randomness, superposition, and entanglement, have become cornerstone concepts in a new quantum information technology. The most important applications are quantum cryptography, quantum computation, and quantum teleportation. Quantum cryptography permits the encoding of confidential information in a way that its security against eavesdropping is guaranteed by the laws of physics. A quantum computer would be able to operate in a quantum superposition of many different states thus enabling exponential speedup for some problems. Quantum teleportation allows transferring directly the quantum state of an individual system onto a distant one thus providing an ideal way for quantum computers to communicate with each other.

12:30 - 14:00 Lunch break

Room: Hall E1

1.1: Parametric effects in fibres

Chair: Periklis Petropoulos University of Southampton, United Kingdom

14:00 1.1.1
Experimental Comparison of Gain and Saturation Characteristics of a Parametric Amplifier in Phase-sensitive and Phase-insensitive Mode
Carl Lundström, Peter A Andrekson, Zhi Tong, Magnus Karlsson Chalmers University of Technology, Sweden; Joseph Kakande, Periklis Petropoulos, Francesca Parmigiani, David J Richardson
♦ We demonstrate a parametric amplifier with precise control of the in-going waves and study gain and saturation properties in both PSA and PIA mode. A PSA gain of 33 dB is achieved.

14:15 1.1.2
Measurement of Sub-1dB Noise Figure in a Non-Degenerate Cascaded Phase-Sensitive Fibre Parametric Amplifier
Zhi Tong, Carl Lundström, Magnus Karlsson, Peter A Andrekson Chalmers University of Technology, Sweden; Antonis Bogris, Dimitris Syvridis, National and Kapodistrian University of Athens, Greece
♦ Noise figure NF spectrum as well as its signal-power-dependence in a non-degenerate cascaded phase-sensitive fibre parametric amplifier was characterized. A 0.8dB NF 2dB below the conventional quantum limit was achieved at 11dB gain.

14:30 1.1.3
Optical Demultiplexing with Extinction Ratio Enhancement Based on Higher Order Parametric Interaction
Camille-Sophie Bres, Andeas O J Wiberg, Jose M Chavez Boggio, Stojan Radic, University of California, San Diego, USA
♦ We present the experimental demonstration of an all-optical demultiplexer for high speed OTDM data with optical regeneration capability. It is shown that higher order parametric interactions provide optical sampling with high extinction ratio.

14:45 1.1.4
Continuous-Wave One-Pump Fiber Optical Parametric Amplifier with 270 nm Gain Bandwidth
Mehdi Jamshidifar, Armand Vedadi, Marhic Swansea University, United Kingdom
♦ We report operation of a continuous-wave one-pump fibre OPA with net gain between 1447 nm and 1717 nm. We used a 114 m long step-index highly-nonlinear fibre, and 5 W of pump power.

15:00 1.1.5
Monolithic-YDFA Based CEP-Stable OPA with Broad Tunability
Lingxiao Zhu, Alma Fernández, Aart Verhoef, Dmitry Sidorov-Biryukov, Audrius Pugzlys, Andrius Baltuska, Institut für Photonik, Technische Universität Wien, Austria; Chi-Hung Liu, Kai-Hsiu Liao, Almantas Galvanauskas Center for Ultrafast Optical Science, University of Michigan, USA; Steve Kane, Mathematics Department, Bridgewater-Raritan Regional High School, USA
♦ We demonstrate an efficient broadband difference-frequency converter emitting carrier-envelope-offset-free seed pulses for chirped-pulse parametric amplification and pumped by a monolithic femtosecond Yb-doped fiber amplifier that simultaneously provides passive optical synchronization for an OPCPA pump pulse source.

15:15 1.1.6
Performance of Parametric Wavelength Exchange for Narrow Pulse Width Return-to-Zero Signal
Mengzhe Shen, Xing Xu, Kim Ka Yi Cheung, Ti Yuk, Kenneth K Y Wong, The University of Hong Kong, Hong Kong
♦ We demonstrate the parametric wavelength exchange for 10-Gb/s RZ and NRZ signals. The narrow pulse width of the exchanged RZ signal indicates that CW or quasi-CW pumps are capable of handling with ultrahigh-speed signal processing.

15:30 1.1.7
Reduced Four-Wave Mixing Crosstalk in a Short Fibre Optical Parametric Amplifier
Mehdi Jamshidifar, Armand Vedadi, Marhic Swansea University, United Kingdom
♦ Four-wave mixing crosstalk in a fibre OPA has been reduced by 16dB by decreasing the fibre length from 340m to 50m and increasing the pump power to maintain the gain at 20dB

Room: Hall E2

1.2: Devices for Optical Switching and Processing

Chair: Yoshiaki Nakano, University of Tokyo, Japan

14:00 1.2.1
High-Speed 1x16 Optical Switch Monolithically Integrated on InP
Ibrahim Murat Soganci, Takuo Tanemura, Yoshiaki Nakano, University of Tokyo, Japan; Kevin Williams, Dorren Harm, Tjibbe de Vries, Meint K Smit, Barry Smalbrugge, Eindhoven University of Technology, The Netherlands; Nicola Calabretta, COBRA Research Institute, The Netherlands
♦ We present the first fully integrated high-speed 1x16 InP optical switch based on arrayed phase modulators, demonstrating average extinction ratio of 17.0 dB, estimated on-chip loss of <8 dB, and reconfiguration time of <6 ns.

14:15 1.2.2
All-Optical Wavelength Conversion at 160Gb/s by Intersubband Transition Switches Utilizing Efficient XPM in InGaAs/AlAsSb Coupled Double Quantum Well
Ryoichi Akimoto, Shin-ichirou Gozu, Kazumichi Akita, Guangwei Cong, Toshifumi Hasama, Hiroshi Ishikawa, Teruo Mozume, National Institute of Advanced Industrial Science and Technology, Japan
♦ We report all-optical wavelength conversion of 160-Gb/s signal by intersubband transition switches with signal pulse energy as low as sub-pJ, which is enabled by newly designed InGaAs/AlGaAs/AlAsSb coupled double quantum wells exhibiting the enhanced cross-phase modulation.

14:30 1.2.3
All Optical NRZ-to-RZ conversion for 43-Gbps Signals for Generation of 172-Gbps OTDM Signals Using Intersubband Transition MQW Optical Gate
Takayuki Kurosu, Shu Namiki, Ryoichi Akimoto, Haruhiko Kuwatsuka, Toshifumi Hasama, Hiroshi Ishikawa, National Institute of Advanced Industrial Science and Technology, Japan
♦ We demonstrate all optical NRZ-to-RZ conversion at a bit rate of 43 Gbps using an intersubband transition optical gate. The converted 2-ps RZ pulses were successfully applied to generate 172-Gbps OTDM signals.

14:45 1.2.4
40Gbps, 3-bit Operation of a Semiconductor Optical Digital-to-Analog Converter
Kengo Sawada, Hiroyuki Uenohara, Tokyo Institute of Technology, Japan
♦ We demonstrate 40Gbps, 3-bit-operation of a semiconductor optical digital-to-analog converter consisting of MMI couplers and delay lines. We achieved output with 7-level amplitude with fixed phase successfully for the first time.

15:00 1.2.5
All-Optical Flip-Flop Based on Mach-Zehnder Interferometer Bistable Laser Diode
Koji Takeda, Mitsuru Takenaka, Takuo, Tanemura Yoshiaki Nakano, The University of Tokyo, Japan
♦ We fabricate and demonstrate all-optical flip-flop based on novel Mach-Zehnder interferometer bistable laser structure. The MZI-BLD successfully improves falling time to 68ps, switching pulse energy to 67pJ, and threshold current, owing to large modes overlap.

15:15 1.2.6
III-V-Based Photonic Crystal Technology for Integrated All-Optical Processing (Invited)
Alfredo De Rossi, Thales Res. & Techn., France
♦ We demonstrate that III-V based photonic crystals allow ultra-fast operations >100 Gb/s and need few power 100 fJ/bit). The perspective of an ultra-compact and massively integrated optical chip is discussed.

15:45 - 16:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall F1

1.3: OFDM

Chair: Andrew Ellis Tyndall, National Institute, Ireland

14:15 1.3.1
Polarization Multiplexed 100 Gbps Direct-Detection OFDM Transmission without MIMO Processing
Abdullah Al Amin, Hidenori Takahashi, Itsuro Morita, Hideaki Tanaka, KDDI R&D Laboratories Inc, Japan
♦ We propose a low-overhead method of polarization multiplexing in direct detection OFDM that requires no digital MIMO processing. Using 16QAM and only 31GHz bandwidth, 100 Gbps transmission over 80 km of SSMF is successfully demonstrated.

14:30 1.3.2
24 Gbit/s, 64 QAM-OFDM Coherent Transmission with a Bandwidth of 2.5 GHz
Tatsunori Omiya, Hiroki Goto, Keisuke Kasai, Masato Yoshida, Masataka Nakazawa, Tohoku University, Japan
♦ We demonstrate 2-Gsymbol/s polarisation-multiplexed coherent optical OFDM transmission with QAM subcarrier modulation as high as 64-states using an optical PLL. 24-Gbit/s data were successfully transmitted over 160 km with a demodulation bandwidth of 2.5 GHz.

14:45 1.3.3
Coherent OFDM Transmission with High Spectral Efficiency (Invited)
Hidenori Takahashi, KDDI R&D Laboratories Inc., Japan
♦ Coherent OFDM is promising for DWDM transmission with higher spectral efficiency and enables a demonstration of the highest spectral efficiency of 7.0 bit/s/Hz. We review optical OFDM technologies to increase a spectral efficiency.

15:15 1.3.4.
Reducing Cyclic Prefix Overhead in Optical OFDM Systems
Arthur Lowery, Monash University, Australia
♦ Simulations show that by pre-compensating for dispersion, using bands transmitted with timing offsets and a single-band receiver, the cyclic prefix to be reduced in optical OFDM systems without compromising their dispersion-compensation ability.

Room: Hall H

1.4: Quantum Key Distribution

Chair: Thomas Jennewein, IQOQI - Austrian Academy of Sciences, Austria

14:15 1.4.1
The SECOQC Quantum Key Distribution Network in Vienna (Invited)
Momtchil Peev, Austrian Research Centers GmbH - ARC, Austria
♦ An overview of the Quantum Key Distribution QKD Network Prototype is given. We present the QKD link devices and the node modules that build up the network and discuss its architecture, functionality and performance.

14:45 1.4.2
Colourless Interferometric Technique for Large Capacity Quantum Key Distribution Systems by use of Wavelength Division Multiplexing
Akihiro Tanaka, Akihisa Tomita, Akio Tajima, NEC Corporation, Japan
♦ A novel interferometric technique is proposed for high-capacity quantum key distribution using wavelength division multiplexing. With additional phase modulation, we exhibited valid interference at any wavelengths while sharing interferometers over multi-channels, resulting in a low-cost configuration

15:45 - 16:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Monday, September 21 · 14:00 - 15:45

Room: Hall G

1.5: Impairment Aware Networking

Chair: Gabriel Junyent, Universitat Politècnica de Catalunya, Spain

14:00 1.5.1
Impairment-Aware Traffic Engineering Using Cross-Layer Protocols
Franz Fidler, Keren Bergman Columbia University New York, USA; Peter Winzer, Lucent Technologies, USA; Marina Thottan, Bell Labs, USA
♦ Traffic engineering based on cross-layer communications to counter-act inter-channel impairments in optical networks is shown to yield significant throughput gains for a variety of traffic models.

14:15 1.5.2
Impact of the optical routing on the transmission in transparent networks
Thierry Zami, Alcatel-Lucent, France; Pascal Henri, Laurence Lorcy, Christian Simonneau, Alcatel-Lucent Bell Labs France, France
♦ We present an upgraded circulating loop to simply account for the actual impact of the different channels optical routings when assessing the transmission performance in the WDM transparent networks

14:30 1.5.3
Lightpath establishment in distributed transparent dynamic optical networks using network kriging
Nicola Sambo, Luca Valcarenghi, Piero Castoldi, Scuola Superiore Sant'Anna, Italy; Yvan Pointurier, Ioannis Tomkos, Athens Information Technology, Greece; Filippo Cugini, CNIT, Italy
♦ A lightpath provisioning scheme is proposed to guarantee Quality of Transmission QoT in transparent optical networks. The scheme novelty consists in utilizing the network kriging framework to estimate lightpath QoT and decrease the number of lightpath establishment attempts before success.

14:45 1.5.4
Design and Implementation of an All Optical Traffic Engineering Server with a Novel Logical Distance Optimization
Rie Hayashi, Kaori Shimizu, Ichiro Inoue, Kohei Shiomoto NTT, Japan
♦ Our proposal "logical distance" makes it simple and effective to judge whether computed routes satisfy QoS or not. We confirm its feasibility by setting-up optical paths on computed routes with developed system in a real network.

15:00 1.5.5
Impairment Constraint Based Routing ICBR with Service Differentiation in Survivable WDM Networks
Amornrat Jirattigalachote, Lena Wosinska, Paolo Monti, Royal Institute of Technology KTH), Sweden; Kostas Michael Katrinis, Anna Tzanakaki, Athens Information Technology AIT), Greece
♦ We propose and evaluate a novel survivable Impairment Constraint Based Routing ICBR algorithm with service differentiation at the Bit Error Rate level. Simulations show significant improvement in connection blocking compared to conventional ICBR solutions.

15:15 1.5.6
Introduction of Confidence Levels for Transparent Network Planning
Annalisa Morea, Thierry Zami, Florence Leplingard, Alcatel-Lucent, France
♦ Confidence level on connection feasibilities is used to obtain Q-estimate margins when parameter uncertainties are considered. Adding such margins to the Q-estimate instead of fixed margins gives 22% fewer regenerators at same 97.5% confidence level.

15:30 1.5.7
Dissemination of Monitoring Information in Transparent Optical Networks
Dimitri Staessens, Ghent University - IBBT - IMEC, Belgium; Didier Colle, Mario Pickavet, Piet Demeester, Ghent University, Belgium
♦ The PCE architecture is designed to be a cost-effective solution for computing optimal paths in next-generation core networks. In this paper we propose a method for disseminating optical monitoring information to the PCE.

Monday, September 21 · 14:15 - 15:30

Room: Hall F2

1.6: FTTH and PON

Chair: Ingrid Van de Voorde, Alcatel-Lucent, Belgium

14:00 1.6.1
Tutorial: FTTH Deployments Options and Economic Challenges
David Payne, University of Swansea, United Kingdom
♦ Fibre to the premises has been studied for over three decades but only in the last few years have the beginnings of significant deployments occurred. The major deployments have been in Japan and Korea where IEEE EPON has dominated. In the US ITU BPON and now GPON dominate. In Europe several technologies have been used for a range of relatively small deployments compared to Japan and Korea). FTTCabinet is an expedient option but is this just delaying full FTTP? R&D is being focussed on static WDM PON but is this best use of the precious wavelength domain? FTTP has the potential for very high bit rate service delivery driving huge bandwidth into the network but is such growth economically viable? Power consumption and carbon footprint are hot topics what are the green solutions? This tutorial will address these questions and look at the architectural options for a viable FTTP future.

15:00 1.6.2
Novel Technique for On-Site Signal-Monitoring in PON Systems without Service Interruption
Takashi Matsui, Kyozo Tsujikawa, Shigeru Tomita, NTT Corporation, Japan
♦ We propose an on-site signal-monitoring technique using a mechanically-induced long-period grating LPG for monitoring specific service signals without service interruption. Using the LPG, leaked signals are clearly observed with low insertion loss and negligible crosstalk.

15:15 1.6.3
FlexPON: a Hybrid TDM/WDM Network enabling Dynamic Bandwidth Reconfiguration using Wavelength Routing
Maurice de Laat, Richard Duijn, Elroy Pluk, Gerlas van den Hoven, Genexis B.V., The Netherlands; Patryk J Urban, Huug de Waardt, Eindhoven University of Technology, The Netherlands
♦ A new cost-effective FTTH network with high bandwidth efficiency and extreme flexibility is demonstrated. FlexPON uses a stack of coloured PONs combined with remote wavelength routing allowing capacity redistribution.

15:30 1.6.4
Online Upstream Scheduling and Wavelength Assignment Algorithms for WDM-EPON Networks
Konstantinos Kanonakis, Ioannis Tomkos, Athens Information Technology, Greece
♦ We show that efficiency problems arise when online scheduling and wavelength assignment is employed in WDM-EPON networks and propose algorithms for minimizing their effect, leading to improved capacity utilization and consequently reduced frame delay.

15:45 - 16:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Monday, September 21 · 14:15 - 15:30

Room: Hall I

1.7: Symposium: InP and Si integrated photonics: competition or symbiosis (1)

InP-based and Si Heterogeneous Integrated Photonics

Chairs: Joe Campbell, University of Texas, USA, Roel Baets, Ghent University - IMEC, Belgium

14:00 1.7.1
Integration Using the Hybrid Silicon Platform
John Bowers, University of California, USA
♦ A brief review of recent progress in photonic integrated circuits PIC and connection to the electronic IC roadmap is presented. Technologies including high-quality wafer bonding, electrically pumped lasers and high speed modulators are essential building blocks for mass production and faster data streams in the future.

14:25 1.7.2
Large Scale Integration of Photonic Integrated Circuits on Indium Phosphide and High-Index-Contrast Si Platforms
Mehrdad Ziari, Masaki Kato, Charles Joyner, Peter Evans, John Hryniewicz, Fred Johnson, Wenlu Chen, David Gill, Oliver King, Matthew Fisher, Vince Dominic, Alan Nilsson, Jeff Rahn, Scott Corzine, Andrew Dentai, Mark Missey, Damien Lambert, Ranjani Muthiah, Randal Salvatore, Sanjeev Murthy, Infinera, USA; Sai T Chu, Wei Chen, Infinera Corp, USA
♦ We report on development of large-scale and high functionality photonic integrated circuits on InP and Si platforms for transmitter, receiver, filtering and routing applications and discuss the merits of both platform.

14:50 1.7.3
InP-based Photonic Integration: Learning from CMOS
Meint K Smit, TU/e, The Netherlands
♦ In the last decades the complexity of InP-based Photonic Integrated Circuits has increased by almost two orders. In this paper past and future developments in Photonic Integration will be discussed.

15:15 1.7.4
Photonic Integration Challenges for Next-Generation Networks
Michael J. Wale, Oclaro, United Kingdom
♦ Photonic integration is a key technology for emerging telecommunications architectures. We examine the drivers for next-generation systems, implications for optical components, present state of the art in photonic integrated devices and drivers for current research.

Notes:

15:45 - 16:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall E1

2.1: Microstructured Fibres

Chair: Hanne Ludvigsen, Helsinki University of Technology, Finland

16:15 2.1.1
Investigating Micro-Bend Sensitivity of a Large-Mode-Area Bragg Fiber
Catherine Baskiotis, Géraud Bouwmans, Yves Quiquempois, Marc Douay, Université de Lille 1, France; Yves Jaouen, Telecom ParisTech, France; Renaud Gabet, GET / Telecom Paris, France; Denis Molin, Draka, France; Pierre Sillard, Draka Communications, France
♦ Phase-sensitive Optical Low Coherence Reflectometry technique is used to characterize the modes couplings induced by micro-bends in a Large-Mode-Area Bragg fiber made with PCVD. Single-point and multi-point lateral pressures have been investigated.

16:30 2.1.2
Observation and analysis of cladding modes in photonic crystal fiber
Sun Do Lim, Hyun Chul Park, Lee Sang-Bae, Byoung Yoon Kim, Korea Institute of Science and Technology, Korea; In-Kag Hwang, Chonnam National University, Korea
♦ We report the observation of cladding modes that are the lowest-order modes having the major optical power in the air-hole region of a photonic crystal fiber. The field profiles agree well with numerical calculation corresponding to LP16-mode groups.

16:45 2.1.3
All-Glass Micro-Structured Optical Fibers (Invited)
Liang Dong, IMRA America Inc, USA
♦ All glass micro-structured fibers made with fluorine-doped silica features embed in silica background, not only are easy to fabricate and use, but also offer many new functionalities. This talk reviews recent advances in this area.

17:15 2.1.4
Bend-Insensitive and Effectively Single-Moded All-Solid Photonic Bandgap Fibers with Heterostructured Cladding
Tadashi Murao, Kunimasa Saitoh, Kuniaki Maeda, Masanori Koshiba, Hokkaido University, Japan; Toshiki Taru, Takuji Nagashima, Takashi Sasaki, Sumitomo Electric Industries, LTD., Japan
♦ We propose a novel concept of cladding structure in all-solid photonic bandgap fibers. It promises low bending and confinement losses with single-mode operation. The mechanism is based on the new concept of heterostructured cladding.

17:30 2.1.5
Large Mode Area Single-Mode Ytterbium Doped All-Solid Photonic Bandgap Fiber
Olga Egorova, Sergei Semjonov, Alexei Kosolapov, Vladimir Velmiskin, Andrey Pryamikov, Aleksandr Biriukov, Evgeny M. Dianov, Fiber Optics Research Center RAS, Russia; Mikhail Yu. Salganskii, Vladimir F. Khopin, Mikhail V. Yashkov, Aleksey N. Guryanov, Institute of Chemistry of High Purity Substances of RAS, Russia
♦ We report on a new fiber design: an ytterbium-doped single-mode all-solid photonic bandgap fiber with a MFD of 18 micrometers. This fiber design has the potential for scaling to larger MFD.

17:45 2.1.6
Ultra-Low Loss All-Solid Photonic Bandgap Fibre
Huifeng Wei Yangtze, Optical Fiber and Cable Co., LTD., P.R. China
♦ We fabricate and characterize an all-solid photonic bandgap fibre with ultra-low transmission loss of 0.65dB/km within the firs-order bandgap band of 1500~1600nm. The bending characteristic of the fibre is also described.

Room: Hall E2

2.2: Devices for Multilevel Transmission

Chair: Liam Barry, Dublin City University, Ireland

16:15 2.2.1
64QAM Modulator with a Hybrid Configuration of Silica PLCs and LiNbO3 Phase Modulators for 100-Gb/s Applications (Invited)
Hiroshi Yamazaki, Takashi Yamada, Takashi Goh, NTT Photonics Laboratories, Japan NTT, Japan; Yohei Sakamaki, Akimasa Kaneko
♦ We demonstrate an optical 64QAM modulator operating at 60 Gb/s with single polarization). Asymmetric couplers and an array of 12 high-speed phase modulators are integrated with a hybrid configuration of silica PLCs and LiNbO3 phase modulators.

16:45 2.2.2
Compact LiNbO3 Optical Modulator for Polarization-division-multiplexing RZ-DQPSK
Takashi Shiraishi, Masaharu Doi, Fujitsu Limited., Japan; Tetsu Hasegawa, Kazuhiro Tanaka, Fujitsu Laboratories Ltd., Japan
♦ An integrated PDM-RZ-DQPSK modulator was developed for the first time with a small bend radius and low-loss, low-crosstalk intersecting U-turn waveguides. This design enables low PDL of less than 0.3 dB

17:00 2.2.3
Novel Optical 90-deg Hybrid with Low Wavelength Sensitive Power Balance and Phase Deviation over 94-nm-wide Spectral Range (Invited)
Seokhwan Jeong, Fujitsu Laboratories Limited, Japan; Ken Morito, Fujitsu limited, Japan
♦ We proposed novel 90-deg hybrid and verified optical quadrature behavior over 94-nm-wide spectral range. Optical demodulation by the proposed 90-deg hybrid can be implemented without waveguide intersections to couple to BPDs, which is well suited for monolithically integrated coherent receivers.

17:30 2.2.4
One-chip Integrated Dual Polarization Optical Hybrid using Silica-based Planar Lightwave Circuit Technology
Yohei Sakamaki, Hiroshi Yamazaki, Yusuke Nasu, Toshikazu Hashimoto, Shin Kamei, Kuninori Hattori, NTT Photonics Laboratories; Takayuki Mizuno, NTT, Japan; Takashi Goh, NTT, Japan; Hiroshi Takahashi, NTT Corporation, Japan
♦ We demonstrate a compact dual polarization optical hybrid - hybrids using achieved by the integration of polarization beam splitters and 90 silica-based planar lightwave circuit. The fabricated device exhibited sufficient characteristics for coherent systems such as DP-QPSK.

17:45 2.2.5
Photonic Balancing in DPSK Detection Using Pulse Collision in a Semiconductor Optical Amplifier
Franko Küppers, University of Arizona, USA; Tuomo von Lerber, Marco Mattila, Luxdyne Ltd., Finland; Werner Weiershausen, Luxdyne Ltd., Germany; Ari Tervonen, Helsinki University of Technology, Finland; Alan Willner, University of Southern California, USA
♦ We present a new DPSK receiver scheme where counter-propagating pulses collide in a saturated semiconductor optical amplifier, realizing photonically balanced single-ended detection. Decreased fluctuation of the mark level and 1.1-dB increased Q-factor is demonstrated experimentally at 22.3 Gbit/s.

19:30 - 21:30 Welcome Reception (Town Hall Vienna)

Room: Hall F1

2.3: OFDM and Multitone

Chair: Joerg-Peter Elbers, ADVA AG Optical Networking, Germany

16:15 2.3.1
Single-Carrier vs. Dual-Carrier Transmission of 100Gb/s coherent PDM-QPSK over NZ-DSF Fibre
Marco Bertolini, Università degli Studi di Parma, Italy; Massimiliano Salsi, Gabriel Charlet, Haïk Mardoyan, Patrice Tran, Jérémie Renaudier Bell Labs, Alcatel-Lucent, France; Oriol Bertran-Pardo, Telecom Paristech ENST-Paris, France; Sebastien Bigo, Alcatel-Lucent, France
♦ We experimentally compare 100Gb/s PDM-QPSK in single-carrier and dual-carrier configuration over 800km of NZ-DSF fibre. Using 40Gb/s P-DPSK and 10Gb/s OOK neighbours the lower tolerance to nonlinear effects of the dual-carrier solution is demonstrated.

16:30 2.3.2
Joint CD and PMD Compensation for Direct-Detected Optical OFDM Using Polarization-Time Coding Approach
Wei-Ren Peng, National Chiao Tung University, Taiwan; Kai-Ming Feng, National Tsing Hua University, Taiwan; Sien Chi Yuan Ze, University, Taiwan
♦ We demonstrate a polarization-time coding method for direct-detected OFDM, which provides the signal with immunity against both fibre CD and PMD effects. Further dynamic PTC method is introduced for trading the PMD tolerance with receiving sensitivity.

16:45 2.3.3
Volterra Nonlinear Compensation of 112Gb/s Ultra-long-haul Coherent Optical OFDM based on Frequency-shaped Decision Feedback
Rakefet Weidenfeld, Moshe Nazarathy, Technion, Israel Institute of Technology, Israel; Reinhold Noé, University of Paderborn, Germany; Isaac Shpantzer, Celight Inc., USA
♦ A novel DSP-based FWM compensation scheme for 112Gb/s CO-OFDM based on decision-feedback-aided frequency-shaped Volterra nonlinear filtering, with low O(MlogM realization complexity, improves the worst Q-factor by ~7dB at 2000Km, outperforming a prior low-complexity nonlinear compensation scheme by ~2dB.

17:00 2.3.4
Experimental Demonstration of Joint SPM Compensation in 44-Gb/s PDM-OFDM Transmission with 16-QAM Subcarrier Modulation
Xiang Liu, Chandrasekhar Sethumadhavan, Alan H. Gnauck, Robert Tkach, Alcatel-Lucent, Bell Laboratories, USA
♦ We report the experimental demonstration of a recently proposed joint self-phase modulation compensation scheme in a single-channel 44-Gb/s polarization-division multiplexed OFDM transmission with 16-QAM subcarrier modulation, achieving power tolerance improvement as large as 5 dB.

17:15 2.3.5
Reduction of Nonlinear Inter-channel Crosstalk Penalty for DQPSK signal in Carrier Phase Locked WDM
Fumikazu Inuzuka, Kazushige Yonenaga, Etsushi Yamazaki NTT Corporation, Japan; Shuto Yamamoto, Atsushi Takada NTT, Japan
♦ This paper shows reduction of nonlinear inter-channel crosstalk penalty for DQPSK signal in carrier phase locked WDM. Experimental results show that carrier phase locking successfully suppress the OSNR penalty caused by four-wave-mixing crosstalk.

Room: Hall H

2.4: Radio-over-Fibre

Chair: Ton Koonen, COBRA, Eindhoven Univ. of Technology, The Netherlands

16:15 2.4.1
WiMAX Radio-on-Fibre in 118-km Long-reach PON with Deployed Fibre
Kamau Prince, Alexey Osadchiy, Idelfonso Tafur, Monroy Technical University of Denmark, Denmark
♦ We demonstrate a radio over fibre link supporting 256-QAM / 12 Mbaud WiMAX signalling over 118-km long-reach PON with deployed fibre. Our colourless implementation uses commercially-available, low-complexity devices typically used in TDM-PON or WDM-PON.

16:30 2.4.2
Integrated Platform of Millimeter-Wave Radio-Over-Fiber and Baseband Services in a Reconfigurable Ring/Bus Access Network Using Wavelength Interleaving and Polarization Multiplexing
Christos Tsekrekos, Ken'ichi Kitayama, Osaka University, Japan; Toshiaki Kuri, NICT, Japan
♦ A novel polarization demultiplexing for wavelength-interleaved 1.25-Gb/s baseband signals and 155-Mb/s 60-GHz radio-over-fiber signals, combined with tunable filtering for access to consecutive remote access nodes in a ring/bus network are experimentally demonstrated.

16:45 2.4.3
Chromatic Dispersion Tolerant Subcarrier Multiplexing Scheme Based on Tandem Frequency Shifted Optical SSB Modulation
Toshihito Fujiwara, Hiro Suzuki, Tomoki Sugawa, NTT, Japan; Naohiko Yuki, NTT ANSL, Japan
♦ We propose a novel CD tolerant SCM scheme using tandem frequency shifted optical SSB modulation, which supports high frequencies and removes fading effect from vestigial sideband. Experiments show the scheme improves 4.1 dB tolerances.

17:00 2.4.4
Optical OFDM Signal Generation by Optical Phase Modulator and Its Application in ROF System
Ze Dong Hunan, University, P.R. China
♦ We have demonstrated optical OFDM signal generation by an optical phase modulator and applied it in a 40GHz ROF symmetric system. The power penalty for the downlink data after transmission over 50km SMF is smaller than 0.5dB.

17:15 2.4.5
Radio over Fibre Networks: Advances and Challenges (Invited))
John Mitchell, University College London, United Kingdom
♦ This talk will review the recent developments advances in Radio-Over-Technologies, highlight the challenges that remain and outline the work being undertaken within the EU Network of Excellence BONE to meet these challenges.

17:45 2.4.6
Bidirectional Multi-UMTS FDD Carrier Distribution over an Extended-Reach PON Architecture using a shared SOA
Florian Frank, Benoit Charbonnier, Orange Labs, France; Anna Pizzinat, Philippe Chanclou, France Telecom Research and Development, France; Catherine Algani Cnam, France
♦ We demonstrate the distribution of a multiplex of UMTS RF carriers over extended reach PON architectures for overall optical budgets up to 47 dB. A SOA and an APD are respectively used for the reach extension and the photodetection.

19:30 - 21:30 Welcome Reception (Town Hall Vienna)

Room: Hall G

2.5: Crosslayer Networking

Chair: Andras Kalmar, Alcatel -Lucent, Austria

16:15 2.5.1
A Unified Architecture for Cross Layer Design in the Future Optical Internet (Invited)
Ilia Baldine, Renaissance Computing Institute, UNC-CH, USA
♦ We present a novel architecture, which naturally enables cross-layer interactions through the construction of application-specific protocol stacks out of small reusable services which expose explicit controls to cross-layer tuning policies. Together with a concept we term 'Software Defined Optics' this architecture can enable the future optical internet.

16:45 2.5.2
Cross-Layer Simulations of Fast Packet Protection Mechanisms
Franz Fidler, Caroline P Lai, Keren Bergman, Columbia University New York, USA; Peter Winzer, Lucent Technologies, USA; Marina Thottan, Bell Labs, USA
♦ Time-dependent inter-packet and intra-packet BER variations are implemented in the ns-2 network simulator to evaluate fast packet protection based on physical-layer monitoring through pre-FEC BER read-out.

17:00 2.5.3
Experimental Demonstration of QoS-Aware Cross-Layer Packet Protection Switching
Caroline P Lai, Franz Fidler, Keren Bergman, Columbia University, USA
♦ A cross-layer based, quality-of-service aware packet protection mechanism is experimentally demonstrated on an optical switching test-bed with 8×10-Gb/s wavelength-striped payloads. The scheme leverages optical performance monitoring to reroute degraded data streams before packets are lost.

17:15 2.5.4
Cycle Attack-Free Logical Topology Design in Optical Code Path Networks
Yosuke Katsukawa, Ken'ichi Kitayama, Osaka University, Japan; Shaowei Huang, NEC System Platforms Research Laboratories, Japan
♦ A tree-based logical topology design approach is proposed to resolves the unintended cycle attack problem in OCDM networks. An effective resource assignment schemes is discovered and a 50% of reduction in connection setup delay is achieved in large-scale networks.

17:30 2.5.5
Demonstration of 100 Tbit/s Scale Multiple Granularity OXC Architecture (Invited)
Kazushige Yonenaga, NTT Corporation, Japan; Atsushi Takada, NTT, Japan; Yasuhiko Aoki, Fujitsu Limited, Japan; Susumu Kinoshita, Fujitsu Laboratories Ltd, Japan
♦ This paper describes demonstration of multiple granularity OXC architecture toward 100-Tbit/s scalability. The architecture provides waveband and wavelength grooming functions with port-count scalability and optical virtual concatenation function enabling bulk-data transmission using some wavelength channels.

Room: Hall F2

2.6: Coding and Modulation

Chair: Alberto Bononi, Università di Parma, Italy

16:15 2.6.1
Tutorial: Fundamentals of Coding and Modulation
Gerhard Kramer, University of Southern California, USA
♦ This tutorial provides an introduction to coding and modulation from a communications engineer's point of view. The tutorial reviews information-theoretic concepts such as channels, channel capacity, modulation sets for Gaussian-noise channels, and spectral efficiency. Coding-theoretic concepts are treated next, including linear block codes, low-density parity-check codes, and hard and soft-decision decoding. The focus is on broad insight rather than detailed design. The tutorial concludes by showing how this insight was recently applied to determine a lower bound estimate on optical fiber capacity.

Monday, September 21 · 16:15 - 18:00

Room: Hall I

2.7: Symposium: InP and Si integrated photonics: competition or symbiosis (2)

Si Photonic Circuits

Chairs: Laurent Fulbert, CEA-LETI, France), Lorenzo Pavesi, University of Trento, Italy

16:15 2.7.1
Trends in Photonic Integrated Circuits
T. L Koch, Lehigh University, USA
♦ Recent applications trends are accelerating a migration of the role of photonic integration from subsystem cost reduction to being a fundamentally enabling technology. This talk discusses the exciting potential of Si and InP-based PIC technologies to address emerging opportunities

16:40 2.7.2
A European Platform for Silicon Photonics R&D
Pieter Dumon, Ghent University, Belgium
♦ We will discuss the progress and challenges in setting up multi project wafer access to silicon photonics technology for R&D purposes.

17:05 2.7.3
Challenges of Si Photonics for on-chip Integration
K. Wada, The University of Tokyo, Japan
♦ To clear fundamental limits of electrical interconnection WDM optical interconnection should be implemented in Si photonics. Challenging issues are strongly connected with temperatures in CMOS processing and in operation.

17:30 2.7.4
Si and InP Integration in the HELIOS project
Jean-Marc Fedeli, CEA-LETI, France
♦ Photonics and Electronics integration is considered using molecular wafer bonding of an optical SOI processed wafer on top of an electronics wafer. InP sources and Ge photodetectors are processed together on 200mm wafers.

Notes:

19:30 - 21:30 Welcome Reception (Town Hall Vienna)

Room: Hall E1

3.1: Optics in Computing

Chair: Ioannis Tomkos, AIT, Greece

9:00 3.1.1
Warehouse Scale Computers: Bandwidth Drivers for Large Scale Compute Systems Invited
Vijay Gill, Google inc., USA
♦ Traditionally, mechanical, power and civil engineers built the data-center building, unencumbered by any useful knowledge of what kinds of machines would be placed there, what kind of software they would run, and what kinds of activity patterns they would experience. The results were not impressive.

9:30 3.1.2
CARRIOCAS Project: An Experimental High Bit Rate Optical Network for Computing-Intensive Scientific and Industrial Applications Invited
Olivier Audouin, Alcatel-Lucent, France, France
♦ CARRIOCAS project is a French collaborative project studying and experimenting high bit rate optical networks 40 Gb/s per wavelength for applications in simulation, data analysis and virtual prototyping remotely accessing to supercomputers and storage servers.

10:00 31.3.
Optics in Supercomputers Invited
Bert Jan Offrein, IBM Research GmbH, Zurich Research Laboratory, Switzerland; Petar Pepeljugoski, IBM Research, USA
♦ Intra-system interconnects bandwidth becomes a critical factor in performance scaling of supercomputers and server systems. The requirements, status and prospects of optical technology for the board and chip level will be reviewed.

Room: Hall E2

3.2: Control Plane Aspects

Chair: Keren Bergman,Columbia University, USA

9:30 3.2.1
Experimental Field-Trial of Multi-domain PCE-based Path Computation for OSNR-aware GMPLS enabled translucent WSON
Ramon Casellas, Ricardo Martinez, Raul Muñoz, Centre Tecnologic de Telecomunicacions de Catalunya, Spain; Takehiro Tsuritani, Shuichi Okamoto, KDDI R&D Laboratories, Inc., Japan
♦ We present the deployment of a PCE for OSNR-aware translucent networks, both in single and multi-domain scenarios. We summarize the algorithm, the control plane extensions and the experimental field trial located in Spain and Japan

9:45 3.2.2
Demonstration of GMPLS-controlled Integrated IP/WDM Routing over a Grooming-capable ASON/GMPLS Network Test-bed
Jordi Perelló, Luis Velasco, Fernando Agraz, Salvatore Spadaro, Jaume Comellas, Gabriel Junyent, Universitat Politècnica de Catalunya, Spain
♦ This paper demonstrates the benefits of GMPLS-based integrated routing and grooming in a 16-Node ASON/GMPLS network test-bed. Experimental results highlight significant blocking probability and E/O port usage reduction against all-optical and opaque transport network alternatives.

10:00 3.2.3
PCE Architecture for OIF E-NNI Multi-domain Routing evaluated in an Intra-domain WSON Scenario
Francesco Paolucci, Alessio Giorgetti, Luca Valcarenghi, Piero Castoldi, Scuola Superiore S.Anna, Italy; Filippo Cugini, CNIT, Italy; Paola Iovanna, Giulio Bottari, Ericsson Telecomunicazioni, Italy; Annikki Welin, Ericsson, Sweden
♦ An integrated PCE-Routing Controller architecture is proposed to enhance the abstraction scheme used for virtual intra-domain link metric definition. Resource utilization and multi-domain control plane stability are improved without significantly affecting the advertised service level.

10:15 3.2.4
Multi-Vendor Interoperability Demonstration of Wavelength Switched Optical Network WSON with GMPLS Lambda-Label Extension Invited
Shuichi Okamoto, Takehiro Tsuritani, Munefumi Tsurusawa, Munefumi Tsurusawa, KDDI R&D Laboratories Inc., Japan; Sota Yoshida, Teruko Fujii, Kazuo Kubo, Shoichiro Seno, Mitsubishi Electric Corporation, Japan; Itaru Nishioka, Soichiro Araki, NEC Corporation, Japan; Masahiro Sakauchi, NEC, Japan
♦ Interoperable wavelength path control was successfully demonstrated on a multi-vendor WSON testbed by utilizing GMPLS signaling extension with lambda-label. Data-plane connections over GMPLS wavelength paths were also confirmed in the testbed with an 880km-in-total network.

10:45 - 11:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

11:15 - 13:00 Exhibition only

13:00 - 14:30 Lunch break

Room: Hall F1

3.3: Optical Signal Processing (1)

Chair: Harm Dorren, Eindhoven University of Technology, The Netherlands

9:00 3.3.1
40 lambda WDM Channel-by-Channel and Flexible Dispersion Compensation at 40 Gb/s Using Multi-channel Tunable Optical Dispersion Compensator
Shunichi Sohma, Kunihiko Mori, Tetsuo Takahashi, Kenya Suzuki, Naoki Ooba, NTT Corporation, Japan
♦ We demonstrated channel-by-channel and flexible CD compensation of 40 lambda WDM signals at 40 Gb/s in 40/80 km spans using pass band widened AWG-LCOS-based multi-channel TODC combined with a single DCF.

9:15 3.3.2
Fibre-Based Parametric Wavelength Conversion of 86 Gb/s RZ-DQPSK Signals With 15 dB Gain Using a Dual-Pump Configuration
Thomas Richter, Colja Schubert, Fraunhofer Heinrich-Hertz-Institut, Germany; Robert Elschner, Klaus Petermann, Technische Universität Berlin, Germany
♦ We show error-free wavelength conversion of 86 Gb/s RZ-DQPSK signals with 15 dB gain in a highly non-linear fibre using a dual-pump configuration with precisely counterphased pump-phase modulations

9:30 3.3.3
All-Optical 3R Regeneration at 40 Gb/s in a Recirculating Loop Utilizing Raman Amplification, Nonlinear Phase Modulation, and Offset Filtering
Sung Han Chung, Xuefeng Tang, John C Cartledge, Queen's University, Canada
♦ The performance of an all-optical 3R regenerator for 40 Gb/s RZ-OOK signals is investigated experimentally using a recirculating loop. A power penalty of 1.2 dB is obtained for 100 loops 8,000 km).

9:45 3.3.4
Impact of Pump-Induced Nonlinear Phase Noise on Parametric Amplification and Wavelength Conversion of Phase-Modulated Signals
Robert Elschner, Klaus Petermann, Technische Universität Berlin, Germany
♦ We calculate the signal SNR penalty resulting from pump-induced nonlinear phase noise in dual-pump fibre optical parametric amplifiers for various phase-shift keying formats.

10:00 3.3.5
Cascaded Phase-Preserving Amplitude Regeneration
Christian Stephan, Georgy Onishchukov, Max Plack Institute for the Science of Light, Germany; Klaus Sponsel, Bernhard Schmauss, Gerd Leuchs, University Erlangen-Nuernberg, Germany
♦ Experimental results obtained on 10 Gb/s RZ-DPSK transmission in a recirculating fiber-loop setup show that nonlinear amplifying loop mirrors can efficiently enhance system performance. Main limiting factor is amplified Rayleigh backscattering in highly nonlinear fiber.

10:15 3.3.6
All-Optical XOR Gate Using Integrated SOA Three-Arm-MZI Wavelength Converter
Iori Takamatsu, Suresh M. Nissanka, Akihiro Maruta, Katsuhiro Shimizu, Ken'ichi Kitayama, Osaka University, Japan; Toshiharu Miyahara, Toshitaka Aoyagi, Atsushi Sugitatsu, Mitsubishi Electric Corporation, Japan
♦ We propose an all-optical XOR gate using integrated SOA three-arm-MZI wavelength converter and experimentally demonstrate an error-free operation converting from two NRZ-OOK signals to one RZ-OOK signal by achieving the XOR operation.

10:30 3.3.7
All-Optical Logic Gates XOR, AND, and OR Based on Cross Phase Modulation in a Highly Nonlinear Fiber
Kai Sun, Martin Rochette, Lawrence Chen, McGill University, Canada; Jifang Qiu Beijing, University of Posts and Telecommunications, P.R. China
♦ We report an all-optical multi-logic gate based on cross-phase modulation in a highly nonlinear fiber and demonstrate XOR, AND, and OR operations at 10 Gb/s.

Room: Hall H

3.4: Coherent vs. Direct-detection

Chair: Polina Bayvel, University College London UCL), United Kingdom

9:00 3.4.1
POLMUX-QPSK modulation and coherent detection: the challenge of long-haul 100G transmission Invited
Dirk van den Borne, Sander Jansen, Torsten Wuth, Nokia Siemens Networks, Germany; Vincent Sleiffer, Mohammad Alfiad, Eindhoven University of Technology, The Netherlands
♦ The rise of coherent detection and digital signal processing is drastically changing the design of optical transmission systems. In this paper we review the challenges and opportunities offered by such receivers in the design of long-haul 100G systems.

9:30 3.4.2
100Gb/s WDM NRZ-PM-QPSK Long-Haul Transmission Experiment over Installed Fiber Probing Non-Linear Reach With and Without DCUs
Giancarlo Gavioli, Enrico Torrengo, Gabriella Bosco, Politecnico di Torino, Italy; Andrea Carena, Vittorio Curri, Valerio Miot, Pierluigi Poggiolini, Michele Belmonte, Andrea Guglierame, AVANEX Corporation, Italy; Andrea Brinciotti, Antonio La Porta, Mi.Tel-Teleoptix, Italy; Fabrizio Forghieri, Cristiana Muzio, Giovanni Osnago, Stefano Piciaccia, Cisco Photonics Italy srl, Italy; Carlo Lezzi, FASTWEB, Italy; Lutz Molle, Ronald Freund, Fraunhofer Institute for Telecommunications, Heinrich-Hertz Institut, Germany
♦ We present an experiment of WDM 100Gb/s coherent NRZ-PM-QPSK transmission over 16 spans of installed SSMF. We used variable span loss, with and without optical dispersion compensation, to investigate maximum non-linear reach.

9:45 3.4.3
Nonlinear Behaviour of 112 Gb/s Polarisation-Multiplexed RZ-DQPSK with Direct Detection in a 630 km Field Trial
Horst Wernz, Stefan Herbst, Steffen Bayer, Helmut Griesser, Evely Martins, Cornelius Fuerst, Ericsson GmbH, Germany; Benjamin Koch, Vitali Mirvoda, Reinhold Noé, University of Paderborn, Germany; Armin Ehrhardt, Lars Schuerer, Malte Schneiders, Deutsche Telekom Netzproduktion GmbH, Germany; Sascha Vorbeck, Deutsche Telekom AG, Germany; Dirk Breuer, Ralf-Peter Braun, Deutsche Telekom T-Labs, Germany
♦ PM-RZ-DQPSK with direct detection and fast optical polarisation tracking achieves 6dB noise margin over a long-haul field link. The crosstalk by 10&40G OOK channels at 50GHz spacing is analysed for high channel power.

10:00 3.4.4
Pseudo-Return-to-Zero Modulation Scheme: Application to the Compensation of Intra-Polarization Skew for PolMux Signals
Emmanuel Le Taillandier de Gabory, Sadao Fujita, Wakako Maeda, NEC Corporation, Japan; Kiyoshi Fukuchi, Principal Researcher, Japan
♦ We demonstrate a precise skew monitoring between multiplexed polarizations, demultiplexed polarization discrimination and large-PMD tolerance enhancement for 110Gbit/s PolMux-QPSK signal, by introducing a new modulation scheme, Pseudo-Return-to-Zero, and using the information it carries.

10:15 3.4.5
On the Required Number of WDM Channels When Assessing Performance of 100Gb/s Coherent PDM-QPSK Overlaying Legacy Systems
Jérémie Renaudier, Gabriel Charlet, Massimiliano Salsi, Patrice Tran, Haïk Mardoyan, Sebastien Bigo, Bell Labs, Alcatel-Lucent, France; Oriol Bertran-Pardo, Telecom Paristech ENST-Paris), France; Marco Bertolini ,Università degli Studi di Parma, Italy
♦ We experimentally analyze WDM nonlinear impairments brought by co-propagating 10Gb/s NRZ channels onto a 100Gb/s PDM-QPSK channel. The PDM-QPSK channel can experience strong nonlinear interactions even from co-propagating channels located far away in the multiplex.

10:30 3.4.6
Simultaneous WDM-DQPSK Demodulation With a Single AWG
Francesco Vacondio, Amirhossein Ghazisaeidi, Leslie Rusch, Laval University, Canada
♦ We experimentally demonstrate simultaneous demodulation of wavelength division multiplexed WDM DQPSK signals with a single arrayed waveguide grating AWG). We then compare this receiver to the conventional one in presence of nonlinear phase noise.

10:45 - 11:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

11:15 - 13:00 Exhibition only

13:00 - 14:30 Lunch break

Tuesday, September 22 · 09:15 - 10:45

Room: Hall G

3.5: Multi-mode Fibres for Access

Chair: Jerzy Siuzdak, Warsaw University of Technology, Poland

9:00 **3.5.1**
4 Gbit/s over 50-m Large Core Diameter GI-POF using Low-cost VCSEL
Hejie Yang, Ton Koonen, COBRA, Eindhoven University of Technology, The Netherlands; Eduward Tangdiongga, Jeffrey Lee, Henrie van den Boom, Eindhoven University of Technology, The Netherlands; Sebastian Randel, Siemens, Germany
♦ We report record transmission systems over 50 metres of 900-µm core diameter graded-index POF using a low-cost VCSEL at 667 nm. A net bit rate of 4 Gbit/s is achieved with BER less than 10-3.

9:15 **3.5.2**
107 Gb/s Transmission over Multimode Fiber with Coherent Optical OFDM Using Center launching Technique
Yiran Ma, William Shieh, University of Melbourne, Australia; Yan Tang, The University of Melbourne, P.R. China
♦ We experimentally demonstrate 107-Gb/s coherent optical OFDM transmission over non-amplified and amplified multimode fiber link. A record performance of 10 Tb/sokm over multimode fiber has been achieved using center launching and OFDM equalization.

9:30 **3.5.3**
High Speed Optical Transmission over Plastic Optical Fibers Invited
Roberto Gaudino, Politecnico di Torino, Italy
♦ We will review the best results from recent EU projects POF-ALL, ALPHA and POF-PLUS on the use of large core plastic optical fibers POF for Gbps transmission over typical home-networking distances up to 50 meters).

10:00 **3.5.4**
Real-Time Implementation of a 1.25-Gbit/s DMT Transmitter for Robust and Low-Cost LED-Based Plastic Optical Fiber Applications
Jeffrey Lee, University of Technology Eindhoven, The Netherlands; Florian Breyer, Technische Universität München, Germany; Daniel Cárdenas, Universidad San Francisco de Quito, Ecuador; Sebastian Randel, Siemens, Germany; Ton Koonen, COBRA, Eindhoven Univ. of Technology, The Netherlands
♦ Real-time implementation of a DMT transmitter in FPGA is demonstrated for low-cost, standard 1-mm step-index plastic optical fiber applications based on commercial resonant-cavity LED and large-diameter 540 µm photodiode

10:15 **3.5.5**
Real-time Gigabit Ethernet Transmission over up to 25 m Step Index Polymer Optical Fibre using LEDs and FPGA-Based Signal Processing
Florian Breyer, Jeffrey Lee, Norbert Hanik, Technische Universität München, Germany; Daniel Cárdenas, Universidad San Francisco de Quito, Ecuador; Sebastian Randel, Siemens, Germany
♦ Real-time Gigabit Ethernet transmission over up to 25 m Step-Index Polymer Optical Fibre is demonstrated using a commercial LED. This is enabled by use of PAM-4 modulation and receiver equalisation including clock recovery, implemented in an FPGA.

10:30 **3.5.6**
Multiservice & multiformat home network based on a low cost optical infrastructure
Philippe Guignard, Anna Pizzinat, Olivier Bouffant, France Telecom R&D, France; Benoit Charbonnier, Orange Labs, France
♦ We propose a new home network delivering various signals Ethernet, digital terrestrial or satellite TV, Radio over Fibre on a unique infrastructure. We have validated this concept by an implementation on graded-index plastic fibre.

10:45 - 11:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

11:15 - 13:00 Exhibition only

13:00 - 14:30 Lunch break

Tuesday, September 22 · 09:30 - 10:45

Room: Hall F2

3.6: Nanophotonics

Chair: Christian Lerminiaux, Université de Technologie de Troyes, France

9:15 **3.6.1**
Tutorial: Nanophotonics: Dressed Photon Technology for Innovative Optical Devices, Fabrications and Systems
Motoichi Ohtsu, The University of Tokyo, Japan
♦ This tutorial reviews recent progress in nanophotonics, a novel optical technology proposed in 1993 by the author. Nanophotonics utilizes the local interaction between nanometric particles via optical near fields. The optical near fields are the elementary surface excitations on nanometric particles, that is, dressed photons that carry the material excitation. The principles of device operation are reviewed considering the excitation energy transfer via the optical near-field interaction and subsequent relaxation. The operations of logic gates, an optical nano-fountain, a nano-coupler, a pulse generator, a nonadiabatic light emitter, etc. are described as well as their single photon emission and extremely low power consumption capability. Experimental results using quantum dos at the room temperature are described. Using a systems-perspective approach, the principles of content-addressable memory for optical router, a multilayer memory retrieval system, etc. are demonstrated. Application to nonadiabatic lithography, etching, etc. are also reviewed.

10:15 **3.6.2**
Electrically Driven Single Photon Sources - Status and Challenges Invited
Alfred Forchel, Würzburg University, Germany
♦ Recent progress in the field of electrically pumped single photon sources based on quantum dot-microcavity systems will be reviewed. We demonstrate efficient single photon emission at rates exceeding 40 MHz from electrically pumped micropillar cavities.

10:45 - 11:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

11:15 - 13:00 Exhibition only

13:00 - 14:30 Lunch break

Notes:

Room: Hall E1

4.1: Fibre Measurement and Characterization

Chair: Pascale Nouchi, Draka, France

14:30 4.1.1
Sub-cm Spatial Resolution Reflectometry over 10 km Based on Phase Noise Compensated OFDR with Third Order Sideband Sweeping
Yusuke Koshikiya, Fumihiko Ito, NTT Corporation, Japan; Xinyu Fan, NTT, Japan
♦ We describe PNC-OFDR employing 3rd order sideband sweeping to realize a broader frequency sweep span. We achieved a sub-cm spatial resolution over a 10 km measurement range.

14:45 4.1.2
10 cm spatial resolution and 20 km range full polarimetric reflectometry for distributed DGD measurement of high PMD fibres
Xinyu Fan, NTT, Japan; Yusuke Koshikiya, Fumihiko Ito, NTT Corporation, Japan
♦ Full polarimetric reflectometry is realized with a spatial resolution of 10 cm over 20 km based on phase-noise compensated optical frequency domain reflectometry. Distributed DGD measurement of high PMD fibres is realized using the technology.

15:00 4.1.3
Localized Measurement of Linear Polarization Rotation Parameters in Short Optical Fibers
Evgeny Myslivets, Stojan Radic, Nikola Alic, University of California San Diego, USA
♦ We present a novel measurement technique for precise longitudinal characterization of polarization parameters in optical fibers based on the modified counter-colliding scanner technique.

15:15 4.1.4
Reflectometric Measurement of Strain Induced Optical Activity Coefficient in Single-Mode Randomly Birefringent Twisted Fibers
Andrea Galtarossa, Daniele Grosso, Luca Palmieri, University of Padova, Italy
♦ A novel technique based on polarization-sensitive frequency-domain reflectometry, for non-invasive measurement of optical activity coefficient, in randomly birefringent twisted fibers, is presented. The method has been applied to spun and unspun fibers.

15:30 4.1.5
Fabry-Perot Lasers in Simultaneous Strain and Temperature Brillouin-based Distributed Sensing
Marcelo A. Soto, Gabriele Bolognini, Fabrizio Di Pasquale, Scuola Superiore Sant'Anna, Italy
♦ The use of Fabry-Perot lasers is proposed for simultaneous strain and temperature sensing based on spontaneous Brillouin scattering. A significant sensing performance enhancement is achieved compared to the use of single-longitudinal mode lasers.

15:45 4.1.6
Straightforward Chromatic Dispersion Measurement Based on Phase Mismatching FWM
Masaaki Hirano, Takashi Sasaki, Sumitomo Electric Industries, Ltd., Japan
♦ Novel chromatic dispersion measurement is demonstrated with simple setup based on phase mismatching four-wave-mixing. According to high accuracy of measured dispersion spectra, zero-dispersion wavelength and higher order dispersion parameters of HNLF can be determined.

16:00 4.1.7
Simple Filter for Dispersion Estimation via optical VSB filtering
Niels Neumann, Tobias Schuster, TU Dresden, Germany; Christian Schaeffer, Helmut Schmidt University, Germany
♦ In this paper, we introduce a simple fiber optical filter for dispersion monitoring using the dispersion-induced electrical phase shift of the received upper and lower sideband signals and present proof-of-concept measurements in a 10G system.

Room: Hall E2

4.2: Heterogeneous Integration

Chair: Guang-Hua Duan, Alcatel Thales III-V Lab, France

14:30 4.2.1
Heterogeneously Integrated SOI Compound Semiconductor Photo nics (Invited)
Dries Van Thourhout, Gunther Roelkens, Ghent University-IMEC, Belgium
♦ We review progress on the realization of on-chip sources on an SOI waveguiding platform using a heterogeneous integration approach based on die-to-wafer bonding. We will discuss their application for optical interconnect applications.

15:00 4.2.2
An Ultra-compact Waveband Cross-connect Switch Module to Create Cost-effective Multi-degree Reconfigurable Optical Node
Kiyo Ishii, Hiroshi Hasegawa, Nagoya University, Japan; Ken-Ichi, Sato, School of Engineering - Nagoya University, Japan; Masayuki Okuno, NTT Electronics, Japan; Shin Kamei, NTT Photonics laboratories, Japan; Hiroshi Takahashi, NTT Corporation, Japan
♦ We demonstrate a compact waveband cross-connect switch module that will be utilized for creating cost-effective multi-degree optical cross-connect nodes. Its measured performance confirms that it can be applied to metro-edge/metro-access networking in the future.

15:15 4.2.3
High Speed Wavelength Conversion in a Heterogeneously Integrated Disc Laser Over Silicon On Insulator for Network on a Chip Applications
Oded Raz, Dorren Harm, Eindhoven University of Technology, The Netherlands; Liu Liu, Dries Van Thourhout, Gent University, Belgium; Pedro Rojo-Romeo, Institut des Nanotechnologies de Lyon, France; Jean-Marc Fedeli, CEA-LETI, France
♦ We present the first BER results for wavelength conversion at 2.5Gb/s for an InP membrane Micro-Disc-Laser bonded on SOI substrate. Measured BER supports error-free operation when FEC is used. Operation at 10GB/s is also demonstrated.

15:30 4.2.4
Compact Passive Devices in InP Membrane on Silicon
Frederic Bordas, Rui Zhang, Erik Jan Geluk, Fouad Karouta, Jos van der Tol, Rene van Veldhoven, Richard Notzel, Meint K Smit, Technische Universiteit Eindhoven, The Netherlands; Gunther Roelkens, Dries Van Thourhout, Roel Baets ,Ghent University - IMEC, Belgium
♦ The high vertical index contrast and the small thickness of thin InP membranes 200nm bonded with BCB allow the achievement of very small devices. In this paper we will present some performances of such photonic integrated circuit building blocks.

15:45 4.2.5
Polarization-Independent and Low-Current Operation of InAlGaAs/InAlAs Mach-Zehnder Interferometer-Type Photonic Switch with Hybrid-Waveguide Structure for Optical Packet Switching
Yuta Ueda ,Waseda University, Japan
♦ We demonstrated a polarization-independent Mach-Zehnder interferometer-type photonic switch with very-low-current of about 5mA. Furthermore, a few nano-second switching response time was also confirmed which suits for application to optical packet switching.

16:00 4.2.6
Compact Polarization-Insensitive Array Isolator Built-in SOA Gate Array Switch Module for Large-Scale Switch Systems
Goji Nakagawa, Nobuhiro Fukushima, Setsuo Yoshida, Yasuhiko Aoki, Shinsuke Tanaka, Ken Morito, Fujitsu Limited, Japan; Kazuo Hironishi, Kyosuke Sone, Susumu Kinoshita, Photonics Laboratories Fujitsu Laboratories Limited, Japan
♦ We developed an SOA gate array switch module with a novel polarization-insensitive built-in array isolator. We achieved excellent optical coupling characteristics that had insertion losses of about 3dB and high-isolation of over 45 dB in 80 nm wide wavelength ranges.

16:15 - 16:45 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall F1

4.3: Optical Signal Processing (2)

Chair: John C Cartledge, Queen's University, Canada

14:30 4.3.1
All-optical Combination of DPSK and OOK to 320-Gb/s DQPSK Signal Using Fiber-based Signal Processors
Fumio Futami, Ryo Okabe, Tomoyuki Kato, Shigeki Watanabe, Fujitsu Laboratories Ltd., Japan; Carsten Schmidt-Langhorst, Colja Schubert, Reinhold Ludwig, Fraunhofer Heinrich-Hertz-Institut, Germany
♦ All-optical combination of 160-Gb/s DPSK and OOK signals into a 320-Gb/s DQPSK signal is demonstrated using highly-nonlinear fibers. A polarization-insensitive optical parametric limiter enabled error-free combination operation midway in a 200 km fiber link.

14:45 4.3.2
All-Optical Demultiplexing of 640 Gbit/s OTDM-DPSK Signal Using a Semiconductor SMZ Switch
Toshihiko Hirooka, Masatada Okazaki, Toshiyuki Hirano, Pengyu Guan, Masataka Nakazawa, Tohoku University, Japan; Shigeru Nakamura, NEC Corporation, Japan
♦ The all-optical demultiplexing of a 640 Gbit/s OTDM signal is successfully demonstrated using a symmetric Mach-Zehnder switch incorporating SOAs. An ultrafast switching gate as narrow as 1.4 ps is realised, which facilitates low-penalty demultiplexing.

15:00 4.3.3
640 Gb/s timing tolerant demultiplexing using a cascaded long-period fiber grating pulse shaper
Evarist Palushani, Hao Hu, Leif Oxenløwe, Michael Galili, Hans Christian Mulvad, Anders Clausen, Palle Jeppesen, Technical University of Denmark, Denmark; Radan Slavík ASCR, Czech Republic
♦ An SMF inscribed with two polarization independent long-period gratings is used for sub-picosecond pulse shaping and validated in a 640 Gb/s data demultiplexing experiment, providing a jitter tolerance of 510 fs.

15:15 4.3.4
Ultrafast All-Optical Analog-to-Digital Conversion using Fiber Nonlinearity Invited
Ken'ichi Kitayama, Osaka University, Japan
♦ Feasibility toward tera-sample/s all-optical ADC using NOLM and its promising applicationssuch as front-end processor of EDC for above 100Gbit/s optical transmission systems are discussed. Recent record-breaking experimental demonstrations of 5-bit ADC will be presented.

15:45 4.3.5
Bit-Rate-Variable and Order-Switchable Optical Multiplexing of 160-Gbit/s PRBS Data Using Tunable Optical Delays
Xiaoxia Wu, Jian Wang, Omer F Yilmaz, Scott R. Nuccio, Alan Willner, University of Southern California, USA; Antonella Bogoni CNIT, Italy
♦ We experimentally demonstrate 160-Gbit/s PRBS data multiplexing with tunable rate and order using switchable optical delays and conversion/dispersion based tunable optical delay. Less than 9 dB penalty at 10^-9 BER is observed after demultiplexing the 160-Gbit/s PRBS to 40-Gbit/s.

16:00 4.3.6
Simultaneous Implementation of Photonic OR and AND Logic Gates for CSRZ-OOK Signal Using Four-Wave Mixing FWM in a Highly Nonlinear Photonic Crystal Fiber HNL-PCF
Fu Songnian, Wen-De Zhong, Ping Perry Shum, Chinlon Lin, Junqiang Zhou, Nanyang Technological University, Singapore, Singapore
♦ A simultaneous implementation of photonic OR and AND logic gates for 10-Gb/s CSRZ-OOK signal is demonstrated using Four-Wave Mixing FWM)in a 60-meter HNL-PCF. The logic integrity and system performance are experimentally evaluated by BER measurements.

Room: Hall H

4.4: Symposium: Real-time Digital Signal Processing for Optical Transceivers (1)

Technology

Chair: John Sitch, Nortel, USA

14:30 Opening and Welcome to the Symposium

14:35 4.4.1
DSP: A Disruptive Technology for Optical Transceivers
Kim Roberts, Nortel Networks, Canada; Ian Roberts, McGill University, Canada
♦ The use of DSP in optical transmission has allowed digital compensation of optical effects, resulting in a reduction in the complexity of the optical line and easy deployment of high speed connections.

14:55 4.4.2
From Algorithm to ASIC: Realising Distortion Tolerant Transmission
Theodor Kupfer, CoreOptics GmbH, Germany
♦ Structural design and functional blocks of a digital equalizer chipset is shown in a case study of two product generations. In addition, challenges from field applications and product solutions are presented.

15:25 4.4.3
Comparison of Current FPGA Technology: Case Study Implementing FEC for the 100G Optical Transport Network
Wally Haas, Avalon Microelectronics, Canada
♦ This case study examines two high performance FEC algorithms implemented in a single state of the art FPGA for the 100G optical network.

15:55 Panel Discussion and Close of Session 1

16:15 - 16:45 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall G

4.5: Ultra-Wideband over Fibre

Chair: Stuart Walker, University of Essex, United Kingdom

14:30 4.5.1
Spectrally Efficient Simultaneous Delivery of 112Gbps Baseband Wireline and 60 GHz MM-Wave Carrying 10Gbps Optical Wireless Signal in Radio-over-Fiber WDM-PON Access Systems
Chowdhury Arshad, Hung-Chang Chien, Ming-Fang Huang, Georgia Institute of Technology, USA; Jianjun Yu, Ting Wang, NEC Labs America, USA; Gee-Kung Chang, Georia Tech, USA
♦ Abstract For the first time, we demonstrate a novel scheme to deliver 112Gbps PolMux-RZ-QPSK baseband and 10Gbps optical wireless signals at 60GHz millimeter-wave in downstream links and 10Gbps centralized lightwave upstream for the super-broadband radio-over-fiber 100GHz spaced WDM-PON networks.

14:45 4.5.2
Simultaneous Generation and Transmission of 60-GHz RF and Baseband Signals Employing Only a Simple Single Electrode MZM
Wen-Jr Jiang, Chun-Ting Lin, Po Tsung Shih, Jyehong Chen, National Chiao Tung University, Taiwan; Sien Chi, Yuan Ze University, Taiwan
♦ Employing only a simple single electrode MZM, a novel hybrid access network, which is capable of generating and transmitting RF-vector 2.5-Gb/s QPSK at 60GHz and baseband signals 1.25-Gb/s OOK simultaneously, is proposed and experimentally demonstrated.

15:00 4.5.3
All-Optical Multicasting of Millimetre-Wave Signals using Optical Frequency Multiplication Technique for In-building Networks
Hyun-Do Jung, Chigo Okonkwo, Eduward Tangdiongga, Eindhoven University of Technology, The Netherlands; Ton Koonen, COBRA, Eindhoven Univ. of Technology, The Netherlands
♦ We demonstrate a new OFM configuration exploiting XGM in SOA for simultaneous all-optical generation and multicasting of mm-wave signals for in-building networks. An EVM of 4.5% is achieved for 20MSymbol/s 64-QAM at 39.6GHz.

15:15 4.5.4
13.75-Gb/s OFDM Signal Generation for 60-GHz RoF System within 7-GHz License-Free Band via Frequency Sextupling
Po Tsung Shih, Chun-Ting Lin, National Chiao Tung University, Taiwan
♦ A 60-GHz RoF system with frequency sextupling is experimentally demonstrated. Based on modified SSB, a 13.75-Gb/s OFDM signal is generated within the 7-GHz license-free band. No penalty is observed after transmission over 25-km single-mode fiber.

15:30 4.5.5
New Time-Frequency Code Scheme for Bidirectional Ultra-wideband WDM Access Networks
Wen-Piao Lin, Chang Gung University, Taiwan; Yu-Fang Hsu, Chienkuo Technology University, Taiwan
♦ A novel time-frequency code scheme for bidirectional multiband OFDM ultra-wideband WDM access networks is proposed. Experiment results demonstrate that the scheme can provide simple structure, reducing wavelength and low-cost usage for high-speed wireless access networks.

15:45 4.5.6
Evolution of Optical Access Network Technologies in Radio Systems Invited
Yukio Horiuchi, KDDI R&D Laboratories, Inc., Japan
♦ Radio system architecture has drastically changed according to the evolution of optical fibre technologies. This paper describes optical access technologies that contribute to the efficient construction of radio systems including mobile communication and terrestrial digital media broadcasting.

Room: Hall F2

4.6: Transport Network Technologies

Chair: Andreas Gladisch, Deutsche Telekom AG, Germany

14:30 4.6.1
Tutorial: Core Photonic Networks - Where Are Things Heading?
Peter D Magill, Robert Doverspike, AT&T Labs - Research, USA
♦ Telecommunications carriers are under great economic pressure to keep their core networks cost effective. To address that, they need to keep reducing the cost-per-bit in the core IP routers and switches as well as the optical transport network which interconnects them. We will discuss the resulting desires for the transport technologies and temper those with Capacity Crunch issues. We will then explore alternate network architectures to better utilize the transport resources. These will include consideration of the pros and cons of a sub-wavelength grooming layer between the Layer 2/3 routers and Layer 1 transport. We will then describe ways to make the "ROADM" layer truly reconfigurable remotely reconfigurable and its value.

15:30 4.6.2
Route and Wavelength/Waveband Assignment for Creation of Compact Hierarchical Optical Cross-Connect for Multi-Ring Connection
Kiyo Ishii, Hiroshi Hasegawa, Ken-Ichi Sato, Nagoya University, Japan
♦ We propose a route and wavelength/waveband assignment method for multi-ring networks linked by hierarchical optical cross-connects. Numerical experiments reveal that the switch scale is significantly reduced at the cost of a marginal drop in routing capability.

15:45 4.6.3
Scalable Optical Packet Switching at 160 Gb/s Data Rate
Wenrui Wang, COBRA Research Institute, Eindhoven University of Technology, P.R. China; Nicola Calabretta, COBRA Research Institute, The Netherlands; Ton Ditewig, Fausto Gomez-Agis, Shangjian Zhang, Oded Raz, Eduward Tangdiongga, Dorren Harm, Eindhoven University of Technology, The Netherlands
♦ We investigate the feasibility of a 1x4096 optical-packet-switch OPS operating at 160Gb/s, by cascading two 1x64 OPSs in a fat-tree configuration. We find error-free operation with 5.7dB penalty over the complete system.

16:00 4.6.4
Demonstration of QoS-Classified Survivability Schemes in Transparent OBS/GMPLS Networks Using Streaming Media Transmission
Yawei Yin, Wenjia Zhang, Hongxiang Guo, Xiaobin Hong, Jian Wu, Hongmei Jiang, Xiaoyuan Cao, Lei Liu, Jintong Lin, Beijing University of Posts and Telecommunications, P.R. China; Takehiro Tsuritani, Tomohiro Otani, KDDI R&D Laboratories, Inc., Japan
♦ Various survivability schemes for the end-to-end transparent optical connectivity in OBS/GMPLS networks are experimentally demonstrated by using streaming media transmission. The results validate the applicability of such reliable connectivity to the high quality services.

16:15 - 16:45 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall I

4.7: Symposium: Next Generation Optical Access Technologies (1)

Chairs: Russell Davey, BT., United Kingdom, Thomas Pearsall, EPIC, France

Next Generation Optical Access Technologies
GPON and GE-PON and point-to-point fibre are now being deployed and can deliver ~100 Mbit/s to end users. In parallel next generation technologies are being developed such as 10 Gbit/s PONs and WDM-PONs. Unless the industry identifies a killer application causing end-users to pay extra revenue for bandwidths higher than can be delivered today, then the cost of future optical access technologies must be comparable to the technologies available today. This is a significant challenge and should be a major focus for the optical research community. This symposium will: -Discuss drivers for next generation optical access technology -Compare capability, cost and power consumption of candidate next generation PON architectures 10Gbit/s PON, WDM-PON etc. versus each other and versus GPON/GE-PON and point-to-point -Discuss enabling optical component technology for next generation optical access with a focus on cost reduction

14:30 4.7.1
What will be the killer application for FTTH and would end users ever need more than ~100 Mbit/s?
Edward Uzzell, Sony, Germany

14:50 4.7.2
How much will end users pay for more bandwidth and what will be the best way to deliver it?
Hartwig Tauber, FTTH Council Europe, Germany

15:10 4.7.3
Next Generation PON: Lessons Learned from G-PON and GE-PON
Frank Effenberger, HUAWEI, United Kingdom
♦ This paper reviews the lessons learned in the standardization and deployment of the current generation of passive optical networks PONs). It suggests how these lessons might be applied to the next round of PON standardization.

15:30 4.7.4
Reducing the Optical Component Cost for Future Fibre Access
David W Smith, CIP, United Kingdom
♦ Next generation fibre access will require components with performance comparable to today's long-haul DWDM but at GPON prices. This paper outlines the role of "colourless" technology and photonic integration in helping meet this challenge.

15:50 4.7.5
Prospects for point-to-point technology to deliver 1Gbit/s to the home
Gerlas van den Hoven, GENEXIS, The Netherlands
♦ The majority of European fiber-to-the-home deployments are point-to-point networks. This paper will discuss the technological and operational/economic aspects of point-to-point networks, especially with regards to the prospects of bringing full Gigabit/s connectivity to the home.

Notes:

16:15 - 16:45 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall E1

5.1: Fibre Devices

Chair: Patrice Mégret, Faculté Polytechnique de Mons F.P.Ms, Belgium

16:45 5.1.1
Complete Temporal Optical Fourier Transformations Using Dark Parabolic Pulses
Trina T Ng, Periklis Petropoulos, Francesca Parmigiani, David J Richardson, University of Southampton, United Kingdom
♦ A study of the dynamics of temporal optical Fourier transforms is presented in the interest of improving transform quality. Experimental verification of how a complete Fourier transform can be obtained in both domains is demonstrated.

17:00 5.1.2
Almost Distortion-Free 1.2 Bit Brillouin Based Slow-Light
Andrzej Wiatrek, Ronny Henker, Thomas Schneider, Hochschule für Telekommunikation Leipzig, Germany
♦ We present the first experimental verification of an almost distortion-free SBS based delay line. Since no distortion will be accumulated by the pulses, any delay can be achieved by a cascading of such stages.

17:15 5.1.3
Fiber Optic Engine for Full Color Micro Projection
Hesam Edin Arabi Ardakani, Kyunghwan Oh, Sohee An Yonsei, University, Korea
♦ In this paper we report a micro projector including RGB sources, a Fiber Optic Color Synthesizer , and a micro scanning mirror. We further report a micro collimator which can enhance the resolution of the screened image.

17:30 5.1.4
Tunable Photonic Microwave Notch Filter Based on a Dual-wavelength Fiber Laser
Kwanil Lee, Lee Sang-Bae, Korea Institute of Science and Technology, Korea; Antonio Malacarne, Sant'Anna School of University Studies and Doctoral Research, Pisa, Italy, Italy; Antonella Bogoni, CNIT, Italy; Giancarlo Prati, Scuola Superiore Sant'Anna, Italy
♦ We experimentally demonstrate a tunable photonic microwave notch filter by employing two fiber Bragg grating-based dual wavelength laser. Based on the bending technique along the gratings, notch frequency can be tuned from 1.1 to 6.5 GHz.

17:45 5.1.5
Tunable Birefringent Phase-Shift Induced in Fiber Bragg Grating by a Shape Memory Alloy Ferrule
Alex Fraser, Éric Weynant, PhasOptx inc, Canada; Martin Bernier, Réal Vallée, Université Laval, Canada
♦ We present a new method to induce low loss tunable birefringent phase shifts in fiber Bragg grating by applying mechanical stresses at precise locations along the FBG with a specially designed shape memory alloy ferrule.

18:00 5.1.6
Multimaterial Multifunctional Fiber Devices (Invited)
Fabien Sorin, Yoel Fink, Massachusetts Institute of Technology, USA
♦ Recent discoveries have enabled the integration of metals, insulators and semiconductors structures into extended length of polymer fibers. The challenges and opportunities associated with this new class of fiber devices will be presented.

Room: Hall E2

5.2: Ultra-fast Integrated Devices

Chair: tba

16:45 5.2.1
Optical MSK Transmitter using a Monolithically Integrated Quad Mach-Zehnder IQ Modulator
Guo-Wei Lu, Takahide Sakamoto, Akito Chiba, Tetsuya Kawanishi, Tetsuya Miyazaki, National Institute of Information and Communications Technology NICT, Japan; Kaoru Higuma, Junichiro Ichikawa, Sumitomo Osaka Cement, Japan
♦ An optical MSK transmitter is proposed and experimentally demonstrated using a single monolithically integrated high-speed quad-MZ IQ modulator, where four sub-MZMs are integrated on a main MZ superstructure.

17:00 5.2.2
80 Gb/s InP Mach-Zehnder Modulator Module using Liquid Crystal Polymer LCP Transmission Line
Ken Tsuzuki, Tadao Ishibashi, Toshio Ito, Nobuhiro Kikuchi, Fumiyoshi Kano, NTT Corporation, Japan
♦ A flexible liquid crystal polymer LCP transmission circuit with excellent high frequency performance was applied to a high-speed optical modulator module. We confirmed the error-free operation of an 80 Gb/s NRZ signal using the InP-based Mach-Zehnder modulator MZM module.

17:15 5.2.3
Cavity-Less 40 GHz Pulse Source Tunable Over 95 nm
Andeas O J Wiberg, Camille-Sophie Bres, Bill Ping Piu Kuo, Evgeny Myslivets, Stojan Radic, University of California San Diego, USA
♦ We demonstrate a widely tunable 40GHz pulse source using linear pulse compression in a cavity less structure. The source is characterized with pulsewidth of 2.2ps and SNR exceeding 30 dB is achieved over 95nm.

17:30 5.2.4
Silicon-Organic Hybrid SOH - A Platform for Ultrafast Optics (Invited)
Jürg Leuthold, University of Karlsruhe, Germany
♦ Silicon signal processing at bitrates beyond 100 Gb/s is demonstrated. A new enabling platform is reviewed, which relies both on silicon-based CMOS technology for waveguide fabrication, and on an organic cladding providing nonlinearity for switching.

18:00 5.2.5
High Quality and Efficient QPM-LiNbO3 Wavelength Converter Integrated With 0.78/1.56-um Wavelength Multiplexer
Takeshi Umeki, Osamu Tadanaga, Masaki Asobe, NTT Photonics Laboratories, Japan
♦ We achieved the first integration of a QPM wavelength converter with an MMI multiplexer by using a direct-bonded LiNbO3 ridge waveguide. We successfully demonstrated high quality grouped wavelength conversion with a parametric gain.

Room: Hall F1

5.3: Network Nodes

Chair: Hercules Avramopoulos, National Technical University of Athens, Greece

16:45 5.3.1
Efficient ROADM-ring Connecting Node Switch Architecture that Utilizes Waveband Routing and its Realization with PLC Technologies
Kiyo Ishii, Hiroshi Hasegawa, Ken-Ichi Sato, Nagoya University, Japan; Osamu Moriwaki, Hiroshi Takahashi, NTT Corporation, Japan; Yoshiteru Jinnnouchi, Masayuki Okuno, NTT Electronics, Japan
♦ An efficient ROADM-ring connecting node architecture is proposed that utilizes waveband routing and achieves small footprint and cost-effectiveness. The key component devices are implemented using PLC technologies and the system performance is experimentally verified.

17:00 5.3.2
Performance of an Advanced Transient Suppressed EDFA in Diverse Dynamic Optical Network Scenarios
Benjamin J Puttnam, Yoshinari Awaji, Naoya Wada, National Institute of Information and Communications Technology NICT, Japan
♦ We extend the study of an advanced transient-suppressed EDFA to wider timescales and investigate its performance as a function of network reconfiguration-time and required optical-feedback power, demonstrating improved performance compared to a conventional amplifier.

17:15 5.3.3
Transparent Nodes. Yes, but to what Extent? (Invited)
Thierry Zami, Alcatel-Lucent, France
♦ While reconfigurable transparent WDM networks are now a reality, this paper reviews how optical nodes impact the transmission reach in a context of increasing spectral efficiency when filtering and crosstalk becomes key parameters

17:45 5.3.4
Wide Range Over 20 dB Output Power Control Using Semiconductor Optical Amplifier for 43.1 Gbps RZ-DQPSK Signal
Hidekazu Takeda, Naoki Hashimoto, Tamotsu Akashi, Hidehiko Narusawa, Kensuke Matsui, Fujitsu Optical Components Limited, Japan; Kazuyuki Mori, Fujitsu Laboratories Ltd., Japan; Shinsuke Tanaka, Ken Morito, Fujitsu limited, Japan
♦ The performance of injection-current-controlled SOA as output power control device for 43.1 Gbps RZ-DQPSK signal was experimentally investigated. Output power control range over 20 dB, from absorption to saturation region, was confirmed with little degradation.

Room: Hall H

5.4: Symposium: Real-time Digital Signal Processing for Optical Transceivers (2)

Applications

Chair: Seb Savory, University College London, United Kingdom

16:45 5.4.1
FPGA based Prototyping of Next Generation Forward Error Correction
Takashi Mizuochi, Mitsubishi Electric Corporation, Japan
♦ The concatenation of LDPC and RS codes has been demonstrated using a real-time FPGA prototype. A net coding gain of 9.0dB for 31.3-Gb/s was achieved with 20.5% redundancy for an input BER of 10-2.

17:10 5.4.2
Real-time FPGA Implementation of Transmitter Based DSP
Philip M Watts, University of Cambridge, United Kingdom; Robert Waegemans, Yannis Benlachtar, Polina Bayvel, Robert I Killey, University College London, United Kingdom
♦ Considerations for implementing transmitter based DSP for optical communications applications at 10 Gb/s and above are discussed including examples of linear and non-linear EPD compensation and OFDM generation.

17:35 5.4.3
Real-time Implementation of Digital Coherent Detection
Reinhold Noé, University of Paderborn, Germany
♦ The implementation of algorithms for coherent detection of advanced modulation formats imposes constraints. A hardware-efficient phase estimator is presented, and measurement results with a CMOS receiver chip designed for 40 Gb/s digital coherent polarization-multiplexed QPSK.

18:00 5.4.4
Realizing Real-Time Implementation of Coherent Optical OFDM Receiver with FPGAs
Noriaki Kaneda, Xiang Liu, Young-Kai Chen, Alcatel-Lucent, USA; Qi Yang, William Shieh, University of Melbourne, Australia
♦ Recent results of real-time coherent optical OFDM receiver are reviewed. Requirements and challenges pertaining to high-speed real-time implementation of CO-OFDM receiver are discussed. An implemented receiver in a FPGA at 2.5GSamples/s is described.

18:25 Wrap up of Symposium

Room: Hall G

5.5: Energy-aware Design

Chair: Marco Schiano, Telecom Italia, Italy

16:45 5.5.1
Optical Technologies Can Improve the Energy Efficiency of Networks (Invited)
Edoardo Bonetto, Luca Chiaraviglio, Guido Alejandro Gavilanes Castillo, Davide Cuda, Fabio Neri, Politecnico di Torino, Italy
♦ Optical technologies, in comparison with electronic technologies, need less power to switch high bitrates and to interconnect farther subsystems. The paper discusses with specific examples how optics can improve the energy efficiency of networks and switches.

17:15 5.5.2
Energy Efficient Multilayer Traffic Engineering
Bart Puype, Didier Colle, Mario Pickavet, Piet Demeester, Ghent University, Belgium
♦ Simulation shows how energy efficiency aware multilayer traffic engineering taking into account network equipment power characteristics can optimize IP-over-optical networks for diurnal traffic variations, lowering total power requirements

17:30 5.5.3
Energy Consumption of Telecommunication Networks
Christoph Lange, Dirk Kosiankowski, Fritz-Joachim Westphal, Andreas Gladisch, Deutsche Telekom AG, Germany; Christoph Gerlach, Deutsche Telekom Netzproduktion GmbH, Germany
♦ The energy consumption of a telecommunication network increases, but at a reduced slope compared to the assumed traffic volume increase. The major energy consumption portion shifts from access to backbone networks with rising traffic volume

17:45 5.5.4
OPEX savings of all-optical core networks
Andrew Lord, British Telecom, United Kingdom; Carl P Engineer Taseon, USA
♦ All-optical networks offer the potential for significant operational cost advantages and deployment benefits. This paper highlights the results from an analysis of BT's Core infrastructure detailing OPEX savings, deployment benefits and new revenue opportunities.

Room: Hall F2

5.6: Optical Packet Switching (2)

Chair: Harm Dorren, Eindhoven University of Technology, The Netherlands

16:45 5.6.1
Tutorial: Optical Signal Processing: The Roadmap towards High-speed Optical Packet/Burst Switching
Masash Usami, KDDI Corporation, Japan; Daniel J. Blumenthal, UCSB, USA
♦ The current explosion in capacity of optical systems and data storage, processing and routing has created a major problem with scaling traditional electronic-only systems in terms of power and footprint. During the last decade there has been significant progress in optical burst and packet switching. In this tutorial we will cover the fundamentals and basic approaches, techniques and underlying technologies for optical packet and optical burst switching. An overview of the latest in state of the art in systems and devices as well as demonstrators in the US and JAPAN will be covered.

Room: Hall I

5.7: Symposium: Next Generation Optical Access Technologies (2)

Chair: Russell Davey BT., United Kingdom

16:45 5.7.1
WDM-PON Overview
Chang-Hee Lee, LG-Nortel Co. Ltd, Korea
♦ WDM-PON with colourless ONU will be a key building block to provide future video centric services to users. We reviewed technologies for the WDM-PON including commercial system and recent research results.

17:05 5.7.2
10G-EPON: Drivers, Challenges, and Solutions
Glen Kramer, Teknovus, Inc, USA
♦ Responding to market demand for increased access capacity, the IEEE 802.3av has standardized 10GEPON. The new specification has successfully resolved a number of technical challenges, including the coexistence with the mass-deployed 1G-EPON, resulting in a highly efficient architecture.

17:25 5.7.3
Comparison of 10 Gbit/s PON vs WDM-PON
Stefan Dahlfort, Ericsson, Sweden
♦ For next generation PONs, the main effort is currently on increasing the line rate with 10GPON while WDM-PON is increasingly being discussed. These approaches are compared based on performance, cost and power consumption.

17:45 5.7.4
Next generation PONs: an operator's view
Jun-ichi Kani, NTT, Japan
♦ This paper discusses future evolution scenarios of PON systems for residential-service application as well as for large business and mobile backhaul applications given the typical network configurations currently deployed.

18:05 Panel and discussion: "After GPON and GE-PON what will be the next optical access technology to see widespread deployment? What will be the key enabling optical component innovations and how will required cost reductions be achieved?

Notes:

Room: Hall E1

6.1: Broadband Lightsources

Chair: Dag R Hjelme, Invivosense, Norway

9:15 6.1.1
Supercontinuum Generation in a Chalcogenide-Tellurite Composite Microstructure Fiber
Meisong Liao, Chitrarekha Chaudhari, Guanshi Qin, Xin Yan, Chihiro Kito, Yasutake Ohishi Takenobu, Suzuki Toyota Technological Institute, Japan; Morio Matsumoto, Takashi Misumi, Furukawa Denshi Co., Ltd, Japan
♦ Three octave supercontinuum of 20-dB bandwidth was generated by a chalcogenide-tellurite composite microstructure fiber, which is designed to have a highly nonlinear coefficient together with a flattened chromatic dispersion in the near infrared range.

9:30 6.1.2
Supercontinuum Generation from UV to 3.85 µm in a Fluoride Fiber
Guanshi Qin, Yasutake Ohishi, Toyota Technological Institute, Japan
♦ We report what we believe to be the first demonstration of supercontinuum generation from UV to 3.85 µm in a 2.5 cm long fluoride fiber pumped by a 1450 nm femtosecond laser

9:45 6.1.3
Supercontinuum Generation by Higher-Order Mode Excitation in a Photonic Crystal Fibre (Invited)
Vittorio Degiorgio, Università di Pavia, Italy
♦ Higher-order-mode excitation experiments are interesting because the anomalous dispersion region is shifted towards smaller wavelengths and because the existence of a cut-off wavelength generates spectral broadening only on the blue side of the pump wavelength.

10:15 6.1.4
Watt-Level Bi-Doped Fiber Lasers: Breakthrough into 1300 - 1500 nm Wavelength Region
Igor A. Bufetov, Sergey Firstov, Vladimir F. Khopin, Alexey V. Shubin, Oleg Medvedkov, Lyudmila Iskhakova, Evgeny M. Dianov, Fiber Optics Research Center of the Russian Academy of Sciences, Russia; Aleksey N. Guryanov, Institute of Chemistry of High Purity Substances of RAS, Russia
♦ Watt-level ~20% efficiency Bi fiber lasers have been demonstrated at 1340 and 1480 nm for the first time. Optical properties of Bi-doped phosphogermanosilicate fibers depending on core composition were investigated.

10:30 6.1.5
Infrared Luminescence Enhancement by UV-Irradiation of H2-loaded Bi-Al-doped Fiber
Christian Ban, Hans Limberger, EPFL, Switzerland; Lenar Bulatov, Vlad Dvoyrin, Valery Mashinsky, Evgeny M. Dianov, Fiber Optics Research Center of the Russian Academy of Sciences, Russia
♦ ArF excimer laser irradiation of H2-loaded fibers increases the intensity of both the 1130 and 1390 nm fluorescence in Bi-Al-doped silica fiber by 18 dB and >16 dB.

Room: Hall E2

6.2: Quantum Dot and SOA

Chair: Christoph S Harder, Swisslaser & HPP, Switzerland

9:00 6.2.1
Quantum-Dot Semiconductor Optical Booster Amplifier with Ultrafast Gain Recovery for Pattern-Effect Free Amplification of 80 Gb/s RZ-OOK Data Signals
Carsten Schmidt-Langhorst, Reinhold Ludwig, Colja Schubert, Fraunhofer Heinrich-Hertz-Institut, Germany; Christian Meuer, Dmitriy Puris, Dieter Bimberg, Klaus Petermann, Technical University of Berlin, Germany; Rene Bonk, Thomas Vallaitis, Juerg Leuthold, University of Karlsruhe, Germany
♦ We present an InGaAs/GaAs quantum dot semiconductor amplifier with a 90-10% nonlinear gain recovery time of only 16 ps which enables pattern-effect free amplification of 80 Gb/s RZ-OOK data signals with only 0.3 dB BER penalty.

9:15 6.2.2
Wavelength Tunability Assessment of a 170 Gbit/s transmitter using a Quantum Dash Fabry Perot mode-locked laser
Marcia Costa e Silva, CNRS-Foton, France; Hary Ramanitra, Telecom Malagasy, Madagascar; Mathilde Gay, Laurent Bramerie, Sebastien Lobo, Michel Joindot, Jean-Claude Simon, ENSSAT / Université de Rennes 1, France; Alexandre Shen, Guang-Hua Duan, Alcatel-Thales III-V Lab, France
♦ We demonstrate the tunability of a 170 Gbit/s transmitter based on a quantum dash mode-locked Fabry-Perot laser. Same performances are obtained over a 8 nm wavelength range simply by adjusting the shaping filter frequency.

9:30 6.2.3
Low Penalty Cascaded Operation of a Monolithically Integrated Quantum Dot 1x8 Port Optical Switch
Haibo Wang, Adrian Wonfor; Richard Penty, Ian White, University of Cambridge, United Kingdom; Kevin Williams, Tjibbe de Vries, Barry Smalbrugge, Yok-Siang Oei, Meint K Smit, Richard Notzel, Shidai Liu, Eindhoven University of Technology, The Netherlands
♦ A novel Quantum Dot monolithically integrated 1x8 switch is shown to provide robust routing of data at 10Gb/s modulation rates. Two cascaded switches providing, 1x64 functionality, operate with a power penalty of only 0.9dB

9:45 6.2.4
Supercontinuum Generating in Ultralong SOAs - Theory and Experiment
Patrick Runge, Klaus Petermann, Technische Universität Berlin, Germany; Michael Schlak, Walter Brinker, Bernd Sartorius, Fraunhofer Institute HHI, Germany
♦ The tremendous Four-Wave Mixing efficiency of ultralong SOAs is used to create a supercontinuum from two CW input signals. As a result, widely tunable short pulses are generated.

10:00 6.2.5
Novel Gain Control Scheme of SOA for High Output Power Operation
Shinsuke Tanaka, Ayahito Uetake, Susumu Yamazaki, Ken Morito, Fujitsu limited, Japan; Mitsuru Ekawa, Fujitsu Laboratories Ltd., Japan
♦ We propose a simple gain control scheme of SOA. The heater-mounted SOA exhibited a wide input power dynamic range of >17 dB while keeping high output power of +8.0 dBm for 10Gbps NRZ modulated signals.

10:15 6.2.6
Multi wavelength amplification and signal processing in InP based quantum dash semiconductor optical amplifiers (Invited)
Gadi Eisenstein, Technion Institute of Technology, Israel
♦ We describe multi-wavelength amplification and processing of quantum dash amplifiers. The multi-wavelength operation is possible due to the inhomogeneously broadened gain.

10:45 - 11:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall F1

6.3: Optical Packet Switching (2)

Chair: Antonio Teixeira, University of Aveiro, Portugal

9:15 6.3.1
4x4 Optical Packet Switching with a Prototype 4x4 Label Processing and Switching Sub-System
Ryohei Urata, Tatsushi Nakahara, Hirokazu Takenouchi, Toru Segawa, Hiroshi Ishikawa, Akira Ohki, Hiroki Sugiyama, Ryo Takahashi, NTT Photonics Laboratories, Japan; Susumu Nishihara, NTT Corporation, Japan
♦ We demonstrate 4x4 optical packet switching for 10-Gb/s, asynchronous burst optical packets with a 4x4 label processing and switching sub-system prototype. Error-free operation BER<10-12 is achieved simultaneously for all 16 I/O input/output combinations.

9:30 6.3.2
Demonstration of 200 Gbit/s DWDM / NRZ-DQPSK Optical Packet Switching and Buffering
Hideaki Furukawa, Naoya Wada, Moriya Nakamura, Tetsuya Miyazaki, NICT, Japan)
♦ We report error-free BER<1E-9 optical packet switching and buffering for 200 10-wavelengths x 20 Gbit/s DWDM/NRZ-DQPSK optical packets. This is a first demonstration for multilevel modulation optical packet-payload to achieve efficient traffic accommodation.

9:45 6.3.3
Terabit-on-Chip: Enabling Ultra-high Capacity Photonic Networks (Invited)
Efstratios Kehayas, National Technical University of Athens, Greece
♦ Potential upgrade paths for developing new generation of transmission and switching systems are presented. Increase of integration scale and density through hybrid and monolithic integration technologies is proposed for realizing miniaturized, cost-effective and power-efficient systems

10:15 6.3.4
Scalable Optical Packet Switch for Optical Packets with Multiple Modulation Formats and Data Rates
Nicola Calabretta, COBRA Research Institute, The Netherlands; Oded Raz, Ton Ditewig, Fausto Gomez-Agis, Shangjian Zhang, Huug de Waardt, Eduward Tangdiongga, Dorren Harm, Eindhoven University of Technology, The Netherlands; Wenrui Wang, COBRA Research Institute, Eindhoven University of Technology, P.R. China
♦ We present a scalable, low latency optical packet switch for optical packets with multiple modulation formats. Results show error-free operation of 1x8 optical packet switch for 160Gb/s RZ-OOK, 320Gb/s NRZ-OOK and 100Gb/s DPSK multi-colored packets.

10:30 6.3.5
160 Gb/s All-Optical Contention Resolution with Prioritization using Integrated Photonic Components
Paraskevas Bakopoulos, Panagiotis Zakynthinos, Efstratios Kehayas, Leontios Stampoulidis, Dimitrios Petrantonakis, Alexandros Maziotis, Christos Kouloumentas, Christos Stamatiadis, Dimitrios Apostolopoulos, Hercules Avramopoulos, National Technical University of Athens, Greece; Francesco Fresi, Claudio Porzi, Sant'Anna School of University Studies and Doctoral Research, Pisa, Italy, Italy; Nicola Calabretta, COBRA Research Institute, The Netherlands; Mircea Guina, Optoelectronics Research Centre, Tampere University of Technology, Finland; Dimitrios Klonidis, Ioannis Tomkos, AIT, Greece; Luca Potì, Antonella Bogoni, Consorzio Nazionale Interuniversitario per le Telecomunicazioni, Italy; Eduward Tangdiongga, Dorren Harm, Eindhoven University of Technology, The Netherlands; Alistair Poustie, Graeme Maxwell, Centre for Integrated Photonics CIP Ltd, United Kingdom
♦ We present for the first time 160Gb/s all-optical contention resolution with prioritization using integrated photonic devices. Error-free operation verifies that complex photonic systems are possible and could play a central role in future high-capacity networks.

Room: Hall H

6.4: High-speed and Long-distance transmission

Chair: Peter A Andrekson, Chalmers University of Technology, Sweden

9:15 6.4.1
Modulation Formats for Ultra Long-Haul Undersea Transmission (Invited)
Jin-Xing Cai, Tyco Telecommunications, USA
♦ This paper reviews recent technology advances in modulation formats including RZ-DQPSK, PDM RZ-DPSK, and offset PDM RZ-DPSK for 40G undersea transmission. Research activities on 100G long-haul transmission are also summarized.

9:45 6.4.2
Novel Design of Very Long, High Capacity Unrepeatered Raman Links
Andrej Puc, Do il Chang, Wayne Pelouch, Philippe Perrier, Datta Krishnappa, Sergey Burtsev, Xtera Communications, Inc., USA
♦ An L-band Raman link concept is analyzed numerically and validated experimentally by transmission of 10×43 Gb/s DPSK channels over 466 km and 82 dB loss, a record capacity for UR links longer than 400 km

10:00 6.4.3
2.6Tb/s 26 x 100Gb/s Unrepeatered Transmission Over 401km Using PDM-QPSK with a Coherent Receiver
Dominique Mongardien, Philippe Bousselet, Patrice Tran, Hans Bissessur, Alcatel-Lucent, France; Oriol Bertran-Pardo, Telecom Paristech ENST-Paris, France
♦ The combination of PDM-QPSK with a coherent receiver and an optimized amplification scheme high power booster and third order pumped ROPA enables the transmission of 26 channels at 100Gb/s over a 401km long unrepeatered link.

10:15 6.4.4
Low-penalty 5x320 Gbit/s 1.6 Tbit/s WDM DPSK Transmission over 525 km Using Time-domain Optical Fourier Transformation
Pengyu Guan, Masatada Okazaki, Toshiyuki Hirano, Toshihiko Hirooka, Masataka Nakazawa, Tohoku University, Japan
♦ A 1.6 Tbit/s-525 km WDM transmission with only 5-channel, 320-Gbit/s OTDM-DPSK signals is successfully demonstrated using time-domain optical Fourier transformation. Error-free transmission with a penalty as small as 1.3~2.1 dB is realised for all channels.

10:45 - 11:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall G

6.5: WDM-PON and OCDMA

Chair: Gerlas van den Hoven, GENEXIS, The Netherlands

9:00 **6.5.1**
Bidirectional Transmission in Colourless WDM-PON based on Injection-Locked Fabry-Perot Laser at 2.5 Gbit/s using Low-Cost Seeding Source
Quoc Thai Nguyen, Pascal Besnard, Foton / CNRS / Université de Rennes 1, France; Laurent Bramerie, Jean-Claude Simon, ENSSAT / Université de Rennes 1, France; Alexandre Shen, Guang-Hua Duan, Christophe Kazmierski, Alcatel-Thales III-V Lab, France
♦ Error-free transmission over 20km of 8-channels for both downstream and upstream in colourless WDM-PON based on injection-locked Fabry-Perot laser is experimentally demonstrated at 2.5Gbit/s, using a single quantum dash mode-locked laser as multi-wavelength seeding source.

9:15 **6.5.2**
Broadband Convergence of 60-GHz ROF and WDM-PON Systems with a Single Modulator for Bidirectional Access Networks
Jianjun Yu, NEC Labs America, USA; Zhensheng Jia, Telcordia Technologies, USA; Gee-Kung Chang, Georia Tech, USA
♦ We experimentally demonstrated a converged 60-GHz ROF and 10-Gb/s WDM-PON system using an integrated modulator and a single wavelength for the first time. Orthogonal phase modulation is used to relieve the crosstalk while providing centralized bidirectional connections.

9:30 **6.5.3**
Spectrum Sliced Sources AMOOFDM Modulated for WDM&TDM PON
Fabia Nirina Raharimanitra, Thanh Nga Duong, Jérome Le Masson, Benoit Charbonnier, Meryem Ouzzif, Naveena Genay, Ahmed Gharba, Orange Labs, France; Philippe Chanclou, France Telecom R&D, France; Fabienne Saliou, Romain Brenot, Guilhem de Valicourt, Alcatel Thales III-V Lab, France
♦ We experimentally demonstrate the use of AMOOFDM format as a cost effective solution for colorless source WDM-PONs based on spectrally sliced ASE source SLED, RSOA and pre-selected RSOA).

9:45 **6.5.4**
Enhancing Crosstalk Tolerance in Single-Feeder Reflective PONs by Using 8B10B Coding and Ad-Hoc Electrical Filtering
Marco Presi, Roberto Proietti, Andrea Chiuchiarelli, Pallab Choudhury, Giampiero Contestabile, Ernesto Ciaramella, Scuola Superiore Sant'Anna University, Italy; Luca Giorgi, Ericsson, Italy
♦ Reflective PONs performance are hard-limited by crosstalk from reflections and backscattering. We demonstrate a seamless approach based on 8B10B coding and high-pass filtering allowing to recover up to 8dB power penalty without FEC.

10:00 **6.5.5**
8x8 Full-duplex Demonstration of Asynchronous, 10Gbps, DPSK-OCDMA System using Apodized SSFBG and multi-port En/Decoder
Nobuyuki Kataoka, Naoya Wada, NICT, Japan; Xu Wang, Heriot Watt University, United Kingdom; Gabriella Cincotti, University Roma Tre, Italy; Yoshihiro Terada, Fujikura Ltd., Japan; Ken'ichi Kitayama, Osaka University, Japan
♦ We develop a novel apodized, 16-level-phase-shifted SSFBG encoder/decoder, which can improve the system performance of OCDMA system. Error free BER<10-9 transmissions of 8x8 full-duplex, asynchronous, 10Gbps, DPSK-OCDMA system over 50km are successfully demonstrated.

10:15 **6.5.6**
mpact of Interferometric Noise on Systems with Soft Blocking Properties
Ivan Glesk, Ivan Andonovic, Craig Michie, University of Strathclyde, United Kingdom; Kensuke Sasaki, Gyaneshwar Gupta, Oki Electric Industry, Japan
♦ Extensive experimental investigation into detrimental effects of interferometric noise on incoherent OCDMA was conducted under varied amount of multiple access interference, with and without applying all-optical signal processing, to better understand and alleviate its influence.

10:30 **6.5.7**
Demonstration of Asynchronous, 10Gbps OCDMA PON system with Colorless and Sourceless ONUs
Gabriella Cincotti, University Roma Tre, Italy; Nobuyuki Kataoka, Naoya Wada, Tetsuya Miyazaki, NICT, Japan; Xu Wang Heriot Watt University, United Kingdom; Ken'ichi Kitayama, Osaka University, Japan
♦ We experimentally demonstrate for the first time an error-free asynchronous, 10-Gbps full-duplex DPSK OCDMA system that does not require any laser source at the users premises

Room: Hall F2

6.6: Real-time Coherent Receivers

Chair: Pierluigi Poggiolini, Politecnico di Torino, Italy

9:15 **6.6.1**
First Experimental Demonstration of Real-Time Optical OFDM Transceivers
Jianming Tang, Roger Giddings, Bangor University, United Kingdom
♦ Real-time optical OFDM transceivers are, for the first time, experimentally implemented, using standard commercially available components including FPGAs and DACs/ADCs. The transceivers support 1.5Gb/s transmission in directly modulated DFB laser-based 500m MMF IMDD systems.

9:30 **6.6.2**
43Gb/s CP-QPSK Realtime Receiver Demonstrator based on FPGAs and Block-Processing
Jonas Geyer, Bernhard Schmauss, University of Erlangen-Nuernberg, Germany; Chris R S Fludger, Thomas Duthel, Paul Presslein, Christoph Schulien, CoreOptics GmbH, Germany
♦ We present measurement results of an FPGA-based 43Gb/s Realtime Coherent Receiver Demonstrator. Due to limitations we use block-aggregation and process 1/32 of the input data stream. We show back-to-back performance and chromatic dispersion tolerance.

9:45 **6.6.3**
Tutorial: Coherent Receivers: Principles and Real-Time Implementations
Andreas Leven, Alcatel-Lucent, Germany
♦ "High-speed digital signal processing has enabled implementation of coherent optical receivers at GBit/s speed. Besides reviewing fundamental principles of DSP-based coherent receivers, we will focus on practical implementation issues of the actual processing algorithm in digital circuitry. Andreas Leven received his Ph.D. Dr.-Ing. degree from Karlsruhe University, Germany, in 2000. From 1997 to 2000 he was at Fraunhofer Institute of Applied Solid State Physics, Freiburg, Germany. In 2000, he joined Bell Laboratories, Murray Hill, NJ, were he worked on high speed optical receivers and broadband optical digital-to analog converters. His current work is focused on digital signal processing for high-speed coherent receivers. Since 2008, he is on leave with Optical Networking Division, Alcatel-Lucent, Nuremberg, Germany.

10:45 - 11:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall I

6.7: Symposium: Dynamic Multi-Layer Mesh Network: Why, How, and When? (1)

Dynamic Optical Mesh Networks

Chair: Sander Jansen, Nokia Siemens Networks, Germany

9:00 **Introduction to Symposium**

9:05 **6.7.1**
Dynamic Optical Networks: A Provider's perspective
Peter D Magill, AT&T Labs - Research, USA

9:30 **6.7.2**
Physical Layer Components, Architectures and Trends for Agile Photonic Layer Mesh Networking
Brandon Collings, JDSU, Optical Networks Research Lab, USA
♦ This presentation will review the devices and architectures of multi-degree optical mesh networks and discuss the emerging trends for further enhancing the flexibility and functionality of photonic transport systems.

9:55 **6.7.3**
Flexible Optical Network Defined and the Value it Represents in an IP and Ethernet Environment
Ron Johnson, Cisco Systems Inc., San Jose, California, USA
♦ The necessary transition of core networks to scale from 10 to 40 to 100 Gigabit interfaces is driving a paradigm shift in the carriers network and underlying cost drivers. As networks make this transition, the cost per bit is going up rather than going down.

10:20 **6.7.4**
Hierarchy and dynamics of optical networks
Fritz-Joachim Westphal, Andreas Gladisch, Matthias Gunkel, Deutsche Telekom AG, Germany

Notes:

10:45 - 11:15 Coffee break (will be served in the Delegates Coffee Area at the Exhibition)

Room: Hall E1

7.1: Lasers and Sources

Chair: Andrea Galtarossa, Universita' di Padova, Italy

11:15 7.1.1
Single-Mode Holey Fibers with Record Aeff of 50,000um2
Masanori Takahashi, Kazunori Mukasa, Takeshi Yagi, Katsunori Imamura The Furukawa Ellectric Co., Ltd., Japan
♦ We demonstrated a single-mode holey fiber HF with record Aeff of 50,000um2 at 1.0um. Fabrication trials to realize Aeff of 80,000um2 were also performed and novel potentials could be confirmed.

11:30 7.1.2
Compact Multiwavelength Fiber Lasers in S, C and L Bands
Sophie LaRochelle, Serge Doucet Université Laval, Canada
♦ We demonstrate multiwavelength CW lasers for S,C and L bands that emit more than 40 wavelengths simultaneously. We achieve a nominal channel spacing of 100+-10 GHz using post-fabrication correction by UV exposure.

11:45 7.1.3
Single-Longitudinal-Mode Continuous-Wave Fiber Optical Parametric Oscillator
Sigang Yang, Yu Liang, Xing Xu, Kenneth K Y Wong, The University of Hong Kong, Hong Kong
♦ Single-longitudinal-mode fiber optical parametric oscillator is realized by resonating independently the signal and idler frequencies in two separate optical cavities, combined with a sub-ring cavity inserted into the signal cavity

12:00 7.1.4
Multiwavelength fiber ring laser utilizing a multiple phase-shifts phase-only sampled fiber Bragg grating
Hongpu Li, Ming Li, Shizuoka University, Japan; Yves Painchaud, TeraXion, Canada
♦ A simple technique to multiply the lasing wavelength in a semiconductor optical amplifier SOA)-based fiber ring laser is proposed and demonstrated, which is based on the utilization of a multiple phase-shifts inserted multichannel fiber Bragg grating

12:15 7.1.5
Large Core Single-Mode Chirally-Coupled-Core Fibers for High Power Fiber Lasers (Invited)
Almantas Galvanauskas, Center for Ultrafast Optical Science, University of Michigan, USA
♦ Novel chirally-coupled-core CCC fibers enabled large-core laser systems operating robustly-singlemode, independently of fiber excitation, splicing and coiling conditions. A variety of high power continuous-wave, nanosecond-pulse and femtosecond-pulse fiber-laser systems have been demonstrated using CCC fibers.

12:45 7.1.6
Effect of Fibre Base and Reflectors Profile on the Efficiency of Ultra- Long Laser Cavities
Vassilios Karalekas, Paul Harper, Atalla El-Taher, Juan Diego Ania-Castanon, Sergei Turitsyn, Aston University, United Kingdom; Xuewen Shu, Ian Bennion, Aston University, Photonics Research Group, United Kingdom
♦ We study the effect of fibre base and grating profile on the efficiency of ultra-long Raman lasers. We show that for the studied parameters, FBG profile does not affect the performance when operating away from the zero-dispersion wavelength

Room: Hall E2

7.2: Silicon Photonics and Planar Devices

Chair: Naoto Kobayashi, National Institute of Advanced Industrial Science and Technology, Japan

11:15 7.2.1
Compact, Low Power Consumption Wavelength Tunable Laser with Silicon Photonic-wire Waveguide Micro-ring Resonators
Tao Chu, National Institute of Advanced Industrial Science and Technology AIST, Japan; Nobuhide Fujioka, Shigeru Nakamura, Masatoshi Tokushima, Masashige Ishizaka, NEC Corporation, Japan
♦ A silicon photonic-wire waveguide based wavelength tunable laser was firstly demonstrated; whose micro-ring resonator footprint was 700 x 450 micrometers. Its wavelength tuning range is 38 nm at a tuning power of 26-mW.

11:30 7.2.2
In-Band OSNR Monitoring via Slow-Light Enhanced Third Harmonic Generation in Silicon Photonic Crystal Waveguides
Bill Corcoran, University of Sydney, Australia
♦ We demonstrate optical performance monitoring of in-band OSNR in 40Gbit/s Return-to-Zero signals via slow-light enhanced third-harmonic generation in silicon photonic crystal waveguides, improving on methods using quadratic transfer functions.

11:45 7.2.3
Nonlinear functions and quantum entanglement generation using silicon photonic wire waveguides. (Invited)
Koji Yamada, Tai Tsuchizawa, Toshifumi Watanabe, Hiroshi Fukuda, Hiroki Takesue, Yasuhiro Tokura, Sei-ichi Itabashi, NTT Corporation, Japan; Hiroyuki Shinojima, Hidetaka Nishi, NTT Microsystem Integration Laboratories, Japan; Ken-ichi Harada, NTT Basic Research Laboratories, Japan
♦ Nonlinear optical phenomena are remarkably enhanced in silicon photonic wire waveguides that have ultra-small cores with hundred-nanometers geometry. Efficient nonlinear functions, such as an all-optical modulation, wavelength conversion and high-purity entangled photon generation, are demonstrated.

12:15 7.2.4
Hybrid Comb-Clad Waveguide fabricated by UV curable Resin enabling Multi-channel 90-deg Light Path Conversion
Masahiro Kanda, Yuji Sugiura, Osamu Mikami, Tokai University, Japan
♦ New multi-channel waveguides having hybrid comb-clad are proposed for optical interconnect. A large delta-n between the core and clad has potential as small bending radius. A prototype shows a 90-deg bending loss of 1.1 dB.

12:30 7.2.5
Integrated In-Band OSNR Monitor Based on Planar Lightwave Circuit
Takayuki Mizuno, Takashi Goh, Takaharu Ohyama, Yasuaki Hashizume, NTT, Japan; Akimasa Kaneko, NTT Photonics Laboratories, Japan
♦ We propose a novel integrated in-band optical signal-to-noise ratio OSNR monitor based on planar lightwave circuit PLC technology. We successfully demonstrate a 10-25 dB in-band OSNR measurement with errors of less than 0.6 dB.

12:45 7.2.6
Tunable Optical Dispersion Compensator Module Using Integrated Multiple Lenses in an Arrayed-Waveguide Grating
Yuichiro Ikuma, Hiroyuki Tsuda, Keio University, Japan; Hiroshi Takahashi, NTT Corporation, Japan; Seiji Fukushima, NTT West Corporation, Japan
♦ An AWG-based tunable dispersion compensator with integrated silicone lenses is fabricated. Its tuning range runs from +47 to +410 ps/nm and error-free dispersion compensation is confirmed for 42.7-Gbps CSRZ-DQPSK optical signals.

13:00 - 14:30 Lunch break

Room: Hall F1

7.3: Coherent Receiver Algorithms

Chair: Seb Savory, University College London, United Kingdom

11:15 7.3.1
Fast and Accurate Automatic Frequency Control for Coherent Receivers
Kittipong Piyawanno, Maxim Kuschnerov, Berthold Lankl, University of the Federal Armed Forces, Munich, Germany; Bernhard Spinnler, Nokia Siemens Networks, Germany
♦ We demonstrate an algorithm for non-data aided spectrum-based automatic frequency control in coherent receivers. The proposed algorithm is independent of modulation formats, robust against channel distortion and outperforms the well-known spectrum-based algorithms.

11:30 7.3.2
A Simple Digital Skew Compensator for Coherent Receiver
Takahito Tanimura, Shoichiro Oda, Toshiki Tanaka, Takeshi Hoshida, Jens C. Rasmussen, Fujitsu Laboratories Ltd., Japan; Zhenning Tao, Fujitsu R&D Center Ltd., P.R. China
♦ A skew compensator is proposed and experimentally demonstrated for coherent front-end, which improved tolerance from +/-3 to +/-21ps at 0.2dB Q-penalty even with 21,000ps/nm CD and 90ps DGD on 112Gb/s DP-QPSK receiver.

11:45 7.3.3
QAM Adaptation of Constant-Modulus Algorithm and Differential Phase Compensation for Polarization Demultiplex in Coherent Receiver
Reinhold Noé, Timo Pfau, Mohamed El-Darawy, University of Paderborn, Germany
♦ The constant modulus algorithm is adapted for QAM signals and complemented with a differential phase compensation. This triples polarization control speed and doubles laser linewidth tolerance.

12:00 7.3.4
Analysis and Dimensioning of Fully Digital Clock Recovery for 112 Gb/s Coherent Polmux QPSK Systems
Darko Zibar, DTU Fotonik, department of Photonic Engineering, Technical University of Denmark, Denmark; Alessandro Bianciotto, Zhe Wang, Antonio Napoli, Bernhard Spinnler, Nokia Siemens Networks, Munich, Germany
♦ Combined effect of polarization mixing and Differential Group Delay DGD on sinusoidal and random jitter tolerance is investigated. Requirements for tolerable DGD, loop bandwidth and loop delay are extrapolated.

12:15 7.3.5
FFT-Based Digital Clock Recovery for Coherent Transmission Systems with Multilevel Modulation Formats
Hadrien Louchet, Andre Richter, VPIsystems, Germany; Konstantin Kuzmin, VPI development Center, Belarus
♦ We propose a digital clock and timing recovery algorithm for coherent transmission with multilevel modulation formats and demonstrate its robustness against signal distortions due to CD, PMD, ASE- and phase noise.

12:30 7.3.6
Complexity of Algorithms for Digital Coherent Receivers (Invited)
Bernhard Spinnler, Nokia Siemens Networks, Germany
♦ We give an overview of digital signal processing algorithms for coherent receivers. We explore single carrier and multi carrier approaches and compare the complexity of blind equalizer adaptation as well as training symbol based algorithms.

Room: Hall G

7.5: High Bit Rate PON

Chair: Russell Davey, BT., United Kingdom

11:15 7.5.1
Evolution of Burst Mode Receivers (Invited)
Xing-Zhi Qiu, Ghent Univ., Belgium
♦ The paper gives an overview of burst-mode receiver developments. The receiver design challenges associated with high speed TDMA PONs will be discussed and recent results of 10Gb/s burst-mode electronics will be compared.

11:45 7.5.2
Experimental Demonstration of a 10 Gbit/s/wavelength 27 km-reach WDM/TDM-PON based on Reconfigurable OADM and Colourless ONU
Patryk J Urban, Frans Huijskens, Giok-Djan Khoe, Huug de Waardt, Eindhoven University of Technology, The Netherlands; Maurice de Laat, Genexis B.V., The Netherlands; Ton Koonen, COBRA, Eindhoven Univ. of Technology, The Netherlands
♦ We present experiments on a wavelength-flexible WDM/TDM-PON with an integrated reconfigurable OADM and a reflective electro-absorption modulator. We successfully transmit multiple wavelength channels of 10 Gbit/s each over 27 km SSMF in different bandwidth allocation schemes.

12:00 7.5.3
10.3Gb/s burst-mode 3R receiver incorporating full AGC optical receiver and 82.5GS/s sampling CDR for 10G-EPON systems
Junichi Nakagawa, Mitsubishi Electric Corporation, Japan
♦ 10.3Gb/s burst-mode 3R receiver incorporating full AGC optical receiver and 82.5GS/s sampling CDR for 10G-EPON is, for the first time, developed. Burst receiver sensitivity of -30.1dBm and upstream power budget of 37.6dB are successfully achieved.

12:15 7.5.4
High Bit Rate Transmission for NG-PON by Direct Modulation of DFB Laser using Discrete Multi-Tone
Thanh Nga Duong, Naveena Genay, Chloé Milion, Benoit Charbonnier, Ahmed Gharba, Meryem Ouzzif, Jérome Le Masson Orange Labs, France; Philippe Chanclou, France Telecom R&D, France; Emmanuel Grard, Victor Rodrigues, 3SPhotonics, France
♦ A bit rate as high as 19Gbit/s transmission was experimentally demonstrated for NG-PON without chromatic dispersion compensation and optical amplifier by direct modulation of DFB laser using DMT signal combined with adaptive power-bit loading algorithm.

12:30 7.5.5
Design Optimization for 10Gb/s Full-duplex Transmission using RSOA-based ONU with electrical and Optical Filtering and Equalization
Mireia Omella, Jose A Lazaro, Josep Prat, Universitat Politècnica de Catalunya, Spain; Ioannis Papagiannakis, Alexios Birbas, University of Patras, Greece; Dimitrios Klonidis, Ioannis Tomkos, AIT, Greece; John Kikidis, Analog Integrated Electronic Systems, Greece
♦ The optimum design characteristics to maximize the performance of 10Gbps full-duplex bidirectional transmission are studied experimentally using a low bandwidth RSOA assisted by electronic equalization and optimum filter offset at the receiver OLT end.

12:45 7.5.6
Colourless FSK/ASK Optical Network Unit Based on a Fabry Pérot Type SOA/REAM for Symmetrical 10 Gb/s WDM-PONs
Bernhard Schrenk, Technical University of Catalonia, Spain; Jose A Lazaro, Josep Prat, Universitat Politècnica de Catalunya UPC, Spain; Christophe Kazmierski, Alcatel-Thales III-V Lab, France
♦ An Optical Network Unit based on colourless detection of optical frequency modulated signals based on a combination of Semiconductor Optical Amplifier and Reflective Electroabsorption modulator with intensity remodulation for symmetrical full-duplex 10Gb/s transmission is demonstrated.

13:00 - 14:30 Lunch break

Room: Hall F2

7.6: Specialty Optical Fibre

Chair: Hanne Ludvigsen, Helsinki University of Technology, Finland

11:15 7.6.1
Tutorial: Structured Light with Optical Fibers: Beams that Can Do What Gaussians Cannot
Siddharth Ramachandran, Technical University of Denmark, Denmark
♦ When we think of light propagating in a fibre, we think of a beam that looks like a spot that is Gaussian- or Bell-shaped). However, many of properties of light are dramatically altered if one were able to generate and stably propagate beams that are higher-order, spatially variant mode-solutions of a fibre. For instance, certain non-uniform polarisation distributions of light, when focussed, result in beams that carry no energy along the optic axis. Alternatively, beams with Bessel-functional profiles can navigate around dark objects in free space. This talk will introduce the physics of such interesting beam shapes. We will illustrate their utility, both from the standpoint of using them to propagate signals in fibres, for telecom and fibre-laser applications, as well as for exploiting their free-space characteristics, in quantum systems, sensors and biomedical applications.

Room: Hall I

7.7: Symposium: Dynamic Multi-Layer Mesh Network: Why, How, and When? (2)

Multi-layer and Cross-layer Networking

Chair: Yvan Pointurier, Athens Information Technology, Greece

11:15 771
Multi-layer Mesh Network Automation
Loudon Blair, Ciena Corp, USA

11:40 7.7.2
Network Planning, Control and Management Perspectives on Dynamic Networking
Thomas Michaelis, Nokia Siemens Networks, Germany
♦ We motivate that network planning, service provisioning and restoration, as well as service management need to be investigated and aligned at large in order to realize dynamic networking.

12:05 7.7.3
Management and Control of Transparent Optical Mesh Networks
Takehiro Tsuritani, KDDI R&D Laboratories, Inc., Japan
♦ The management and control of transparent optical mesh networks considering optical impairments and quality assessment are presented.

12:30 7.7.4
Dynamic Optical Mesh Networks: Drivers, Challenges and Solutions for the Future
Masahiko Jinno, NTT Network Innovation Laboratories, Japan
♦ We discuss the scalability challenges facing the optical networks. Using the architecture based on spectrum-sliced elastic optical path network SLICE), we demonstrate how the networking functionality can be effectively shifted to the optical domain.

12:55 Wrap up of Symposium

13:00 - 14:30 Lunch break

Notes:

13:00 - 14:30 Lunch break

Room: Hall E2

8.2: Semiconductor Lasers

Chair: Norbert Lichtenstein, Oclaro, Switzerland

14:30 8.2.1
1.55 µm InP-based Short-Cavity-VCSELs with Enhanced Modulation-Bandwidths of 15 GHz (Invited)
Michael Mueller, Werner Hofmann, Gerhard Böhm, Markus-Christian Amann Walter, Schottky Institut, Technische Univeristät München, Germany
♦ InP-based burried tunnel junction VCSELs incorporating a novel short-cavity design are presented. These devices show record-high modulation-bandwidths in excess of 15 GHz together with greatly enhanced intrinsic resonance-frequencies. Intrinsic damping is improved due to reduced photon-lifetime.

15:00 8.2.2
First Complex Coupled 1490nm CSDFB Lasers: High Yield, Low Feedback Sensitivity, and uncooled 10Gb/s Modulation
Martin Moehrle, Fraunhofer Institute for Telecommunications, Germany
♦ Novel 1490nm complex-coupled Curved Stripe CS DFB BH lasers show excellent single mode yield, high optical output power, narrow optical farfield, uncooled 10Gb/s modulation capability and low feedback sensitivity.

15:15 8.2.3
Clear eye opening 1.3µm-25 / 43Gbps EML with novel tensile-strained asymmetric QW absorption layer
Takeshi Saito, Takeshi Yamatoya, Yoshimichi Morita, Eitaro Ishimura, Chikara Watatani, Toshitaka Aoyagi, Takahide Ishikawa, Mitsubishi Electric Corporation, Japan)
♦ We demonstrate 1.3µm-25/43Gbps EML with novel tensile-strained asymmetric quantum well absorption layer. Clear eye opening was achieved under high output power condition >+5dBm both before / after 10km normal SMF transmission up to 43Gbps.

15:30 8.2.4
1.3 µm Passive Feedback Laser for 28 Gb/s and 40 Gb/s Transmission over Uncompensated SSMF Links
Ute Troppenz, Jochen Kreissl, Wolfgang Rehbein, Martin Schell, Carsten Bornholdt, Bernd Sartorius, Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut, Germany; Gregory Letal, Ian Woods, COGO Optronics Inc., USA)
♦ Passive Feedback Lasers for operation at 1.3 µm are developed with 32 GHz bandwidth and 7 dB extinction ratio. Transmission over 20 km uncompensated fibre link is demonstrated at 28 Gb/s and 40 Gb/s.

15:45 8.2.5
95 °C Uncooled and High Power 25-Gbps Direct Modulation of InGaAlAs Ridge Waveguide DFB Laser
Toshihiko Fukamachi, Takashi Shiota, Takeshi Kitatani, Takuma Ban, Yasunobu Matsuoka, Reiko Mita, Toshiki Sugawara, Shigehisa Tanaka, Kazunori Shinoda, Koichiro Adachi, Masahiro Aoki, Hitachi Ltd.,Central Research Laboratory, Japan
♦ 95 °C, 25-Gbps direct modulation of a high-power >15mW 1.3-micron-InGaAlAs-DFB laser is developed for the first time. The device will be a key for 4-channel CWDM uncooled light-sources used in the lower-power-consumption 100-GbE subsystems.

16:00 8.2.6
Novel Integrated Tunable Laser using Filtered Feedback for simple and very fast tuning
Boudewijn Docter, Eindhoven University of Technology, The Netherlands
♦ We present a novel integrated tunable laser based on filtered feedback, which combines a simple tuning method with ns switching speed.

Room: Hall F1

8.3: Dynamic and Tunable Networking

Chair: Masatoshi Suzuki, KDDI R&D Laboratories, Japan

14:30 8.3.1
Resilient Global IP/Optical Networks: DARPA CORONET (Invited)
Ann Von Lehmen, Telcordia, USA
♦ This paper describes progress on the DARPA CORONET Program, which is focused on a 20-100 Tbps, highly dynamic, resilient IP/Optical network. The Program requires extremely rapid provisioning and restoration times, and resilience against multiple failures.

15:00 8.3.2
Interleaving OFDM Signals for Multiple Access with Optical Routing Capability and High Spectral Efficiency
Roman Dischler, Axel Klekamp, Fred Buchali, Alcatel-Lucent, Bell Labs, Germany
♦ We propose interleaving of OFDM signals as a scheme for multiple access. By filtering of subbands a routing function is realised. The concept is demonstrated by transmission over 400km SSMF with spectral efficiency of 3.1bit/s/Hz.

15:15 8.3.3
Optimized ODU Routing for 100 Gb/s Ethernet over High-Speed Optical Networks with Distributed Differential Delay Compensation
João Santos, Paulo Monteiro, Nokia Siemens Networks Portugal SA, Portugal; João Manuel Ferreira, Pedro,m João Pires Instituto de Telecomunicações, Portugal
♦ We propose an optimization framework for routing virtually-concatenated 100 Gb/s Ethernet signals over optical transport networks with optimal buffer dimensioning and minimum capacity requirements in distributed differential delay compensation architectures.

15:30 8.3.4
Optical Network Planning with Rate-Tunable NRZ Transponders
Olivier Rival, Annalisa Morea, Jean-Christophe Antona, Alcatel Lucent Bell Labs France, France
♦ We present simple reach estimators for 5 to 15Gb/s NRZ channels in commonly deployed networks and assess the benefits of tunable data-rate in core optical networks through routing and resource allocation studies.

15:45 8.3.5
1 Tb/s Optical Path Aggregation with Spectrum-Sliced Elastic Optical Path Network SLICE (Invited)
Bartlomiej Kozicki, Hidehiko Takara, Yukio Tsukishima, Takayuki Kobayashi, NTT, Japan; Toshihide Yoshimatsu, Kazushige Yonenaga, NTT Corporation, Japan; Masahiko Jinno, NTT Network Innovation Laboratories, Japan
♦ We demonstrate highly spectrally-efficient path aggregation directly in the optical domain. Multiple hundred-gigabit class flows are aggregated into a seamless 1 Tb/s optical path and transmitted in spectrum-sliced elastic optical path network.

16:15 - 16:45 Coffee break (will be served in the Main Lobby)

Room: Hall H

8.4: Higher-Order Modulation Formats

Chair: Christophe Peucheret, Technical University of Denmark, Denmark

14:30 8.4.1
Improvement of tolerance to fibre non-linearity of incoherent multilevel signalling for WDM transmission with 10-Gbit/s OOK channels
Nobuhiko Kikuchi, Shinya Sasaki, Central Research Lab., Hitachi Ltd., Japan
♦ Fibre nonlinear effect on incoherent multilevel signalling with co-propagating 10-G OOK channels is investigated by experiments and numerical simulations, and QAM signals with non-Euclidean decision boundaries are shown to alleviate SPM and XPM effects.

14:45 8.4.2
10 × 112-Gb/s PDM 16-QAM Transmission over 1022 km of SSMF with a Spectral Efficiency of 4.1 b/s/Hz and no Optical Filtering
Alan H. Gnauck, Alcatel-Lucent, Bell Laboratories, USA; Peter Winzer, Lucent Technologies, USA
♦ Ten 25-GHz-spaced wavelength-division-multiplexed channels using 112-Gb/s polarization-division-multiplexed 16-QAM are transmitted over 1022 km of standard single-mode fiber. Owing to electrical-drive pre-filtering, no optical filtering is needed for WDM combination

15:00 8.4.3
High Spectral Efficiency Phase and Quadrature Amplitude Modulation for Optical Fiber Transmission: Configurations, Trends and Reach (Invited)
Matthias Seimetz, Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut, Germany
♦ Catering to the current interest in high-order modulation formats, this paper discusses possible transmitter configurations and receiver concepts. Moreover, the major trends in system performance are identified, regarding relevant degradation effects and transmission reach.

15:30 8.4.4
Polarization Multiplexed 20 Gbaud Square 16QAM Long-Haul Transmission over 1120 km using EDFA Amplification
Lutz Molle, Matthias Seimetz, Dirk Daniel Gross, Ronald Freund, Fraunhofer Institute for Telecommunications, Heinrich-Hertz Institut, Germany; Michael Rohde Beuth, Hochschule für Technik Berlin, Germany
♦ Single-channel transmission of 20 Gbaud single-polarization / polarization multiplexed Square 16QAM at bitrates of 80 /160 Gbit/s is experimentally demonstrated over record distances of 1300 / 1120 km.

15:45 8.4.5
Cancellation of SPM in Self-Homodyne Coherent Systems
Martin Sjödin, Pontus Johannisson, Mats Sköld, Magnus Karlsson, Peter A Andrekson, Chalmers University of Technology, Sweden
♦ The signal and local oscillator acquire identical nonlinear phase shifts during propagation in a self-homodyne coherent system. We exploit this to obtain cancellation of the phase distortion caused by self-phase modulation.

16:00 8.4.6
200-km transmission of 100-Gbit/s 32-QAM Dual-Polarization Signals using a Digital Coherent Receiver
Yojiro Mori, Chao Zhang, Masatoshi Usui, Koji Igarashi, Kazuhiro Katoh, Kazuhiro Katoh, Kazuro Kikuchi, The University of Tokyo, Japan
♦ We demonstrate transmission of a 100-Gbit/s 32-QAM dual-polarization signal over a 200-km dispersion-managed fiber link using a digital coherent receiver. The receiver sensitivity of -20 dBm at BER = 10-3 is obtained after 200-km transmission.

Room: Hall G

8.5: Hybrid and Long-reach PON

Chair: Josep Prat, UPC, Spain

14:30 8.5.1
100km Long Reach Upstream 36Gb/s-OFDMA-PON over a Single Wavelength with Source-Free ONUs
Dayou Qian, Neda Cvijetic, Yue-Kai Huang, Jianjun Yu, Ting Wang, NEC Laboratories America, USA
♦ We experimentally demonstrate 36-Gb/s source-free single-wavelength upstream OFDMA-PON transmission, enabled by ONU carrier suppression and coherent reception at the OLT. A BER <10-3 is reported over 100km SSMF and a 1:32 optical split.

14:45 8.5.2
Demonstration of Signal Remodulation Long Reach Carrier Distributed Passive Optical Network using OFDM-QAM Signal
Chi Wai Chow, C. H. Wang, F. Y. Shih, National Chiao Tung University, Taiwan; Chien-Hung Yeh, Industrial Technology Research Institute, Taiwan; Sien Chi, Yuan Ze University, Taiwan
♦ OFDM is a promising candidate for LR-PON. We study the possibility of using OFDM for signal remodulation in the LR-PON. Three different colorless ONU architectures are tested and compared.

15:00 8.5.3
Upstream burst-mode operation of a 100km reach,16x 512 split hybrid DWDM-TDM PON using tuneable external cavity lasers at the ONU-side
Cleitus Antony, Peter Ossieur, Paul Townsend, Tyndall National Institute, Ireland; Giuseppe Talli, University College Cork, Ireland; Heinz Krimmel, Alcatel-Lucent Germany, Germany; Alistair Poustie, Richard Wyatt, Robert Harmon, Ian F Lealman, Graeme Maxwell, Dave Rogers, David W Smith, Centre for Integrated Photonics CIP Ltd, United Kingdom
♦ Upstream burst-mode operation of a hybrid 10Gb/s DWDM-TDM PON is demonstrated. DWDM operation is achieved using innovative, cost-effective tuneable lasers in the ONUs. A gain-stabilized EDFA amplifies the burst-mode traffic without transients in the pakkets.

15:15 8.5.4
Enhanced Transmission in Long Reach WDM/TDM Passive Optical Networks by Means of Multiple Downstream Cancellation Techniques
Bernhard Schrenk, Technical University of Catalonia, Spain; Francesc Bonada, Mireia Omella, Jose A Lazaro, Josep Prat, Universitat Politècnica de Catalunya UPC), Spain
♦ Downstream cancellation based on feed-forward injection and square root equalization in a WDM/TDM-PON based on intensity modulation and wavelength reuse for asymmetrical 2.5G/1.25G transmission over 100km reach and high split is demonstrated.

15:30 8.5.5
GPON reach extension to 60 km with entirely passive fibre plant using Raman amplification
Benyuan Zhu ,OFS Labs, USA; Derek Nesset, BT plc, United Kingdom
♦ We describe a purely-passive GPON compatible reach extender using distributed Raman amplification. Operation over 60 km of AllWave fibre at 2.5 Gbit/s is demonstrated with a total loss budget of 43 dB at 1310 nm.

15:45 8.5.6
A 40Gb/s CWDM-TDM PON with a Cyclic CWDM Multiplexer/Demultiplexer
Patrick Iannone, Kenneth C Reichmann, AT&T, USA; Christopher R Doerr, Larry L Buhl, Mark Cappuzzo, Yifan Chen, Louis Gomez, Bell Labs, Alcatel-Lucent, USA; John Johnson, Ayman Kanan, Janet Lentz, CyOptics, USA; Robert McDonough, Vitesse Semiconductor, USA
♦ We demonstrate a 40-Gb/s hybrid CWDM-TDM PON with a novel remote node including a cyclic CWDM multiplexer/demultiplexer. The system uses commercially available 10-Gb/s 1.3-um directly modulated laser transmitters upstream and 1.5-um electroabsorption modulated laser transmitters downstream.

16:00 8.5.7
A Novel Hybrid WDM/TDM-PON using Downlink DPSK and Uplink Remodulated OOK Signals Based on a Shared DI
Cheng Xiaofei, Yong kee Yeo, Yixin Wang, Institute for Infocomm Research, Singapore; Zhaowen Xu Nanyang, Technological University, Singapore
♦ We propose a novel hybrid WDM/TDM-PON using downlink DPSK and uplink remodulated OOK signals based on a single shared delay interferometer DI at remote node. Experiments of 10-Gb/s downstream and 1.25-Gb/s upstream transmissions verify the proposed scheme.

16:15 - 16:45 Coffee break (will be served in the Main Lobby)

Room: Hall F2

8.6: Integrated Optical Transceivers

Chair: Graeme Maxwell, Centre for Integrated Photonics CIP Ltd, United Kingdom

14:30 8.6.1
Tutorial: High-Speed InP and Silicon Transceivers for Terabit Transport Networks
Christopher R Doerr, Bell Labs, Alcatel-Lucent, USA
♦ This tutorial will cover group III-V and group IV photonic integrated circuits PICs for transmitting and receiving optical signals in fiber-optic networks. We include such topics as quadrature phase-shift keying, polarization division multiplexing, multi-wavelength transmitters and receivers, and coherent reception.

15:30 8.6.2
One-Step Growth Optical Transceiver PIC in InP
Valery Tolstikhin, OneChip Photonics Inc., Canada
♦ We report the design and characterization of optical transceiver PIC in InP, fabricated in one growth step and comprising DFB laser / monitor in 1310nm, PIN photodetector in 1490nm, 1310nm - 1490nm wavelength splitter and 1310nm / 1490nm spot-size converter.

15:45 8.6.3
Colourless 10Gb/s Reflective SOA-EAM with Low Polarization Sensitivity for Long-reach DWDM-PON Networks
David W Smith, Richard Wyatt, Ian F Lealman, Xin Chen, David Moodie, Paul Cannard, Jeevan Dosanjh, Lesley Rivers, Colin Ford, Richard Cronin, Tina Kerr, Lilianne Johnston, Robert Waller, Rick Firth, Anna Borghesani, Alistair Poustie, CIP, United Kingdom
♦ We demonstrate a 10Gb/s reflective SOA-REAM device that has low polarization sensitivity, high output power and colourless operation over the C-band. Long reach capability is also demonstrated by transmission over 80km of standard optical fibre

16:00 8.6.4
First 40-km SMF Transmission for 100-Gbit/s Ethernet System Based on 25-Gbit/s 1.3-um Electroabsorption Modulator Integrated with a DFB Laser Module
Takeshi Fujisawa, Masakazu Arai, Naoki Fujiwara, Wataru Kobayashi, Takashi Tadokoro, Ken Tsuzuki, Yuichi Akage, Ryuzo Iga, Fumiyoshi Kano, NTT Corporation, Japan; Takayuki Yamanaka, NTT Photonics Labs., NTT Corporation, Japan
♦ High-performance 1.3-um InGaAlAs electroabsorption modulator integrated with DFB laser module for metro-area 100-Gbi/s Ethernet system 100GBASE-ER4 has been realized. Long-reach 40 km error-free transmission under 25-Gbit/s operation on SMF is achieved for the first time.

16:15 - 16:45 Coffee break (will be served in the Main Lobby)

Central Lobby

Poster Session 1

P1.01:
Single-Longitudinal-Mode Lanthanum-Codoped Bismuth-Based Erbium Doped Fiber Ring Laser
Khurram K Qureshi, Tam, Chao Lu, Ping-Kong, Alex Wai, The Hong Kong Polytechnic University, P.R. China
♦ We propose and demonstrate a stable single-longitudinal-mode lanthanum-codoped bismuth oxide-based erbium doped fiber ring laser. The combination of a free-space thin-film filter and a Lyot filter enable single longitudinal mode efficiency.

P1.02:
Wavelength-Tunable Nearly-Transform-Limited Pulse Generation Based on Fiber Optical Parametric Oscillator
Yue Zhou, Kim Ka Yi Cheung, Sigang Yang, P. C. Chui, Kenneth K Y Wong, The University of Hong Kong, Hong Kong
♦ We demonstrate an all-fiber widely-tunable sub-picosecond fiber optical parametric oscillator based on highly-nonlinear dispersion-shifted fiber. Nearly-transform-limited sub-picosecond pulses are generated over a 60-nm tuning range around 1550 nm.

P1.03:
Broadening Adjustable Range on Post-Fabrication Resonance Wavelength Trimming of Long-Period Fiber Gratings by Heating
Fatemeh Abrishamian, Katsumi Morishita, Osaka Electro-Communication University, Japan
♦ The adjustable range of resonance wavelengths of long-period gratings was broadened toward the blue side by heating, and the mechanism was studied. The large blue shift, 41 nm, was obtained by heating at 600 °C.

P1.04:
Fast SOP Variation Measurement on WDM Systems Are the OPMDC Fast Enough?
Suzanne Salaun, Frederic Neddam, Bruno Raguenes, Maryse Moignard, Orange Labs, France
♦ Orange Labs organized a 6 month field trial to characterize states of polarization SOP variations on representative 40 Gbit/s links. The SOP variations speed can reach more than 50°/1ms which seems not fully compatible with OPMDC specifications.

P1.05:
Ultra Low Nonlinear Telecom Fibre by Hole Assisted Technique
Iwao Shimotakahara, Ryuichi Sugizaki, Yu Mimura, Takeshi Yagi, The Furukawa Electric Co., Ltd, Japan
♦ Hole assisted fibre with less than half nonlinearity of standard SMFs was investigated. Fabricated fibre has Aeff of 180um2, reduced n2 and larger dispersion coefficient, simultaneously. Low loss splice is available with regular fusion splicer.

P1.06:
Compact Electrically Controlled Broadband Liquid Crystal Photonic Bandgap Fiber Polarizer
Lei Wei, Anders Bjarklev Technical University of Denmark, Denmark; Thomas Tanggaard, Alkeskjold Crystal Fibre A/S, Denmark
♦ An electrically controlled liquid crystal photonic-bandgap fiber polarizer is experimentally demonstrated. A maximum 21.3dB electrically tunable polarization extinction ratio is achieved with 45° rotatable transmission axis as well as switched on and off in 1300nm-1600nm.

P1.07:
Widely Wavelength-Tunable and Pulsewidth-Variable Harmonically Mode-Locked Short-Cavity Fiber Ring Laser Using a Bismuth-Oxide-Based Highly Nonlinear Erbium-Doped Fiber
Yutaka Fukuchi, Joji Maeda, Tokyo University of Science, Japan
♦ We demonstrate a stable 10GHz harmonically modelocked laser employing a 151cm-long bismuth-based highly nonlinear erbium-doped fiber and a bandwidth-variable tunable filter. The wavelength tuning range is 80nm. The pulsewidth is varied from 7.8ps to 23.1ps.

P1.08:
Full C-L Band Tunable Wavelength Conversionby by Zero Dispersion and Zero Dispersion Slope HNLF
Masanori Takahashi, Kazunori Mukasa, Takeshi Yagi, The Furukawa Electric Co., Ltd., Japan
♦ We demonstrated full C-L band tunable wavelength conversion by zero dispersion and zero dispersion slope HNLF. A signal from whole C-L band was converted to an arbitrary wavelength in almost whole C-L band.

P1.09:
A Hole-Assisted Fiber for Wideband Transmission from 1.0 μm to 1.6 μm
Shoji Tanigawa, Katsuhiro Takenaga, Shoichiro Matsuo, Munehisa, Fujimaki Fujikura Ltd., Japan
♦ A novel hole-assisted fiber with single-mode propagation down to 1.0 μm and relatively low macro-bending loss up to L band is fabricated. The fiber also has low loss and large effective area properties.

P1.10:
Linearly-Polarized Lasing at 1180 nm Using Polarization-Maintaining Yb-Doped Solid Photonic Bandgap Fiber
Katsuhiro Takenaga, Shoji Tanigawa, Masahiro Kashiwagi, Shoichiro Matsuo, Fujikura Ltd., Japan; Ryuichiro Goto, University of Sydney, Australia
♦ Linearly-polarized lasing at 1180 nm is demonstrated by utilizing polarization maintaining Yb-doped solid photonic bandgap fiber. The extinction ratio of the output light between two lineary-polarized lights is more than 20 dB.

P1.11:
Highly Versatile Photonic Crystal Fibre Enabled Fabry-Perot Interferometer
Joel Villatoro, Vittoria Finazzi, Gianluca Coviello, ICFO, Spain; Valerio Pruneri, ICFO and ICREA, Spain
♦ We report a Fabry-Perot interferometer whose cavity is a microscopic air-bubble. The later is formed when splicing together conventional and index-guiding photonic crystal fiber. The interferometer exhibits low thermal sensitivity and has multiple sensing applications.

P1.12:
Evaluation of Fiber Fuse Characteristics of Hole-Assisted Fiber for High Power Optical Transmission Systems
Hidehiko Takara, Kazuo Hagimoto, NTT, Japan; Hirohji Masuda, Yutaka Miyamoto, NTT Network Innovation Laboratories, Japan; Hirohisa Kanbara, Yoshiteru Abe, Toshio Morioka, Shinji Matsuoka, Masatoshi Shimizu, NTT Corporation, Japan; Ryo Nagase, NTT Photonics Labs., Japan
♦ We evaluate fiber fuse characteristics of bend-insensitive optical fibers and show that hole-assisted fiber HAF is applicable as fiber fuse stopper in high-power optical transmission systems. We also clarify fiber fuse stopping mechanism of HAF.

P1.13:
Four-Wave Mixing based Wavelength Conversion in a Carbon Nanotubes Deposited Tapered Fiber
K. K. Chow, M. Tsuji, Shinji Yamashita, The University of Tokyo, Japan
♦ We report the observation of four-wave mixing in carbon nanotubes deposited around a tapered fiber with optical deposition method. Wavelength conversion of 10 Gb/s non-return-to-zero signal is demonstrated using the generated four-wave mixing effect.

P1.14:
Proposal of Reliable Cutoff Wavelength Measurement for Bend Insensitive Fiber
Tetsuya Nakanishi, Masaaki Hirano, Takashi Sasaki, Sumitomo Electric Industries, LTD., Japan
♦ Reliable technique to determine the cutoff wavelength using singe-mode fiber as a reference is newly proposed. This technique identify cutoff wavelength of 1st higher-order-mode in BIF precisely, which is difficult with existing techniques.

P1.15:
Sectioned Core Doping Effect on Higher-Order Mode Amplification in Yb-Doped Rod-Type Photonic Crystal Fibers
Federica Poli, Davide Passaro, Annamaria Cucinotta, Stefano Selleri, University of Parma, Italy; Jesper Lægsgaard, COMoDTU, Technical University of Denmark, Denmark; Jes Broeng, Crystal Fibre A/S, Denmark
♦ The amplification properties of guided modes in Yb-doped rod-type photonic crystal fibers with sectioned core doping have been investigated, evaluating the doped-area radius which provides the effective suppression of both LP11- and LP02-like modes.

P1.16:
Simple Modal Analysis Method for Multi-Mode Fibers
Stéphane Blin, Duc Minh Nguyen, Thanh Nam Nguyen, Monique Thual, Foton / CNRS / Université de Rennes 1, France; Laurent Provino Perfos, France; Thierry Chartier, Laboratoire Foton, France
♦ We demonstrate a simple technique to measure the modal content of a multi-mode optical fiber by using a tunable source and a camera, and processing the near-field images measured at the fiber output.

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Central Lobby

Poster Session 1

P1.17:
Simple Method to Measure the Third-Order Nonlinear Coefficient of Optical Fibres
Thanh Nam Nguyen, Monique Thual, Foton / CNRS / Université de Rennes 1, France; Thierry Chartier, Laboratoire Foton, France; Jean-Claude Simon, ENSSAT / Université de Rennes 1, France; Laurent Brilland, Johann Troles, EVC, Umr CNRS 6226, France; Trung Hieu Bui, Posts and Telecommunications Institute of Technology, Vietnam
♦ We report a new method to measure the third order Kerr coefficient of optical fibres. This method is based on the self-phase-modulation-induced spectral broadening of optical pulses.

P1.18:
Demonstration of a Photonic Integrator-Based Loadable and Erasable Optical Memory Unit with Picosecond Switching Times
Mohammad H. Asghari, Jose Azana, INRS, Canada; Yongwoo Park, University of Quebec, Canada
♦ A novel ultrahigh-speed optical memory concept is demonstrated using an FBG-based photonic integrator with ultra-large memory storage-to-switching time ratio >300). An all-optical memory unit with unprecedented switching times of ~2.6ps is demonstrated using discrete components.

P1.19:
Broadband, spectrally controlled Raman-active attenuator
Michael Holtmannspoetter, Emil Pitschujew, Bernhard Schmauss, University of Erlangen, Germany
♦ We present numerical investigations on a broadband Raman-active attenuator using a WDM-scheme of control signals. It is shown to hold a feasible control characteristic for mitigation of residual transients arising in spite of inline-amplifier control.

P1.20:
Precise Low-Cost Optical Time Multiplexer Based on the Birefringence of Polarization Maintaining Fibers
An Truong Nguyen, Emma Lazzeri, Scuola Superiore Sant'Anna, Italy; Paolo Ghelfi, Antonella Bogoni, Luca Potì Consorzio, Nazionale Interuniversitario per le Telecomunicazioni, Italy
♦ A novel scheme of optical time multiplexer is presented, based on the high birefringence of polarization maintaining fiber. The scheme is highly precise, and its fiber-only construction reduces the multiplexer loss and cost.

P1.21:
Bandpass Filters on End-Faces of Optical Fibers
Stefan Meister, Bülent Franke, Dziedzina Marcus, Dawid Z. Schweda, Scharfenorth Chris, Hans Eichler, Technische Universität Berlin, Germany
♦ Bandpass filters based on a Fabry-Perot structure are coated on end-faces of optical fibers. The layer design and the deposition process were optimized to achieve high transmission. Bandwidths of less than 1 nm were obtained.

P1.22:
Measurement of Fiber Chromatic Dispersion Using Spectral Interferometry with Modulation of Dispersed Laser Pulses
Naum Berger, Boris Levit, Baruch Fischer, Technion - Israel Institute of Technology, Israel
We propose and experimentally demonstrate a simple accurate method for fiber dispersion measurement based on modulation of laser pulses stretched by the tested fiber. The spectral interferometry is implemented without an interferometer and the results are insensitive to environmental conditions.

P1.23:
Improved Supercontinuum Generation by Dispersion Tuning and Dual Wavelength Pumping
Atalla El-Taher, Mercedes Alcon-Camas, Vassilios Karalekas, Juan Diego Ania-Castanon, Paul Harper, Aston University, United Kingdom
♦ Supercontinuum generation in ultra-long Raman fibre laser cavities is compared for a range of fibre dispersions in the anomalous and normal regimes. For normal dispersion improved performance and efficiency is achieved using dual wavelength pumping

P1.24:
Dissipative Dispersion Managed Solitons in Mode-locked Fibre Lasers
Brandon Bale, Sonia Boscolo, Sergei Turitsyn, Aston University, United Kingdom
♦ We extend theory of dispersion-managed solitons to dissipative systems with a focus on mode-locked fibre lasers. Dissipative structures exist at high map strengths, and different pulse evolutions are observed depending on the net cavity dispersion.

P1.25:
Photonic Crystal Fiber with Ring-Core Hollow-Defect for Evanescent Wave Chemical Sensing
Jiyoung Park, Kyunghwan Oh, Yonsei University, Korea; Jens Kobelke, Institute of Photonic Technology IPHT, Germany
♦ A doped-ring hollow-defect structure is proposed in photonic crystal fiber to acheive a higher evanescent field. Vectorial modal analysis with finite element method and experimental results confirmed significantly enhanced sensitivity in the near IR region.

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Wednesday, September 23, 2009 · 16:45 - 18:30

Central Lobby

Poster Session 2

P2.01:
Highly Nonlinear Ge11.5As24Se64.5 Chalcogenide Glass Waveguides
Steve J Madden, Amrita Prasad, Ron-Ping Wang, Douglas Bulla, Australian National University, Australia; Barry Luther-Davies, Centre for Ultrahigh bandwidth Devices for Optical Systems CUDOS), Australia
♦ We report on the fabrication and properties of waveguides made from a new Chalcogenide glass; Ge11.5As24Se64.5. The highest nonlinearity ever in a glass waveguide is demonstrated and a range of non-linear processes explored.

P2.02:
Novel Optical Generation of Ultrawideband UWB Signals Using Quadratic Nonlinear Interactions Seeded By Normal/Dark Pulses
Jian Wang, Qizhen Sun, Junqiang Sun, Huazhong University of Science and Technology, P.R. China
♦ We report two approaches to generate optical ultrawideband UWB signals using quadratic nonlinear interactions in periodically poled lithium niobate PPLN seeded by either normal or dark pulses. Pairs of polarity-inverted UWB monocycle pulses are obtained.

P2.03:
Three-Dimensional Low-loss Waveguide Shuffler and Splitter / Combiner using Novel Mirror Structure
Hidetoshi Numata, IBM Japan, Japan
♦ We present 3D low-loss optical waveguide shuffler and splitter/combiner which will become important for high-channel count optical interconnect. We used a couple of TIR mirrors at a shuffling point and could avoid crosstalk and crossing-loss.

P2.04:
Demonstration of a Wavelength Selective Switch Using an LCOS and a Stacked Arrayed Waveguide Grating
Keisuke Sorimoto, Hiroyuki Tsuda, Keio University, Japan; Hiroshi Ishikawa, Toshifumi Hasama, Hitoshi Kawashima, Kenji Kintaka, Masahiko Mori, National Institute of Advanced Industrial Science and Technology, Japan; Hisato Uetsuka, Hitachi Cable Ltd., Japan
♦ We successfully fabricated a stacked AWG with an accuracy of 0.3% and demonstrated an LCOS-based wavelength selective switch with it. Flat-top spectral response with a crosstalk of less than -31dB was obtained.

P2.05:
A Compact 100-GbE Quadplex Receiver
Kazuhiko Hosomi, Takuma Ban, Yong Lee, Daichi Kawamura, Kazuyuki Nagatsuma, Toshiki Sugawara, Shinji Tsuji, Hitachi Ltd., Japan; Reiko Mita, Kazunori Shinoda, Koichiro Adachi, Masahiro Aoki, Hitachi Ltd.,Central Research Laboratory, Japan
♦ We developed a compact quadplex receiver for 100-Gbps Ethernet. High responsivity 0.74 A/W is achieved for all channels using microlens-integrated photodiodes. The fabricated module was successfully operated at 25 Gbit/s with error free 10-km SMF transmission.

P2.06:
Silicon Lateral Avalanche Photodiodes Fabricated by Standard 0.18 um CMOS Process
Koichi Iiyama, Hideki Takamatsu, Takeo Maruyama, Kanazawa University, Japan
♦ A Si APD was fabricated by standard 0.18 um CMOS process. The maximum avalanche gain was 224 for only 8 V bias. The bandwidth was 1.6 GHz for low avalanche gain and 800 MHz for large avalanche gain.

P2.07:
Analysis of Nonlinear Optical Effects in Monolithically Integrated FM-Mode-Locked Semiconductor Laser Diodes
Haruhiko Kuwatsuka, National Institute of Advanced Industrial Science and Technology, Japan
♦ Simulation shows that asymmetric nonlinear optical gain causing the mode instability of mode-locked lasers can be compensated by phase modulation. Mode stabilization was confirmed experimentally using monolithically integrated FM-mode-locked semiconductor laser diodes.

P2.08:
High-order micro-ring resonator assisted wavelength converters for scalable and power efficient photonic routers
Konstantinos Vyrsokinos, National Technical University of Athens, Greece
♦ We design and demonstrate the first higher-order silicon micro-ring resonators suitable for wavelength conversion. We show that 40 and 160Gb/s wavelength conversion is feasible with a SOA followed by 2nd and 3rd order MRRs respectively.

P2.09:
High-speed DBPSK signal generation by low-Vpi modulator using thin LiNbO3 substrate
Atsushi Kanno, Takahide Sakamoto, Akito Chiba, Tetsuya Kawanishi, National Institute of Information and Communications Technology, Japan; Kaoru Higuma, Masaaki Sudo, ; Junichiro Ichikawa, Sumitomo Osaka Cement, Japan
♦ We demonstrated 100-Gb/s DBPSK signal generation by using a thin-LiNbO3-substrate modulator. The low Vpi and the reduction in the propagation loss of electrodes helps realize high-speed PSK operation.

P2.10:
25 Gbps EML TOSA Employing Novel Impedance-Matched FPC Design
Toshitsugu Uesugi, Mitsubishi Electric Corporation, Japan
♦ 25 Gbps EML TOSA employing novel impedance-matched flexible printed circuit design realizes 30 GHz 3-dB bandwidth and a low-jitter optical waveform with 39 % mask margin for 100 Gbps Ethernet application.

P2.11:
2.5Gbps WDM-PON Tunable Light Source Hybrid Integrated with Superluminescent Diode and Polymeric Waveguide Bragg Reflector
Ki-Hong Yoon, Electronics and Telecommunications Research Institute ETRI), Korea
♦ We successfully fabricated a very compact tunable laser based on a superluminescent diode and a polymeric waveguide Bragg reflector for WDM-PON colorless light source. This module operated successfully in the direct modulation for 2.5Gbit/s transmissions over 20 km.

P2.12:
160 Gbit/s OTDM System Based on 40 GHz Optical Pulses Generated Using Simultaneous Two-Arm Modulation of a Mach-Zehnder Modulator
Ke Wang, Royal Institute of Technology, Sweden; Jie Li Acreo, AB, Sweden
♦ Bit-error-rate free performance of 160 Gbit/s OTDM data based on 1.9 ps 40 GHz optical pulses generated by simultaneous two-arm modulation of a Mach-Zehnder intensity modulator has been demonstrated.

P2.13:
Frequency Response Enhancement in Optical Injection Locked Semiconductor Ring Laser using Master Laser Modulation
Muhammad Irfan I Memon, Bei Li, Zhuoran Wang, Siyuan Yu, University of Bristol, United Kingdom; Gabor Mezosi, Marc Sorel, University of Glasgow, United Kingdom
♦ Bandwidth of optical injection locked OIL semiconductor ring laser SRL is enhanced from 15GHz to >40GHz using master-laser modulation. Unidirectional SRLs allow monolithic integration of OIL scheme as it produces no feedback towards the master-laser.

P2.14:
2.5 Gbps Operation of RSOA for Low-Cost WDM-PON Sources
Dong Churl Kim, Byung-Seok Choi, Hyun-Soo Kim, Ki Soo Kim, O-Kyun Kown, Dae-Kon Oh, Electronics and Telecommunications Research Institute, Korea
♦ We present design issue of RSOA and device/module characteristics for WDM-PON. Optical gain, 3dB ASE-bandwidth and PDG were about 25dB, 35nm and 0.8dB, respectively. BER power penalty after 20km transmission was about 1.9dB at 10-9 BER.

P2.15:
Integrated 4-bit Optical Memory Elements with Single Common and Low Operation Current 55mA Using Novel Active MMI
Hany Bastawrous, Haisong Jiang, Yuichiro Tahara, Kiichi Hamamoto, Kyushu University, Japan; Shinji Matsuo, NTT Photonics laboratories, Japan
♦ Integrated 4-bit 355x1200 micron-m2 optical memory elements, using novel active multi-mode-interferometer bi-stable laser diodes, showed single, common and low operation current 55mA with uniform characteristics.

P2.16:
Novel 3D Hollow Optical Waveguide with Lateral and Vertical Periodicity for Tunable Photonic Integrated Circuits
Mukesh Kumar, Takahiro Sakaguchi, Fumio Koyama, Tokyo Institute of Technology Japan, Japan; Chris Chase, Vadim Karagodsky, Connie J. Chang-Hasnain, University of California Berkeley, USA
♦ A novel design-flexible 3D-hollow-waveguide with lateral- and vertical-periodicity has been demonstrated. A high-index-contrast-grating-(HCG), introduced as a lateral-periodicity, provides vertical as well as lateral-optical-confinement. The combined effect of vertical and lateral periodicity results in a low-polarization-dependence.

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Central Lobby

Poster Session 2

P2.17:
Multisection RSOA for 2.5 Gbps Colorless WDM-PON
Hyun-Soo Kim, Byung-Seok Choi, Ki Soo Kim, Dong Churl Kim, O-Kyun Kown, Dae-Kon Oh, Electronics and Telecommunications Research Institute, Korea
♦ We demonstrated two-section RSOA with improved modulation bandwidth of 8 GHz as colorless source for WDM-PON. Good performance at 2.5 Gbps was obtained with a power penalty of 2 dB up to 20 km transmission.

P2.18:
A 1 × 8 Optical Switch of Mach-Zehnder Interferometers Using Si-Waveguides with Ferroelectric Liquid Crystal Cladding
Takahiro Sawa, Katsumi Nakatsuhara, Takakiyo Nakagami, Kanagawa Institute of Technology, Japan
♦ We fabricated a 1×8 optical switch using tunable phase shifters in Si-waveguides with ferroelectric liquid crystal cladding. The tunable phase shifters were 340 ?m long. A switching operation was demonstrated at a 1550-nm wavelength.

P2.19:
720-fs Pulse Generation with 40 GHz Passively-Mode Locked Quantum-Dash Fabry-Pérot Laser
Ramón Maldonado-Basilio, Sylwester Latkowski, Pascal Landais, Dublin City University, Ireland
♦ Generation of 720-fs pulses by passively mode-locked Fabry-Pérot lasers is demonstrated. Pulse width is analyzed in terms of the longitudinal modes passing through a variable band-pass filter placed at the laser output

P2.20:
Ge-on-Si Photodetectors for Optical Communications
Johann Osmond, Laurent Vivien, Delphine Marris-Morini, Paul Crozat, Eric Cassan, Suzanne Laval, Institut d'Electronique Fondamentale, France; Jean-Marc Fedeli, CEA-LETI, France; Jean-François Damlencourt, CEA, France
♦ Ge-on-Si waveguide integrated photodetectors including Metal-Semiconductor-Metal MSM), vertical PIN and lateral PIN diodes are reviewed.

P2.21:
Characterization of a Mode-Locked Quantum-Dash Fabry-Perot Laser Based on Measurement of the Complex Optical Spectrum
Xuefeng Tang, Abdullah Karar, John C Cartledge, Queen's University, Canada; Alexandre Shen, Guang-Hua Duan, Alcatel-Thales III-V Lab, France
♦ By measuring the complex optical spectrum using a half-rate, sinusoidal modulation method, a mode locked quantum-dash Fabry-Perot laser is characterized for free-running operation and actively mode-locked operation by injection of a 40 Gb/s RZ-OOK signal.

P2.22:
Influence of SG-DBR Laser Linewidth on 10.7 Gb/s DPSK and OOK Transmission
Frank Smyth, Kai Shi, Prince Anandarajah, Douglas Reid, Liam Barry, Dublin City University, Ireland
♦ Calibration of tunable lasers is currently based on achieving sufficient SMSR and output power for transmission. As systems employing these devices move towards advanced modulation formats it becomes imperative that the linewidth is also considered.

P2.23:
Fabry-Perot Resonator Based on InGaAs/AlGaAs/AlAsSb Quantum Well Waveguide and its all-optical Tuning at GHz-Repetition Rate
Kazi Sarwar Abedin, Tetsuya Miyazaki, National Institute of Information and Communications Technology NICT, Japan; Ryoichi Akimoto, Haruhiko Kuwatsuka, National Institute of Advanced Industrial Science and Technology, Japan
♦ We report a Fabry-Perot resonator constructed from InGaAs/AlGaAs/AlAsSb quantum well waveguide, which can be optically tuned. Tuning using optical pulses at 1.552?m at 1GHz-repetition-rate is achieved by intersubband transition induced cross-phase modulation effect.

P2.24:
MMI-Reflector: A Novel On-chip Reflector for Photonic Integrated Circuits
Xaveer Leijtens, Boudewijn Docter, Tjibbe de Vries, Barry Smalbrugge, Fouad Karouta, Meint K Smit, Eindhoven University of Technology, The Netherlands; Ling Xu, COBRA - Eindhoven University of Technology, The Netherlands
♦ We present a novel, compact, on-chip multi-mode interference MMI reflector, with near-100% theoretical reflection. We measured 78+-10% reflection for an InP-based MMI-reflector fabricated with a single etch step with inductively coupled plasma ICP etching technique.

P2.25:
Effect of the wetting layer on intensity noise in quantum dot laser
Jean-François Hayau, Pascal Besnard, Foton / CNRS / Université de Rennes I, France; Olivier Dehaese, Frédéric Grillot, Madhoussoudhana Dontabouctouny, Rozenn Piron, Slimane Loualiche, Foton / CNRS / Insa, France; Anthony Martinez, Abderrahim Ramdane, Kamel Merghem, CNRS/LPN, France
♦ We show through a simple theoretical formulation and in good agreement with experimental measurements that the wetting layer may increase the relative intensity noise at low frequencies in quantum-dot lasers while modifying the damping rate.

P2.26:
Athermal and Tunable Operations of 850 nm VCSEL with Thermally Actuated Cantilever Structure
Hayato Sano, Akihiro Matsutani, Fumio Koyama, Tokyo Institute of Technology, Japan
♦ We present the first demonstration of athermal and tunable operations of VCSELs using thermally actuated cantilever for compensating the temperature dependence of wavelength. The temperature dependence is as low as 0.002nm/K and the wavelength tuning of 1nm is obtained.

P2.27:
All-Optical Spatial Multicasting Using Cascaded Silicon Photonic Devices
Aleksandr Biberman, Noam Ophir, Benjamin G. Lee, Keren Bergman, Columbia University, USA; Amy Turner-Foster, Mark Foster, Nicolás Sherwood-Droz, Carl B. Poitras, Michal Lipson, Alexander L Gaeta Cornell, University, USA
♦ We demonstrate all-optical spatial multicasting enabled by nanophotonic devices in two cascaded silicon chips. We evaluate each spatially-multicasted signal using 10-Gb/s BER measurements, facilitating the path towards fully-monolithic photonic integrated circuits performing complex network-level functionalities.

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Wednesday, September 23, 2009 · 16:45 - 18:30

Central Lobby

Poster Session 3

P3.01:
Low Cost Multi-Impairment Monitoring Technique for 43 Gbps DPSK and 86 Gbps DP-DPSK Using Delay Tap Asynchronous Sampling Method
David Dahan, David Levy, ECI Telecom, Israel; Uri Mahlab, Ecitele, Israel
♦ We present a novel low-cost method for multi-impairment monitoring for 43Gbps DPSK using delay-tap asynchronous sampling with 12 GHz receivers. This technique is also demonstrated for 86Gbps DP-DPSK and therefore, is potentially applicable to 112 Gbps DP-QPSK

P3.02:
Efficient Interleaving of FEC Codewords for Optical PSK Systems
Sami Mumtaz Yves Jaouen, Télécom ParisTech, France; Ghaya Rekaya, ENST Paris, France; Gabriel Charlet ,Bell Labs, Alcatel-Lucent, France
♦ Differential encoding is required for phase modulation optical transmission systems but leads to higher bit error rate. We propose a construction of the codeword of the forward error correction allowing performance enhancement and complexity decrease.

P3.03:
Improvement of Wavelength Switch Performance Consisting of a SSG-DBR-LD and a SOA-DISC with BPF Detuning
Takayoshi Mori, Hiroyuki Uenohara, Kobayashi Kohroh, Tokyo Institute of Technology, Japan
♦ We demonstrate dynamic wavelength switch operation using a SSG-DBR-LD and a SOA-DISC-type wavelength converter. Error free performance was achieved with precise adjustment of signal wavelength to periodical MZDI transmissivity and BPF detuning.

P3.04:
Optical Performance Monitoring of PSK Data Channels Using Artificial Neural Networks Trained with Parameters Derived from Delay-Tap Asynchronous Diagrams via Balanced Detection
Xiaoxia Wu, Alan Willner, University of Southern California, USA; Jeffrey Jargon, National Institute of Standards and Technology, USA; Zhensheng Jia, Ronald Skoog, Telcordia Technologies, USA; Loukas Paraschis, Cisco Systems, USA
♦ We demonstrate a technique of using artificial neural networks for optical performance monitoring of PSK data signals. Parameters for training are derived from delay-tap asynchronous diagrams using balanced-detection. We also compare the results with the case of using direct detection.

P3.05:
Widely Wavelength Flexible Operation of All-Optical Regeneration in RZ-OOK Signals Using Gain-Band Tunable Raman Amplifier
Motoharu Matsuura, The University of Electro-Communications, Japan
♦ We demonstrate operating wavelength flexible all-optical signal regeneration with 80 nm wavelength range by simply controlling the pump wavelength of Raman amplifier and the passband of broadened signal spectrum filtering.

P3.06:
Novel Opto-Electrical Tunable Dispersion Compensator for IM Signals
Miguel Drummond, Manuel Violas, Instituto de Telecomunicações, pólo de Aveiro, Portugal; Rogério N Nogueira, Paulo Monteiro, Nokia Siemens Networks Portugal S.A, Portugal; Carola Sterner, Pierre-Yves Fonjallaz Kista, Photonic Research Centre KPRC), Acreo AB, Sweden
♦ A novel opto-electrical tunable dispersion compensator with a tuning time lower than 150 µs is proposed and experimentally demonstrated. Compensation of 0-340 ps/nm for a 40 Gb/s NRZ signal is achieved.

P3.07:
Impact of Non-Ideal Pulse Carving Induced Phase Distortions on QPSK based Modulation Format
Hwan Seok Chung, Sun Hyok Chang, Kwangjoon Kim, ETRI, Korea
♦ We investigate impact of nonideal pulse carver induced phase distortions on QPSK format. The results show only 0.5 dB amplitude imbalance of sinusoidal wave applied into carver produces 2 dB ONSR penalty in case of 67 % pulse carving.

P3.08:
Accurate Digital Frequency Offset Estimator for Coherent PolMux QAM Transmission Systems
Mehrez Selmi, Yves Jaouen, Telecom ParisTech, France; Philippe Ciblat, ENST, France
♦ An accurate blind frequency offset estimator adapted to QAM modulated signal is proposed. For coherent 100Gbit/s QAM PolMux transmission, frequency offset can be recovered with an accuracy of a few kHz.

P3.09:
Full-mesh Wavelength Routing over Interconnected AWG-STARs Employing Coprime-Channel-Cycle Arrayed-Waveguide Gratings
Osamu Moriwaki, Kazuto Noguchi, Tadashi Sakamoto, Hiroshi Takahashi, Nippon Telegraph and Telephone Corporation, Japan
♦ We propose and demonstrate a novel technique for interconnecting AWG-based wavelength routing networks. Experiments successfully demonstrated that this enables us to establish full-mesh wavelength paths between arbitrary nodes in two networks.

P3.10:
A novel linear photonic RF phase shifter base on polarization controller
Han Chen, Yi Dong, Hao He, Weisheng Hu, Shanghai Jiao Tong University, P.R. China; Le Min Li, University of Electronic Science and Technology of China, P.R. China
A novel linear photonic RF phase shifter base on polarization controller is presented and the theoretical fundamentals of the design are explained. A prototype of the phase shifter with 26.75GHz bandwidth and 360 degrees tuning range is experimentally demonstrated.

P3.11:
Subcarrier Selection for IM/DD OFDM Systems
Henning Paul, Karl-Dirk Kammeyer, University of Bremen, Germany
♦ Subcarrier selection mitigates the need for suppression of one sideband at the transmitter side for Intensity Modulation/Direct Detection OFDM systems caused by group velocity dispersion of the fiber and thus reduces optical hardware efforts.

P3.12:
Optical Comb and Filter Bank De)Mux Enabling 1 Tb/s Orthogonal Subband Multiplexed CO-OFDM Free of ADC/DAC Limits
Moshe Nazarathy, Technion, Israel Institute of Technology, Israel; Dan Marom, Hebrew University, Jerusalem, Israel; William Shieh, The University of Melbourne, Australia
♦ Realizations of 100-1000Gb/s CO-OFDM are hindered by electronic ADC/DAC rates. By de)multiplexing the OFDM sub-bands by means of optical-comb generators with repetition rate matched to sub-band separation, we eliminate complex RF up/down-converters and relieve ADC/DAC requirements.

P3.13:
Dispersion Compensation Using Decision-Feedback MLSE for Spectrally-Efficient Optical Transmission
Jian Zhao, Tyndall National Institute, Ireland; Lian-Kuan Chen, The Chinese University of Hong Kong, Hong Kong
♦ We propose a novel decision-feedback maximum likelihood sequence estimation, and numerically demonstrate its use in 10GS/s 8-ASK-DQPSK 8-ASK-QPSK systems to significantly improve the dispersion tolerance, without increasing the computation complexity exponentially with the format-level number.

P3.14:
W-band 3.75-Gb/s 8PSK Wireless Signal Generation and Transmission via Optical Frequency Octupling and Bias Modulation of NBUTC-PD with Feed-Forward Equalizer
Po Tsung Shih, Chun-Ting Lin, National Chiao Tung University, Taiwan
♦ Generation and transmission of a wireless W-band 8PSK signal with 3.75-Gb/s data rate are experimentally demonstrated. The W-band carrier is generated from millimeter-wave generation with frequency octupling. Bias modulation of a NBUTC-PD is also utilized.

P3.15:
Experimental 2.5 Gbit/s QPSK WDM Coherent Phase Modulated Radio-over-Fibre Link with Digital Demodulation by a K-means Algorithm
Neil Guerrero Gonzalez, Idelfonso Tafur Monroy, Technical University of Denmark, Denmark; Antonio Caballero Jambrina, Darko Zibar, DTU Fotonik, department of Photonic Engineering, Technical University of Denmark, Denmark; Ferney Amaya, GIDATI Research Group, Colombia
♦ Highest reported bit rate of 2.5 Gb/s for optically phase modulated radio-over-fibre link employing coherent detection is demonstrated. Demodulation of 3x2.5 Gb/s QPSK modulated WDM channels, is achieved after 79km of transmission through deployed fiber.

P3.16:
XPM Tolerant Adaptive Carrier Phase Recovery for Coherent Receiver Based on Phase Noise Statistics Monitoring
Lei Li, Zhenning Tao, Ling Liu, Weizhen Yan, Fujitsu Research & Development Center, P.R. China; Shoichiro Oda, Takeshi Hoshida, Jens C. Rasmussen, Fujitsu Laboratories Ltd., Japan
♦ According to the monitored phase noise statistics, the averaging weights in carrier phase recovery is adaptively optimized. Comparing with existing optimization techniques, 1dB Q value improvement can be achieved by the proposed algorithm at most.

Poster Session

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Central Lobby

Poster Session 3

P3.17:
Optical trellis-coded modulation with multi-parallel MZM
Takahide Sakamoto, Akito Chiba, Isao Morohashi, Tetsuya Kawanishi, National Institution of Information and Communications Technology, Japan
♦ We demonstrated trellis-coded modulation onto 10-Gbaud 16QAM by electro-optic vector digital-to-analogue converter employing multi-parallel MZM and trellis encoder. The signal was demodulated with a digital homodyne employing Viterbi decoder.

P3.18:
High Sensitive Clock Recovery for a 160Gbit/s OTDM Signal by Optoelectronic Phase-Locked Loop Technique
Shigehiro Takasaka, Yu Mimura, Takeshi Yagi, Furukawa Electric Co., Ltd., Japan
♦ We demonstrate high sensitive clock recovery for a 160Gbit/s OTDM signal realized by an optoelectronic phase-locked loop with new 9.7dBm configuration. The recovered 10GHz clock has timing jitter of 101fs for signal input.

P3.19:
An Optical Differential 8-PSK Modulator Using Cascaded QPSK Modulators
Yanfu Yang, Linghao Cheng, Chao Lu, Tam, P K A Wai, The Hong Kong Polytechnic University, Hong Kong; Xiaogeng Xu, Lei Liu Huawei, Technologies Co. Ltd., P.R. China
♦ A new optical D8PSK modulator implementation is proposed. The proposed scheme removes the need for precise driving signal voltage control. Simulation results show the scheme enables modulation signal generation with more relaxed EO bandwidth requirements.

P3.20:
Coherent Detection of a 50 Gb/s QPSK Signal Using an InP 90°Hybrid Monolithically Integrated with Balanced Photodetectors
Reinhold Ludwig, Lutz Molle, Detlef Schmidt, Fraunhofer Heinrich-Hertz-Institut, Germany; Andreas Matiss, Christoph Leonhardt, u2t Photonics AG, Germany; Heinz-Gunter Bach, Fraunhofer-Institut fuer Nachrichtentechnik, Germany; Reinhard Kunkel, Fraunhofer Institute for Telecommunications, Germany
♦ Error-free detection of a single-polarization 50Gb/s NRZ-QPSK signal using a coherent detector based on monolithic integration of a waveguide 90°hybrid with two pairs of high-speed balanced photo-detectors is demonstrated and the BER-performance is evaluated in a 480km transmission experiment.

P3.21:
All-Optical Counter Based on Optical Flip-Flop and Optical AND Gate
Jing Wang, Department of Electronic Engineering, Tsinghua University, Italy; Gianluca Meloni, Luca Poti, Antonella Bogoni Consorzio, Nazionale Interuniversitario per le Telecomunicazioni, Italy; Gianluca Berrettini, Scuola Superiore Sant'Anna, Italy
♦ An all-optical counter is presented using cascaded stages composed by SOA fiber laser based optical flip-flops and SOA four wave mixing AND logic gates. Two-bit all-optical pulse counting and optical frequency division are demonstrated.

P3.22:
Multi-sampling Stacked Optical Code Label for Scalable Multicasting in Optical Packet Switching Networks
Ming Xin, Hongwei Chen, Feifei Yin, Shizhong Xie, Tsinghua University, P.R. China; Minghua Chen, Broadband Optical Network Research Laboratory, P.R. China
♦ A multi-sampling technique is introduced in the stacked optical code label's encoder implemented by fiber Bragg gratings. The experimental results of a 19-node setup show that scalable optical multicasting can be well supported.

P3.23:
Optical Performance Monitoring of Data Degradation by Evaluating the Deformation of an Asynchronously Generated I/Q Data Constellation
Vahidreza R Arbab, Xiaoxia Wu, Alan Willner, Charles Weber, University of Southern California, USA
♦ We present a technique of using asynchronously generated constellation pattern to simultaneously monitor CD and first order PMD in DQPSK systems. By characterizing deformations in the patterns, the amount of accumulated CD and PMD can be estimated.

Central Lobby

Poster Session 4

P4.01:
Use of the Zero Forcing Method for Compensation of Polarization Dependent Loss in Coherent Fiber-Optic Links
Anton Andrusier, Mark Shtaif, Tel Aviv University, Israel
♦ We show that a zero-forcing receiver can be used to achieve nearly optimal performance in coherent polarization multiplexed systems. The advantage is in the receiver simplicity relative to the joint detection scheme for which the ultimate performance can be achieved.

P4.02:
8x114Gbit/s, 25GHz spaced, PolMux-RZ-8QAM straight-line transmission over 800km of SSMF
Jianjun Yu, Ming-Fang Huang, NEC Labs America, USA; Xiang Zhou, AT&T Labs-Research, USA
♦ By using PolMux-RZ-8QAM modulation format and digital coherent detection, we have demonstrated 8x114Gbit/s DWDM signals in 25GHz channel spacing to transmit over 800km of SSMF without using Raman amplification or optical dispersion compensation.

P4.03:
On the Relation between Atmospheric Visibility and the Drop Size Distribution of Fog for FSO Link Planning
Martin Grabner, Vaclav Kvicera, Czech Metrology Institute, Czech Republic
♦ Based on the Mie scattering theory and estimated drop size distribution, dependence between atmospheric visibility, microphysical parameters of fog and specific attenuation is studied. The measured and calculated attenuation is compared.

P4.04:
Suppression of XPM Penalty in Dispersion Managed Hybrid 10G/40G/100G DWDM Networks Using Group Delay Management
Olga Vassilieva, Takeshi Hoshida, Kevin Croussore, Inwoong Kim, Takao Naito, Fujitsu Laboratories of America, Inc., USA
♦ We proposed a novel group delay management technique which effectively suppresses XPM accumulation in hybrid 10G/40G/100G DWDM networks. Systematic investigation revealed its high effectiveness for various co-propagating signals, dispersion maps and fiber types.

P4.05:
Scaling of Nonlinear Threshold in WDM Transmission Systems using Electronic Precompensation of Intrachannel Nonlinearities
Johannes K. Fischer, Klaus Petermann, Technische Universität Berlin, Germany
♦ A simple criterion is presented which describes the impact of interchannel nonlinearities in wavelength-division multiplexing systems with electronic precompensation of intrachannel nonlinearities. Furthermore, limits of electronic precompensation imposed by multiplexer filter bandwidth are explored.

P4.06:
Gigahertz Clocked Quantum Key Distribution System using FPGA
Toshimori Honjo, NTT Corporation, Japan
♦ An implementation of 1-GHz clocked differential-phase-shift quantum key distribution system is reported. High speed signal generation and its storage were realized by using FPGA. A stable operation was demonstrated for over a 1-hour.

P4.07:
Enhancement of 43Gb/s DPSK Transmission Though 66 Wavelength Selective Switches Using Adaptive Channel Shape Optimization
Meinert Jordan, Juerg Leuthold, University of Karlsruhe, Israel; Er'el Granot Ariel, University Center of Samaria, Israel; Motti Caspi, Yinnon Stav, Niv Narkiss, Michael Roelens, Steve Frisken, Simon Poole, Shalva Ben-Ezra, Finisar Israel, Israel
♦ A 43Gb/s DPSK format data transmission is demonstrated through 66 Wavelength Selective Switches WSSes). By optimizing the channel shape of one of the WSSes, the transmission distance was increased from 1600 km to 2640 km with improved BER.

P4.08:
Suppression of Inter-Channel Nonlinearities in WDM Coherent PDM-QPSK Systems Using Periodic-Group-Delay Dispersion Compensators
Chongjin Xie, Bell Labs, Alcatel-Lucent, USA
♦ We show that periodic-group-delay dispersion compensators can significantly suppress inter-channel nonlinearities in a WDM coherent polarization-division-multiplexed quardrature-phase-shift-keying system and make systems with dispersion management have higher nonlinear tolerance than those with only electronic dispersion compensation.

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Wednesday, September 23, 2009 · 16:45 - 18:30

Central Lobby

Poster Session 4

P4.09:
111Gb/s No-Guard-Interval OFDM using Low Sampling Rate Analogue-to-Digital Converter
Riichi Kudo, Etsushi Yamazaki, Koichi Ishihara, Eiji Yoshida, Munehiro Matsui, Tadao Nakagawa, Masato Mizoguchi, Nippon Telegraph and Telephone Corporation, Japan; Takayuki Kobayashi, NTT, Japan; Yasushi Takatori, Akihide Sano, Yutaka Miyamoto, NTT Network Innovation Laboratories, Japan
♦ We evaluate the OSNR tolerance of 111Gb/s No-guard interval OFDM signal using low sampling rate analogue-to-digital converter. The back-to-back experiment shows that the OSNR penalty is less than 0.1dB when using 1.4 times oversampling rate.

P4.10:
111 Gb/s Transmission with Compensation of FBG-induced Phase Ripple Enabled by Coherent Detection and Digital Signal Processing
Mohammad Alfiad, Huug de Waardt, Eindhoven University of Technology, The Netherlands; Dirk van den Borne, Torsten Wuth, Sander Jansen, Vladimir Veljanovski, Antonio Napoli, Nokia Siemens Networks, Germany; Maxim Kuschnerov, University of the Federal Armed Forces, Munich, Germany
♦ We demonstrate that coherent detection combined with digital signal processing can completely compensate for FBG induced phase ripple. We report penalty free transmission of 40x111-Gb/s POLMUX-RZ-DQPSK over 1,425-km of SSMF with FBG for in-line dispersion compensation

P4.11:
Non-Linear Propagation Limits and Optimal Dispersion Map for 222 Gbit/s WDM Coherent PM-16QAM transmission
Vittorio Curri, Andrea Carena, Pierluigi Poggiolini, Politecnico di Torino, Italy; Fabrizio Forghieri, Cisco Photonics Italy srl, Italy
♦ We investigate through simulation the impact of non-linear propagation on 222Gbit/s WDM coherent PM-16QAM. We show that the best performance is achieved using full electronic dispersion compensation, with a significant system reach of about 1000km

P4.12:
Nonlinear Phase Noise Mitigation by Polarization Mode Dispersion in Dispersion Managed coherent PDM-QPSK Systems
Paolo Serena, Alberto Bononi, University of Parma, Italy
♦ We show by simulation that PMD helps reduce nonlinear phase noise in single-channel coherent PDM-QPSK systems at both 43 and 112 Gbit/s, with improved resilience at 112 Gbit/s.

P4.13:
Integrated Optical Receiver for Lens-Less Short Range Free-Space Gigabit Communication
Wolfgang Gaberl Horst Zimmermann, Vienna University of Technology, Austria; Robert Swoboda, A3PICs Electronics Development GmbH, Austria
♦ High data rate lens-free free-space communication using an optoelectronic integrated true light-to-logic BiCMOS receiver demonstrates a cheap and easy single-chip solution for flexible wireless gigabit interconnects

P4.14:
Pre-compensation for the Effects of Cascaded Optical Filtering on 10 Gsymbol/s DPSK and DQPSK Signals
Ying Jiang, Xuefeng Tang, John C Cartledge, Queen's University, Canada; Kim Roberts Nortel Networks, Canada
♦ The effects of cascaded optical filtering on 10 Gsymbol/s DPSK and DQPSK signals are mitigated by pre-compensation based on the use of digital signal processing to generate the drive signals for a dual-parallel Mach-Zehnder modulator.

P4.15:
Electronic Equalization of Polarization Mode Dispersion in Coherent POL-MUX QPSK Systems
Nikolaos Mantzoukis, Constantinos S Petrou, Athanasios Vgenis, Ioannis Roudas, University of Patras, Greece; Thomas Kamalakis, University of Athens, Greece
♦ We present a comparison of adaptive electronic PMD equalizers for coherent phase- and polarization-diversity QPSK receivers using the multicanonical Monte Carlo method. A 5-tap equalizer using the CMA sufficiently reduces the outage probability below 10-5.

P4.16:
Spectrally Efficient Direct-Detected Optical OFDM Transmission Using Carrier-Data Timely Multiplexing Technique
Wei-Ren Peng, National Chiao Tung University, Taiwan
♦ We timely multiplex the carrier and data symbols for DD-OFDM that improves the spectral efficiency, receiving sensitivity, and tolerances to PMD and optical filtering effects, when compared with the previous DD-OFDM transmission. It also reduces the receiver's sampling rate.

P4.17:
Node Modules and Protocols for the Quantum-Back-Bone of a Quantum-Key-Distribution Network
Oliver Maurhart, Thomas Lorünser, Thomas Länger, Christoph Pacher, Momtchil Peev, Andreas Poppe, Austrian Research Centers GmbH - ARC, Austria
♦ The very recent demonstration of the SECOQC QKD-network convincingly extended single QKD-links to QKD-networks gaining new functionalities. The needed interfaces, protocols and node modules are explained.

P4.18:
Feasibility Study of Integrated Optical Phased Arrays for Indoor Gb/s Wireless Optical Links
Karel Van Acoleyen, Hendrik Rogier, Roel Baets, Ghent University - IMEC, Belgium
♦ Link budget calculations are performed to study the potential of integrated optical phased arrays for Gb/s wireless links. A link with two integrated OPAs is feasible with a beam steering range of a few degrees.

P4.19:
Faults and Recovery Methods in Regional Undersea OADM Networks
Alexey Turukhin, Adnan Akhtar, Georg Mohs, Ekaterina Golovchenko, Tyco Telecommunications, USA
♦ An experimental study of faults in an important class of undersea OADM networks demonstrates that channel performance through surviving segments can be recovered by the terminal-based procedures enabled by a fault resilient network design.

P4.20:
Experimental Verification of the Dispersion Tolerance Improvement of Partial DPSK with Optimised Filtering.
Pablo Moreno-Gomez, Donald S Govan, University of Wales Swansea, United Kingdom; Nick Doran, IAT, Swansea University, United Kingdom
♦ We experimentally confirm the optimum combination of modulator delay and filter bandwidth to maximize the dispersion tolerance of partial DPSK.

P4.21:
Realization of Optical OFDM Using Time Lenses and Its Comparison with Conventional OFDM for Fiber-optic Systems
Dong Yang, McMaster University, Canada
♦ It is proposed to use Fourier transforms in optical domain using time lenses both at transmitter and at receiver to realize optical OFDM. Results show that coherent OFDM systems have higher nonlinear tolerance than direct detection OFDM.

P4.22:
Experimental Characterisation of the Impact of Neighbouring Modulation-Formats on 42.7Gb/s P-DPSK over SSMF and LEAF
Marc Stephens, Michal Dlubek, Ian Phillips, Alan Squires, Darren Cox, Ian Riggs, Nick Pike, Hayden Fews, Liam Gleeson, Ericsson Ltd., United Kingdom
♦ We experimentally characterise the impact of differing 50GHz neighbouring modulation formats and bit rates on the performance of 43Gb/s P-DPSK over 1300km of SSMF and LEAF fibre types. Performance is shown to be robust for hybrid P-DPSK and OOK systems.

P4.23:
Polarization-Multiplexed Multilevel LDPC-Coded Modulation for Optical Communication Systems
Lyubomir L Minkov, Ivan B. Djordjevic, University of Arizona, USA; Lei Xu, Ting Wang, NEC Laboratories America, Inc., USA
♦ Polarization-multiplexed coded-modulation, with joint coherent MAP detection and soft-iterative decoding, which considers independent symbols transmitted over both polarizations as a super-symbol is proposed. Penalty of only 1.5 dB at 20 Gb/s for DGD of 100 ps is reported.

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Central Lobby

Poster Session 5

P5.01:
Scalability Study of a Prototype 640Gbit/s/port Optical Packet Switch for Network Applications
Szilárd Zsigmond, Budapest University of Technology and Economics, Hungary; Hideaki Furukawa, Naoya Wada, Tetsuya Miyazaki, NICT, Japan
♦ We investigate the scalability of a prototype 640Gbit/s/port optical packet switched system. Based on the expected new component parameters by extensive simulations a scalability of 8 nodes is demonstrated for the worst case scenario.

P5.02:
A Novel Optical Encoding Scheme for Network Node Tracing in All-Optical Reconfigurable Wavelength Routing Networks
Kam Hon Tse, Chun-Kit Chan, The Chinese University of Hong Kong, Hong Kong
♦ An optical prime-number-encoded tag is employed as distinct network node identifier so as to realize network node tracing in reconfigurable wavelength routing networks, via prime number multiplication. Possible network looping problem can also be identified.

P5.03:
A Novel Scheme to Integrate All-optical Burst Amplification and Cloning/multicasting in OBS Node
Xiaoyuan Cao, Xiaobin Hong, Jian Wu, Hongxiang Guo, Kun Xu, Jintong Lin, Yong Zuo, Yan Li, Beijing University of Posts and Telecommunications, P.R. China
♦ A novel scheme that integrates suppression of transients for burst amplification and generation of cloned bursts all-optically is proposed and demonstrated experimentally. Impacts of control power and burst parameters are investigated while results are optimized.

P5.04:
Analysis of Static Versus Fully-Dynamic Routing in IP/GMPLS over WDM Optical Networks with Physical-Layer Impairment Constraints
Stephan Pachnicke, Nicolas Luck, Peter Krummrich, TU Dortmund, Germany; Gokhan Sahin, Jens Mueller, Gregory Reese, Miami University, USA
♦ We investigate static and dynamic routing approaches in overlay IP/GMPLS over optical networks. Dynamic operation for full-wavelength services benefits from physical-layer impairment aware routing whereas static routing with sub-wavelength granularity demands relaxes transparent reach requirements.

P5.05:
Experiment of Transport and Control Protocols in Control-plane Integrated Next Generation Wide Area Layer2 Network
Daisuke Ishii, Kou Kikuta, Satoru Okamoto, Naoaki Yamanaka, Keio University, Japan
♦ This paper presents experimental results of GMPLS controlled Next Generation Layer2 NGL2 networks. By experiment, it is confirmed that NGL2 paths can be established dynamically and correctly by the extended GMPLS for NGL2.

P5.06:
Multicast Protection in WDM Optical Networks with Scheduled Traffic
Shuqiang Zhang, Chun-Kit Chan, The Chinese University of Hong Kong, Hong Kong
♦ We formulate and investigate the multicast tree protection in WDM optical networks with scheduled traffic. By optimizing the network resources jointly in space and time, survivable multicast sessions can be provisioned at much lower costs.

P5.07:
Weight-based Algorithm for Demand Aggregation in SONET/DWDM Networks
Xi Wang, Qiong Zhang, Paparao Palacharla, Takao Naito, Fujitsu Laboratories of America, USA
♦ A weight-based heuristic algorithm was developed to efficiently aggregate UPSR demands into SONET rings over DWDM networks in order to minimize the total number of optical line cards for a given set of demands.

P5.08:
Why Traffic Engineering Does Not Work for Physical Impairments Based Routing
Péter Balázs Soproni, Tibor Cinkler, Budapest University of Technology and Economics, Hungary
♦ In all optical routing the main question is the permissible distance. Signal power is a key resource. The most common idea of resource balancing is Traffic Engineering. We will show with examples and simulations why TE is not suitable here.

P5.09:
Experimental Investigation of High Definition Video Clips HDVC Streaming over OBS Networks
Wenjia Zhang, Xiaobin Hong, Yawei Yin, Hongmei Jiang, Lei Liu, Hongxiang Guo, Jian Wu, Jintong Lin, Beijing University of Posts and Telecommunications, P.R. China
♦ This paper experimentally investigates the impact of burst aggregation and contention on HDVC streaming over OBS testbed. Novel scheme is proposed and demonstrated to guarantee excellent performance of HDVC transmission

P5.10:
Plug and Play Techniques for Optical Network Configuration
Kaori Shimizu, Rie Hayashi, Ichiro Inoue, Kohei Shiomoto, NTT, Japan
♦ This paper proposes plug and play techniques for optical network configuration. The techniques can reduce the manual operation labor needed to commence services and simplifies management activities. Evaluation results in a real network are reported.

P5.11:
Evaluation of Recovery Methods for Layer-1 Bandwidth on Demand Service
Kaori Shimizu, Shigeo Urushidani, Rie Hayashi, Ichiro Inoue, Kohei Shiomoto, Kensuke Fukuda, Michihiro Koibuchi, Shunji Abe, Yusheng Ji, Motonori Nakamura, Shigeki Yamada, National Institute of Informatics, Japan
♦ This paper proposes and evaluates recovery methods for high-availability layer-1 BoD service. It also proposes a segment recovery architecture that hides the recovery operation from the users' view. Evaluations in an experimental environment are reported.

P5.12:
Power-Aware Routing and Wavelength Assignment in Optical Networks
Yong Wu, Luca Chiaraviglio, Marco Mellia, Fabio Neri, Politecnico di Torino, Italy
♦ We introduce the Power-Aware RWA problem, whose goal is to accommodate lightpaths in wavelength routing networks minimizing the power consumption. Formulation, algorithms, and results are presented, showing that significant power savings are possible.

P5.13:
Impairment Aware Routing and End-to-End Compensation in WSON
Xuping Cao, Jie Zhang, Guanjun Gao, Xiuzhong Chen, Dahai Han, Wanyi Gu, Yuefeng Ji, Beijing University of Posts and Telecommunications, P.R. China; Cheng Xiaofei, Institute for Infocomm Research, Singapore
♦ We experimentally investigate impairment aware routing and end-to-end compensation in a WSON testbed. The extended control plane modules for QoT optimization and two compensation control strategies are realized and verified in terms of optical power adaptive adjustment.

P5.14:
Management and Control Scheme Employing Wavelength-Grouped Transmission-Guaranteed Link for Highly-Manageable and Cost-Efficient Transparent Optical Mesh Networks
Yoshiaki Sone, Akihiro Kadohata, Atsushi Watanabe, Wataru Imajuku, Masahiko Jinno, Akio Sahara, NTT Network Innovation Laboratories, Japan; Kazuhiro Matsuda, Tetsuo Takahashi, Shinji MAtsuoka, NTT Corporation, Japan; Atsuhiro Suzuki, NTT East corporation, Japan; Hideyuki Tokuda, Keio University, Japan
♦ This paper proposes a GMPLS-based management and control scheme that visualizes the route and available resources considering optical reachability and wavelength assignment in transparent-optical-mesh networks. The proposed scheme is demonstrated using a field network.

P5.15:
Efficient Routing Algorithms for Hierarchical ASON
Pei Luo, Shanguo Huang, Lian Hua, Bingli Guo, Beijing University of Posts and Telecommunications, P.R. China; Wanyi Gu Key, Laboratory of Optical Communication and Lightwave Technologies, Ministry of Education, Beijing U, P.R. China
♦ Three operational routing algorithms for hierarchical Automatically Switched Optical Networks ASON are proposed. Their effectiveness is demonstrated in terms of blocking probability and time performance on the simulation platform developed.

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Central Lobby

Poster Session 5

P5.16:
Successful Demonstration of the Compatibility of Optical Packet and Wavelength Circuit Switching in Optical Networks
Dominique Chiaroni, Gema Buforn, Christian Simonneau, Jean-Christophe Antona, Jesse Edward Simsarian, Etienne Sophie, Alcatel-Lucent Bell Labs France, France
♦ We demonstrate the compatibility of optical packet switching and wavelength circuit switching in a system using fast tunable lasers. Optical gating is shown as a necessary function to remove spurious signals during wavelength switching

P5.17:
Scalability Analysis and Evaluation of the Multi-domain, Optical Network Service Plane in Harmony
Joan A. Garcia-Espin, Sergi Figuerola, Jordi Ferrer Riera, Fundació i2CAT, Internet i Innovació Digital a Catalunya, Spain; Alexander Willner, University of Bonn, Germany
♦ Performance study of successful responses to incremental and poison requests for the Harmony system, a multi-domain distributed Optical Network Service Plane capable of providing end-to-end advance provisioning services by means of a resource brokering system

Central Lobby

Poster Session 6

P6.01:
3.125 Gb/s Impulse Radio UWB over Fiber Transmission
Timothy B Gibbon, Xianbin Yu, Neil Guerrero Gonzalez, Idelfonso Tafur, Monroy Technical University of Denmark, Denmark; Romeo R, G Gamatham, Nelson Mandela Metropolitan University, South Africa
♦ We demonstrate 3.125 Gb/s photonic impulse radio UWB generation using an uncooled distributed feedback laser. After 50km fiber transmission the signal is recovered without errors using a digital signal processing receiver.

P6.02:
New Optical Fibre Line Testing System Function for Facility Location and Identification Using Multivalued Brillouin Frequency Shift Assigned Fibre
Nazuki Honda, Masaaki Inoue, Noriyuki Araki, Yuji Azuma, NTT Corp., Japan
♦ We propose a new optical fibre line testing system function for locating and identifying facilities in optical fibre networks with high accuracy by using 1 cm of multivalued Brillouin frequency shift assigned fibre.

P6.03:
Simultaneous Broadband Wired/Millimeter-Wave Band Transmission with Broadcasting Signal Using Direct ASE Modulation of an RSOA for WDM/SCM-PON Systems
Moon-Ki Hong, Hyun-Seung Kim, Won Yong-Yuk, Han Sang-Kook, Dept. of Electrical and Electronic Engineering, Yonsei University, Seoul, Korea
♦ A novel scheme of simultaneous-broadband-data-transmission for both wired-and millimeter-wave-band with broadcasting signal is proposed based on a directly modulated amplified-spontaneous-emission using a reflective-semiconductor-optical-amplifier. Both baseband and 60-GHz band transmissions of 622Mbps data with broadcasting of 5-Msps-16QAM signal were experimentally demonstrated.

P6.04:
A UWB over Fibre Transmitter Reconfigurable for Multiple Modulation Schemes
Shilong Pan, Jianping Yao, University of Ottawa, Canada
♦ A UWB over fiber transmitter that can be reconfigured to implement pulse-polarity modulation, pulse-shape modulation, pulse-amplitude modulation and on-off keying modulation is proposed and demonstrated, with the performance evaluated by bit-error-rate measurement.

P6.05:
Broadcast Capable 40-Gb/s WDM Passive Optical Networks
Zhaowen Xu, Tee Hiang Cheng, Nanyang Technological University, Singapore; Cheng Xiaofei, Yong kee Yeo, Yixin Wang, Weifeng Rong, Institute for Infocomm Research, Singapore; Yang Jing Wen, Huawei USA, USA
♦ A novel architecture for broadcast capable high-speed WDM-PONs is proposed. 40-Gb/s downlink and 10-Gb/s broadcast are demonstrated to transmit simultaneously on the same set of wavelength channels. A colourless 40-Gb/s uplink transmission is also demonstrated with an EAM.

P6.06:
A 82.5-GSample/s 10.3125-GHz x 8 phase-shifted clocks sampling IC for 10G-EPON burst-mode CDR
Naoki Suzuki, Mitsubishi Electric Corporation, Japan
♦ New very high-speed 82.5-GS/s sampling IC and its incorporated burst-mode CDR compliant for 10G-EPON is presented. The 82.5-GS/s CDR successfully achieved a high pulse-width distortion tolerance of +/-0.53UI under distorted burst packets received condition of BER=1E-3.

P6.07:
Novel Optical Fiber Identification Method for PONs Based on Polarization Modulation Caused by Pressure-Induced Retardation
Koji Enbutsu, Noriyuki Araki, Nazuki Honda, Yuji Azuma, NTT Corporation, Japan
♦ We proposed a new technique for identifying fibers in PONs using polarization-modulation caused by a transverse force. We demonstrate our method using conventional and bend-insensitive fibers in a branched region below optical splitters.

P6.08:
Dynamic Range in Hybrid DWDM/TDMA PON
Martin Bouda, Takao Naito, Fujitsu Laboratories of America, USA
♦ We studied four-wave mixing in hybrid DWDM-TDMA PON operating in the 1.3μm band experimentally and show feasibility of 15dB dynamic range at 50GHz channel spacing with 28 channels without, and 7 channels with backhaul fibre.

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

P6.09:
Long Reach and Enhanced Power Budget DWDM Radio-over-Fibre Link Supported by Raman Amplification and Coherent Detection
Antonio Caballero Jambrina, Darko Zibar, Fotonik DTU, Denmark; Neil Guerrero Gonzalez, Idelfonso Tafur, Monroy Technical University of Denmark, Denmark; Ferney Amaya, GIDATI Research Group, Colombia; DTU Fotonik, department of Photonic Engineering, Technical University of Denmark, Denmark
♦ We report on a scalable and enhanced power budget radio-over-fibre system for hybrid-wireless access networks operating at 12.5 GHz DWDM spacing for 5 GHz RF carriers over a 60 km fibre link with Raman amplification.

P6.10:
Short Reach Radio over Polymer Fibre Links
Fan Yang, Michael J Crisp, Ke Fang, Richard Penty, Ian White, University of Cambridge, United Kingdom
♦ Successful transmission of IEEE 802.11g signals at 2.412GHz over 50m of low cost 1mm core graded index PMMA optical fibre is demonstrated.

P6.11:
Effect of PDL in WDM-PON Based on ASE Seeded RSOA
Jung-Hyung Moon, Sil-Gu Mun, Chang-Hee Lee, Korea Advanced Institute of Science and Technology, Korea
♦ We investigate the effect of polarisation dependent loss PDL in wavelength division multiplexing-passive optical network WDM-PON with injection seeded reflective semiconductor optical amplifier RSOA). The PDL can give a serious penalty on the system performance.

P6.12:
TCP Friendly Active Optical Access Network Having Automatic Ranging and Slot Allocation Function
Kunitaka Ashizawa, Kazumasa Tokuhashi, Daisuke Ishii, Naoaki Yamanaka, Keio University, Japan; Yutaka Arakawa, Kyushu University, Japan
♦ A new optical access network using high-speed PLZT optical switch is presented. The access network, having automatic ranging and slot allocation fuction, can guarantee TCP throughput designing with frame cycle, slot size and guard time.

P6.13:
A Novel Optical Access Network Architecture Supporting Seamless Integration of RoF and OFDMA Signals
Lin Yu-Min, Optical Communications & Networking Technologies Department, ICRL/ITRI, Taiwan, Taiwan; Po L. Tien, Maria C. Yuang, Steven S. W. Lee, Jyehong Chen, Shing-Yu Chen, Yi-Min Huang, Julin Shih, National Chung Cheng University, Taiwan; Chih-Hung Hsu Industrial Technology Research Institute, Taiwan
♦ We present a novel PON architecture supporting RoF and OFDMA signal integration without WDM lasers, and demonstrate 10-Gb/s OFDMA and three RF signals at 2.1GHz are successfully transmitted over 20km SMF in a 32-ONU PON.

P6.14:
A Novel Multicast Overlay Scheme for WDM Passive Optical Networks using Optical Carrier Suppression Technique
Yang Qiu, Chun-Kit Chan, The Chinese University of Hong Kong, Hong Kong
♦ A WDM-PON with simultaneous delivery of 10-Gb/s downstream unicast and upstream data as well as 10-Gb/s multicast data is proposed. Downstream multicast data is superimposed onto the subcarrier generated by optical carrier suppression technique.

P6.15:
Optimisation of In-Building Optical Networks
Ton Koonen, COBRA, Eindhoven Univ. of Technology, The Netherlands; Anna Pizzinat, Philippe Guignard, France Telecom Research and Development, France; Hyun-Do Jung, Eduward Tangdiongga; Henrie van den Boom, Eindhoven University of Technology, The Netherlands
♦ A single in-building optical fibre network can efficiently deliver wired and wireless services. Point-to-point architectures using POF are attractive for small buildings; for large buildings SMF-based all-optical bus architectures using weighted tap couplers are preferable.

P6.16:
Performance Assessment of Flexible Time-Wavelength Routing for a Self-aggregating Transparent Metro-Access Interface
Marcin Więckowski; Jaroslaw Turkiewicz, Warsaw University of Technology, Poland; Alexey Osadchiy; Idelfonso Tafur, Monroy Technical University of Denmark, Denmark
♦ A time-WDM architecture with on-the-fly wavelength routing and traffic self-aggregation is proposed. Metro-accesss ligthpaths are established using ONUs with reflective modulators. Simulations results show the advantages of the proposed architecture over WDM-PONs

P6.17:
Very low power of <7mW/Gbps, 1060-nm 120-Gbps optical link employing high-density optical modules
Hideyuki Nasu, The Furukawa Electric Co., Ltd., Japan
♦ We demonstrate a very low power consumption of <7mW/Gbps on 120-Gbps optical link using high-density parallel-optical modules, by suppressing driving currents and voltages of high efficient 1060-nm VCSEL array

P6.18:
Transparent Radio-over-Multimode Fiber Transmission System with Novel Transceiver for Picocellular Infrastructures
Ingo Möllers, Dieter Jäger, Universität Duisburg-Essen, Germany
♦ A characterization of a Radio-over-Multimode fiber link using a novel reflective electro-optic transceiver for bidirectional transmission over a single fiber is presented. EVM measurements show that the requirements for multiple-standard wireless signals have been fulfilled.

P6.19:
C+L Band Remote Node for Amplification in Extended Reach Full-Duplex 10Gb/s WDM/TDM Passive Optical Networks
Bernhard Schrenk, Technical University of Catalonia, Spain; Sotiria Chatzi, Francesc Bonada, Jose A Lazaro, Josep Prat, Universitat Politécnica de Catalunya, Spain; Dimitrios Klonidis; Ioannis Tomkos, AIT, Greece
♦ A remote node design for C+L band amplification is shown to cover the advanced optical power budget for a 50km reach, symmetrical 10G/10G WDM/TDM-PON. 5-10dB of margin is left despite OSNR degradation.

P6.20:
Network Coding in Passive Optical Networks
Martin Belzner, Herbert Haunstein, University of Erlangen-Nuremberg, Germany
♦ The application of network coding in passive optical networks is shown to provide benefits in intra-PON communication scenarios with respect to reducing the packet loss ratio and queuing delay in case of congestion.

P6.21:
SOA or EDFA Amplifying 10Gbit/s OFDM Signals for Access Networks
Fabienne Saliou, Alcatel Thales III-V Lab, France; Philippe Chanclou, France Telecom R&D, France; Benoit Charbonnier, Thanh Nga Duong, Naveena Genay, Ahmed Gharba, Chloé Milion, Meryem Ouzzif, Orange Labs, France
♦ An OFDM transmission system is amplified through SOA or EDFA to provide an access network at 10Gbit/s with increased optical budgets. Bit-rate optimization and BER measurement characterize amplifier's behaviour with OFDM signals for access network.

P6.22:
Generation and Transmission of FCC-Compliant Impulse Radio Ultra Wideband Signals over 100-m GI-POF
S Abraha, Hejie Yang, Ton Koonen, COBRA Research Institute, Eindhoven University of Technology, The Netherlands; Eduward Tangdiongga, Eindhoven University of Technology, The Netherlands
♦ We demonstrate a novel technique for generation and transmission of IR-UWB signals over 100 metres 50 micrometres core GI-POF. IR-UWB pulses are made by linearly combining two 3rd-order derivatives of Gaussian pulses with different pulse-shaping factors.

P6.23:
Passive OADM Network Element for Hybrid Ring-Tree WDM/TDM-PON
Josep Prat, Jose A Lazaro, Universitat Politècnica de Catalunya UPC, Spain; Philippe Chanclou, France Telecom R&D, France; Sergio Cascelli, Italian Ministry of the Economic Development - Communications, Italy
♦ The operation of a ring-tree WDM/TDM-PON and the enabling OADMs remote nodes performing the hybrid interface are described and specified, validating the capacity and functionality of the NGPON architecture.

P6.24:
Gain Transient Mitigation in Remote Erbium Doped Fibre Amplifiers by Burst Packet Carving at the ONU for Extended Power Budget PONs
Francesc Bonada Bo, Jose A Lazaro, Victor Polo, Josep Prat, Universitat Politècnica de Catalunya, Spain; Bernhard Schrenk, Technical University of Catalonia, Spain; Philippe Chanclou, France Telecom R&D, France
♦ We present a new approach to mitigate the gain transients in remote Erbium Doped Fibre Amplifiers by means of pre-distortion of data packets at the ONU, allowing a strong reduction 30% of the packet overshoot.

Wednesday, September 23, 2009 · 16:45 - 18:30

Central Lobby

Poster Session 6

P6.25:
Lightwave Centralized WDM-PON System at Symmetric Rate of 10Gbit/s Employing Cost-effective Directly Modulated Laser
Ming-Fang Huang, Georgia Tech, USA; Jianjun Yu, NEC Labs America, USA; Gee-Kung Chang, Georia Tech, ?
♦ We demonstrate the first lightwave-centralized WDM-PON operating at symmetric rate of 10Gbit/s using cost-effective directly modulated lasers to generate downstream and provide upstream OOK/OFDM-QPSK signals using a re-modulation scheme by an intensity modulator.

P6.26:
SSB NRZ and SSB Manchester Downstream Signals for Remodulated Extended Reach WDM-TDM PONs
Natasa Pavlovic, Liliana Costa, Instituto de Telecomunicações, Portugal; Antonio Teixeira, University of Aveiro, Portugal
♦ Experimental demonstration of intensity-modulated IM remodulation by IM single-sideband SSB non-return-to-zero and SSB Manchester formats is shown in wavelength division multiplexing bidirectional transmission passive optical network and the extended reach is demonstrated with low penalty.

P6.27:
ONU Optimal Gain and Position of the Distribution Element in Rayleigh-limited WDM and TDM PONs with reflective ONU
Eduardo Tommy López-Pastor, Jose A Lazaro, Victor Polo, Josep Prat, Universitat Politècnica de Catalunya, Spain; Cristina Arellano, VPI system, Germany
♦ The influence of the distribution element position in PONs is reported. Best Crosstalk-to-Signal ratio C/S is achieved if it is placed either in the ONU or OLT vicinity with optimum ONU gain depending of the MUX position.

P6.28:
A New Architecture and MAC Protocol for Fully Flexible Hybrid WDM/TDM PON
Goutam Das, Bart Lannoo, Didier Colle, Mario Pickavet, Piet Demeester, University of Ghent, Belgium; Hyun-Do Jung, Eindhoven University of Technology, The Netherlands; Ton Koonen, COBRA, Eindhoven Univ. of Technology, The Netherlands
♦ In this paper we propose a novel architecture and MAC protocol for a scalable, cost effective WDM/TDM PON providing fully flexible dynamic bandwidth allocation for upstream and downstream data transmission.

P6.29:
First Demonstration of A Fast Response/Locking Burst-mode Physical-layer Chipset for Emerging 10G PON Standards
Frank Chang, Vitesse, USA
♦ This paper reviews system-level requirements and challenges for next-generation coexistence 10G PON, and demonstrates for the first time a fast response/locking burst-mode physical-layer chipset to operate at various worst-case conditions for either IEEE 10G EPON or FSAN/ITU 10G NG-PON standards.

P6.30:
Mitigation of Laser Linewidth induced AM-PM Noise using Optical Phase Conjugation in OSSB Radio over Fiber Systems
Esakki Muthu K, Sant Sharan Pathak, Nirmal Chakrabarti, Indian Institute of Technology Kharagpur, India
♦ Transmitter laser linewidth is an important parameter which enhances the relative intensity noise of the system and hence limits the bit error rate. We demonstrate use of Optical Phase Conjugation technique can mitigate laser linewidth induced RIN

Notes:

20:00 - 23:00 Gala Dinner (Vienna Konzerthaus)

Room: Hall E1

9.1: Nonlinear Processing in Fibres

Chairs: Christian Schaeffer, Helmut Schmidt University, Germany

9:00 9.1.1
Continuously Tuneable 40-Gb/s Parametric 1.56- Delay
Evgeny Myslivets, Nikola Alic, Slaven Moro, Bill Ping Piu Kuo, Stojan Radic, University of California San Diego, USA; Robert M. Jopson, Alan H. Gnauck, Colin McKinstrie, Alcatel-Lucent, Bell Laboratories, USA; Magnus Karlsson Chalmers, University of Technology, Sweden
♦ We experimentally demonstrate an all-optical continuously tunable delay line with a record delay-bitrate product of 62400 and characterize the delay performance using a 40-Gb/s signal.

9:15 9.1.2
Nearly octave-spanning cascaded four-wave-mixing generation in low dispersion highly nonlinear fiber
Jose M Chavez Boggio, Slaven Moro, Nikola Alic, Stojan Radic, University of California, San diego, USA; Magnus Karlsson Chalmers, University of Technology, Sweden; Joss Bland-Hawthorn, University of Sidney, Australia
♦ Efficient generation of cascaded four-wave mixing using a dispersion flattened optical fiber is reported. The measured optical frequency comb with 300GHz spacing spans over 900nm.

9:30 9.1.3
Four-wave mixing-based wavelength conversion in a Short-Length of a Solid 1D Microstructured Fibre
Angela Camerlingo, Francesca Parmigiani, Xian Feng, Francesco Poletti, Peter Horak, Wei Loh, David J Richardson, Periklis Petropoulos, ORC, University of Southampton, United Kingdom
♦ We demonstrate a four-wave mixing based wavelength m in a 1.5m long highly nonlinear, dispersion tailored conversion scheme at 1.55 one-dimensional 1D soft glass microstructured optical fibre.

9:45 9.1.4
FWM-based All-Optical Phase Drop for Format Conversion from 320-Gb/s RZ-DQPSK to 160-Gb/s RZ-DPSK
Guo-Wei Lu, Tetsuya Miyazaki, National Institute of Information and Communications Technology NICT, Japan, Japan
♦ We experimentally demonstrated format conversion from 320-Gb/s RZ-DQPSK to 160-Gb/s RZ-DPSK through the proposed all-optical phase drop scheme. It can be applied to drop a binary tributary from a multilevel modulation format.

10:00 9.1.5
Amplitude Limiting of Time-Interleaved Multi-Wavelength Optical Signals Using Saturation of Four-Wave Mixing in a Fiber
Saori Tanabe, Masayuki Matsumoto, Osaka University, Japan
♦ Simultaneous noise suppression of time-interleaved three-wavelength optical signals using saturation of four-wave mixing in a fiber is reported. Nonlinear phase noise reduction of three-wavelength DPSK signals is demonstrated using the phase-preserving amplitude equalization.

10:15 9.1.6
Fiber-Based Nonlinear Processing of Optical Signals (Invited)
Robert M. Jopson, Alcatel-Lucent, Bell Laboratories, USA
♦ Optical processing in fiber has enabled recent advances such as large, tuneable signal delays, the shifting of signals to mid-IR wavelengths, and the creation of specific quantum states useful in sensing, imaging, and communication applications.

Room: Hall E2

9.2: Photodetectors and Receivers

Chair: Christopher R Doerr, Bell Labs, Alcatel-Lucent, USA

9:00 9.2.1
A 25-Gb/s, 2.8-mW/Gb/s Low Power CMOS Optical Receiver
Takashi Takemoto, Fumio Yuuki, Hiroki Yamashita, Takuma Banm, Masashi Kono, Yong Lee, Tetsuya Saito, Shinji Tsuji, Hitachi, Ltd., Japan; Shinji Nishimura, Central Research Lab., Hitachi. Ltd., Japan
♦ We demonstrate a high speed 25-Gb/s and low power 2.8-mW/Gb/s operation of a CMOS receiver for 100-Gb/s Ethernet, consisting of a novel transimpedance amplifier based on 65-nm CMOS technology and a back-illuminated PIN-PD.

9:15 9.2.2
Very Low Dark Current AlInAs/GaInAs SAGM Avalanche Photodiodes for 10Gb/s applications
Majda Lahrichi, Estelle Derouin, Danièle Carpentier, Nadine Lagay, Jean Decobert, Geneviève Glastre, Mohand Achouche, Alcatel-Thales III-V Lab, France
♦ We report a planar AlInAs/GaInAs APD presenting simultaneously the lowest multiplied dark current ever reported IdM=0.19nA), a responsivity of 0.9A/W at M=1), a very low noise F(M=10)=3.3), and a high gainxbandwidth 150GHz).

9:30 9.2.3
Ge on Si p-i-n Photodiodes for a Bit Rate of up to 25 Gbit/s
Sandra Klinger, Markus Groezing, Wissem Sfar Zaoui, Manfred Berroth, Mathias Kaschel, Michael Oehme, Erich Kasper, Joerg Schulze, University of Stuttgart, Germany
♦ Ge on Si p-i-n photodiodes are characterized in the time domain at 1550 nm. The photodiode output signal is sampled by a flip flop. At a bit rate of 25 Gbit/s, the BER is smaller than 10^-12.

9:45 9.2.4
Highly Linear, High Power Handling Photodiode for RF Photonic Links
Abhay Joshi, Shubhashish Datta, Discovery Semiconductors Inc., USA
♦ We report a highly linear, high power handling InGaAs photodiode having a third order harmonic output intercept point of +53.7 dBm and an estimated OIP3 of +48.9 dBm up to 40 mA DC photocurrent.

10:00 9.2.5
High Linearity and High Responsivity UTC Photodiode for Multi-Level Formats Applications
Christophe Caillaud, Geneviève Glastre, Danièle Carpentier, Francois Lelarge, Benjamin Rousseau, Fabrice Blache, Mohand Achouche, Alcatel-Thales III-V Lab, France
♦ We present an evanescent waveguide InGaAs/InGaAsP UTC PD with respectively a bandwidth > 50 GHz, a responsivity of 0.55A/W and an IP3 of 19.7 dBm at 10 mA and 20 GHz.

10:15 9.2.6
Hybrid Co-Packaged Receiver Module with pin-Photodiode Chip and DEMUX-IC for 107 Gb/s Data Rates
G. Giorgis Mekonnen, Reinhard Kunkel, Colja Schubert, Detlef Pech, Thomas Rosin, Fraunhofer Institute for Telecommunications/Heinrich-Hertz-Institut, Germany; Heinz-Gunter Bach, Fraunhofer-Institut fuer Nachrichtentechnik, Germany; Agnieszka Konczykowska, Filipe Jorge, André Scavennec, Muriel Riet Alcatel Thales, III-V Lab, joint la: Bell Labs and Thales Research and Technology, France
♦ A hybrid co-packaged receiver with pin-photodetector and DEMUX-IC for 107 Gb/s is presented. Well opened demultiplexed eye diagrams at 53.5 Gb/s for 107 Gb/s input and error-free demultiplexing performance at PRBS31 were demonstrated.

10:30 9.2.7
Investigation of DGD and Delay-Line Interferometer Phase Tolerance of Integrated Receiver Module for 86 Gb/s NRZ-DQPSK modulation
Mads Nielsen, Andreas Gerhard Steffan, Georgios Tsianos, Günter Unterbörsch, Andreas Umbach, u2t Photonics AG, Germany; Reinhold Ludwig Fraunhofer Heinrich-Hertz-Institut, Germany; Aurelien Boutin, Ludovic Fulop, Frederic Verluise, Kylia, France
♦ We investigate the performance of a free-space DLI integrated receiver for 43 Gbaud/s NRZ-DQPSK. The DGD tolerance 1dB penalty is quantified at 47% of the baudrate, and the DLI phase tolerance 1dB penalty at +/-5deg, far exceeding the PDFS

10:45 - 11:15 Coffee break (will be served in the Main Lobby)

Room: Hall F1

9.3: Performance Monitoring

Chair: Jean-Pierre Hamaide, Alcatel-Lucent Bell Labs, France

9:00 9.3.1
In-service Monitoring of PMD Induced Optical Signal Degradation Using SOP Vector Trajectory on the Poincare Sphere for High-Speed Reconfigurable Optical Networks
Hitoshi Takeshita, Satomi Shioiri, Emmanuel Le Taillandier de Gabory, NEC Corporation, Japan; Kiyoshi Fukuchi, Principal Researcher, Japan
♦ We studied an in-service signal quality estimation method by using wavelength resolved SOP vector trajectories on Poincare Sphere and successfully distinguished PMD induced signal degradation with sufficient accuracy from the other signal degradation factors.

9:15 9.3.2
Complete Characterization of PMD Vector through Time-resolved Waveform Analysis Based on xy-field Sampling
Keiji Okamoto, NTT, Japan; Fumihiko Ito, NTT Access Network Service Systems Laboratories, NTT Corporation, Japan
♦ We develop a method for characterizing PMD vector including high-order components through temporal waveform analysis based on xy-field sampling. Simultaneous monitoring of PMD vector and eye diagram of ultrafast RZ-OOK signals is demonstrated.

9:30 9.3.3
Optical Performance Monitoring for Intelligent Optical Networks (Invited)
Trevor Anderson, Monitoring Division Inc, Australia
♦ Optical Performance Monitoring is a key enabler for fully reconfigurable and transparent optical networks. In this paper we review the technologies and challenges for monitoring 40G/100G networks with an emphasis on multi-impairment monitoring solutions.

10:00 9.3.4
Demonstration of Simultaneous OSNR and CD Monitoring using Asynchronous Delay Tap Sampling on an 800 km WDM Test Bed
Trevor Anderson, Dan Beaman, Olivier Jerphagnon, Monitoring Division Inc, Australia; Jonathan C Li, National ICT Australia, Australia; Esther Le Rouzic, Frederic Neddam, Suzanne Salaun, Orange Labs, France
♦ We demonstrate simultaneous monitoring of OSNR and CD using asynchronous delay-tap sampling on a commercial WDM system. Accuracies of 0.5 dB for OSNR and 30 ps/nm for CD was obtained in the presence of ROADMs.

Room: Hall H

9.4: Nonlinearity Mitigation in Coherent Systems

Chair: Sebastien Bigo, Alcatel-Lucent, France

9:00 9.4.1
System Benefits of Temporal Polarization Interleaving with 100Gb/s Coherent PDM-QPSK
Oriol Bertran-Pardo, Telecom Paristech ENST-Paris), France; Jérémie Renaudier, Gabriel Charlet, Massimiliano Salsi, Patrice Tran, Haïk Mardoyan, Clemens Koebele, Sebastien Bigo, Bell Labs, Alcatel-Lucent, France; Marco Bertolini, Università degli Studi di Parma, Italy
♦ We demonstrate, over a NZDSF link, that the system benefits provided by the temporal interleaving of polarization tributaries of 100Gb/s coherent RZ-PDM-QPSK data depend on the WDM system configuration

9:15 9.4.2
The Impact of DWDM Channel De-correlation Method in Optical PSK Coherent Transmission Experiment
Zhenning Tao, Weizhen Yan, Liang Dou, Lei Li, Fujitsu Research & Development Center Co.,LTD., P.R. China; Shoichiro Oda, Takeshi Hoshida, Jens C. Rasmussen, Fujitsu Laboratories Ltd., Japan
♦ In a DWDM PSK coherent experiment, the even/odd channel de-correlation overestimates XPM phase noise by two and underestimates its autocorrelation length by 40%, which suggests that enhanced de-correlation is necessary for accurate evaluation.

9:30 9.4.3
Dispersion Management in WDM Coherent PDM-QPSK Systems
Chongjin Xie, Bell Labs, Alcatel-Lucent, USA
♦ We show that dispersion management with DCF does not outperform electronic dispersion compensation for WDM coherent NRZ-PDM-QPSK systems, but for time-interleaved RZ-PDM-QPSK systems, dispersion management provides higher nonlinear tolerance than electronic dispersion compensation alone.

9:45 9.4.4
Experimental Comparison of Nonlinear Compensation in Long-Haul PDM-QPSK Transmission at 42.7 and 85.4 Gb/s
David Millar, Sergejs Makovejs, Robert I Killey, Vitaly Mikhailov, Polina Bayvel, Seb Savory, University College London, United Kingdom
♦ We compare the nonlinear limits of 42.7 and 85.4 Gb/s PDM-QPSK transmission. Intra-channel nonlinearity compensation is demonstrated, with increase of optimum launch power by 1dB and corresponding increase in maximum reach to 11635km and 8100km, respectively.

10:00 9.4.5
Systematic Analysis on Multi-Segment Dual-Polarisation Nonlinear Compensation in 112 Gb/s DP-QPSK Coherent Receiver
Takahito Tanimura, Takeshi Hoshida, Shoichiro Oda, Toshiki Tanaka, Chihiro Ohsima, Jens C. Rasmussen, Fujitsu Laboratories Ltd., Japan; Zhenning Tao, Fujitsu R&D Center Ltd., P.R. China
♦ Dependencies on segment number, dispersion map, and fibre launched power were investigated experimentally and numerically. Uncompensated 25span standard SMF link can enjoy net Q gain of 1.7dB with 25segment compensation.

10:15 9.4.6
Multi-staged Nonlinear Compensation in Coherent Receiver for 16,340-km Transmission of 111-Gb/s No-Guard-Interval Co-OFDM
Etsushi Yamazaki, Eiji Yoshida, Riichi Kudo, Koichi Ishihara, Munehiro Matsui, NTT Corporation, Japan; Hirohji Masuda, Akihide Sano, Toshihide Yoshimatsu, Yutaka Miyamoto, Yasushi Takatori, NTT Network Innovation Laboratories, Japan; Takayuki Kobayashi, NTT, Japan
♦ Evaluation of the back-propagation step size for SPM compensation in a coherent receiver shows that setting step size to the amplifier section length extends the distance of 111Gb/s transmission from 14,418 km to 16,340 km.

10:30 9.4.7
Experimental Demonstration of Nonlinear Electrical Equalizer to Mitigate Intra-channel Nonlinearities in Coherent QPSK Systems
Yan Gao, Fan Zhang, Juhao Li, Liang Liu, Zhangyuan Chen, Lixin Zhu, Li Li, Anshi Xu, Peking University, China, P.R. China
♦ We experimentally demonstrate the mitigation of intra-channel nonlinearities in 10GBaud coherent quadrature phase shift keying systems via nonlinear electrical equalizer based on Volterra theory. The performance of nonlinear transmission systems is significantly improved.

10:45 - 11:15 Coffee break (will be served in the Main Lobby)

Room: Hall G

9.5: Access Components and Subsystems

Chair: Russell Davey, BT., United Kingdom

9:00 9.5.1
Evolution of Optical Component Technologies for Access and Metro Networks (Invited)
Andy Carter, Oclaro, United Kingdom
♦ Progress and innovation in a number of technologies including optoelectronic integration are leading to components for highly cost effective wavelength agile 40Gbps transport and will increasingly start to shape the next generations of broadband access and access - metro convergence.

9:30 9.5.2
New RSOA Devices for Extended Reach and High Capacity Hybrid TDM/WDM -PON Networks
Guilhem de Valicourt, Romain Brenot, Alcatel-Thales III-V lab, France; Philippe Chanclou, France Telecom R&D, France
♦ We demonstrate that the use of a high gain reflective semiconductor optical amplifier as remote modulator enables 36 dB optical budget for colourless operation at 2.5 Gbit/s over 45 km single mode fiber.

9:45 9.5.3
Hybrid Electro-Optical Feedback Gain-Stabilized EDFAs
Heinz Krimmel, Thomas Pfeiffer, Bernhard Deppisch, Lothar Jentsch, Alcatel-Lucent Germany, Germany
♦ A novel EDFA gain stabilization technique is given for low-noise WDM upstream amplification in long-reach, high-split passive optical networks. Hybrid opto-electrical feedback avoids drawbacks from known optical feedback or pump-laser steering methods in access networks.

10:00 9.5.4
Operation of an Integrated DWDM Comb Source in a Reflection Modulated WDM-PON System
Amaia Legarrea, Derek Nesset, Kristan Farrow, Paul Wright, British Telecommunications PLC, United Kingdom; Richard Wyatt, Alistair Poustie, CIP, United Kingdom
♦ We present a compact DWDM optical comb source based on an integrated optical platform. Successful operation of the device in a 32-way, 50 km reach WDM-PON system using 1.25 Gbit/s reflective modulation is reported.

10:15 9.5.5
Study on ISI Mitigation Capability of MLSE Equalizers in RSOA-based 10Gbit/s WDM PON
Akira Agata, Yukio Horiuchi, KDDI R&D Laboratories Inc., Japan; Keun Yeong Cho, Yuichi Takushima, Yun C. Chung, KAIST, Korea
♦ Detailed performance analysis of MLSE receivers in RSOA-based 10Gbit/s WDM PON systems is presented. We found the impact of ISI from preceding bits could be larger than succeeding bits and 8-state MLSE would be sufficient.

10:30 9.5.6
Simplified Wavelength-Tunable DWDM Selector using Removable Driving Circuit for Coexistence-Type WDM-PON
Hiro Suzuki, Kiyomi Kumozaki, NTT, Japan; Masamichi Fujiwara, Naoto Yoshimoto, Hideaki Kimura, NTT Access Network Service Systems Laboratories, Japan
♦ This paper proposes a removable architecture for the wavelength-tunable DWDM-ONU in coexistence-type WDM-PONs. The performance of a 50-GHz-spaced DWDM selector based on a simple angle-tuned multilayer thin-film filter is evaluated and the applicability is discussed.

Room: Hall F2

9.6: Free-Space Optical Communications

Chair: Michel Joindot, FOTON-ENSSAT / University of Rennes 1 / CNRS, France

9:00 9.6.1
Tutorial: Free-space Laser Communications: Global Communications and Beyond
David Caplan, Mark Stevens, Bryan Robinson, MIT Lincoln Laboratory, USA
♦ Just as optical communications has become the dominant means of transporting information at high-rates through long-distance guided channels, it shows great promise to provide power-efficient wide-band capacity in the future free-space networks where RF technologies are presently the incumbent. Free-space laser communications has potential to surround the planet with flexible and agile high-speed connectivity that can extend to interplanetary distances. For these applications, power-efficient transceiver designs are essential for cost-effective implementation. State-of-the-art designs can leverage advances in optical technology that have led to fiber-optic networks with multiple Tbit/s capacities. While spectral efficiency is a key design parameter in the telecommunications industry, the many THz of excess channel bandwidth in the optical regime can be utilized to improve receiver sensitivities where photon efficiency is a design driver. This tutorial will discuss state-of-the-art optical transmitter and receiver designs that are particularly well-suited for photon-starved links in intersatellite and deep-space applications.

10:00 9.6.2
Sensitivity of Balanced Receivers for Polarization Shift Keying in Free-Space Optical Communications
Franz Fidler, Jasmin Grosinger, Walter Leeb, Vienna University of Technology, Austria
♦ Polarization modulation is a robust and efficient format for optical free-space communications. We study the sensitivity of real-world balanced receivers, including possible atmospheric effects on the state-of-polarization.

10:15 9.6.3
100 Gb/s Per-Channel Free-Space Optical Transmission with Coherent Detection and MIMO Processing
Neda Cvijetic, Dayou Qian, Jianjun Yu, Yue-Kai Huang, Ting Wang, NEC Laboratories America, Inc., USA
♦ We experimentally demonstrate the first 100 Gb/s per-channel free-space optical transmission using polarization-multiplexed QPSK, coherent detection, and MIMO processing. This is the highest per-channel FSO rate yet reported, highly-suitable for short-distance 100 Gb/s fiber backhaul.

10:30 9.6.4
125 Mbit/s over 5 m Wireless Distance by Use of OOK-Modulated Phosphorescent White LEDs
Jelena Vucic, Christoph Kottke, Kai Habel, Klaus-Dieter Langer, Fraunhofer Heinrich-Hertz Institut, Germany; Stefan Nerreter, Siemens AG, Germany; Andreas Buettner, TFH Berlin, Germany; Joachim W. Walewski, Siemens Corporate Technology, Germany
♦ We report a wireless visible-light link operating for the first time at 125 Mbit/s 50% beyond previous record over 5 m distance indoor by use of on-off-keying OOK), resulting in bit-error-ratios below 2·10^(-3).

10:45 - 11:15 Coffee break (will be served in the Main Lobby)

Room: Hall I

9.7: Symposium: Subsea Communications: Recent advances and Future Prospects (1) System Perspective

Chair: Stuart Walker, University of Essex, United Kingdom

9:05 9.7.1
Operator View: Drivers in the Submarine Networking Industry Today and moving Forward
Nicolas Brochier, Orange Labs, France
♦ This paper examines the current state of submarine networks and reviews their evolution in the light of traffic increase. The technical challenges of future submarine systems and required breakthroughs are also identified and discussed.

9:30 9.7.2
Lessons Learned Designing and Building Turnkey Submarine Systems Systems
Ekaterina Golovchenko, Tyco Telecommunications, USA
♦ Transoceanic submarine communication systems are one of the most challenging products in the field of optical communications, requiring application of cutting edge technologies. We review the processes behind design and construction of modern WDM ultra-long-haul systems with emphasis on turn-key solutions for trans-Pacific links and OADM networks.

9:55 9.7.3
Taking long repeatered submarine systems to 40Gbit/s and beyond
Massimiliano Salsi, Gabriel Charlet, Bell Labs, Alcatel-Lucent, France; Marco Bertolini, Università degli Studi di Parma, Italy
♦ We review recent advances in experimental demonstrations of transmission at 40Gbit/s and 100Gbit/s per channel over submarine distances. Coherent detection, large effective area fibers, and hybrid amplification are the key technologies for these new systems.

10:20 9.7.4
Recent Advances and Deployments in the Asia-Pacific Region
Yasuhiro Aoki, NEC Corporation, Japan
♦ This paper reviews the Tb/s capacity trans-oceanic transmission technologies and relevant advanced equipment, as applied to the latest 10Gbps DWDM system deployments. It also discusses the higher capacity and global IP-based networking, including 40Gb/s, TCP engine and OADM meshed design.

Notes:

10:45 - 11:15 Coffee break (will be served in the Main Lobby)

Room: Hall E1

10.1: Glasses for Nonlinear Processes and Amplification

Chair: Hans Limberger, EPFL & APL, Switzerland

11:15 10.1.1
Ultrafast Nonlinear Optics on a Chalcogenide Chip Invited
Benjamin Eggleton, University of Physics, Australia
♦ I review our recent demonstrations of ultrafast nonlinear optics on a chalcogenide chip exploiting the strong nonlinearity and tailored dispersion. Highlights include demonstration of 640Gb/s OTDM switching and terahertz RF spectrum analysis.

11:45 10.1.2
Ultra Highly Nonlinear AsSe Chalcogenide Holey Fiber for Nonlinear Applications
Thanh Nam Nguyen, Monique Thual, Foton / CNRS / Université de Rennes 1, France; Thierry Chartier, Laboratoire Foton, France; Quentin Coulombier, Patrick Houizot, Laurent Brilland, Johann Troles, EVC, Umr CNRS 6226, France; Frederic Smektala, Coraline Fortier, Julien Fatome, Institut Carnot de Bourgogne, UMR 5209 CNRS, France
♦ We report the characterizations of an AsSe chalcogenide holey fiber including loss, dispersion, effective area and nonlinear coefficient. The fiber exhibits a record Kerr nonlinearity of 15000 W-1km-1, which allows great potential for nonlinear applications.

12:00 10.1.3
Fiber Bragg Gratings Made in Highly Nonlinear Bismuth Oxide Fibers Using IR Ultrafast Radiation
Dan Grobnic, Stephen Mihailov, Robert Walker, Communication Research Center, Canada
♦ We have written for the first time high quality Bragg grating structures in highly nonlinear single mode bismuth oxide fibers . The grating inscription method is presented along with the annealing behavior of these gratings

12:15 10.1.4
Exotic Emissions of Erbium and Ytterbium Doped Silica-Zirconia Nanostructured Optical Fibers
Gurvan Brasse, XLIM Research Institute, France
♦ Original emissions in nanostructured silica-zirconia based optical fibers doped with erbium and ytterbium ions are presented. The influence of the nanostructure on the luminescence properties is highlighted and the different mechanisms are explained.

12:30 10.1.5
Influence of AlPO4 Joint on Silica-Based Er-Doped Fibers Properties
Mikhail E. Likhachev, Kiril V. Zotov, Mikhail M. Bubnov, Fiber Optics Research Center of RAS, Russia; Denis S. Lipatov, Mikhail V. Yashkov, Aleksey N. Guryanov, Institute of Chemistry of High Purity Substances of RAS, Russia
♦ Er-doped fibers based on P2O5-Al2O3-SiO2 ternary glass have been studied. An increase of pump-to-signal conversion efficiency as compared to phosphorosilicate and aluminosilicate 1.5 mol.% Al2O3 or less fibers is demonstrated.

Room: Hall F1

10.3: High-speed Coherent Systems

Chair: Werner Rosenkranz, University of Kiel, Germany

11:15 10.3.1
Generation of 173-Gbits/s single-polarization QPSK signals by all-optical format conversion using a photonic integrated device
Inuk Kang, Mahmoud Rasras, Mihaela Dinu, Sanjay Patel, Alcatel-Lucent, USA; Larry L Buhl, Mark Cappuzzo, Louis Gomez, Yifan Chen, Randy C. Giles, Bell Laboratories, Alcatel-Lucent, USA; Steve Cabot, Niloy Dutta, Al Piccirilli, James Jaques, LGS innovations, USA
♦ We report generation of high spectral-efficiency modulation formats at 86.4 Gbaud/s by all-optical format conversion using a device integrating semiconductor optical amplifies. We demonstrate generation of 173 Gbits/s QPSK signals and 86.4 Gbits/s Binary-PSK signals.

11:30 10.3.2
Compact and Broadband Coherent Receiver Front-End for Complete Demodulation of a 1.12-Terabit/s Multi-Carrier PDM-QPSK Signal
Xiang Liu, Doug Gill, Chandrasekhar Sethumadhavan, Larry L Buhl, Mark Earnshaw, Mark Cappuzzo, Louis Gomez, Yifan Chen, Fred Klemens, Ellsworth C. Burrows, Young-Kai Chen, Robert Tkach, Alcatel-Lucent, Bell Laboratories, USA
♦ We report a compact coherent receiver front-end consisting of an integrated 4x40 arrayed-waveguide-grating array following a polarization-diversity hybrid for complete demodulation of a 1.12-Tb/s multi-carrier-signal having 10x112-Gb/s PDM-QPSK subchannels, achieving 17-dB required OSNR/subchannel at BER=1e-3.

11:45 10.3.3
Digital Modulation Challenges for High-Capacity Optical Transport Network with 100G Channels and Beyond Invited
Yutaka Miyamoto, NTT Network Innovation Laboratories, Japan
♦ Digital signal processing technologies have great advantages for realizing the high-capacity Optical Transport Network based on over 100 Gbps channels. Novel no-guard-interval OFDM with frequency domain equalization is proposed and shown to offer long-haul transport at over 10Tbps.

12:15 10.3.4
Wavelength conversion of 4x 112Gbit/s PD-RZ-QPSK Signals based on single pump polarization diversity FWM scheme
Jianjun Yu, NEC Labs America, USA
♦ We report wavelength conversion of 4x112Gb/s PD-RZ-QPSK signals based on a single pump polarization diversity scheme and digital coherent detection. The OSNR penalty after wavelength conversion is smaller than 1dB.

12:30 10.3.5
200-Gb/s PDM-16QAM generation using a new synthesizing method
Xiang Zhou, AT&T Labs-Research, USA; Jianjun Yu, NEC Labs America, USA
♦ 160 and 200-Gb/s polarization multiplexed 16QAM has been generated using commercial modulators with binary electrical driving signals through a novel synthesizing method. Intradyne detection with robust polarization de-multiplexing has been demonstrated using a new blind equalization algorithm

12:45 10.3.6
Transmission of 160-Gbit/s QPSK Signals on a Single Carrier over 1,000 km using Digital Coherent Receivers
Chao Zhang, Yojiro Mori, Masatoshi Usui, Koji Igarashi, Kazuhiro Katoh, Kazuro Kikuchi, The University of Tokyo, Japan
♦ We demonstrate 1,000-km transmission of a 160-Gbit/s QPSK signal, using a digital coherent receiver with the time-division demultiplexing function, and confirm the applicability of such a receiver to long-haul transmission systems for the first time.

13:00 - 14:30 Lunch break

Room: Hall H

10.4: Nonlinearity-Impaired Transmission

Chair: Giovanni Bellotti, Alcatel-Lucent, Italy

11:15 10.4.1
Reducing the Impact of Intrachannel Nonlinearities By Pulse-Width Optimisation in Multi-level Phase-Shift-Keyed Transmission
Carsten Behrens, Robert I Killey, Seb Savory, Polina Bayvel, University College London, United Kingdom; Ming Chen, European Research Centre, Huawei Technologies, Germany
♦ We investigate the potential benefit of the reduction in the duty-cycle for M-phase-shift-keyed modulation formats, demonstrating performance improvement in the range of 2-8 dB in nonlinear threshold NLT due to intrachannel-four wave mixing IFWM), and nonlinear phase noise NLPN).

11:30 10.4.2
Revisiting the evaluation of non-linear propagation impairments in highly dispersive systems
Edouard Grellier, Alcatel-Lucent Bell Labs France, France; Jean-Christophe Antona, Sebastien Bigo, Alcatel-Lucent, France
♦ The relevance of the nonlinear phase criterion for predicting performance in highly dispersive systems is investigated. For such systems, we propose and validate a more accurate criterion accounting for dispersion

11:45 10.4.3
Nonlinear Penalty Reduction Induced by PMD in 112 Gbit/s WDM PDM-QPSK Coherent Systems
Paolo Serena, Alberto Bononi, Nicola Rossi, University of Parma, Italy
♦ We show by simulation that when linear PMD is fully compensated by the receiver, the presence of DGD along the link reduces the amount of residual nonlinear penalty in 112 Gbit/s PDM-QPSK coherent systems.

12:00 10.4.4
Interchannel Nonlinearities in Polarization-Multiplexed Transmission
Marcus Winter, Klaus Petermann, Technische Universität Berlin, Germany; Dario Setti, Nokia Siemens Networks GmbH & Co. KG, Germany
♦ We examine the impact of cross-polarization modulation and cross-phase modulation in polarization-multiplexed systems by means of computer simulations and show how symbol-interleaving reduces the XPolM-related penalty.

12:15 10.4.5
Investigating the Noise Statistics in Practical Systems
Ernesto Ciaramella, Luca Banchi, Andrea Di Mauro, Giampiero Contestabile, Marco Presi, Scuola Superiore Sant'Anna University, Italy
♦ We use a recirculating fibre loop setup to determine the probability density function of sampled bits in long links under linear and nonlinear propagation conditions. Our measurements confirm a recent theoretical simplified model.

12:30 10.4.6
Modeling of Signal-Noise Interactions in Nonlinear Fiber Transmission with Different Modulation Formats Invited
Alberto Bononi, Università di Parma, Italy
♦ We describe the physical principles behind nonlinear signal-noise interaction and its impact on dispersionmanaged optical transmission system performance for both intensity and phase modulated signals

Room: Hall G

10.5: Advanced Techniques for Access

Chair: Josep Prat, UPC, Spain

11:15 10.5.1
Simultaneous Triple Data Transmissions on A Single Wavelength
Zhaowen Xu, Jianguo Liu, Nanyang Technological University, Singapore; Cheng Tee, Yong kee Yeo Hiang, Yixin Wang, Cheng Xiaofei, Institute for Infocomm Research, Singapore
♦ We propose and experimentally demonstrate a novel optical access network providing bidirectional data transmissions and a broadcast service simultaneously with a single wavelength. All these services are provided through the same fibre link.

11:30 10.5.2
A Novel Optical Direct-Detection I/Q Up-Conversion with I/Q Imbalance Compensation via Gram-Schmidt Orthogonalization Procedure
Wen-Jr Jiang, Chun-Ting Lin, Po Tsung Shih National Chiao Tung University, Taiwan; Jyehong Chen, National Chung Cheng University, Taiwan; Sien Chi, Yuan Ze University, Taiwan
♦ We proposed RF detect-detection vector signal generation using optical I/Q up-conversion. The Gram-Schmidt orthogonalization procedure is employed to compensate I/Q imbalance. After transmission over 100-km SMF, penalties of 5-Gb/s QPSK signals can be ignored.

11:45 10.5.3
Sensing Ultra-Low-Power Radio Signals by Photonic Analog-to-Digital Conversion
Roberto Llorente, Maria Morant, Universidad Politecnica de Valencia, Spain; Jose Puche, DAS Photonics S.L, Spain; Jac Romme, IMST GmbH, Germany; Tiago Alves, Instituto de Telecomunicações, Portugal
♦ A time stretched photonic analog-to-digital converter with optical amplification is proposed to sense ultra-low power signals for cognitive radio applications. Experimental results show that -65 dBm RF carrier can be monitored with 20.84 dB signal-to-noise ratio.

12:00 10.5.4
Bandwidth-On-Demand Ultra Dense WDM Access 1.25/2.5 Gb/s × N-ch Employing Time-Domain Interleaved Wavelength-Swept Transmitter
Tomohiro Taniguchi, Naoya Sakurai, NTT Corporation, Japan; Hideaki Kimura, NTT Access Network Service Systems Laboratories, Japan; Kiyomi Kumozaki, NTT, Japan
♦ To realize a flexible WDM signal format, the dynamic control of channel number and data rate is proposed. A total rate of more than 10 Gb/s with ultra-dense spacing < 10 GHz is demonstrated experimentally.

12:15 10.5.5
Next Generation Optical Access: 1 Gbit/s for Everyone Invited
Harald Rohde, Sylvia Smolorz, Karl Kloppe, Erich Gottwald, Nokia Siemens Networks GmbH & Co. KG, Germany
♦ A PON based on coherent heterodyne receivers is presented. The wavelength selectivity and sensitivity of heterodyne receivers enables a filterless ultra-dense WDM system with long reach and simplified logistics, offering 1Gbit/s sustained datarate per user.

13:00 - 14:30 Lunch break

Room: Hall F2

10.6: Symposium: Optical Space Communications

Chairs: Josep Maria Perdigues Armengol, ESA, The Netherlands), Zoran Sodnik, ESA, The Netherlands

Optical technologies will play a key role in future space communication systems. This symposium will present the status of some of the latest technology developments in Europe ESA), United States NASA and Japan NICT both in the areas of Free Space Optical Communications e.g., second generation of optical communications terminals for optical inter-satellite links with increased data transmission rate and reduced mass, size and power consumption; the new European DRS system; the new Japanese DRS system, etc. and for on-board Satellite Communications e.g., on-board digital and analog communications; optical signal processing, etc.). The symposium will conclude with a panel discussion about future developments, in-orbit demonstrations, potential operational services and novel applications.

11:15 10.6.1
High Data Rate Optical Inter-Satellite Links
Robert Lange, Tesat-Spacecom, Germany
♦ Optical developments and in-orbit demonstration of multi-gigabit per second data transmission based on BPSK modulation and homodyne detection receiver at 1064nm. It includes future developments for an operational service towards an European Data Relay Service EDRS).

11:38 10.6.2
Free space laser communications: the Japanese experience
Morio Toyoshima, National Institute of Information and Communications Technology, Japan
♦ Optical/optoelectronic technology developments for high data rate communication systems between satellites and satellite to ground, in preparation of new Japanese Data Relay Service JDRS). Besides, heritage and trade-offs of various operational wavelengths 800nm, 1064nm, 1550nm).

12:01 10.6.3
Microwave Photonic Technologies for Flexible Satellite Telecom Payloads
Michael Sotom, Thales Alenia Space, France
♦ Photonics and microwave photonics are emerging as enabling technologies for advanced payload concepts with enhanced flexibility in future telecom satellites.

12:24 10.6.4
The Fiber Optic Subsystem Components on Express Logistics Carrier for International Space Station
Melanie N Ott, NASA Goddard Space Flight Center, USA
♦ The Photonics Group at the United States NASA Goddard Space Flight Center has been supporting the design, development, manufacturing and integration of the optical fiber subsystem on the Express Logistics Carrier for the ISS. Some lessons learned are presented.

12:47 10.6.5
Panel discussion: future perspectives of optical technologies for Space Communications
Josep Maria Perdigues Armengol, Zoran Sodnik, ESA, The Netherland
♦ Open discussion on future trends of optical technologies for Free Space Optical Communications and on-board Satellite Communications e.g., planned in-orbit demonstrations and operational systems, novel applications like quantum communications in space, component qualification status, standarization issues, etc.).

Room: Hall I

10.7: Symposium:
Subsea Communications: Recent advances and Future Prospects (2)

Future Technology Enablers

Chair: Vincent Letellier, Alcatel-Lucent Submarine Networks, France

11:15 10.7.1
The future of Submarine Systems - Where Do Upgrades Fit?
Tony Frisch, Xtera Communications, United Kingdom
♦ There are many technologies and techniques being considered for future builds; this paper will consider how some of these might impact the potential for third party upgrades.

11:40 10.7.2
Coherent Electronic Compensation Techniques for Long-Haul Optical Fibre Transmission - Opportunities and Challenges
Polina Bayvel, University College London UCL, United Kingdom
♦ We review recent advances in the use coherent detection and digital signal processing to compensate for dispersion and nonlinearity in long-haul WDM links, and assess the use of these techniques for long-haul and subsea applications.

12:05 10.7.3
Advances in Fibers and Transmission Line Technology for Long Haul Submarine Systems
Ole A. Levring, OFS Fitel Denmark, Denmark
♦ We review recent development of optical fibers for submarine networks. Further we discuss how new signal formats and increased bit rates change the requirements for fibers and challenge the balance between effective area and cable performance.

12:30 Panel Discussion: Risks and Opportunities for Submarine Systems

13:00 - 14:30 Lunch break

Room: Hall E 1

Post Deadline
Session 1

Room: Hall F 1

Post Deadline
Session 3

Thursday, September 24 · 14:30 - 16:15

Room: Hall E 2

Post Deadline
Session 2

Room: Hall F 2

Post Deadline
Session 4

Room: Hall E 1

Closing Session

General Information

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Conference Venue

ECOC 2009 will take place at the ACV (Austria Center Vienna) which is one of Europe's top venues for large international conferences. With its distinctive hexagonal ground plan, it is located between the tower blocks of the Donau City and the United Nations Vienna Headquarters, in the most modern part of the city. The centre offers 17 air-conditioned rooms with a capacity of up to 4,200 people and a total of 22,200 sqm of exhibition space, ensuring an exciting conference and exhibition experience.

The ACV is accessible within a few minutes from Vienna's city centre by metro U1 (red line) and is also rapidly reached from the Vienna International Airport (VIE).

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Business Center

A business center is on service daily from 9 a.m. to 5 p.m. Phone, fax, internet access, printing services and WiFi access are available.

Conference language

All sessions will be held in English. There will be no simultaneous translation.

Destination Vienna

Welcome to Vienna, which has always been and continues to be a place where European history is made. Throughout the centuries, Viennese culture has exerted a strong influence on European arts and lifestyle. Among many others, the works of Strauss, Mozart, Beethoven and Schubert have made Vienna the musical capital of the world.
In addition to its rich cultural heritage, from Lippizaner horses and famous museums to Hofburg and Secession, modern-day Vienna boasts the vibrant cultural scene of a 21st century metropolis (www.vienna.at).
A selection of touristic and cultural highlights in Vienna are listed on the city map inserted in your congress bag. For indivdiual questions please contact the agency EuroKongress at the registration counter.

Currency

The official currency in Austria is the euro (EUR). Standard credit cards (Mastercard, American Express, VISA) are accepted in hotels, department stores and restaurants. Currently (September 2009) the exchange rate is approx. 1 EUR = 1,4 USD

Electricity

Power supply is 230 V AC, 50 Hz. It is recommended to have a suitable plug-in for European standard when charging your laptop

Emergency Services

Police call 133, Ambulance 144 and Fire Brigade call 122

Insurance

The organizer may not be held responsible for any injury to participants or damage, theft and loss of personal belongings. Participants should therefore make their own insurance arrangements.

Shopping

Vienna is an ideal city to go on a leisurely stroll through the shops - on Vienna's famous Kaerntner Strasse - the noble shopping street you will discover an immense variety of pleasurable shopping opportunities. For more details please visit www.vienna.at.

Time Zone

GMT (UTC) +01:00

Transportation

By Air: From Vienna Airport take the airport bus to VIC (Vienna International Centre). There is a stop right in front of the hotel Arcotel Kaiserwasser (300 m to the conference center.)
Direct taxi rides from the airport to the ACV are offered at a rate of 60 EUR incl. return ticket, if you book it at the airport (September 2009).

By Car: Take the A22 towards the centre of Vienna. - Just after the Kaisermühlen tunnel take the 2nd right into Wagramerstrasse and follow the signs ACV.

By Public Transport: Take the underground line U1 (red line) to Kaisermühlen-VIC, located at the ACV.

Visa/Letter of confirmation

Nationals from some countries may require a visa to enter Austria. Please check with the Austrian Embassy in your country. If documentation/letter of confirmation is required, please contact the conference organizer for support for a visa application after having registered for the conference.

Weather

The weather in Vienna in September is still beautiful and warm. However, there might be chilly and rainy days. The temperature can range between 10C° and 25C°. Please check the actual weather on **www.weather.com**

Parking

Covered parking for approx. 1,000 cars
Parking for approx. 40 coaches at main entrance level
Ample HGV parking

Payment

Payment for registration must be made in EURO. The conference fee has to be fully paid in advance.
The following methods of payment are accepted:
- By credit card authorisation
- Cash payment on-site in EURO (€)

Badges

Delegates will receive badges and vouchers for the booked events. Participants are kindly requested to wear their badge throughout the conference, even at social events. Lost badges will not be replaced. A new registration will be mandatory.

Cancellation

In the case of cancellation or no show, no refund will be made. Proceedings and CDROM will be sent to the registrant after the conference.

Restaurants in the surroundings of the Austria Center Vienna.

Name	Type	Distance	Address	Phone	Opening hours
Don Pepino Ristorante Pizzeria	Italian	0,3 km	Leonard-Bernstein-Str. 4-6	+43 1 9551452	Mo-Fr: 9:00-22:00 Sa-So: closed; for groups up from 15 people upon request
Asian Noodles Chang	Asian	0,3 km	Donau-City-Str. 6	+43 1 2698382	Mo-Fr: 11:30-15:00 Sa-So: closed
Coffee Lounge Tech Gate	Coffee…	0,3 km	Donau-City-Str. 1	+43 1 2050170100	Mo-Thu: 08:00-21:00 Fr: 08:00-19:00
Café Restaurant Donaucity	Coffee…	0,3 km	Leonard-Bernstein-Straße 4-6	+43 1 2635252	Mo-Sa: 7:30-22:00 So: 9:00-22:00
ARCOTEL Kaiserwasser	International	0,4 km	Wagramer Str. 8	+43 1 224240	Mo-So: 12:00-14:30 18:00-22:30
Café Max	Coffee…	0,5 km	Schüttaustraße 4-10	+43 1 2691052	Mo-Fr: 05:30-21:00 Sa: 08:00-14:00
Café Uno	Coffee…	0,5 km	Wagramer Str. 5	+43 1 2630905	Mo-Fr: 08:00-18:00 Sa-So: closed
China-Restaurant Sichuan	Chinese	0,7 km	Arbeiterstrandbad-Str. 122	+43 1 2633713	Mo-Fr: 11:30-14:30 17:30-23:00 Sa-So: 11:30-23:00
Rembetiko Donauinsel	Greek	0,8 km U1 1 stop → dir Reumannplatz	Donauinsel, Copa Kagrana	+43 1 2636633	Mo-So: 10:00-01:00
Mercado	Mediterranean	0,8 km U1 1 stop → dir. Reumannplatz	Donauinsel, Copa Kagrana	+43 1 2637171	Mo-So: 10:00-01:00
Aliento	Mexican	0,8 km U1 stop → dir. Reumannplatz	Donauinsel, Copa Kagrana, Arkade 5	+43 1 2633233	Mo-So: 10:00-02:00
All'Isola Pasta & Pesce	Italian	0,8 km U1 1 stop → dir. Reumannplatz	Donauninsel, Copa Kagrana	+43 664 5571083	Mo-So: 11:30-24:00
Taverne los	Greek	0,8 km U1 1 stop → dir. Reumannplatz	Neue Donau Linkes Ufer	+43 1 2633504	Mo-So: 11:00-02:00
Kaori Japanische Spezialitäten	Japanese	0,8 km	Wagramer Str. 22	+43 1 2690681	Mo-Fr: 11:30-15.00 17:30-22.30 So: 17:30-22.30
Rembetiko Donauplex	Greek	0,9 km	Wagramer Str., Donauplex	+43 1 2039845	Mo-So: 11:30-01:00
Alte Kaisermühle	Austrian	1,3 km U1 1 stop → dir. Kagran	Fischerstrand 21a	+43 1 2633529	Mo-Sa: 11:30-23:00 So: 11:30-22:00
Al Capone	Italian	1,3 km U1 1 stop → dir. Kagran	Kratochwjlestrasse 12/Turm 1/ Lokal 2	+43 1 2636078	Mo-Fr; So: 10:00-23:00

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Saturday September 19

16:00 - 18:00	Registration

Sunday September 20

	Hall E1	Hall E2	Hall F1	Hall H	Hall G	Hall F2	Hall I
08:00 - 18:00	Registration						
10:00 - 13:00	**Workshop 1** DSP & FEC: Towards the Shannon Limit	**Workshop 2** New Directions in Fiber Technology	**Workshop 3** Optics in Computing		**Workshop 4** How much Energy Efficiency Can we Achieve in Next Generation Core Networks and Switches?		
13:00 - 14:30	**Lunch break**						
14:30 - 17:30	**Workshop 5** 100 Gb/s - How, Where, When?	**Workshop 6** Installing Fibre in the Acess Network: Experiences and Remaining Challenges	**Workshop 7** Monolithic and Hybrid Photonic Integrated Transceivers for Advanced Modulation Formats		**Workshop 8** Multi-Layer Dynamic Transport Networks Enabling Rich Bandwidth Services	**Workshop 9** Quantum Information Technologies	
18:00 - 20:00	Get Together Reception (Lobby ACV)						

Monday September 21

	Hall E1	Hall E2	Hall F1	Hall H	Hall G	Hall F2	Hall I
08:00 - 18:00	Registration						
09:30 - 12:30	**Opening Ceremony and Plenary Sessions (Hall A)**						
12:30 - 14:00	**Lunch break**						
14:00 - 15:45	**Session 1.1** Parametric Effects in Fibres	**Session 1.2** Devices for Optical Switching and Processing	**Session 1.3** OFDM	**Session 1.4** Quantum Key Distribution	**Session 1.5** Impairment Aware Networking	**Session 1.6** FTTH and PON	**Session 1.7** Symposium: InP and Si Integrated photonics: Competition or Symbiosis (1)
15:45 - 16:15	**Coffee break** (Delegates Coffee Area at the Exhibition)						
16:15 - 18:00	**Session 2.1** Microstructured Fibres	**Session 2.2** Devices for Multilevel Transmission	**Session 2.3** OFDM and Multitone	**Session 2.4** Radio-over-Fibre	**Session 2.5** Crosslayer Networking	**Session 2.6** Coding and Modulation	**Session 2.7** Symposium: InP and Si Integrated photonics: Competition or Symbiosis (2)
19:30 - 21:30	Welcome Reception (Town Hall Vienna)						

Tuesday September 22

	Hall E1	Hall E2	Hall F1	Hall H	Hall G	Hall F2	Hall I
08:00 - 18:30	Registration						
09:00 - 10:45	**Session 3.1** Optics in Computing	**Session 3.2** Control Plane Aspects	**Session 3.3** Optical Signal Processing (1)	**Session 3.4** Coherent vs. Direct-detection	**Session 3.5** Multi-mode Fibres for Access	**Session 3.6** Nanophotonics	
10:45 - 11:15	**Coffee break** (Delegates Coffee Area at the Exhibition)						
11:15 - 13:00	**Exhibition only**						
13:00 - 14:30	**Lunch break**						
14:30 - 16:15	**Session 4.1** Fibre Measurement and Characterization	**Session 4.2** Heterogeneous Integration	**Session 4.3** Optical Signal Processing (2)	**Session 4.4** Symposium: Real-time Digital Signal Processing for Optical Transceivers (1)	**Session 4.5** Ultra-Wideband over Fibre	**Session 4.6** Transport Network Technologies	**Session 4.7** Symposium: Next Generation Optical Access Technologies (1)
16:15 - 16:45	**Coffee break** (Delegates Coffee Area at the Exhibition)						
16:45 - 18:30	**Session 5.1** Fibre Devices	**Session 5.2** Ultra-fast Integrated Devices	**Session 5.3** Network Nodes	**Session 5.4** Symposium: Real-time Digital Signal Processing for Optical Transceivers (2)	**Session 5.5** Energy-aware Design	**Session 5.6** Optical Packet Switching (1)	**Session 5.7** Symposium: Next Generation Optical Access Technologies (2)

Wednesday September 23

	Hall E1	Hall E2	Hall F1	Hall H	Hall G	Hall F2	Hall I
08:00 - 18:30	Registration						
09:00 - 10:45	**Session 6.1** Broadband Lightsources	**Session 6.2** Quantum Dot and SOA	**Session 6.3** Optical Packet Switching (2)	**Session 6.4** High-speed and Long-distance Transmission	**Session 6.5** WDM-PON and OCDMA	**Session 6.6** Real-time Coherent Receivers	**Session 6.7** Symposium: Dynamic Multi Layer Mesh Network ... Why, How, and When? (1)
10:45 - 11:15	**Coffee break** (Delegates Coffee Area at the Exhibition)						
11:15 - 13:00	**Session 7.1** Lasers and Sources	**Session 7.2** Silicon Photonics and Planar Devices	**Session 7.3** Coherent Receiver Algorithms		**Session 7.5** High Bit Rate PON	**Session 7.6** Specialty Optical Fibre	**Session 7.7** Symposium: Dynamic Multi Layer Mesh Network ... Why, How, and When? (2)
13:00 - 14:30	**Lunch break**						
14:30 - 16:15		**Session 8.2** Semiconductor Lasers	**Session 8.3** Dynamic and Tunable Networking	**Session 8.4** Higher-Order Modulation Formats	**Session 8.5** Hybrid and Long-reach PON	**Session 8.6** Integrated Optical Transceivers	
16:15 - 16:45	**Coffee break** (Main Lobby)						
16:45 - 18:30	**Poster Session Central Lobby**						
20:00 - 23:00	Gala Dinner (Vienna Konzerthaus)						

Thursday September 24

	Hall E1	Hall E2	Hall F1	Hall H	Hall G	Hall F2	Hall I
08:00 - 18:30	Registration						
09:00 - 10:45	**Session 9.1** Nonlinear Processing in Fibres	**Session 9.2** Photodetectors and Receivers	**Session 9.3** Performance Monitoring	**Session 9.4** Nonlinearity Mitigation in Coherent Systems	**Session 9.5** Access Components and Subsystems	**Session 9.6** Free-Space Optical Communications	**Session 9.7** Symposium: Subsea Communications: Recent Advances and Future Prospects (1)
10:45 - 11:15	**Coffee break** (Main Lobby)						
11:15 - 13:00	**Session 10.1** Glasses for Nonlinear Processes and Amplification		**Session 10.3** High-speed Coherent Systems	**Session 10.4** Nonlinearity-impaired Transmission	**Session 10.5** Advanced Techniques for Access	**Session 10.6** Symposium: Optical Space Communications	**Session 10.7** Symposium: Subsea Communications: Recent Advances and Future Prospects (2)
13:00 - 14:30	**Lunch break**						
	Hall E1	**Hall E2**	**Hall F1**	**Hall H**	**Hall G**	**Hall F2**	**Hall I**
14:30 - 16:15	**Post Deadline Session 1**	**Post Deadline Session 2**	**Post Deadline Session 3**			**Post Deadline Session 4**	
16:15 - 16:45	**Closing Session Hall E1**						

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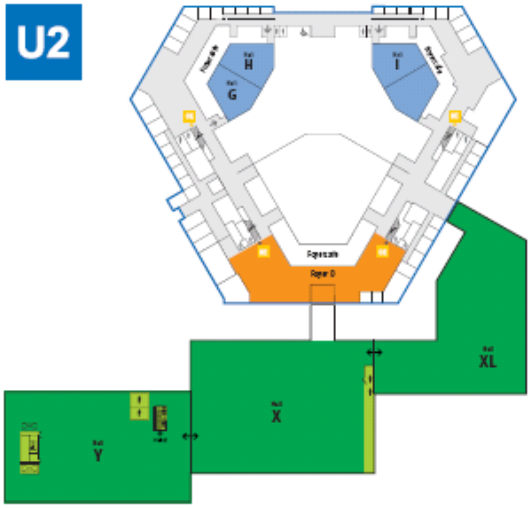

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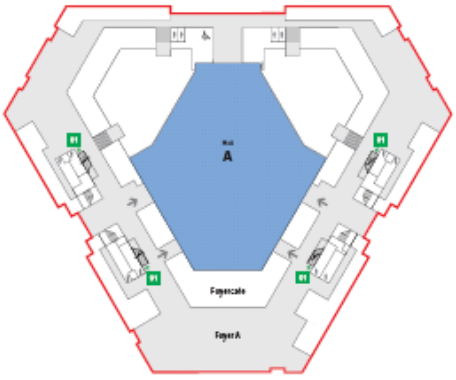

Registration

Conference

Exhibition

Delegate Coffee Area