Registration form for Polish research institution

1. Research institution data (name and address):

National Institute of Telecommunications - the State Research Institute. Szachowa Str. 1; 04-894 Warsaw

2. Type of research institution:

1) research institute

3. Head of the institution:

Jerzy Żurek

Director of the Institute

4. Contact information of designated person(s) for applicants and the NCN:

Jordi Mongay Batalla

Scientific Director

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Tel. 22 512 82 77

Szachowa Str. 1; 04-894 Warsaw

5. Research discipline in which the strong international position of the institution ensures establishing a Dioscuri Centre:

Natural Sciences and Technology

■ Systems and communication engineering

6. Description of important research achievements from the selected discipline from the last 5 years including a list of the most important publications, patents, other (*up to one page in A4 format*):

Developing an innovative optical fiber bases sensors and other passive photonic components. The National Institute of Telecommunications (NIT) conducts research in designing, manufacturing, characterization, and application of photonic structures for metrology, sensing, and optical telecommunications. In the listed areas NIT closely cooperates with the key national centers and collaborates with foreign partners (e.g., UQO – Université du Québec en Outaouais, Canada, US - University of Sannio, Italy). In particular, NIT's photonic team focuses its studies on the development and implementation of innovative fiber optic sensors and sub-systems based on: periodic (e.g., Bragg and long period gratings), interferometric (e.g., Fabry-Perot, Mach-Zehnder), and thin-film (e.g., single and multilayer coatings) structures applied to optical fibers. Additionally, the research areas completed by modeling of low-dimensional photonic structures and elements of diffractive optics for applications in

optics and photonics. The team publishes in leading photonics magazines such as: Biosensors and Bioelectronics (IF=8.173), Sensors and Actuators B: Chemical (IF=5.667), Scientific Reports (IF=4.122), Journal of Lightwave Technology (IF=3.652), Optics Letters (IF=3.589), Optics Express (IF=3.356), Biomedical Optics Express (IF=3.337), IEEE Sensors Journal (IF=2.617), IEEE Photonics Technology Letters (IF=2.446), Sensors and Actuators A: Physical (IF=2.331), etc.

Installation of a two-way satellite time transfer system (TWSTFT) under Special Research Equipment – SPUB. In 2017 Special Research Equipment: Assembly of Time and Frequency Standards for participation in Polish Atomic Timescale TA(PL) – SPUB was extended with transceiver station of satellite two-way time transfer system for comparisons of UTC(PL) implemented by GUM (Polish Central Office of Measures) with international timescales TAI (International Atomic Time Scale) and UTC (Universal Time Coordinated).

Developing an innovative system to deliver high quality media services to users. Developing an innovative Media Distribution System, including the Media Distribution Middleware (MDM), the Media Advanced Streamer (MAS), the Media QoE Meter (MQM) and the Media Services Manager (MSM). The MDM coordinates, dynamically and continuously, taking into account the process of event prediction, the optimal use of resources for the implementation of media services available from providers. Based on the results obtained from MQM and information on the availability of resources from service providers, MDM provides MSM with information on the requirements for streaming and the desired functionality on an ongoing basis. The MDM will be a part of the media distribution system located at the operator's premises. The system was developed within a consortium consisting of two research units (NIT and the University of Nicosia). The result of research and development of the system is a number of significant scientific publications produced jointly by employees NIT and the members of the consortium, which have been published, among others, in journals: IEEE Wireless Communications Magazine (IF=8.972), IEEE Systems Journal (IF=2.114), Springer Soft Computing Journal (IF=1.263). In addition, two patents were obtained: a patent granted by the Polish Patent Office, Application No. P.412498, patent No. PL227259 and a patent granted by the European Patent Office, Application No.EP16186667.8, patent No.EP3301945.

Developing an ID-based secure communications system for unified Access in IoT. Developing an secure platform for self-management of the things and services in the Internet of Things (IoT) environment. The platform brings the functionalities of the so-called ID layer to the network structure and integrates self-management, mobility and security/privacy functionalities in order to create a network infrastructure that offers an easier (and intuitive) access to the IoT services. The secure ID layer has been extended, which solves object and service access in the network itself. The system extends current solutions by: addressing not only objects but also services, distributing and facilitating general process as registration and publication of objects/services, adding enhanced security and privacy mechanisms, introducing ID layer self-management functionalities in network level, improving flexibility in multicast/anycast communications at different levels and optimizing information forwarding. The result of research and development of the system is a number of important scientific publications in leading magazines such as: IEEE Communications Magazine (IF=10.435), IEEE Wireless Communications (IF=8.972), ACM Computing Surveys (IF=6.748), Cluster Computing (IF=2.040), Elsevier Computer & Electrical Engineering (IF=1.570), Journal of Supercomputing (IF=1.326), Wiley International Journal of Network Management (IF=1.118), and one patent application (Polish Patent Office, Application No.

P.410746). The results were also presented at international scientific conferences (i.e., IEEE GLOBECOM 2014, 2016; IEEE International Conference on Communications (ICC) 2016, 2017).

Organization of the International Conference International Conferences on Transparent Optical Networks – ICTON. The conference has been organized continuously since 1999 in cooperation with leading European research centers and IEEE Photonics Society. The thematic scope of ICTON includes the latest developments in optical communication, optoelectronics, photonics, new phenomena and photonic materials. Recent conferences were organized in cooperation with local research centers in: 2015 Budapest, Hungary (428 participants from 46 countries), 2016 Trento, Italy (474 participants from 42 countries), 2017 Girona, Spain (418 participants from 42 countries). The ICTON conference remains at the forefront of thematic fibre-optic conferences, in terms of interest of the scientific community, substantive level, and overall organizational level. The ICTON currently comprises more than twenty thematic workshops listed on the ICTON website on the IMI server: http://www.itl.waw.pl/konferencje/icton; ICTON materials are available in the IEEE-Xplore Digital Library and are archived, among others, in Web of Knowledge and SCOPUS.

7. List of no more than 3 important research projects from the selected discipline awarded in national and international calls to the institution in the last 5 years (title, name of PI, source of funding, amount of funding):

Project 1

Title: Efficient, Safe and Sustainable Traffic at Sea (EfficienSea2)

Programme: Horizon 2020; *Contract no.:* 636329; *Duration:* 2015–2018;
Name of PI: Danish Maritime Authority; *Responsible in NIT:* Dr. Krzysztof Bronk; *Source of funding:* the European Union; *Project value:* 11 482 500,89 euro; *Implementation*: consortium 32 dedicated partners from 12 countries in the Baltic Sea region and beyond.
Project aim: EfficienSea2 was a Flagship Project in the European Union Strategy for the Baltic Sea Region. Innovative and smart solutions for efficient, safe and sustainable traffic at sea through improved connectivity for ships were created and implemented. EfficienSea2 has been a demonstrator in the Arctic and Baltic Sea and the first generation of a coherent e-Navigation solution. Through global collaboration, use of open-source software and an explicit aim for standardized solutions, EfficienSea2 paved the way for a global roll-out of e-Navigation. Within the WP2 project thematic group, the NIT dealt with the development of radio link switching mechanisms for the needs of the hybrid communication system and the development of a new standard for wireless data transmission system VDES (VHF Data Exchange System).

Project 2

Title: Network-Aware Delivery Clouds for User Centric Media Events (DELTA)

Programme: EUROSTARS; *Contract no.:* E8111/1/NCBR/2014; *Duration:* 2014-2016; *Name of PI*: Olimpiu Negru; *Project Technical Coordinator*: Dr. Jordi Mongay Batalla; *Source of funding:* the European Union and the Polish National Centre for Research and Development (NCBR); *Project value:* 1 562 850,00 euro; *Implementation*: *consortium*: VIOTECH Communications (France) – *coordinator;* BSOFT (Italy) – partner, UNIVERSITY of NICOSIA (Cyprus) – *partner*, CABLENET (Cyprus) – *partner*, National Institute of Telecommunication (Poland) – *partner*; MINT MEDIA (Poland*)* – *partner.*

Project aim: DELTA project aimed at developing an innovative and ready-to-market solution that synergistically combines Networked Media and Telecommunications technologies with Cloud Computing assets into a unified digital ecosystem, enabling users to exploit OTT and Telco services with maximum possible QoE. By designing and deploying a novel media delivery architecture implementing a "Future Internet Media-Aware Environment", DELTA paved the way towards Universal Media Provision via open environments, enabling personalisation and most predominant user-centric involvement capabilities in networked media activities. This new architecture was aimed to be built upon the existing loosely-coupled Internet thus preserving the current investments. It could be gradually enhanced from a "blind", service-agnostic platform towards a global flexible environment offering improved Quality of Experience.

Project 3

Title: Tunable hyperbolic metamaterials for photonic devices of novel generation (HYPERMAT)

Programme: TECHMATSTRATEG*; Contract no.:* TECHMATSTARTEG1/347012/3/NCBR/2017; *Duration*: 2017–2020; *Name of PI*: Prof Michał Malinowski; *Responsible in NIT*: Dr. Mariusz Zdanowicz; *Source of funding*: the Polish National Centre for Research and Development (NCBR); *Project value*: 8 062 300,00 PLN; *Implementation*: *consortium:* Warsaw University of Technology – *coordinator;* PCO S.A. - *partner*, National Institute of Telecommunication – *partner*, Military University of Technology – *partner,* Institute of Physics Polish Academy of Sciences – *partner.*
Project aim: The main objective of this project is to develop an innovative technology of tunable multilayer hyperbolic metamaterials (THMMs) operating in NIR and MIR frequency ranges. Such structures exhibit extraordinary features unprecedented in commercially available state-of-the-art photonic solutions, resulting from unusual dispersion characteristics which can be controlled by an external electric field. THMMs can be used as efficient, adaptive antireflective coatings (AR) or as tunable edge-filters in photonic components commercially offered by our large industrial partner, i.e., PCO S.A. The development of the technology of tunable hyperbolic metamaterials, demonstration of the proof of concept, and transfer of the technology to PCO S.A. could become the foundation for the technological platform of a novel class of photonic components, which would significantly enrich PCO S.A.'s commercial offer and become a strong impulse for the development of innovative national photonics industry, offering products globally. It is expected that the results of the project will contribute to the development of science related to nanotechnology and photonics. An intensive cooperation between Consortium partners will emerge to advance scientific leadership of the Polish scientific units as the leaders in the modelling, technology and characterization of photonic devices including nanostructures based on THMMs.

8. Description of the available laboratory and office space for the Dioscuri Centre (*up to one page in A4 format*):

Laboratories:

PL-LAB2020 research laboratory. The laboratory was established as a result of a national project that was implemented in a consortium of five partners and NIT as a leader. The PL-LAB2020 is a distributed laboratory, involving equipment installed in different project partners' locations. It allows researchers to create virtual laboratories, with guaranteed resources and remote access to laboratory equipment. The NIT's PL-LAB2020 laboratory allows for research and experimentation in the following areas:

Network Virtualization, Software Defined Networking, Information Centric Networks and Network Management.

Optics and photonics laboratory within the Laboratory of Electrical, Electronic & Optoelectronic Metrology (LMEEiO). The successful grant awarded by the National Centre for Research and Development allowed us to develop the competences of the Laboratory of Electrical, Electronic & Optoelectronic Metrology (LMEEiO) by introducing the advanced optics and photonics laboratory. Apart from the usual calibration services confirmed by the accreditation certificate issued by the Polish Centre for Accreditation (AP 015), the experiments in the field of the nonlinear and linear optics in order to develop new materials for photonics are carried out. Above all, research work on creating of novel composites for the optical devices and integrated photonics is also possible. In particular LMEEIO allows conducting research on composites consisting of metals, dielectrics and semiconductors for the new and unpreceded metamaterial structures for the use in communication systems, sensors and nonlinear optical components.

Assembly of Time and frequency Standards for participation in Polish Atomic Timescale TA(PL) – Special Research Equipment (SPUB) within Central Chamber for Telecommunication Measurement. The Special Research Equipment of the NIT consists of two atomic caesium time standards along with many measurements instruments and a set of devices to maintain their continuous, failure-free work. The support system consists of several redundant uninterrupted power supply systems, precision air conditioning and a generator set. NIT's timestandards are continuously participating in independent Polish Atomic Scale (in realization Official Polish Time UTC(PL)), which is distributed by Polish Central Office of Measures (GUM) and in international Universal Time Coordinated UTC calculated by the International Bureau of Measures (BIPM). BIPM makes available the results of the comparisons of the NIT standards to the entire world of time metrology in the form of regular reports on its website (BIPM). Lately SPUB was extended with transceiver station of satellite two-way time transfer system TWSTFT for comparisons of UTC(PL) implemented by GUM with international timescales TAI and UTC. In addition to research and development, the SPUB is used to provide the highest level of accuracy calibration services for measuring instruments.

PIBUK – IT platform for research and diagnosis of the properties of electronic communication services. The platform was built in NIT, as part of the POIG 2007-2013 programme, co-financed by EFRR. It can be also applied for BigData analysis in other areas. PIBUK is a combination of infrastructure and advanced IT applications for analysing large amounts of data that may come from various areas of telecommunications and from other fields. It allows for quick exploration and visualization of huge data volumes, offering tools for advanced analyses (correlation, regression, time series), several dozen forms of visualization, including map charts, and enables independent reporting on creating and distributing reports and analyses through a browser, mobile channels, and MS Office. PIBUK has a SAS Event Stream Processing (ESP) module for real-time data streaming and a Research and Diagnostics System (PSBD) which allow conducting multidimensional data analysis and presentation of results in the form of interactive dynamic reports and static reports, also by placing report elements on the maps.

Office space

The Institute may provide office space for each member of the Dioscuri team in the form of a separate room with an area of 13 m^2.

9. List of the available research equipment for the Dioscuri Centre:

PL-LAB2020 research laboratory

The main research equipment located in the NIT PL-LAB2020 laboratory is as follows:

- devices for SDN networks, including Pica switches with hardware support for SDN/OpenFlow, QuantaMesh "bare metal" switches and servers with high end network interfaces that support DPDK (Data Plane Development Kit);
- variety of devices for virtualization of services and network functions (among others, HP and Dell multiprocessor virtualization servers);
- network testers/analyzers (Spirent TestCenter, Spirent Attero) with 1/10 Gbps interfaces and a wide range of specialized applications for the measurement and emulation of services in packet networks.

Optics and photonics laboratory

- Onefive ORIGAMI 10HP high-power laser system;
- Vibration isolated optical table and other opto-mechanical and measurement equipment.

The research laboratory available for the Dioscuri Centre is a state of the art nonlinear optics and micromachining laboratory with a high-power, femtosecond laser, and all the optical components required for the characterisation of both: linear and nonlinear properties of the optical materials. Optical table with vibration isolation legs is placed in a dark room to prevent any contamination of the experimental data.

Assembly of Time and frequency Standards for participation in Polish Atomic Timescale TA(PL) – Special Research Equipment (SPUB)

The main research equipment located in the SPUB covers a wide range of measuring instruments in the field of time and frequency metrology:

- reference time and frequency signals from atomic cesium standards;
- frequency meters;
- time / time interval meters.

PIBUK – IT platform

The platform consists of two virtualization clusters, each containing 3 servers (14 cores, 2.3 GHz, 35 MB cache, 393 GB RAM). Data are stored on 16 TB SAN matrix. The Business Intelligence (BI) system, which is run on the hardware platform, consists of a data integration module, data warehouse, analysis and modeling modules, visualization and alarm modules. The data integration module is equipped with Extract-Transform-Load/Extract-Load-Transform (ETL/ELT) modules available as part of the SAS Data Integration Server and a data stream processing module in the form of SAS Event Stream Processing Engine. The data warehouse is based on the PostgreSQL relational database and SAS datasets, including the On-line Analytical Processing (OLAP) cube. Analysis and modeling modules enable conducting statistical analyzes, forecasting, exploration of numerical and text data, multidimensional data analysis, geospatial data analysis using maps, modeling for numerical and text data using SAS Enterprise Guide software, SAS Enterprise Miner, SAS Text Miner, SAS Model Manager, SAS Visual Analytics, SAS Visual Statistics, SAS OLAP, SAS Add-in to Microsoft Office. Data visualization modules enable text and graphical reporting (including various charts or maps) using SAS Visual Analytics, SAS Information Maps,

SAS OLAP Server, SAS Stored Processes, SAS Web Report Studio, and SAS Output Delivery System (ODS). The alerting modules allow real-time information on events detected in the streaming data using SAS Event Stream Processing Engine, information on events detected during ETL/ELT processing or batch execution of SAS 4GL code using SAS Data Integration Server, Platform Suite for SAS or SAS Job Server.

10. List of the additional benefits (other than listed in call text) that the Institution declares to provide for the Dioscuri Centre (i.e.: additional funds, personal benefits, other) (*up to one page in A4 format*):

Company's social benefits fund – co-financing holidays, sports activities and cultural events for employees and their children, as well as nurseries and kindergartens for employees' childrens.
A company apartment – the Institute of Telecommunications owns a number of apartments situated 5 min. walk from the Institute that are rented to the employees on attractive conditions (rental fee is cost-based). Apartments will be at disposal of the researchers, if available.
Courses and trainings – capability of self-improvement through trainings, courses and conferences in the field of telecommunication, electronics, computer science etc.
Financial support to education at high schools and post diploma education – co-financing studies on the basis of agreement with two-years period of employment after ended studies.

11. Other information about the internationalisation of the research institution, international researchers employed at the institution, the availability of English language seminars etc. (*up to one page in A4 format*):

Participation in projects of the European Union Framework Programme and in other international research programmes (including: FP7: ALICANTE, IDEALIST; Horizon 2020: EfficienSea 2, SIMFREE; POLLUX: IDSECOM; EUROSTARS: DELTA; Celtic+, the EUREKA initiative: MONALIS; Interreg Baltic Sea Region Programme: R-Mode Baltic).
Participation in international research programmes COST (European Cooperation in Science and Technology) – In 2017 the Institute participated in the following COST Actions: COST Action TU1208 , COST Action MP1302; COST Action MP1401, COST Action MP1403, COST AAPELE IC1303; COST Action CA15127, COST Action CA16220.
Cooperation with the European Space Agency. Work on satellite systems (AIS satellite system): SAT-AIS-PL (Phase A) project, co-funded by ESA; VDE Future/Jericho VDE project, co-funded by ESA under the ARTES (IAP).
Contributing to the development of new telecommunications regulations and standards: The Institute's staff are experts or delegates in international standards organizations, including: ETSI, CEN, CENELEC,CEPT, CISPR, IEC, IEEE, ISO, ITU-R, ITU-T.
Cooperation with Bureau International des Poids et Mesures, Paris, France, coordinated by the Central Office of Measures, cooperation in the creation of the TAI International Time Scale and the ITC Universal Coordinated Time.
Organization/co-organization of international conferences, seminars and workshops: NIT organizes and co-organizes regular international scientific conferences: (ICTON) dedicated to optical fiber communications networks (since 1999); International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility symposium

organized every two years jointly with Wroclaw Institute of Technology dedicated to issues of electromagnetic compatibility (since 1972).

Bilateral cooperation – the Institute researchers cooperated on a bilateral basis with foreign research organizations and teams, the results of which are e.g.: joint research on science, articles, scientific publications, book chapter, conference papers, speeches at international conferences, joint project proposals.

Membership of the Institute's staff in the Programme Boards of foreign periodicals: Optical and Quantum Electronics (Springer); Studia Logica; Journal of Applied Non-Classical Logics; Transactions on Rough Sets, LNCS Journal: Subline;Trends in Logic (Springer book series).

Membership of the Institute's staff in the following foreign or international organizations, research institutions and societies: IEEE; FITCE; Foundation of Logic, Language, Information; International Rough Set Society; Polish Association of Logic and Philosophy of Science; IALA (International Association of Lighthouse Authorities).

Evaluation of proposals for international projects from Horizon 2020 by NIT's experts at the invitation of the European Commission (e.g. WiSHFUL, eWINE).

Preparing reviews of dozens of articles published in foreign scientific journals – for example in IEEE Communications Magazine, IEEE Wireless Communications, IET Network, IEEE Transactions on Information Forensics & Security and many others.

Publishing activity – the Institute is a publisher of research magazine Journal of Telecommunications and Information Technology (JTIT). The JTIT is published quarterly in English and is indexed, among others, by: SCOPUS, INSPEC and ProQuest.

Trainings and Courses – the NIT Training Center in cooperation with the ITU, organizes workshops in English as part of the ITU Centres of Excellence project to be implemented in 2015–2018.