



**NESTOR**  
DOCTORAL NETWORK



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**ICTON**

# NESTOR WORKSHOP

## 6th Workshop on Machine Learning for Optical Communications (MALOC)

26<sup>th</sup> International Conference on  
Transparent Optical Networks ICTON 2026  
12-16 July 2026



# About ICTON 2026

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The International Conference on Transparent Optical Networks (ICTON) is an annual conference covering optical communications, lasers and photonics. Its 26th edition was held at the Hotel Diplomat in Prague, Czech Republic, from 12 to 16 July 2026, alongside the 16th Sub-Wavelength Photonics Conference (SWP) and the 6th Conference on Advanced Fibre Lasers and Coherent Sources (AFLaser).

ICTON 2026 was organised by the National Institute of Telecommunications in Warsaw, together with the Institute of Photonics and Electronics of the Czech Academy of Sciences and the IEEE Photonics Society Poland Chapter, with technical co-sponsorship from the IEEE Photonics Society. Pavel Peterka served as General Chair and Jiří Čtyroký as Honorary Chair. The conference was held as an in-person-only meeting and drew more than 400 participants from academia and industry over five days.

The scope of ICTON and its co-located events cover the application of transparent and all-optical technologies across telecommunications, computing, sensing, imaging and quantum applications. Topics range from photonics and nanophotonic, nonlinear optics and fibre lasers through to optical switching and routing, broadband metro and access networks, network planning and design tools, quantum communications, and the convergence of optical and wireless technologies.

A distinctive feature of ICTON is the breadth of its co-located programme. The 2026 edition ran more than forty workshops and special sessions, covering areas including quantum photonics, photonic integrated components, free-space and satellite optical communications, multi-band open optical networks, green optical communications, data centre interconnects, and 6G network operation. The 6th Workshop on Machine Learning for Optical Communications (MALOC) was one of these.

Since its first edition in 1999, ICTON has provided a forum for presenting the results of collaborative European research projects and has grown into one of Europe's leading conferences in the field. Students, doctoral candidates and early-career scientists are actively encouraged to contribute.

# About NESTOR

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NESTOR “Next generation high-speed optical networks for metro access” is a Marie Skłodowska-Curie Doctoral Network funded under Horizon Europe, Grant Agreement no. 101119983.

NESTOR develops high-capacity, low-power optical networks for the metro and access segment, using advanced pluggable coherent transceivers to simplify network architectures. Work is organised across three technical strands: advanced DSP and transmission techniques; digital twin and real-time physical-layer control; and green network architecture, management and techno-economics.

The network hosts and trains twelve doctoral candidates across its partner institutions, combining academic supervision with industrial secondments at the project's vendor and operator partners.

NESTOR is coordinated by the Nokia Portugal team. The consortium comprises the beneficiaries: Nokia/Coriant R&D GmbH (Germany), Politecnico di Torino, Scuola Superiore Sant'Anna (Italy), Universitat Politècnica de Catalunya (Spain), Technische Universiteit Eindhoven (Netherlands), as well as associated partners such as Aston University and BT Group (United Kingdom), Orange (France), VPIphotonics (Germany), ISCTE (Portugal) and Ericsson (Italy).

Aston University's participation is supported through the UKRI Horizon Europe Guarantee, administered by the Engineering and Physical Sciences Research Council (EPSRC), under grant reference EP/Y031024/1.

# Workshop Agenda

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The workshop was organised and chaired by Professor Luis Velasco of Universitat Politècnica de Catalunya (UPC), a senior member of the NESTOR Doctoral Network leadership team.

- **Fabrication-Aware Design of a 3-Ring RAMZI Interlacer via Gaussian Process Surrogate Modeling**  
**Alberto Otero-Casado** *Chalmers University of Technology, Sweden*
- **Nonlinear Interference Noise Impact for Scalable Optical Network Planning in Horseshoe Scenarios**  
**Tiago Silvério** *Nokia, Germany*
- **Automated Extraction of Parameters from Optical Transceiver Datasheets Using a Multi-Stage LLM Pipeline**  
**Haris Hassan** *Nokia, Portugal*
- **Symbol Rate–Code Rate Trade-offs for IM/DD 200G/400G per Lane LPO Transceivers**  
**José Núñez Kasaneva** *Eindhoven University of Technology (TU/e), the Netherlands*
- **ML-based Physics-Guided Method for Low-Margin Nonlinear Interference Estimation in Optical Links**  
**Imran Chowdhury Dipto** *Politecnico di Torino, Italy*
- **OCATA Optical Time-Domain Digital Twin: Continuous Model Tuning with Signal-Domain Fidelity Assessment**  
**Mohammad Sadegh Ghasrizadeh** *Universitat Politècnica de Catalunya (UPC), Spain*
- **Isolated Control and Monitoring for Multi-Operator IPoWDM Networks**  
**Ghulam Bahoo** *Scuola Superiore Sant'Anna, Italy*
- **LLM-Orchestrated Digital Twin for Smart Optical Network Operations**  
**Sanwal Zeb** *Politecnico di Torino, Italy*
- **QoS-Aware Cooperative Bandwidth Allocation for Mobile Fronthaul Traffic in TDM-PON**  
**Xiang Lu** *Universitat Politècnica de Catalunya (UPC), Spain*

## Fabrication-Aware Design of a 3-Ring RAMZI Interlacer via Gaussian Process Surrogate Modeling

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**Alberto Otero-Casado<sup>4</sup>**

*Doctoral candidate, EMPOWER-6G (Marie Skłodowska-Curie)*

**Co-authors:** Christos Christofidis<sup>2</sup>, Dan Marom<sup>3</sup>, Ioannis Tomkos<sup>2</sup>, Paolo Monti<sup>4</sup>, Antonio Napoli<sup>1</sup>

<sup>1</sup> Nokia, Munich, Germany, <sup>2</sup> University of Patras, Greece, <sup>3</sup> The Hebrew University, Jerusalem, Israel, <sup>4</sup> Chalmers University, Gothenburg, Sweden

**Abstract:** This work addresses how to tune the RAMZI filter for optimal performance in metro-access networks. The coupling coefficients of the device are first refined using a staged search procedure based on a tested analytical model that emulates the system performance. A local fabrication-aware analysis is then performed around the selected candidates, and Gaussian process surrogate models are trained to estimate the sensitivity penalty under expected fabrication variations with reduced computational cost. The surrogate predictions are validated against analytical model evaluations, showing that the proposed approach can identify robust candidate designs while substantially reducing the computational time.

 [Read the full paper on the ICTON website](#)

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## Nonlinear Interference Noise Impact for Scalable Optical Network Planning in Horseshoe Scenarios

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**Tiago Silvério<sup>1,2</sup>**

*NESTOR Doctoral Candidate*

**Co-authors:** Mohammad Hosseini<sup>1</sup>, Giuseppe Parisi<sup>1</sup>, Sasipim Srivallapanondh<sup>1</sup>, Luis Velasco<sup>2</sup>, Antonio Napoli<sup>1</sup>

<sup>1</sup> Nokia, Munich, Germany, <sup>2</sup> Universitat Politècnica de Catalunya, Barcelona, Spain

**Abstract:** This study investigates the impact of Nonlinear Interference (NLI) noise on the scalability of optical networks built using horseshoe-like topologies. By varying key design parameters such as the number of nodes, per-node capacity and span length, the work quantifies how nonlinear effects limit achievable reach and aggregate throughput as network scale increases. The analysis provides insight into the balance between traffic growth and physical-layer constraints, highlighting design trade-offs that guide efficient dimensioning of future flexible optical infrastructures.

 [Read the full paper on the ICTON website](#)

## Automated Extraction of Parameters from Optical Transceiver Datasheets Using a Multi-Stage LLM Pipeline

**Haris Hassan**<sup>1</sup>

*NESTOR Doctoral Candidate*

**Co-authors:** João Pedro<sup>1,2</sup>, Luís Gonalo Cancela<sup>3,2</sup>

<sup>1</sup> Nokia, Carnaxide, Portugal, <sup>2</sup> Instituto de Telecomunicações, IST, Lisbon, Portugal, <sup>3</sup> Iscte — Instituto Universitário de Lisboa, Portugal

**Abstract:** Unlike conventional top-down extraction approaches that assume a predefined hierarchy, the proposed framework discovers operational structures and mode relationships before performing scoped parameter extraction and schema synthesis. The system combines layout-aware PDF parsing, schema-grounded prompting, multi-stage LLM orchestration and operational mode synthesis. The core contribution is a progressive mode discovery pipeline that treats operational modes as first-class entities rather than derived metadata. This enables robust resolution of parameter scope ambiguity across coherent and direct-detect optical modules. The framework supports explicit, fixed and parametric mode representations while preserving inheritance relationships and conditional constraints.

 [Read the full paper on the ICTON website](#)

## Symbol Rate–Code Rate Trade-offs for IM/DD 200G/400G per Lane LPO Transceivers

**José Núñez Kasaneva**<sup>1</sup>

*NESTOR Doctoral Candidate*

**Co-authors:** Yunus Can Gültekin<sup>1</sup>, Stefanos Dris<sup>2</sup>, Paraskevas Bakopoulos<sup>2</sup>, Nikos Argyris<sup>2</sup>, Gabriele Liga<sup>1</sup>

<sup>1</sup> Department of Electrical Engineering, Eindhoven University of Technology (TU/e), the Netherlands, <sup>2</sup> NVIDIA, Athens, Greece

**Abstract:** We analyse the symbol rate–code rate trade-off in bandwidth-limited IM/DD systems targeting LPO transceivers, using PAM-4/6/8 as candidate modulation formats. We use the capacity of the binary symmetric channel as an achievable information rate under hard-decision decoding, serving as a performance metric for 200G and 400G per-lane throughput targets. Our results show that reducing the FEC code rate below the KP4 baseline allows higher-order PAM formats to operate at substantially lower symbol rates than PAM-4 while meeting the throughput requirement.

 [Read the full paper on the ICTON website](#)

## ML-based Physics-Guided Method for Low-Margin Nonlinear Interference Estimation in Optical Links

**Imran Chowdhury Dipto<sup>1</sup>**

*NESTOR Doctoral Candidate*

**Co-authors:** Rosario Ietro<sup>1</sup>, Emanuele Virgillito<sup>1</sup>, Sanwal Zeb<sup>1</sup>, Sai Kishore Bhyri<sup>2</sup>, Gabriele Maria Galimberti<sup>3</sup>, Nelson Costa<sup>4</sup>, Giuseppe Parisi<sup>5</sup>, João Pedro<sup>6,7</sup>, Antonio Napoli<sup>5</sup>, Vittorio Curri<sup>1</sup>

<sup>1</sup> Politecnico di Torino, Italy, <sup>2</sup> Nokia, Bengaluru, India, <sup>3</sup> Nokia, Vimercate, Italy, <sup>4</sup> Nokia, Lisbon, Portugal, <sup>5</sup> Nokia, Munich, Germany, <sup>6</sup> Nokia, Carnaxide, Portugal, <sup>7</sup> Instituto de Telecomunicações, IST, Lisbon, Portugal

**Abstract:** This research focuses on the semi-analytical NLI model recently introduced for SCI and XCI in DM systems, where the GN contribution is corrected through two key parameters: the spatial correlation factor  $C_{ij}$ , accounting for nonlinear interactions between spans  $i$  and  $j$ , and the GN conservativity correction  $\pi_i$ , correcting the intrinsic overestimation of the GN model. As these terms lack closed-form expressions, we tested three regression Machine Learning models and proposed the PhysicsXGB model for predicting  $C_{ij}$  and  $\pi_i$  separately for SCI and XCI. The analysis investigated the impact of physics-derived engineered features and span-level heterogeneity on regression accuracy, evaluating all models under realistic DM link configurations. The results showed that the proposed model enabled real-time and spectrally disaggregated NLI estimation with significant accuracy, providing a viable path towards a fast and reliable Digital Twin engine for optical networks.

 [Read the full paper on the ICTON website](#)

## OCATA Optical Time-Domain Digital Twin: Continuous Model Tuning with Signal-Domain Fidelity Assessment

**Mohammad Sadegh Ghasrizadeh**

*NESTOR Doctoral Candidate*

**Co-authors:** Marc Ruiz, Luis Velasco

All authors: Optical Communications Group (GCO), Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

**Abstract:** Multiband (MB) optical transmission entails large nonlinear impairments (NLI) affecting optical channels differently. Accurate quality of transmission (QoT) estimation during lightpath provisioning is therefore strictly required to ensure the feasibility of the optical transmission over the computed lightpaths. In this paper we review the OCATA MB optical time-domain digital twin, which provides fast and accurate QoT estimation while reducing the complexity associated with NLI. In addition, we show how NLI noise can be mitigated by optimising parameters at the receiver side during lightpath provisioning to further optimise network performance.

 [Read the full paper on the ICTON website](#)

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## Isolated Control and Monitoring for Multi-Operator IPoWDM Networks

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**Ghulam Bahoo**

*NESTOR Doctoral Candidate*

**Co-authors:** A. Sgambelluri, N. Sambo

All authors: Scuola Superiore Sant'Anna, Pisa, Italy

**Abstract:** Multi-Operator IP over Wavelength Division Multiplexing (IPoWDM) networks require strict isolation of control and telemetry data. This paper presents an Apache Kafka-based control architecture for a multi-operator environment in which each virtual operator (vOp) is activated and assigned dedicated coherent pluggable transceiver interfaces. A virtual agent (vAgent) is deployed directly on IPoWDM nodes, enabling isolated control, telemetry collection and optical service provisioning. Experimental results show low-latency operator activation, optical service setup time, memory utilisation and isolated monitoring per operator.

 [Read the full paper on the ICTON website](#)

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## LLM-Orchestrated Digital Twin for Smart Optical Network Operations

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**Sanwal Zeb<sup>1</sup>**

*NESTOR Doctoral Candidate*

**Co-authors:** Imran Chowdhury Dipto<sup>1</sup>, Muhammad Umar Masood<sup>1</sup>, João Pedro<sup>2</sup>, Antonio Napoli<sup>3</sup>, Vittorio Curri<sup>1</sup>

<sup>1</sup> Dept. of Electronics & Telecommunications, Politecnico di Torino, Italy, <sup>2</sup> Nokia Optical Networks, Carnaxide, Portugal, <sup>3</sup> Nokia Optical Networks, Munich, Germany

**Abstract:** This presentation proposes a large language model (LLM)-orchestrated framework that enables intent-driven interaction with optical network digital twins (DTs) using natural language. A locally deployed, non-fine-tuned Mistral-7B model serves as a reasoning and orchestration layer, translating user queries into structured and validated digital twin operations through prompt-guided tool selection. A lightweight agent ensures parameter consistency before execution, enabling reliable automation of tasks such as topology generation, routing and quality-of-transmission (QoT) analysis via deterministic backend computations. The framework is evaluated on a domain-specific benchmark covering multi-step network operations. It achieves a Domain-Grounded Accuracy of 89.22% with an average latency of 15.11 seconds, while maintaining low computational overhead and minimal hallucination. These results demonstrate that compact, locally deployed LLMs, combined with structured tool integration, provide a practical alternative to fine-tuned or cloud-based solutions for smart optical network operations.

 [Read the full paper on the ICTON website](#)

## QoS-Aware Cooperative Bandwidth Allocation for Mobile Fronthaul Traffic in TDM-PON

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**Xiang Lu**

*NESTOR Doctoral Candidate*

**Co-authors:** Luis Velasco, Marc Ruiz

All authors: Optical Communications Group (GCO), Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

**Abstract:** Emerging mobile fronthaul services introduce new challenges for traffic scheduling in time-division multiplexing passive optical networks (TDM-PON), as they impose stringent deterministic latency requirements and high reliability demands. We propose a novel QoS-aware Co-DBA scheme for TDM-PON-based fronthaul to better satisfy the various latency requirements of fronthaul traffic flows. Through simulations, we investigate the conditions under which deterministic latency guarantees can be achieved for mobile fronthaul traffic under different traffic loads.

PDF

[Read the full paper on the ICTON website](#)

# Workshop in Pictures

*NESTOR doctoral candidates presenting their research during the MALOC workshop at ICTON 2026, Prague.*



*NESTOR doctoral candidates and supervisors at ICTON 2026, Hotel Diplomat, Prague.*



**José Núñez Kasaneva**

*Symbol Rate–Code Rate Trade-offs for IM/DD 200G/400G per Lane LPO Transceivers*



**Imran Chowdhury Dipto**

*ML-based Physics-Guided Method for Low-Margin Nonlinear Interference Estimation in Optical Links*



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**Tiago Silvério**

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