

**NEBULA project: Combining BTO based plasmonic modulators with Neuromorphic Augmented Receivers for higher than 100Gbaud Intra- and Inter- Data Center Interconnects**

D. Chatzitheocharis<sup>1,2</sup>, T. Chrysostomidis<sup>1,2</sup>, I. Roumpos<sup>1,2</sup>, M. Kohli<sup>3</sup>, U. Koch<sup>3</sup>, J. Leuthold<sup>3</sup>, F. Eltes<sup>4</sup>, S. Sackesyn<sup>5,6</sup>, S. Masaad<sup>5,6</sup>, P. Bienstman<sup>5,6</sup>, T. Buriakova<sup>7</sup>, M. Zervas<sup>7</sup>, C. Caillaud<sup>8</sup>, H. Bertin<sup>8</sup>, C. Besançon<sup>8</sup>, D. K. Sharma<sup>9</sup>, A. Bouhelier<sup>9</sup>, V. Grimaldi<sup>10</sup>, C. De Vita<sup>10</sup>, F. Zanetto<sup>10</sup>, A. Ivan Martinez Rojas<sup>10</sup>, G. Ferrari<sup>10</sup>, F. Morichetti<sup>10</sup>, M. Sampietro<sup>10</sup>, E. Kyriazi<sup>11</sup>, D. Apostolopoulos<sup>11</sup>, H. Avramopoulos<sup>11</sup>, D. Petousi<sup>12</sup>, B. Wohlfeil<sup>12</sup>, S. Alnairat<sup>13</sup>, N. Argyris<sup>13</sup>, P. Bakopoulos<sup>13</sup>, B. Atias<sup>13</sup>, E. Mentovich<sup>13</sup>, J. Declercq<sup>14</sup>, J. Lambrecht<sup>14</sup>, J. Van Kerrebrouck<sup>14</sup>, X. Yin<sup>14</sup>, J. Van Campenhout<sup>14</sup>, B. Offrein<sup>15</sup>, F. Hermann<sup>15</sup> and K. Vyrsokinos<sup>1,2</sup>

<sup>1</sup>School of Physics, Aristotle University of Thessaloniki, Thessaloniki, 54124, Greece

<sup>2</sup>Center of Interdisciplinary Research and Innovation, Aristotle University of Thessaloniki, 52124, Greece

<sup>3</sup>ETH Zürich, Institute of Electromagnetic Fields (IEF), 8092 Zürich, Switzerland

<sup>4</sup>Lumiphase AG, Dorfstrasse 147, 8802 Kilchberg, Switzerland

<sup>5</sup>Photonics Research Group, Department of Information Technology, Ghent University - imec, Belgium

<sup>6</sup>Center for Nano- and Biophotonics (NB-Photonics), Ghent University, Belgium

<sup>7</sup>Ligentec SA, 1024 Ecublens, Switzerland

<sup>8</sup>III-V Lab, A Joint Laboratory Between Nokia, Thalès, and CEA Leti, 1 av. A. Fresnel 91767 Palaiseau, France

<sup>9</sup>Laboratoire Interdisciplinaire Carnot de Bourgogne, UMR 6303 CNRS, Université de Bourgogne Franche-Comté, Dijon 21078, France

<sup>10</sup>Department of Electronics, Information and Bioengineering, Politecnico di Milano, 20133 Milano, Italy

<sup>11</sup>School of Electrical & Computer Engineering, National Technical University of Athens, 15773 Athens, Greece

<sup>12</sup>ADVA Optical Networking SE, Maerzenquelle 1-3, 98617 Meiningen, Germany

<sup>13</sup>NVIDIA networking, Yokneam, Israel

<sup>14</sup>IDLab, Ghent University - imec, Ghent 9052, Belgium

<sup>15</sup>IBM Research—Zurich, 8803 Rüschlikon, Switzerland

**Abstract:** This presentation will showcase the technology advancements of NEBULA EU project aiming to provide the foundations for a common future-proof transceiver technology platform with ultra-high bandwidth capabilities offered by a CMOS compatible tailored made toolkit, towards meeting performance, cost and energy metrics in both inter-DCI coherent and intra-DCI ASIC co-packaged optics. The first part of the talk will focus on the transmitter side providing details about the fabrication efforts for plasmonic modulators featuring BaTiO<sub>3</sub> (BTO) as electro-optical material on the Si<sub>3</sub>N<sub>4</sub> platform for sub-volt operation. The second part will present the architecture of the neuromorphic assisted receiver targeting ASICless efficient demodulation of QAM coherent signals at higher than 100Gbaud, highlighting also recent experimental results from recently fabricated photonic integrated circuits and assemblies.