

PhoxTroT

Photonics for High-Performance, Low-Cost & Low-Energy
Data Centers, High Performance Computing Systems:
Terabit/s Optical Interconnect Technologies for On-Board,
Board-to-Board, Rack-to-Rack Data Links

Collaborative Project
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Lead beneficiary:	Fraunhofer
Contact person:	Tolga Tekin
Address:	Gustav-Meyer-Allee 25, 13355 Berlin, Germany
Phone:	+49 30 464 03639
Email:	tolga.tekin@izm.fraunhofer.de
Author(s):	Kathrin Erhard
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Abstract:

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Project duration: 48 months

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Project coordinator: Dr. Tolga Tekin - Fraunhofer

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Table of Contents

1	Executive Summary	4
2	Introduction	5
2.1	Document structure	Fehler! Textmarke nicht definiert.
2.2	Audience	5
3	The first PhoxTroT Newsletter	6
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	Appendix.....	Fehler! Textmarke nicht definiert.

1 Executive Summary

The second PhoxTroT Newsletter was published as a special edition to the ECO workshop at the ECOC 2013 in London. The Newsletter was sent to the subscribers of the newsletter and to all the PhoxTroT Partners. In addition it was circulated at the ECOC 2013.

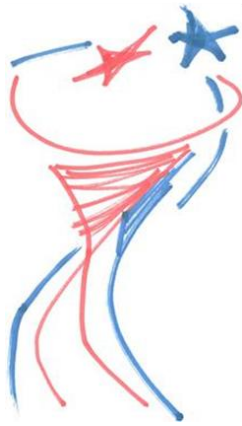
In the second newsletter, PhoxTroT welcomes their new partner, TE connectivity. It furthermore gives an overview over the presentations at the ECOC and describes the aims of the European cluster of optical interconnects (ECO). It also contains an article on Photonic Interconnect Technologies and presents one of PhoxTroT's scientists, Kobi Hasharoni.

2 Introduction

Newsletters: Distribution of electronic newsletters through the Internet and bulletin boards intended for the project beneficiaries and, importantly, to a more general audience. A PhoxTroT Newsletter will be produced on a regular basis and will be distributed electronically to well-known mailing lists of professionals in the field (IEEE Optical and Networking Community, PROSPECT HPC cluster mailing list, European projects , etc).

2.1 Audience

This document is to PhoxTroT project consortium and external the EU Commission.



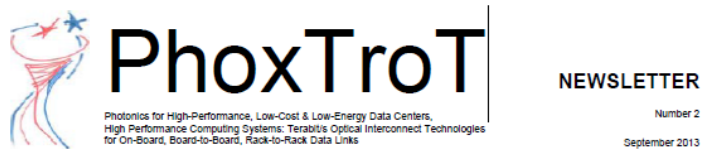
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3 The second PhoxTroT Newsletter

2nd Newsletter, page No. 1



ECOC 2013 - Special Edition

Dear Readers,

For the Photonics Community September has been one of the distinguished months of the year due to the largest optical communication event in Europe: The European Conference and Exhibition on Optical Communication (ECOC).

This year's ECOC in London is of particular importance for PhoxTroT since it gives us the opportunity to present *proudly* the highlights of PhoxTroT's first year.

This second newsletter is dedicated to PhoxTroT's wide range of activities during ECOC 2013.

Welcome to the ECOC 2013 - Special Edition of the PhoxTroT newsletter!

We are looking forward to discuss with you the achievements in following sessions...

@ Workshops

WS2 15:10 *Photonic IC design (Tools)*, Twan Korthorst (Phoenix Software)

WS2 16:50 *Silicon-organic Hybrid Integration*, Christian Koos (KIT)

WS4 15:10 *Migration of Embedded Optical Interconnect into Data Centre Systems*, Richard Pitwon (Xyratex)

WS4 16:20 *Development of Optical Interconnect PCBs for High Speed Electronic Systems - Fabricator's View*, Marika Immonen (TTM Technologies)

WS4 17:00 *PolyBoards for Short Reach Optical Interconnects*, Ziyang Zhang (Fraunhofer HHI)

@ Conference

Mo.4.F.4 *High-Speed Electronics for Short-Link Communication [invited]*, Johan Bauwelinck (IMEC) et al.

We.3.B.3 *High-Speed Silicon-Organic Hybrid (SOH) Modulator with 1.6 Tbit and 180 pm/V In-Device Nonlinearity [invited]*, Robert Palmer (KIT) et al.

Th.2.B.1 *Silicon-Organic Hybrid (SOH) frequency comb source for data transmission at 784 Gbit/s*, Claudius Weimann (KIT) et al.

@ Special Symposia

Tu.1.G.2 *Active plasmonics in true data traffic applications*, Nikos Pleros (AUTH/CERTH) et al.

Tu.3.H.2 *On the way to the Photonic Router*, Kobi Hasharoni (Compass EOS)

Tu.4.H.3 *Photonic Interconnect Technologies for Data Center and HPC in the EU Project PhoxTroT*, Tolga Tekin (Fraunhofer IZM), Dimitris Apostolopoulos (ICCS/NTUA)

@ European Cluster in Optical Interconnects Workshop

Wednesday 25th September 2013, 12:00 - 17:30, Meeting Room: 5G21 & 5G22

(hosted by PhoxTroT)

12:00 Introduction to European Cluster for Optical Interconnects, Dimitris Apostolopoulos (ICCS/NTUA)

12:30 Overview and Roadmap for European projects in Optical Interconnects, Nikos Pleros (AUTH/CERTH)

14:30 System Embedded Photonic Interconnect Technologies for Data Centre Applications, Richard Pitwon (Xyratex)

15:30 Parallel Optics as an Enabler for >1Tb/s Optical Interconnects, Kobi Hasharoni (Compass EOS)

@ Exhibition

Stand 313 Vertilas GmbH; Stands 205,306,308 Fraunhofer HHI

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*Global forum
of stakeholders
and beneficiaries
of optical
interconnect
technology.*

The European Cluster in Optical Interconnects Workshop

Following the successful launch of the *European Cluster in Optical Interconnects (ECO)* Cluster in April 2013, PhoxTroT proudly host also the second meeting of the cluster, the *1st European Cluster in Optical Interconnects Workshop* with distinguished invited speakers, on Wednesday 25th September 2013 in Meeting Room SG21 & SG22 at the ExCeL London Exhibition and Convention Centre, co-located with the ECOC 2013. ECO has been formed to create a global forum of stakeholders and beneficiaries of *optical interconnect* technology spanning a broad application space from chip-level, board-level and rack-level optical interconnect to system integration and to promote visibility, sustainability and exploitation of European R&D efforts in the broad field of Optical Interconnects and to foster collaboration between European industry and research consortia and global organizations to leverage world-leading expertise in different areas of the optical interconnect eco-system and accelerate wide-spread commercial transition to embedded optical interconnect.

Motivated by recent breakthroughs and emerging technologies in short reach optical interconnect and the evolution of data center architectures, this workshop aims to highlight the latest achievements across the entire spectrum of system embedded optical interconnects including electro-optical PCB, optical waveguide fabrication, connectors, components, devices and systems that are placing photonics among the key enabling technologies of datacom and computercom evolution. Moreover, this workshop aims to focus on the practical application perspectives of this technology as well as the remaining challenges to be tackled on the way to full deployment within future datacom systems.

Invited speakers at the 1st European Cluster in Optical Interconnects Workshop are:

- Dimitris Apostolopoulos, National Technical University of Athens (Greece)
- Nikos Pleros, Aristotle University of Thessaloniki / Center for Research and Technology Hellas (Greece)
- Richard Penty, University of Cambridge (UK)
- Geert van Steenberge, University of Ghent (Belgium)
- Richard Pitwon, Xyratex Technology Ltd (UK)
- Takaaki Ishigure, Keio University (Japan)
- Kobi Hasharoni, Compass EOS (Israel)
- Makoto Fujiwara, Sumitomo Bakelite (Japan)
- Carlos Lee, European Photonics Industry Consortium (EPIC)

PhoxTroT Consortium welcomes TE connectivity

TE connectivity joined the PhoxTroT Consortium with its expertise in the area of AOC.

TE connectivity is one of the world's largest suppliers of connectivity with global R&D and production sites. TE connectivity is well positioned in the growing industries such as broadband connectivity, automotive, consumer and energy & industrial. In the project, TE is developing and evaluating 16QAM AOC for rack-to-rack data links.

Nineteen European partners from industry and research are committed to the success of the large scale integrating research project PhoxTroT.

Industrial partners:

AMO GmbH, Austriamicrosystems AG, Bright Photonics, Compass Electro Optical Systems Ltd, DAS Photonics, Phoenix BV, TE Connectivity, TTM Technologies / Meadville Aspocomp International Ltd, Vertilas GmbH, Xyratex Technology Ltd

Universities and research institutes:

Centre for Research and Technology Hellas / Informatics and Telematics Institute, Centre National de la Recherche Scientifique (CNRS-UB, CNRS-LPN), Computer Technology Institute and Press "Diophantus", Institute of Communication and Computer Systems / National Technical University of Athens, Interuniversitair Micro-Elektronica Centrum, Karlsruhe Institute of Technology, Syddansk Denmark University, Universidad Politecnica de Valencia NTC, Fraunhofer Gesellschaft (Fraunhofer HHI, Fraunhofer IZM).

*Active
Optical Cable*

*19
partners
committed
to the
success*

The Light Alternative - Photonic Interconnect Technologies In Future Data Center Environments

Data centers provide dedicated computer, storage and server equipment designed to meet the data processing and storage requirements of an organization, where such requirements can vary strongly from organization to organization. Different ICT requirements must be satisfied by different configurations of the modular data storage subsystems, which form the building blocks of modern data centers (figure 1). These building blocks include data storage arrays, integrated application platforms, storage servers, switches and high performance storage and computer subsystems.

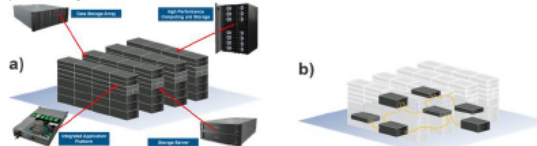


Figure 1: a) Building blocks of modern data center, b) Disaggregated data center architectures



Fully optically enabled 2U24 drive data storage platform demonstrator.

The drive to increasing virtualization of the data center through *Software Defined Network (SDN)* architectures also promises to provide significantly greater user control, Quality of Service and flexibility while optimizing resource use. Ideally the user can be provided a virtual data center solution with the optimum combination and amount of compute, memory and storage, even though the actual corresponding hardware allocated could be dispersed. In order to satisfy these requirements without over-provisioning of hardware resources, one must have the capability to convey *high bandwidth data over far longer distances* than is typical or possible today between subsystems, and this can only be satisfied by low-cost high-bandwidth optical links. Fiber-based commercial optical modules are now common in data center to provide connectivity between racks and enclosure. However as system bandwidths increase new bottlenecks will emerge or existing ones will become more exposed deeper in the system enclosure itself. Thus the need for commercially viable, dense interconnect solutions will continue inevitably to migrate down through the data communication tiers of the system from board-to-board, chip-to-chip and ultimately to the chip itself.

One of the *early achievements* on the PhoxTroT project has been the *successful* development and *demonstration* of a fully optically enabled data storage demonstrator - ThunderValley2, in which all internal high speed links were implemented optically. This was instrumental in our early assessment of the viability of embedding optical links within prevailing data storage architectures.

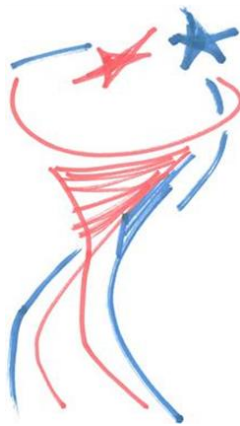
The PhoxTroT partners have *successfully completed* a comprehensive set of initial design and subsystem specifications for the optical interconnect platform demonstrators that are targeted for HPC & Data Centers within the project.

One of us :

Kobi Hasharoni



Kobi Hasharoni received his Ph.D. in physical chemistry from the Hebrew University of Jerusalem in 1995. His research was on time-resolved electron paramagnetic resonance studies of electron transfer reactions. He was a post graduate researcher at UC Santa Barbara where his work was on optical properties of conducting polymers. Since 1998 he has worked as group leader in Applied materials, Trellis photonics and several other startup companies in Israel focusing on electro optics. His fields of interest are optical design, photorefractive physics, optical communication, fiber optics and photonic integration. He has been with Compass EOS since 2007 as director of Electro Optics and was responsible for the development of a hybrid, III-V on CMOS parallel optical transceiver with the highest bandwidth and data density reported so far. In his spare time he likes to read, listen to opera and trek in the Indian Himalayas.



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Page No. 4

PhoxTroT Newsletter No.2

September 2013

PhoxTroT Presentations & Events

IEEE CPMT Webinar: Arjen Bakker (Phoenix), Ronald Broeke (Bright Photonics), 'Platform Independent Photonic Design Tools and Concepts', 17 Oct. 2013.

The Optical Fiber Communication Conference and Exposition (OFC): T. Tekin, 'Photonic Interconnects for Data Centers', 9-13 March 2014.

Technology Workshop "Optical Interconnects in Data Centers": Organized by PhoxTroT and EPIC, 18-19 March 2014, Berlin, Germany.

Technology Workshop

'Optical Interconnects in Data Centers', 18-19 March 2014

In conjunction with *laser optics - International Trade Fair and Congress for Optical Technologies and Microsystems* (www.laser-optics-berlin.de)

Organized by PhoxTroT and EPIC with the support of IEEE CPMT German Chapter and ECO, held in conjunction with *laser optics 2014 Berlin*

The workshop is focused on *high-performance, low-energy and low-cost and small-size* optical interconnect across the different hierarchy levels in data center and high-performance computing systems: *on-board, board-to-board and rack-to-rack*.

Pre-register now for free to remain informed on www.epic-assoc.com/events

Session 1: Data Centers

The projected increase in capacity, processing power and bandwidth density in data center environments must be addressed by the migration of high density optical interconnect into the data communication enclosures. This workshop will therefore consider the optical technologies required to support the migration of short reach optical interconnect into ICT systems and the resulting architectural advancements that can be opened up in data center environments.

Session 2: Components

The penetration of optical technologies into short-range interconnect systems calls for a new generation of optical components that will optimally blend low-loss, low-power, low-footprint, high-speed and low-cost characteristics across the complete chain of functional systems required at all-levels of interconnect hierarchy. This workshop intends to provide a broader view of progress into respective components technologies in the effort to highlight the perspectives opened in the interconnect area and to identify the most promising roadmap.

Session 3: Systems

The increasing deployment of optical technologies for rack-to rack communication in current generation data center and HPC systems has so far lead to faster and greener system implementations. This workshop aims to highlight the latest achievements on optical system solutions that are placing photonics among the key enabling technologies of datacom and computercom evolution.

Session 4: Architecture

HPC and datacenter systems are being built out of increasing numbers of processors. To obtain high system efficiency, computation versus communication performance needs to be balanced and given the aggressive rate of increase in compute density it is of paramount importance to avoid having the interconnection network become the bottleneck. The workshop will look into HPC and DC systems from a high perspective, focusing on application requirements and interconnect architectures at different levels.

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- project.phoxtroT@izm.fraunhofer.de
- +49 30 46403 639



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Cordinator: Fraunhofer-Gesellschaft, Dr. Tolga Tekin, Fraunhofer Institute for Reliability and Microintegration IZM, Gustav-Meyer-Allee 25, 13355 Berlin, Germany.