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1. GENERAL INFORMATION
The National Institute of Telecommunications (NIT) operates on the basis of the following legal documents:

- The Act of 30 April 2010 on Research Institutes (Journal of Laws, 2010, No 96, Item 618, with later amendments);

- The Decision of 18 September 1951 issued by the Minister of Posts and Telegraphs on the constitution of the Institute of Telecommunications (Official Gazette of the Republic of Poland, 1991, No A-91, Item 1261);

- The Resolution of 31 May 2005, issued by the Council of Ministers, granting to NIT the status of the National Research Institute (Journal of Laws, 2005, No 103, Item 862);

- The Statute of NIT, approved by the Decision No 7 of 13 May 2016, issued by the Minister of Digital Affairs (Official Journal of Minister of Digital Affairs, 2016, Item 16).

The Institute is supervised by the Ministry of Digital Affairs.

In 2005, NIT obtained the status of National Research Institute (Państwowy Instytut Badawczy). Such status is granted to research units which have the ability to perform duties considered especially important for planning and executing the State policy, and it obliges granted units to carry out these special duties.
The activities carried out by the Institute are focused mainly on research and development in the area of ICT (Information and Communication Technologies), frequently performed in cooperation with different partners (see Fig. 1), and on complementary activities such as:

- technical expertise, opinions and consultancy,
- implementation and deployment of equipment and systems,
- services of accredited laboratories,
- scientific publications, possibly featured in leading international journals,
- national and international standardization,
- publishing of periodicals and books,
- professional training and courses,
- organization of seminars, conferences etc.
NIT’s activities are concentrated mainly on the following subjects:

- intelligent environment networks – integrated telecommunication systems,
- optoelectronics and photonics for the needs of ultrafast telecommunications,
- electromagnetic compatibility – EMC,
- spectrum management and radio networks planning,
- maritime radio communication, cellular and wireless systems and networks,
- digital radio and TV, broadband networks, NGN networks, Future Internet, 5G technology
- satellite systems of communication and navigation,
- power systems for telecommunications, maintenance and security systems, systems for public administration,
- software, knowledge and decision support engineering,
- telecommunications infrastructure: organizational, functional and development aspects, intelligent transport systems,
- quality of service in telecommunications networks,
- telecommunications, data transmission and postal markets,
- postal and electronic communication services: legal, economic, market, social and development aspects,
- national and international standardization,
- metrology.
The activities are financed from:

- government support;
- European and national research projects (obtained by the participation in competition calls);
- projects executed with commercial organisations, such as network operators and industry (including SMEs);
- laboratory services.

Fig. 1 Partners
2. STRUCTURE
2.1.
BOARD OF DIRECTORS

Director of the Institute
Jerzy Żurek
PhD

Deputy Director for Operational Affairs
Marcin Osiecki
MA

Deputy Director for Research
Zbigniew Jaroszewicz
Professor, PhD, DSc

Chief Accountant
Liliana Lejman
MSc
The Scientific Council plays an important role in NIT’s activity. The tasks of the Council concentrate on continuous monitoring of the Institute in the matters of research, development, structure, financial status and human resources. In particular, the Council provides opinions on current issues to the Director.

In the current term (2017–2021), the Council consists of 24 members. At the end of 2017, the Scientific Council consisted of 12 professors and external experts nominated by the Minister of Digital Affairs as well as 12 persons elected among the Institute employees, including 10 professors, DSc and PhD holders and 2 employees without PhD degree.

There are three Commissions appointed by the Council:

- Commission for Human Resources
- Commission for Development
- Commission for Economic Issues.

The meetings of the Council are held quarterly and whenever necessary.
2.2. The Scientific Council

Janusz Zawiła-Niedźwiedzki, DSc – Chairman, Warsaw University of Technology (PW)

Grzegorz Wójcik, MSc – Council Secretary

Daniel Bachan – Ministry of Digital Affairs (MC)

Wojciech Burakowski, Prof.

Krzysztof Dyl – Office of Electronic Communications (UKE)

Stanisław Dziekoński, Prof. – Cardinal Stefan Wyszyński University (UKSW)

Wojciech Kamieniecki, DSc – NASK

Mirosław Klinkowski, DSc

Marian Kowalewski, DSc

Marian Marciniak, DSc

Rafał Niski, PhD

Karol Okoński – Ministry of Digital Affairs (MC)

Magdalena Olender-Skorek, PhD

Stanisław Piątek, Prof. – Warsaw University (UW)

Michał Pożun – Ministry of Digital Affairs (MC)

Konrad Sienkiewicz

Magdalena Soszyńska – Ministry of Digital Affairs (MC)

Ryszard Strużak, Prof.

Arkadiusz Szczebiot – Ministry of Digital Affairs (MC)

Paweł Szczepański, Prof.

Dariusz Więcek, PhD

Radosław Wiśniewski, DSc – Ministry of Digital Affairs (MC)

Piotr Woźni – Ministry of Digital Affairs (MC)

Andrzej Zieliński, Prof.
NIT consists of the following basic units:

- **research departments**, where the majority of R&D activities are carried out. Each research department has its number e.g. Z-1, Z-3. Research Departments are described in detail in Section 3.

- **laboratories**, in which technical tests and assessment procedures for telecommunications equipment as well as calibration of measurement equipment and interlaboratory comparisons are performed in accordance with national and EU standards. The laboratories are described in Section 4.

- **departments and sections**, which constitute research assistance units, administrative and support units. These departments are described in Section 5.
Organization chart of the NIT
2.4. FINANCIAL RESULTS

Income total

23 186 877 PLN

Expenses total

25 936 854 PLN

Financial result gross in 2017

– 2 749 977 PLN

Liquid assets

5 818 234 PLN
2.4. Financial results

Fig. 2 Income by category

- Other income: 16.6%
- Commercial activity: 30.6%
- R&D projects and other R&D activity: 26.2%
- Government grant for statutory activity: 26.6%

Fig. 3 Expenses by category

- Salaries: 60.3%
- Social benefits (incl. social security): 11.3%
- Depreciation: 6.7%
- Supplies, equipment, energy: 9.0%
- External services: 7.2%
- Other expenses (incl. taxes): 5.5%
- Commercial activity: 30.6%
- Other income: 16.6%
## Employment Structure

### Employment according to post held

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>In R&amp;D units</td>
<td>145</td>
<td>145</td>
</tr>
<tr>
<td>Professor</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Associate Professor</td>
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<td>5</td>
</tr>
<tr>
<td>Assistant Professor</td>
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<td>21</td>
</tr>
<tr>
<td>Research Assistant</td>
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<td>4</td>
</tr>
<tr>
<td>R&amp;D Specialist</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Other R&amp;D staff</td>
<td>92</td>
<td>87</td>
</tr>
<tr>
<td>In other units</td>
<td>79</td>
<td>85</td>
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<tr>
<td>Support administrative staff</td>
<td>79</td>
<td>85</td>
</tr>
<tr>
<td>Total</td>
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<td>230</td>
</tr>
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</table>

### Employment in R&D units according to titles, degrees and education

<table>
<thead>
<tr>
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<td>Professor</td>
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<td>DSc</td>
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</tr>
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<td>BSc</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Other staff</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>145</td>
<td>145</td>
</tr>
</tbody>
</table>
3. RESEARCH DEPARTMENTS
3.1. EQUIPMENT AND SYSTEMS TESTING DEPARTMENT (Z-1)

Profile

The Equipment and Systems Testing Department carries out research in the field of radiocommunication.

An important part of the Department activity is related to the Telecommunications Equipment Testing Laboratory, accredited according to PN-EN ISO/IEC 17025:2005 standard by the Polish Centre for Accreditation (Certificate AB 121). In the period time from 1 January 2017 to 12 June 2017 the Department also supports all Institute activities as Notified Body No. 1471 under Directive 1999/5/EC (R&TTE Directive) and offers consultancy services concerning technical requirements and standards.

Achievements in 2017

The most significant achievements of the Department in 2017 are:

- Execution of the second stage of measurement campaign in the frame of Ministry of Digital Affairs project (continuation of 2016 project) for evaluation of electromagnetic fields (EMF) levels in environment generated by base stations of mobile communications networks (joint work carried out in three research departments Z-1, Z-10, Z-21). Selective measurements of EMF levels in 64 base station locations chosen in 16 province capitals were performed in following cellular networks bands: GSM900, GSM1800, UMTS900, UMTS2100, LTE800, LTE1800, LTE2100, LTE2600. Other sources of EMF, as DAB+ and DVB-T, were also considered if were present in given location. For analyses and reporting of tests results computer platform of the System for Research and Evaluation of Electronic Communication Services Properties (PIBUK in Polish) was applied. Tests results are presented in uniform reports. These reports are available for interested parties. Moreover preliminary tests of EMF levels in neighborhood of RLAN access points operating in 2.4 GHz and 5 GHz frequency bands were done. Pilot information and educational campaign on EMF issues was also being carried.


Acting Head of Department
Rafał Pawlak
MSc, Leading Specialist
3.1. Equipment and Systems Testing Department (Z-1)

• Preparation of expert opinion defining the criteria for protection of active antennas and measuring receivers, which are used in the Regional Radio Emission Control Stations (RSKER) belonging to the Office of Electronic Communications, against an interference caused from nearby cellular base station antennas;

• Preparation of expert opinion regarding the choice of a digital, trunking radiocommunication system for the needs of Tramwaje Warszawskie Spółka z o.o.;

• Preparation of expert opinion for Police Headquarter regarding functional and technical requirements for the based on ETSI TETRA specifications radiocommunication system to be used for rescue and emergency services in Poland.

Staff

Andrzej Chudziński
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Specialist

Dariusz Oleszczuk
MSc, Senior Specialist

Aleksander Orłowski
MSc, Leading Specialist

Maksym Ostrowski
MSc, Specialist

Rafał Pawlak
MSc, Leading Specialist

Elżbieta Tomaszuk
MSc, Leading Specialist

Augustyn Wójcik
MSc, Specialist

Arkadiusz Kalinowski
Student

Competences and offers of the department:

• cooperation in research programs dealing with radio equipment and systems;

• expert opinions concerning telecommunications equipment and systems;

• consultancy in radiocommunication requirements and standards;

• preparation of test plans for conformance assessment with essential requirements of European Directives (as a base for CE marking and manufactures declaration of conformity);

• testing of radio equipment and systems within the frequency range of 9 kHz to 40 GHz, performed according to the standard procedures or test plans agreed with the customer;

• testing of electronic and electrical devices in respect of EMC characteristics and user safety;

• preparation of technical requirements and test methodology for ICT equipment.
3.2. ICT MARKET ANALYSIS AND DEVELOPMENT DEPARTMENT (Z-2)

Profile

The activities of the Department are focused on:

- analysis of the ICT (Information and Communication Technologies) markets in Poland and forecasting its development;

- analysis of the development of ICT markets in Europe and in selected countries and proposing changes in ICT market development policy in Poland;

- analysis of the development and structure of the postal market in Poland and in Europe and proposing its development and forecasting of changes in sector regulations;

- preparing reports and conducting analysis concerning both the ICT market and the postal market and the presentation of the results of these works;

- conducting analysis of regulatory solutions and legal documents, including an opinion on their impact on ICT market development;

- current monitoring of regulatory changes introduced by the European Union in the field of telecommunications and postal market.

These activities support the deployment of:

- broadband networks as well as information systems for public administration,

- network convergence, network addressing, network testing, quality of services, telecommunications network management,

- implementation of the European Digital Agenda in Poland.

The Department supports the Ministry of Digital Affairs and the Office of Electronic Communications (UKE) in the area of regulation and deployment of infrastructure for broadband access and information society in Poland.

Head of Department
Magdalena Olender-Skorek
PhD, Assistant Professor
Achievements in 2017

- Report: *Analysis of the possibility of implementing short text messages (SMS) to the 112 emergency number.* The study presents the analysis of the ability of the operators’ obligation to provide their end-users can send short text messages (SMS) to the emergency number 112 in the light of actual law rules, consultations with operators and the different implementations benchmarking across Europe.

- Report: *Development of the postal market in 2012-2016.* The postal market was presented in terms of basic parameters changes in 2012—2017. The report included also the selected postal services prices and elements of econometric analysis. Moreover, with the decrease of the traditional postal services volume, attention was drawn to the developing cooperation of postal operators in the field of delivery services on the e-commerce market. The cooperation between operators designated with state administration as part of providing e-services to citizens was also highlighted.

- Report: *Rules for numbering building and premises – examples of solutions on the international market* was implemented in cooperation with the Project Development and Coordination Department (DRP). The study presents rules for determining address points, including marking streets, buildings and premises used in selected countries. It also contains an overview of standards and normative documents of relevance for the introduction of a uniform way of recording address points.

- Report: *Smart Cities on the threshold of 5G technology.* Review of the state of knowledge and the 5G concept for the Tricity area development was implemented in cooperation with the Wireless Systems and Networks Department (Z-8). The report indicates the methodology and directions of Smart Cities implementation in the country in the context of use of 5G technology based on the experience of other countries.

- Report on the digitization of the country was implemented in cooperation with the Ministry of Digital Affairs. The report presents digitization in such aspects as: coordination of digitization management, infrastructure, software, systems and registers, competences in IT, e-services, projects, cybersecurity and international affairs. For each of the sections the key facts, the conclusions drawn from them and actions carried out and planned under the direction of the Ministry of Digital Affairs are presented.

- The ‘5G for Poland’ strategy was implemented in cooperation with the Ministry of Digital Affairs. It is a strategic document that defines actions and means to achieve the goal by the year 2025 to implement the 5G network in Poland in a cost-effective manner.

Participation in projects and other important activities

The most important projects implemented in 2017 were:

- **System of Teleinformatic Systems Inventory (SIST).** The system is used to collect information about existing and planned ICT systems, data centers and licenses in the public administration. The system is part of the Common State Infrastructure and is part of the Ministry of Digital Affairs in the area of developing e-administration data processing centres as well as stock-taking and monitoring of e-administration systems. In 2017 there were conducted two inventories of ICT systems. WIDOK.GOV.PL is an analytical public administration portal, which collects the statistics of e-services of public administration. The Project is conducted in cooperation with the Ministry of Digital Affairs. As a result of the Project, version 0.13 beta was built and tested.

Participation in other important activities:

- Research and expert analysis of problems concerning the construction of broadband access infrastructure,

- Analyses regarding the technical conditions of competitions within the Digital Poland Operational Program,

- Development of the technical concept and architecture of the National Education Network.
Competences and offer

- development of broadband infrastructure of telecommunications networks and services – expert reports, consulting and analytical services,
- ICT market analysis (technical, economic and legal aspects),
- support for public administration in the implementation of broadband projects,
- evaluation of innovativeness of projects financed by the European Union,
- digital sustainability development – systems and procedures.

Staff

Barbara Bartoszewska  
MSc, R&D Specialist

Przemysław Cieślik  
MA, Senior Specialist

Robert Czarnecki  
MSc, R&D Specialist

Piotr Grajkowski  
MSc, Senior Specialist

Wojciech Michalski  
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Sylwester Nowak  
BSc, Senior Specialist

Jerzy Paczocha  
MSc, Leading Specialist

Andrzej Piekut  
MSc, Leading Specialist

Anna Stolarczyk  
MSc, Senior R&D Specialist

Marek Sylwestrzak  
MA, Research Assistant

Włodzimierz Zalewski  
MSc, Leading Specialist

Marcin Zasiewski  
Student
3.3. INTERNET ARCHITECTURES AND APPLICATIONS DEPARTMENT (Z-3)

Profile

The Department of Internet Architectures and Applications conducts research on the issues related to current and future packet-switched networks. In particular, the Department concentrates on R&D related to new architectures of telecommunications networks (IPv4/IPv6-based networks as well as Future Internet, including the Internet of Things, Information-Centric Networks, Software Defined Networks), their protocols and applications. Research activities encompass practical aspects of migration from IPv4 towards IPv6 as well as implementation of new services in IPv6 environment with special focus on multimedia streaming. Machine to Machine communication (M2M) services and applications for new generation of mobile networks and cloud computing.

Projects and achievements in 2017

The Department was the leader of the IDSECOM project – ID-based SEcure COMmunications system for unified access in IoT performed under PoLLux International Research Program (2014–2017). The IDSECOM aimed to build a secure communication platform for selfmanagement of the Things and Services in the Internet of Things environment. It also investigated the effectiveness of M2M communication in various network architectures.

The Department has also started the Eureka Celtic Plus project: Monitoring and control of QoE in large scale media distribution architectures – MONALIS (2017-2019). The project's objectives include developing an innovative solution for monitoring and analyzing media streaming performance for millions of clients in real-time, in order to find and repair performance problems and media distribution system failures to avoid service degradations.

See more about the projects in Chapter 7.
Competences and offers

The Department offers its advanced know-how and expertise in the field of information and communication technologies. It is interested in cooperation with different industrial partners and scientific organizations in order to realize joint projects in the framework of national and international programs. In particular, the department offers cooperation in the following areas of interest, not being limited to these:

- research on networks supporting effective streaming transmission and cloud computing,
- research issues on the architectures of Content Aware Networks, Internet of Things and Software Defined Networks (SDN),
- planning, dimensioning and implementation of IP QoS networks aimed to ensure end to end Quality of Service,
- analysis of communication effectiveness in new network architectures as well as research on scalability issues;
- solutions design for M2M communication and Internet of Things (IoT) services,
- design, implementation and tests of Future Internet networks based on virtualization of network resources,
- implementation and programming of hardware platforms with virtualization features,
- technical expertise concerning network devices, services, protocols and technologies,
- technical consultation concerning migration of IPv4 networks towards IPv6, including implementation and tests.

Staff

Wojciech Burakowski  
Prof., Professor

Mariusz Gajewski  
MSc, Leading R&D Specialist

Piotr Krawiec  
PhD, Assistant Professor

Waldemar Latoszek  
MSc, Specialist

Konrad Sienkiewicz  
MSc, Senior R&D Specialist

Maciej Sosnowski  
MSc, Research Assistant

Piotr Wiśniewski  
MSc, Specialist
3.4. ADVANCED INFORMATION TECHNOLOGIES DEPARTMENT (Z-6)

Profile
The Department research activities are focused on designing of information systems, decision support systems, network management, big data analytics, data mining, knowledge management and engineering, as well as optimization and multicriteria analysis.

Projects and achievements in 2017
- Pilot solution for on-line monitoring and analysis of transport of selected goods based on Bigdata solutions for the Ministry of Digital Affairs.
- Start of the project NPC (consortium with NASK and National Centre for Nuclear Research) in the area of cybersecurity.
- Participation in works aimed at maintaining the project: Infrastructure for research and experimentation to support Horizon 2020 activities – PL-LAB2020 results.
- Participation in works for maintaining IT platform system of research, testing and diagnostics of electronic communications services project – PIBUK results.

The statutory project of NIT performed at the Z-6 Department was Logics and Knowledge Engineering in Telecommunications and Network Management, including research in logic and knowledge engineering, as well as research on and construction of a new algorithm of optimization, including multicriteria optimization, in applications to contemporary telecommunications networks. The results of this work were presented in many publications.
Competences and offers

Development and implementation:

- Big Data solutions,
- Data mining,
- Decision support systems,
- Multicriteria analysis,
- Optimization algorithms,
- Knowledge management,
- Telecommunications network management,
- Techno-economical models of network construction and development.

Staff

Paweł Białoń
PhD, Assistant Professor

Szymon Jaroszewicz
DSc, Associate Professor

Edward Klimasara
MSc, Leading Specialist

Paweł Olender
PhD, Assistant Professor

Ewa Orłowska
Prof., Professor

Mariusz Pajer
MSc, Senior Specialist

Piotr Rzepakowski
PhD, Assistant Professor

Wojciech Szymak
BSc, Leading Specialist

Andrzej P. Wierzbicki
Prof., Professor

Grzegorz Zalewski
MSc, Specialist
Profile

The areas of scientific activities of the Department include:

- digital radio communication (cellular, trunked and Wi-Fi systems) including marine communications,
- measurements of the mobile services quality in the cellular networks (2G, 3G, 4G and 5G),
- modern transmission techniques in wireless systems,
- wireless sensor networks,
- software-defined and cognitive radio,
- digital signal processing (DSP),
- satellite communications (Inmarsat, Cospas-Sarsat, VSAT, Satellite AIS etc.),
- radio navigation – GPS, DGPS, Galileo, AIS,
- e-Navigation – new approach to navigation safety,
- the e-Call system,
- propagation measurements, systems radio planning,
- wind farms influence on wireless communication and radar systems,
- monitoring and location services.

Projects and achievements in 2017

In 2017, the Department continued its involvement in the development of a new wireless communication standard for maritime environment – the VHF Data Exchange System (VDES). Close cooperation with the International Association of Lighthouse Authorities (IALA) gives an opportunity to take an active role in this task and to share our knowledge and experience with this international community.

In 2017, the Department was also continuing its involvement in the netBaltic, EfficienSea 2 and ESA SAT-AIS PL projects.

In the netBaltic project, the Department was mainly responsible for the development of the radio links’ quality assessment algorithms for zones A, B and C. Those algorithms will be mainly based on the parameter called LQI – Link Quality Indicator. To define and verify the obtained algorithms, three measurement campaigns in the Baltic Sea area were conducted in 2017.

In the EfficienSea 2 project, the Z-8 Department conducted the Seamless Roaming algorithms on-board tests in the Gdansk Bay Area (preceded by 50 days of pre-tests), as well as simulation tests of this solution, with several different test scenarios based on real world situations. Additionally, the Z-8 conducted a thorough analysis of the VDES physical layer measurement results obtained during tests on the Baltic Sea and provided by one of the project partners.

The phase A of the SAT-AIS PL project (co-financed by the European Space Agency (ESA)) was successfully concluded in 2017. The feasibility study for the microsatellite sup-
porting AIS operation was developed and subsequently accepted by the ESA.

Additionally, three new projects started in 2017:

- R-Mode Baltic (Ranging Mode for the Baltic Sea), co-financed in the Interreg V Baltic Sea Region programme. The main goal of the project is the development and demonstration of a new maritime system for PNT (position, navigation and timing) purposes. It is intended the system should serve as a backup to the ‘classic’ GNSS systems, such as GPS, GLONASS, GALILEO. The reason to do this is the fact that all GNSSs are highly vulnerable to jamming and interference and that for now no other system can overtake the task of absolute positioning in case of a temporal loss of GNSS. The R-Mode project consortium is comprised of 12 partners (including the NIT) from various countries in the Baltic region. The project started on 1 October 2017 and its duration is 36 months.

- IDSoC project (Innovative, hardware-software component, based on a dedicated integrated circuit and software to perform various cryptographic application, with the particular attention paid to electronic identification systems with the high level of confidence), co-financed by the NCBR in the CyberSecIdent Programme. The aim of the project is to develop and manufacture an innovative single-chip secure processor – IDSoC. The developed system on chip will be composed of a proprietary application processor with an increased fault tolerance and security level. The processor will include a non-volatile memory area dedicated to storing both embedded software and sensitive user data, such as biometric data. The project will be carried out in consortium comprising of the NIT and the Warsaw University of Technology. It started on 1 September 2017 and its duration is 36 months.

- Jericho (Assessing the potential of future maritime applications in the context of VDES (VHF Data Exchange System)), co-financed by the European Space Agency. The main goal of the project is to develop e-navigation applications based on the satellite techniques. The project is carried out in a consortium of 4 Polish partners, it started on 8 May 2017 and its duration is 9 months.

In 2017, the Department also participated in several large commercial projects and other activities:

- The Z-8 Department conducted measurements of the internet access solutions offered by three independent vendors; one of those solutions might potentially be installed aboard all Pendolino trains operating in Poland. The tests were organized in one of the trains on the Warsaw-Krakow and Krakow-Warsaw routes and their main purpose was to identify the solution that provides the highest quality of service with respect to achievable data rate, transmission delays and jitter.

- In 2017, the Z-8 Department conducted extended functional tests of the dispatcher system offered by Voxtronic company. The system integrates various voice transmission standards (e.g. VoIP, digital radio, analogue radio, TETRA, analogue telephony, etc.) and enables a seamless communication between users operating different standards (e.g. police and fire brigade). Additionally, tests of a relatively similar system provided by the MindMade company were also conducted.

- The Z-8 Department continued to support the Ministry of Digital Affairs with expert knowledge. Most notably, in 2017, an extensive report was prepared regarding the concept of smart cities in the context of the emerging 5G technology.

- Four members of the Z-8 staff were involved in the expert evaluation of the applications submitted in the 2nd edition of the POPC Programme.

- Members of the Z-8 staff took part in the translation of the Radio Regulations into Polish (the complete Polish version of the RR is now available online).
3.5. Wireless Networks and Systems Department (Z-8)

Plans for 2018

• Successful completion of netBaltic, EfficienSea 2 and Jericho projects.

• Two GSA grants will start in 2018; they will be dedicated to the GALILEO Public Regulated Service (PRS) measurement and will be carried out in cooperation with partners from several European countries. The Z-8 Department will be involved in both of them.

• It is expected the Department will continue to support Polish Railways in their efforts to establish Internet connection aboard all Pendolino trains operating in Poland.

• It is also expected the Department will continue its cooperation with Polish administration in several areas, especially those connected with the advent of 5G technology and the development of the pilot commercial 5G network in one of the Polish cities.

Competences and offer

The Department’s expertise enables performing different research and commercial tasks concerning communication systems development and evaluation, including:

• development of technical specifications and standards,
• consultancy and management of technical projects,
• defining technical and operational requirements,
• technical audits of the wireless systems and networks,
• mobile services quality measurements,
• designing of the communication devices,
• designing and evaluation of the radio communication systems,
• radio planning and network optimization,
• analysis and measurement of the wind farms impact on wireless communication and radar systems,
• professional training and courses.

Staff

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Magdalena Januszewska
Student
3.6. ELECTRONIC COMMUNICATION APPLICATIONS AND POWER SYSTEMS DEPARTMENT (Z-10)

Profile

The activities of the Department are related to the applications of electronic communication technologies (including special purpose systems) for the state administration, public safety and rescue services. The detailed areas of interest, among others, include the following:

- available technologies, unique systems and devices of electronic communication systems,
- computer tools for communication systems analysis, design and testing,
- operations of electronic communication systems and cooperation of public and special purpose electronic communication networks,
- characteristics and quality of telecommunications and postal services,
- security of information, systems and communication networks, including special purpose networks,
- power supply and power systems devices, especially batteries of energy storage systems,
- smart grid control and renewable energy power sources.

Achievements in 2017

Among the 2017 achievements of the Department, the following can be mentioned:

- one international patent have been granted in the field of battery capacity and measurement tests for telecommunication power plants (EP2972330),
- one national patent have been granted in the field of battery status diagnostics related to of PLC effect,
- two patent applications have been filed with the Patent Office of the Republic of Poland, both concern testing the capacity of batteries used in telecommunications power plants.
Participation in projects and other activities

The Department was engaged in 2017 in the following projects:

- Measurements of electromagnetic fields (EMF) produced by mobile communications base stations (continuation of 2016 project). Stage II – measurements on the entire country area. Analyses and reporting of measurements using the Computer platform of the System for Research and Evaluation of Electronic Communication Services Properties (PIBUK). Project carried out by three research departments (Z-1, Z-10, Z-21), as part of the agreement on the specific subsidy with the Ministry of the Digital Affairs. As part of the work there were prepared and performed selective measurements of EMF levels in 64 locations marked out in the entire country, mainly in 16 province capitals. The crucial objective was verification whether, in the places accessible to the population, near the installation of base station antennas, the effective agreed value of the electric component of the electromagnetic field is below permissible value of 7 V/m. As part of the work a methodology of the research, documentation, methodologies of measurements, patterns of reports, styles of results presentation, applied in examinations carried out in 2017 were verified and recommended for application in next campaigns of the research program. Moreover a pilot research on EMF levels was carried in surrounding of access points of the 2.4 GHz and 5 GHz RLAN network. Pilot information and educational campaign on EMF issues was also being carried,

- Development of concept of construction and deployment of the of the nationwide land mobile radio communication network modernization for forestry and its surroundings (SRR LP). Research and development work was planned for 2016-2019, in frames of the agreement with the General Directorate of the State Forests. The realization concept of SRR LP and guidelines for quality-quantitative requirements was developed in 2017 for the model part on the areas of three Regional Managements of National Forests (RDLP). Moreover model maps of the radio signal coverage were developed for remaining 14 RDLP of nationwide SRR LP and prepared for individual agreements with RDLP in consecutive year of the project,

- Cooperation with Orange on systems of remote powering telecommunications objects, including applied solution conformity assessments with Polish standards and health and safety regulations, as well as on company standards development,

- Development works connected to PIBUK IT platform deployment for the execution of research and development, statute and market projects,

- Electronic communication services quality test and measurements (speech quality, electromagnetic fields, IP communication quality) performed with Mobile Test Laboratory,

- Servicing of TBA—IŁ equipment family for controlled discharging-charging of batteries in telecommunications sites.

See more about the projects in Chapter 7.

Apart from projects presented above, the Department activities included:

- Continuation of works on SmartGrid concept applications in cooperation with a number of academic and industrial centres,

- Audit of measurements of domestic postal services,

- Contribution to Polish and international standardization activities in postal services area, including CEN TC331 Postal Services,

- Contribution to Polish standardization in telecommunications area.
Competences and offer

The Department’s offer includes:

- analyses, evaluations and surveys of solutions, possibilities and directions of electronic communication systems development,
- elaboration of proprietary solutions of methodologies and procedures for the investigation of telecommunication and postal services characteristics and quality,
- design and implementation of computer systems and tools for the analysis and testing of communication systems,
- design of measurement devices and special equipment applicable in operation and testing of communication systems,
- execution of telecommunications services quality inspection, based, among others, on own solutions of control and measurement systems and devices,
- implementation, maintenance and development of proprietary solutions.

Staff

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Lech Jóźwik  
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Mikołaj Waszkiewicz  
MSc, Senior Specialist
3.7. CENTRAL CHAMBER FOR TELECOMMUNICATION METROLOGY (Z-12)

Profile

The main aims of the Central Chamber for Telecommunications Metrology (Z-12) activity are to provide measurement traceability and to conduct research on new and more accurate measurement and calibration methods.

Z-12 consists of the following teams:

- **Basic Parameter Metrology Team**, which works on the metrology of basic parameters, such as DC&AC, LF voltage and current, resistance, capacitance, inductance, impedance and power and also on automation of measurement systems.

- **Telecommunications Parameters Metrology Team**, which works on telecommunication parameters in telecommunications networks (PDH/SDH, Ethernet, SONET etc.).

- **Optoelectronic Metrology Team**, which works on optoelectronic metrology of such parameters as optical power, back reflection, wavelength, chromatic and polarization mode dispersion, optical attenuation and optical fibre length.

- **Time and Frequency Metrology Team**, which works on time and frequency metrology, especially the implementation of atomic clocks comparison algorithms and determination and control of timescales, time transfer systems, measurements automation, accurate measurements of frequency, time, phase time, interval, TIE.

- **Optical Communications Team**, which conducts research on ultra-fast transmission in optical fibre transparent networks, wavelength and space-division multiplexing (SDM), optical fibre access (FTTH), nonlinear optical effects, application of innovative photonic crystal technologies, sub-wavelength photonics, microwave photonics, reliability of optical components and networks, optimization of SDM and Optical Elastic Networks (EON), its energy efficiency and assurance of Quality of Service (QoS).
Achievements in 2017

- participation in International Atomic Time – TAI and Polish Atomic Timescale – TA (PL), which have been for years the most important research areas of Departments Time Team,
- increase in calibration services performed with respect to the previous year,
- 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 and UTC. The process of launching the full operation of the station is now ongoing,
- Advanced research in the field of developing theoretical/numerical methods for investigation of plasmonic photonic structures was done, with significant progress in understanding and applications of micro – and nanoscale optical phenomena. This research included in particular: resonance phenomena in 1D and 2D periodic structures, application of 2D and 3D photonic crystals for detection of mechanical strain in structural engineering, plasmonic phenomena in metal-dielectric nanostructures, and photovoltaic structures with distributed Bragg reflectors,
- Development of models and optimization algorithms for diverse network scenarios in spectrally Elastic Optical Networks (EON) using the SDM technology: routing with allocation of space modes and optical spectrum, influence of maximum transmission distance specific to each modulation format on network throughput, and schematics of signal elastic regeneration.

Research activity of Z-12 focuses on optical fibre metrology, theoretical and experimental studies of periodic and other (mainly fibre optic) structures for telecom and sensing applications in cooperation with domestic and international partners. Moreover, Z-12 carries out research in the area of modelling and design of diffractive optical elements for optics and photonics.

National Institute of Telecommunications (NIT) has been operating time standards for over 15 years. They are part of worldwide and national time comparison system and are used in calculations of international and Polish timescales, International Atomic Time Scale (TAI), Universal Time Coordinated (UTC), Polish Atomic Time Scale (TA(PL)) and Polish Official Time (UTC(PL)). Thanks to close cooperation with the Central Office of Measures (GUM) and the operating fiber-optic time transfer system between NIT and GUM, the National Institute of Telecommunications has installed and operates a two-way satellite transfer system (TWSTFT) for Polish official time UTC (PL). As part of the world system of national time scales comparisons, supervised by BIPM work, only about 25 such sets. The Institute has also developed and manages an automatic acquisition and calculation system for the Polish Atomic Time Scale TA (PL) created from time clocks working in laboratories from Poland and Lithuania.

The Optical Communications Team (former Transmission and Optical Technologies Department, Z-14), since 1999 has annually organized the International Conference on Transparent Optical Networks (ICTON). ICTON 2017 conference, which was held in Girona, Catalonia, Spain, with technical support of IEEE Photonics Society, attracted 418 participants with 468 scientific presentations. See more in Chapter 9.3.

The following units operate within the Central Chamber for Telecommunications Metrology:

- Calibration Laboratory: Laboratory of Electrical, Electronic & Optoelectronic Metrology (LMEEO), which has accreditation certificate issued by the Polish Centre for Accreditation (AP 015),
- Proficiency Testing Organization: Unit of Interlaboratory Comparisons, which has accreditation certificate issued by the Polish Centre for Accreditation (PT 001).

The Optical Communications Team (former Transmission and Optical Technologies Department, Z-14), since 1999 has annually organized the International Conference on Transparent Optical Networks (ICTON). ICTON 2017 conference, which was held in Girona, Catalonia, Spain, with technical support of IEEE Photonics Society, attracted 418 participants with 468 scientific presentations. See more in Chapter 9.3.
3.7. Central Chamber for Telecommunication Metrology (Z-12)

**Participation in research projects**

Participation in TAI and TA(PL) and implementation of new algorithms for TA(PL). This work is carried out in cooperation with numerous research partners, such as Central Office of Measures (GUM), AGH University of Science and Technology, Polish branch of Orange telecom (CBR), Central Military Calibration Laboratory (CWOM) and Polish Academy of Sciences, Space Research Centre, Borowiec Astrogodynmost Observatory (CBK).

Project: **Modeling and optimization of space division multiplexing (SDM) elastic optical networks** (2017–2020), granted by NCN within the OPUS 11 programme. The research objectives concern development, implementation, and evaluation of: mathematical models and optimization algorithms for planning and operating SDM elastic optical networks, and analytical models and simulation tools for evaluation of quality of transmission (QoT) in SDM systems.

Marie Skłodowska-Curie Actions Individual Fellowship SIMFREE – **Open-source freeware for fiber optic communication and sensing simulations**, beneficiary Dr Paweł Rosa, NIT supervisors: Prof. M. Marciniak, Dr M. Jaworski. Cooperation with VPIphotonics VPI Germany, University of Alcalá UAH Spain The Optical Networks Lab. Project start date: 1 July 2017, duration 24 months.

Participation in the following COST Actions:

- TUI208 Civil engineering applications of ground penetrating radar (4 April 2013 — 3 October 2017)
- MPI302 NanoSpectroscopy (15 November 2013 — 14 November 2017)
- MPI401 Advanced fibre laser and coherent source as tools for society, manufacturing and lifescience 10 December 2014 — 9 December 2018)
- MPI403 Nanoscale quantum optics (2 December 2014 — 1 December 2018)
- CA15127 Resilient communication services protecting end-user applications from disaster-based failures (RECODIS) (1 March 2016 — 29 February 2020)
- CA16220 European network for high performance integrated microwave photonics (4 October 2017 — 3 October 2021).

**Services**

Z-12 is open for cooperation with anyone interested in improving their measurement accuracy and reliability. Its competences are proven by customers and also by the Polish Centre for Accreditation.

Z-12 can offer calibration service of a wide scope of electronic measurement equipment in its laboratory and on-site. The development of automated measurement systems according to customer requirements is also an important part of the activity. Z-12 full-scale measurement facilities would be helpful in R&D activity performed for the clients.

In terms of R&D activity, Optoelectronic Metrology Team offers cooperation in the field of basic and applied research in optics and photonics. In particular, the team has experience in the area of fibre optic measurements as well as design of photonic and diffractive optical elements, especially periodic structures (such as photonic crystals, FBGs, LPGs), and their applications in telecommunication and sensing.

The Optical Communications Team offers conformance and certification testing of optical fibre cables and passive components, in particular connectors and patch cords, measurements of fibre attenuation, return loss, PMD, as well as diverse environmental tests. The team has experience in modelling, design and optimization of modern optical communication networks, considering the quality of service, physical layer impairments, energy efficiency, and elastic spectrum assignment, as well as in the area of photonic crystal technologies, micro-structured fibres (PCF), microwave photonics, and subwavelength photonics.

Another area of activity is technical consultancy and training for the Polish telecom sector, especially in the fields of fibre optics, measurements, and broadband access networks.

**Standardization**

Employees of Z-12 are involved in work of the Polish Committee for Standardization (PKN) Technical Committees: KT53 ‘Cables and Wires’, and KT282 ‘Fibre Optics Technology’, primarily development of IEC/CEIENLEC standards and their adoption in Poland. They have been also involved in development of several company standards of Polish telecom operators.
Staff

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Elżbieta Hercan-Sereda
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Agnieszka Szczepańska
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Paweł Szczepański
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Mariusz Zdanowicz
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Profile

The EMC Department carries out studies and practical research in the field of electromagnetic compatibility (EMC) of systems and devices, as well as of spectrum engineering, spectrum management and radio networks planning and optimization.

In particular, the activities of the Department are focused on:

- radio network optimization (techno-economic) for various radio systems: broadcasting, fixed and mobile radio communication, point-to-point, point-to-multipoint and point to area systems (DVB-T, DVB-T2, DAB+, DRM, UKF FM, eMBMS, TETRA, PMR, DMR, cellular GSM-R, 3G, WiMAX, CDMA, LTE and others),
- radio wave propagation measurements and analysis, prediction of terrestrial radio stations (transmitters, base stations, etc.) and network coverage in real interference conditions, wireless networks coverage optimization,
- development and standardization of new digital radio technology: 5G, Cognitive Radio, White Space Radio Systems, etc.,
- electromagnetic compatibility analysis and measurements for radio systems in co-channel and adjacent bands scenarios,
- analysis of the availability of radio spectrum resources to radio applications, searching for radio frequency resources for new radio services,
- support in regulatory issues for spectrum management and engineering activities (national and international), such as preparing proposals for strategy documents for new radio systems introductions for governmental institutions (e.g. the Ministry of Digital Affairs, the Office of Electronic Communications, the National Broadcasting Council),
- representing the government of Poland in international telecommunications activities when needed (e.g. WRC of the ITU, CEPT) and international cooperation and standardization work within CEPT, ITU, ECC, ERO, ETSI, IEEE; and electromagnetic compatibility standardization – working within the framework of IEC, CISPR, and Polish Committee for Standardization (PKN),
- solving electromagnetic compatibility of electrical and electronic equipment problems, including medical, military and industrial equipment, as well as the equipment used in mining,
- development of new electromagnetic compatibility measurement techniques,
- electromagnetic environment research, especially of special industrial environments,
- electromagnetic fields and their influence on people’s safety and environment protection problems,
- electromagnetic fields estimations from transmitting stations for environmental protection assessments.
Achievements in 2017

The major achievements of the Department in 2017 are as follows:

- network planning and optimization analysis for broadcasters and operators (DVB-T, DVB-T2, DAB+, UKF FM, etc.),
  - future concepts of the MUX4 DVB-T network in Poland,
  - DVB-T MUX3 failure analysis,
  - MUX8 DVB-T coverage verification,
  - various analysis for UKF FM network operators.

- frequency findings for broadcasters and network operators,

- updated services and software tools for radio networks planning and propagation analysis included in PIAST system, available via: www.piast.edu.pl,

- trunking network planning for Warsaw Local Transportation operator,

- air navigation systems analysis (e.g. DVOR/DME),

- preparation and publication of two contributions to the ITU-R SG3 on propagation issues,

- series of EMC expertise and in-situ measurements performed in industrial conditions, including EMC tests of heavy industrial equipment, for example machines used in underground mines,

- EMC tests of numerous types of electric and electronic equipment including heavy industry, medical and military equipment,

- Calibration of EMC testing equipment (emission and immunity) and test antennas,

- Development of new measurement procedures for in-situ EMC measurements,

- for the Ministry of Digital Affairs:
  - pilot tests and analyses of electromagnetic fields from base stations in 8 voivodships in Poland,
  - expertise of translation of the Radio Regulations into Polish based on RR2016 edition,
  - preparation of draft DVB-T2 receivers specification for Poland,
  - electromagnetic compatibility analysis between 4G/5G networks and the DTT networks.

- partnership in the third edition of Night of Laboratories event in Wrocław in 2017. The EMC testing equipment exhibition was prepared together with several presentations, some of them interactive. From 17:00 to 23:00 on the day of the event, over 100 people visited the Laboratories, including primary school and junior high school pupils.

Participation in projects

- **Single Frequency Network using DAB+ software emission platforms for local broadcasters in Poland – LokalDAB (2015—2017).** The basic and crucial aim of the project is to elaborate a single-frequency (SFN) demonstrator based on a set of three transmission platforms operating in DAB+ standard, with the use of universal programmable circuits USRP and an open source software. An indirect aim will consist in encouraging and propagating the digital radio concept in the community of local broadcasters, owing to the constructed, relatively inexpensive, complete transmission platform as well as to the demonstrated feasibility and tests of the SFN networks created with its use,

- **COST Action IC1303 Algorithms, Architectures and Platforms for Enhanced Living Environments – AAPELE (2014–2017).** Ambient Assisted Living (AAL) is based on the notion that technology and science can provide improvements in the quality of life for people in their homes.

See more about the main Projects in Chapter 7.
Organization of the department

The EMC Department consists of two sections:

- Spectrum Engineering and Management Section,
- Fields and Disturbance Measurements Section.

Within the Department, two testing laboratories accredited by the Polish Centre for Accreditation (PCA) are located:

- Laboratory of EMC Measuring Apparatus, certificate No AP 016,
- EMC Testing Laboratory, certificate No AB 666.

Competences and offers

The Department's offer includes:

- propagation analysis, radio coverage prediction, radio network optimization (CAPEx and coverage) analysis for various radio systems (DVB-T, DVB-T2, DAB+, DRM, DVB-H, UKF FM, TETRA, DMR, PMR, cellular, WiMAx, CDMA, LTE, various mobile systems, point-to-point, point-to-multipoint point-to-area and others) and frequency bands, and other services,
- assistance and support in preparation of applications to the Office of Electronic Communications and the National Broadcasting Council for radio licenses and permissions according to their procedures,
- support on international level in international organizations and standardization bodies (ITU, CEPT, ECC, ETSI, IEEE),
- radio spectrum availability analysis, finding new available frequencies for planned new radio, television and other services,
- propagation analyses with the application of precise digital maps,
- analysis of compatibility and interferences conditions between various radio systems,
- offer for educational institutions: web software tool for teaching and learning of radio propagation and network planning,
Staff

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4. LABORATORIES
4.1.
TELECOMMUNICATIONS EQUIPMENT TESTING LABORATORY (LBUT) [WARSAW]

Profile

The competences of the Telecommunications Equipment Testing Laboratory accredited according to PN-EN ISO/IEC 17025:2005 standard by the Polish Centre for Accreditation (Certificate AB 121), being the biggest in Poland of such kind, cover more than 90 European standards concerning:

- parameters of radio transmitters and receivers in the frequency range up to 40 GHz,
- electromagnetic compatibility (EMC) emissions:
  - radiated emissions,
  - conducted emissions,
  - harmonic currents injected into the public supply system,
  - voltage fluctuations and flicker impressed on public supply system,
- electromagnetic compatibility (EMC) immunity to:
  - radiated radio frequency electromagnetic fields (up to 6 GHz),
  - conducted disturbances induced by radio frequency fields,
  - electrostatic discharges,
  - electrical fast transients/bursts,
  - surges caused by overvoltage,
  - supply voltage dips, short interruptions and voltage variations.

Note: EMC tests methods are in flexible accreditation scope, which allows the laboratory to carry out changes within its accreditation, for example:

- introduce new methods within a specific scope,
- introduce new versions of standard methods,
- introduce new products in a method that has already been accredited.

List of activities conducted in the flexible scope is available to the interested parties on request.

Activities

In 2017 the Laboratory carried out more than 100 commercial tasks.

Offer

The Telecommunications Equipment Testing Laboratory offers testing of a wide range electronic equipment intended for introduction on the European market.

Head of Laboratory
Aleksander Orłowski
MSc
The National Institute of Telecommunications kindly invites manufacturers of electric and electronic equipment to test their products for EMC in its Laboratory. EMC compliance is one of the required elements for CE marking. Tests for EMC are performed in the Laboratory or on site.

Laboratory is accredited according to PN-EN ISO/IEC 17025:2005 standard. EMC Testing Laboratory is a signatory of ILAC MRA; tests performed by the Laboratory are recognized as meeting international standards and accepted by other signatories of ILAC MRA all over the world. The Laboratory is located within the Electromagnetic Compatibility Department (Z-21).

In 2017 EMC Testing Laboratory added new procedures to the scope of accreditation regarding immunity tests for oscillatory waves and made significant changes in the scope of accreditation regarding electromagnetic fields measurements (legally regulated area).

Apart from the above specified tests, the Laboratory performs the following measurements:

- shielding effectiveness of structures, according to military NO standard,
- NSA measurements of open area test sites and anechoic chambers, according to PN-EN 55016-1-4 standard.

The unique part of the Laboratory offer are in-situ measurements of industrial equipment, performed on its installation site or in place of manufacturing, including equipment for use in special environments.

**Profile**

EMC Testing Laboratory, accredited by the Polish Centre for Accreditation (AB 666), performs tests in four main areas:

- EMC measurements of equipment covered in EMC Directive, according to the PN-EN and EN standards, and military equipment according to the NO standards,
- antennas, according to the PN-T standards,
- coaxial cables, according to IEC 1196–1 standard,
- electromagnetic field sources for safety and environment protection, according to the Polish government regulations.

Apart from the above specified tests, the Laboratory performs the following measurements:

- shielding effectiveness of structures, according to military NO standard,
- NSA measurements of open area test sites and anechoic chambers, according to PN-EN 55016-1-4 standard.

The unique part of the Laboratory offer are in-situ measurements of industrial equipment, performed on its installation site or in place of manufacturing, including equipment for use in special environments.

**Offer**

The National Institute of Telecommunications kindly invites manufacturers of electric and electronic equipment to test their products for EMC in its Laboratory. EMC compliance is one of the required elements for CE marking. Tests for EMC are performed in the Laboratory or on site.
Profile

The Laboratory of Electrical, Electronic & Optoelectronic Metrology has an accreditation certificate issued by the Polish Centre for Accreditation (AP 015). It confirms compliance with PN-EN ISO/IEC 17025:2005 in the following calibration areas:

- basic parameter metrology such as DC&AC, LF voltage and current, resistance, capacitance, inductance, impedance as well as power and automation of measurement systems,
- telecommunication parameters metrology – RF and microwave signals and also transmission parameters of telecommunications networks (PDH/SDH, Ethernet, SONET etc.),
- optoelectronic metrology of such parameters as optical power, wavelength, chromatic and polarization dispersion, optical attenuation and optical fibre length,
- temperature and humidity metrology,
- time and frequency metrology – accurate measurements of frequency, time, phase time, interval, TIE.

Activities

The main activity of LMEEiO is the calibration of measurement equipment for telecommunications and electronics companies. The measurement capabilities of LMEEiO meet even the highest customer demands. The on-site LMEEiO premises calibration service is also offered.

In 2017, accreditation scope was expanded in microwave, temperature and optoelectronic areas.

The precise time is distributed by LMEEiO by means of NTP server (Stratum 1), which is directly connected to atomic time standards (type 5071A made of Agilent).

Recently, the companies are more interested in calibration of measurement equipment, which resulted in the same level of calibration services performed by LMEEiO in comparison to previous year.

The Laboratory is located within the Central Chamber for Telecommunication Metrology (Z-12).
Profile

The Laboratory has a unique capability to calibrate the equipment used in EMC measurements according to EMC Directive requirements. It is the first laboratory in Poland of that kind and, to some extent unique also in Europe, being completely independent of the manufacturers of measuring equipment.

The Laboratory, due to modern calibration equipment and highly qualified personnel, is authorized to check and calibrate (according to standard EN 55016–x-x series, unless stated otherwise) the parameters of the following measuring apparatus used in the EMC measurements:

- radio interference meters/test receivers,
- artificial mains networks (AMN)/line impedance stabilization networks (LISN),
- click analysers,
- absorption clamps,
- test antennas,
- test signal generators for checking radio interference meters and click analysers,
- voltage and current RF probes,
- coupling/decoupling networks (CDN),
- power meters,
- ESD generators – according to PN-EN 61000-4-2,
- EFT/B generators – according to PN-EN 61000-4-4,
- surge generators – according to PN-EN 61000-4-5.


Laboratory is a signatory of ILAC MRA, calibration certificates are accepted by other signatories of ILAC MRA all over the world.

The Laboratory is located within Electromagnetic Compatibility Department (Z-21).

Offer

The Institute of Telecommunications kindly invites all EMC testing laboratories and manufacturers to calibrate their measuring equipment in our Laboratory.
4.5.
UNIT FOR INTERLABORATORY COMPARISONS (JPM)

Profile
The Unit for Interlaboratory Comparisons holds accreditation issued by the Polish Centre for Accreditation (PT 001). JPM grants claims of PN-EN ISO/IEC 17043:2011. The Unit organizes Proficiency Testing (evaluation of participant performance against pre-established criteria by means of interlaboratory comparisons) and Interlaboratory Comparisons (organization, performance and evaluation of measurements or tests on the same or similar items by two or more laboratories in accordance with predetermined conditions) programmes for laboratories in the area of LF electrical DC & AC parameters.

The Unit meets the requirements for the competences of providers of proficiency testing schemes and for the development and operation of proficiency testing schemes.

The Unit has at its disposal high-quality measurement standards of resistance, capacitance and inductance.

In 2017, the Unit declared interlaboratory comparisons for calibration laboratories with these standards as proficiency test item.

Activity
In 2017, JPM activities were related to:

- end of the proficiency testing scheme for international calibration laboratories with standards of capacitance as a proficiency test item,
- end of the proficiency testing scheme for calibration and testing laboratories with the digital multimeter of voltage, current and resistance as a proficiency test item,
- preparing the proficiency testing scheme for calibration and testing laboratories with the meter of resistance as a proficiency test item.

The Unit is located within the Central Chamber for Telecommunications Metrology (Z-12).

Offer
Organizing and conducting the interlaboratory programs and proficiency testing for calibration and testing laboratories.
4.6. 
NOTIFIED BODY NO 1471

Notified Body No 1471


In the period of time from 1 January 2017 to 12 June 2017, the Notified Body issued 8 confirmations of conformity with essential requirements of R&TTE Directive. In the second half of 2017 activities were initiated to obtain accreditation of Polish Centre for Accreditation (PCA) for notification purposes under Radio Equipment Directive (RED). The Notified Body is located within Equipment and Systems Testing Department (Z-1) and is supervised directly by the Director of the Institute.
5. DEPARTMENTS
5.1. EDUCATION DEPARTMENT (DSZ)

The Education Department leads technical and business trainings and courses. Technical trainings cover such fields as: security of networks and telecommunications systems, internet technologies, telecommunications protocols, access networks, Next Generation Networks, signaling and maintenance, Quality of Service, intelligent networks, mobile and radio networks, teletransmission systems, power systems, fibre technologies, SAP business objects, IBM Cognos and Microsoft SQL Server, programming languages, Linux, IBM Cognos. Business trainings cover such fields as innovation and technology transfer, emotional intelligence, business ethics, EU funds, telecommunication law and regulations, negotiations, leadership, management, selling techniques, public relations, project management, the art of presentations.

Technical trainings are mostly addressed to ICT market and businesses that use technologies and techniques of this field. Business trainings cover problems and aspects occurring also in different fields of human activity, and are addressed to a wider range of businesses.

Trainings are organized in a public scheduled formula and as closed, precisely tailored to customer requirements workshops.

Education Centre cooperates with the International Telecommunications Union as the ITU Centre of Excellence.
5.2.
IT DEPARTMENT (DIT)

The IT Department deals with the maintenance and development of the Institute's computer network, i.e. administration of network devices and central servers, maintenance of computer hardware, handling connections with the wide area network, maintenance of network services, provision of consulting and training services for the network users. Certain design works are also conducted by the Centre and expert opinions are prepared for third parties.
5.3.
SCIENTIFIC INFORMATION AND PROMOTION
DEPARTMENT (DINP)

The range of activities of the Department is rather wide, and includes:

• Running the Institute’s library, which has the largest in Poland collection of printed books and journals in the field of telecommunications. In 2017, the library provided the Institute’s employees with 35 Polish and international journals in telecommunications, informatics, EMC etc. The library is open to the public free of charge,

• Enabling access to the IEEExplore Digital Library for the Institute’s employees, and via Virtual Library of Science (provided by ICM) to an electronic version of publications of Elsevier, Springer and Wiley-Blackwell, as well as to databases of EBSCO, Web of Knowledge and Scopus,

• Responsibility for collecting and processing the scientific and technical data of research performed in NIT. In 2017, DINP added 19 scientific reports of the statutory works to the database containing information on all Institute’s publications. Some of them are available for free via the Internet,

• Responsibility for collecting information about the employees’ publications in 2017. Information about 120 new records was added,

• DINP is running Digital Library, which presents via the Internet all papers which have been published by the Institute’s employees in the Institute’s journals throughout its history,

• Responsibility for running the editorial board of *Journal of Telecommunications and Information Technology* magazine continuously issued by NIT,

• Responsibility for the promotion of the Institute, so the Department is present at most important conferences and fairs, coordinates and prepares promotional publications of different kinds, issues yearly *Annual Report of NIT*, etc.,

• Coordination of the national and international standardization activities of NIT’s employees.

Head

Ewa Kapuściarek

MSc
5.4. OTHER DEPARTMENTS

The following departments and sections make NIT’s organization scheme:

- **Accounts Department (DK)**
  Head: Liliana Lejman, MSc

- **Human Resources Department (DSP)**
  Head: Kinga Bogus, MSc

- **Administration Department (DA)**
  Head: Elżbieta Zabłocka

- **Supplies Department (DZ)**
  Head: Małgorzata Olszewska

- **Project Development and Coordination Department (DRP)**
  Head: Dariusz Gacon, MSc

- **Analysis and Budget Section (ZAB)**
  Head: Mirosław Fereniec, MSc.
6. SCIENTIFIC RESEARCHERS, PROFESSORS AND ASSOCIATE PROFESSORS
Wojciech Burakowski received his MSc, PhD and DSc degrees in Telecommunications from Warsaw University of Technology in 1975, 1982 and 1992, respectively. Now he is a full professor in the Institute of Telecommunications, Warsaw University of Technology and the National Institute of Telecommunications, Warsaw. He also leads the TNT research group (tnt.tele.pw.edu.pl). Since 1990 he has been involved in several COST and EU Framework Projects. He is a member of Telecommunication Section of the Polish Academy of Sciences and an expert in European Framework Programme. He was a chairman and a member of many technical programme committees of national and international conferences. He is the author or co-author of about 200 papers published in books, international and national journals and conference proceedings and about 80 technical reports. He supervised 15 PhD dissertations. His research areas include new networks techniques, ATM, IP, heterogeneous networks (fixed and wireless), network architecture, traffic engineering, simulation techniques, network mechanisms and algorithms, and recently Future Internet. He was leading the strategic national project Future Internet Engineering (2010–2013).
Marian Marciniak graduated in solid state physics from Marie Curie-Sklodowska University in Lublin, Poland, in 1977. In the 1985–1989 period he attended the PhD studies on the theory of electromagnetic waves at the Institute of Fundamental Technological Research of Polish Academy of Sciences in Warsaw. He received the PhD degree in optoelectronics from the Military Academy of Technology in Warsaw in 1989 and the Doctor of Sciences degree in physics-optics from The Institute of Physics of the Warsaw University of Technology in 1997. He is a Professor at the National Institute of Telecommunications and at Kielce University of Technology (till July 2017). Since 2004 he has served as an Honorary International Advisor for the George Green Institute for Electromagnetics Research at the University of Nottingham. He was a pioneer of applying the Beam-Propagation Method for optical waveguide circuits in Poland. His current research interests include electromagnetic wave propagation, transparent and all-optical packet—and burst-switched telecommunication networks, ultrafast and nanoscale/sub-wavelength photonics, quantum nanophotonics, fibre lasers, Terahertz photonics, microwave photonics, Radio-over-Fibre systems, and the future global optical and wireless networking and services. He has introduced and developed a non-conventional model of a hybrid photonic real-time service and packet communications network. In early 2001, he originated the IEEE/LEOS (now IEEE Photonics Society) Poland Chapter, and he served as the first elected Chairman of that Chapter till 2003. He is a Senior Member of the IEEE Photonics and Communications Societies, and a Member of the Optical Society of America, Japan Society of Applied Physics, SPIE – The International Society for Optics and Photonics, and URSI – The International Union of Radio Science, Commission D – Electronics and Photonics. He serves as the Editor-in-Chief for Springer *Optical and Quantum Electronics* journal together with Prof Trevor Benson and Prof Yaping Zhang. He is the Editorial Board Member for *Microwave & Optoelectronics Technology Letters* journal, Wiley (USA), *Journal of Electromagnetic Optics* (France), *International Journal of Scientific and Technological Research* (USA), the *International Journal of Electronics and Telecommunications* (Poland), and the *Journal of Telecommunications and Information Technology* (Poland). He serves as an Independent Expert for the European Commission, Information Science and Technology and for Horizon 2020, Future and Emerging Technologies domains (Vice-Chairmanship in 2015–2016), for European Cooperation in Science and Technology (COST), for the European Science Foundation, and for national research funding agencies in the UK (Royal Society), Cyprus, Greece, Hungary, Ireland, Switzerland, Slovenia, Qatar, Republic of Serbia, Sweden, and Poland. He was the originator and elected chairman of COST

In addition to the above, 2017 activities of Professor Marciniak included:

- Conference chairmanship for: CH-Optical Sensing and Metrology, the Conference on Lasers and Electro-Optics Europe CLEO/Europe 2017, Munich, Germany, 25–29 June 2017; 19th International Conference on Transparent Optical Networks ICTON 2017, Girona, Catalonia, Spain, 2–6 July 2017 (for ICTON series he has acted as the originator and the Organising Committee Chairman for since its very beginnings in 1999); Final Conference of the COST Action TU1208 ‘Civil engineering applications of Ground Penetrating Radar’ hosted by the National Institute of Telecommunications, Warsaw, Poland: 25–27 September 2017 – together with Action’s Chair Prof. Lara Pajewski.


- realisation/coordination of research projects: SIMFREE – Open-source freeware for fiber optic communication and sensing simulations, Marie Skłodowska-Curie Actions Individual Fellowships (IF), guest researcher Dr. Paweł Rosa, in cooperation with VPIphotonics Germany, and University of Alcalá UAH Spain; and Actions COST – European Cooperation in Science and Technology; TU1208 Civil Engineering Applications of Ground Penetrating Radar (4 April 2013 – 3 October 2017) – Management Committee Member, Short-Term Scientific Missions Manager; MP1302 NanoSpectroscopy (15 November 2013 – 14 November 2017) – Management Committee Member; MP1401 Advanced fibre laser and coherent source as tools for society, manufacturing and life science (10 December 2014 – 9 December 2018) – Management Committee Deputy Member; Working Group 2 Chairman; MP1403 Nanoscale Quantum Optics (2 December 2014 – 1 December 2018) – Management Committee Member; CA16220 European Network for High Performance Integrated Microwave Photonics (4 October 2017 – 3 October 2021) – Management Committee Member.

- hosting of five COST Short-Term Scientific Missions from abroad: Italy – 3, and Armenia – 2.

- participation to examination committees: for the degree of Doctor of Sciences at Warsaw University of Technology, Poland (Dr. Patryk Urban, D.Sc. Thesis on ‘Fibre Faillure Detection in Optical Access Networks’), and for the Ph.D. degree at The Military Academy of Technology in Warsaw, Poland (Mr. Rafał Słomski, Ph.D. Thesis entitled ‘Hybrid Communication Network for Special Applications’), and at The University of Nottingham, Ningbo Campus, China (Ms. Najla Najeeb, Ph.D. Thesis entitled ‘Design, Fabrication and Evaluation of a Label-free Silicon-on-Insulator Lab on a Chip Optical Biosensor’).


Jordi Mongay Batalla received his MSc at the Universitat Politècnica de València in 2000, whereas he obtained PhD and DSc degrees at Warsaw University of Technology in 2010 and 2017, respectively. He is currently the Head of Internet Technologies and Applications Department at National Institute of Telecommunications. He is also with Warsaw University of Technology, where he provides research on Future Internet. He is editor of several books and author or co-author of more than 150 papers published in international journals and conferences in the fields of Telecommunications technologies (radio: 4G and 5G, wired: Network services chain, SDN) and applications (Internet of Things, Smart Cities, multimedia) for the Future Internet. He is in the editorial board of several JCR journals and many international conferences. He has leaded several special issues in high impact factor journals and magazines.
Ewa Orłowska received her MSc (1957), PhD with honors (1971), the Ministry of Science and Education award for the dissertation in 1972 and DSc (1978) degrees in mathematics from Warsaw University, Department of Mathematics, Mechanics and Computer Science, and the scientific title of professor in 1993. She was employed at Warsaw University, Polish Academy of Sciences, and since 1996 she has been professor at the National Institute of Telecommunications. She authored or co-authored over 100 publications in international journals, 3 monographs, and edited several special issues of journals, conference proceedings and books. She participated in international projects from the Esprit series (as a member of a French group), Tempus, COST (a member of the management committees and in the COST Action 274 she was a working group coordinator), a NATO project, an INTAS project, bilateral collaboration projects with France, the UK and South Africa. She was a guest speaker or a member of the programme committees at many international conferences. She was a visiting professor at universities in Europe, Canada, Japan, and South Africa. She served as an assessor for the Council of the Division of Logic, Methodology and Philosophy of Science of the International Union of History and Philosophy of Science (1999–2003), a member of the international committee of the E. V. Beth PhD dissertation prize (2005, 2006, 2007), and an Expert for the Research Executive Agency of the European Commission (2008, 2009, 2010, 2011). In 2016 she has been elected to the grade of fellow of the International Rough Set Society. She is a member of the editorial boards of 5 international journals, including the Journal of Telecommunications and Information Technology. Her current research interests include knowledge representation, reasoning with incomplete or uncertain information, and duality theory. Her book co-authored with Anna Radzikowska and Ingrid Rewitzky ‘Dualities for Structures of Applied Logics’, College Publications, Studies in Logic vol. 56, 2015 received the Jan Łukasiewicz Award in 2016.
Tomasz Osuch received BSc in optoelectronics and measurement & control systems (2003), MSc in electronics (2004) from Warsaw University of Technology. He also received PhD from National Institute of Telecommunications (NIT) in 2010, and DSc from Warsaw University of Technology (WUT) in 2017. He is currently an assistant professor at Warsaw University of Technology and at National Institute of Telecommunications. He is a head of Optoelectronic Metrology Group (NIT) and leads the Fiber Optic Sensors and Measurement Systems Group in the Institute of Electronic Systems (WUT). His current research interests include fiber optic sensors and metrology, especially photonic periodic structures (mainly fiber Bragg gratings), diffractive optical elements as well as the design, implementation and testing of optoelectronic metrology systems for characterization and evaluation of photonic components and devices. He is an author or co-author of more than 70 journal publications and conference contributions. He participated in several research projects in the area of optics and photonics. He is a member of IEEE (Institute of Electrical and Electronics Engineers), PTTS (Polish Sensor Society), OSA (Optical Society of America) and PSP (Photonics Society of Poland). Since 2016 he is also a member of editorial advisory board of Journal of Telecommunications and Information Technology.
Dominik A. Rutkowski received MSc, PhD and DSc degrees (all with distinction) in Electronic Engineering from Gdansk University of Technology (GUT), Gdansk, in 1963, 1968 and 1975, respectively. He has been with GUT since 1963, where in 1968 he became an Assistant Professor in the Institute of Control Systems and in 1975 Associate Professor in the Institute of Communications Systems. From 1963 to 1975, his activities focused mostly on the problems of automatic control systems and, in particular, on the problems of optimal control in the stochastic environment, the optimal identification of control plants and adaptive control systems. During the years 1968–1969, he participated in a project concerning a digital radio system for the measurements of sea waves and the transmission of the results to a computer system for further processing, for which he co-designed a digital electronic sounder, patented later. From 1970 to 1972, he participated in an international project, concerning the fishery research vessel ‘Prof. Siedlecki’, built in Gdansk Shipyard. For that reason, he stayed for half a year in Marconi Elliott Company, England. His activities concentrated there on algorithms and programs for processing data from over 80 devices and sensors on the real time computer system. After 1973 he became more engaged in the design of computer networks and, in particular, in the analysis and design of protocols concerning routing, flow and congestion control. In 1975/1976 he was awarded a year-long Fulbright – Hays Fellowship and was engaged in research into computer networks, and in education at the Department of Electrical Engineering and Computer Science, Columbia University, New York. After 1983 his scientific interests focused on problems of digital radio communications systems such as digital modulation, channel coding and adaptive reception of signals. In 1989 he obtained the position of full professor at GUT in Radio Communications Systems. In 1990 he became full professor in Digital Communications Systems at the Department of Electronic Systems, Aalborg University, Denmark, and stayed there until 1996. His research concentrated there on the development of spread spectrum systems and the cellular GSM system, particularly on their performance and capacity evaluation, as well as on adaptive receivers. Additionally, in 1993 he was elected for one year as a foreign professor to provide the lectures and scientific consultations in spread spectrum systems for the doctoral students at the Lund University, Sweden. Since 1996 he has continued at GUT and in the next years his research focused on the development of channel coding, adaptive reception of signals, the performance and capacity evaluation of next generations cellular systems, wireless systems, system TETRA, and the MIMO techniques. Professor Rutkowski has published more than 189 papers in scientific journals and conference proceedings in Poland and abroad; he is the author of 5 books. He has also been engaged in many other national and international scientific projects, and has supervised 20 PhD dissertations in Poland and abroad. Since May 2014 he has been with NIT as full professor.
Ryszard Strużak received his BSc grade in 1954 and MSc degree in 1956, both in Telecommunications from Wrocław University of Technology, and PhD and DSc degrees from Warsaw University of Technology in 1962 and 1968, respectively. Presently he is a full professor at NIT. In years 1998–2015 he served also as a Co-director of schools’ series for young scientists on Wireless Networking and Applications convened at the International Centre for Theoretical Physics (ICTP) in Trieste (IT). He was elected co-chair of URSI international Working Group on Spectrum Management and was nominated a Focal Point of Central Europe Initiative. Earlier, he organized and headed the NIT EMC Laboratory, the first one in Poland, headed the Wrocław Branch of NIT and in 1972 co-founded and later chaired the first in Europe regular international symposium on electromagnetic compatibility (EMC), known as the Wrocław EMC Symposium until 2010, when it merged with the ‘EMC Europe’ symposium. He authored/ co-authored a few hundred papers published in books, international and national journals and conference proceedings, 10 patents and a number of technical reports. He supervised ten PhD dissertations. He served as the Head of Technical Department and Acting Assistant Director at CCIR/ITU in Geneva, Visiting Professor at Institute National Polytechnique de Toulouse, Professor at Wrocław University of Technology, Professor at the University of Information Technology and Management at Rzeszów, as well as the Editor-in-Chief and Chair of Editorial Board of Global Communications. He worked as consultant to ITU, IUCAF, UNOCHA, UNESCO, WB, PWC, and to government agencies and industry in the UK, USA, Switzerland, Turkey, Poland, and other countries at shorter missions. He served as a Member of the Board of the HAWE Group. He was active in international and intergovernmental organizations: among others, he was elected Vice-Chairman of the ITU Radio Regulation Board. He was awarded the TU Silver Medal, two international awards, the IEEE EMCS Special Symposium Recognition Award and highest national awards and decorations. He received the Honorary ITU 150 Award; earlier the Wrocław University of Technology honored him with the Gold Badge with Diamond. He was elected a Life Fellow of IEEE, an Academician of the International Telecommunication Academy and a member of New York Academy of Science. His research areas include radio communications, electromagnetic compatibility, spectrum engineering, spectrum management and Information Society.
Paweł Szczepański graduated from Warsaw University of Technology, Faculty of Electronics (1981); academic teacher and research worker at Warsaw University of Technology (since 1981), the director of the Institute of Microelectronics and Optoelectronics at Warsaw University of Technology (since 2008); research worker at NIT in Warsaw (since 1998), deputy director for research at NIT (2002–2006); member of Committee of Electronics and Telecommunications of Polish Academy of Sciences, Optoelectronics Section; member of Polish Committee of Optoelectronics of Association of Polish Electrical Engineers, Optical Society of America, SPIE and IEEE; author or co-author of over 300 publications (including approx. 100 in periodicals listed on JCR); coordinator of PBZ (2007–2011 – national funds NCBR), participant in FP6 and FP7 projects (NEMO, AC-MOST, Paradigm), editor-in-chief of the Journal of Telecommunications and Information Technology and member of editorial advisory boards of many periodicals, among others Telekomunikacja i Techniki Informacyjne. His current scientific interests include: lasers, photonics, nonlinear optics, integrated optoelectronics and photonic crystals.
Andrzej P. Wierzbicki got his MSc in telecommunications and control engineering in 1960, in 1964 PhD in nonlinear dynamics in control, and DSc in optimization and decision science in 1968. He worked, among others, as the Dean of the Faculty of Electronics, Warsaw University of Technology (WUT), Poland (1975–1978); Chairman of Systems and Decision Sciences Program of International Institute for Applied System Analysis in Laxenburg n. Vienna, Austria (1979–1984). He was elected a member of the State Committee for Scientific Research of the Republic of Poland and the Chairman of its Commission of Applied Research (1991–1994). He was the director of the National Institute of Telecommunications (NIT) in Poland (1996–2004). He worked as a research professor at Japan Advanced Institute of Science and Technology (JAIST), Nomi, Ishikawa, Japan (2004–2007). Besides teaching and lecturing for over 45 years and promoting over 100 master’s theses and 18 doctoral dissertations at WUT, he also lectured at doctoral studies at many Polish and international universities, including the AGH University of Science and Technology in Kraków, Poland, University of Minnesota in the USA and Kyoto University as well as JAIST in Japan. Currently, he is a member of the presidium of the Committee of Future Studies ‘Poland 2000 Plus’ at the Presidium of Polish Academy of Sciences. Professor Wierzbicki is the author of over 200 publications, including 20 books, over 120 articles in scientific journals; he also authored 3 patents granted and industrially applied. His current interests include vector optimization, multiple criteria and game theory approaches, negotiation and decision support, issues of information society and knowledge civilization, rational evolutionary theory of intuition, theories of knowledge creation and management.
Andrzej Zieliński received master’s degree in engineering from the Faculty of Communications, Warsaw University of Technology (WUT) in 1959, and PhD degree from the same University in 1966. During 1957–1970, he was a member of the scientific staff of WUT. In 1970–1980 and in 1982–1993, the director of the National Institute of Telecommunications and professor in this Institute. In the meantime, the director of Union of Radio and TV Stations of Poland. In 1993–1997, Minister of Communications (Post and Telecommunications) of Poland. Since 1998 up to now, he is a professor at NIT. In 2005, member of National Council for Radio and TV Broadcasting. In 1993-2000 President of Federation of Engineering Associations in Poland. Member of the Polish Academy of Engineering, member of IEEE. Honorary member of SEP (Association of Polish Electrical Engineers) and SIP (Association of Telecommunications Engineers). He is the author or co-author of over 100 publications as well as 5 patents in the areas of nonlinear effects in transmission lines, optical communications and the problems of the telecommunication market development. He supervised four PhD dissertations.
7. R&D ACTIVITY
EUROPEAN PROJECTS


The overall objective of the EfficienSea 2 project is to co-create and deploy innovative solutions for safer and more efficient waterborne operations. With a total of seven specific objectives all interacting within one framework, the project targets the following:

• Create and implement a ground-breaking communication framework – the ‘Maritime Cloud’ that will enhance information sharing in and around the maritime sector for smarter traffic management, facilitating a comprehensive e-maritime and e-navigation environment, enabling the maritime internet of things.

• Identify, develop, test and, wherever possible, standardise and implement e-navigation solutions that will reduce the risk of accidents, especially in dense waterways, as well as increase the efficiency of the transport chain.

• Develop, test and, wherever possible, implement e-maritime solutions for automated reporting and efficient port information and, thus, minimise delays and turnaround times as well as administrative burdens.

• Create and implement navigational support services and a new self-organizing emergency response solution in remote and difficult environments such as the Arctic in order to reduce the risk of loss of life.

• Develop solutions to monitor emissions with a focus on SOx and conduct validation trials in the Baltic Sea Region.

• Create innovative and cost-effective solutions with novel communication technology to deal with ships’ challenge of getting access to information services at a reasonable price, especially in remote places such as the Arctic.

• Set the technical and governance standard for the above areas, particularly in regard to e-navigation solutions.

The EfficienSea 2 project has 32 partners from the countries in the Baltic Sea region and beyond – including the NIT.

Responsible in NIT: Dr Krzysztof Bronk, Z-8.

Project’s website
7.1. European Projects

**R-Mode Baltic (2017–2020)**

The project launches the development of a technical system that allows for safe ship navigation when the established Global Navigation Satellite Systems fail due to interference or jamming. The partners test broadcast signals transmitted via radio beacons and other existing infrastructure. This serves to develop prototypes for ranging mode transmitters and receivers. The Baltic Sea is the first operational test area for this technology worldwide.

The main goal of the R-Mode Baltic project is to develop and demonstrate of a new maritime backup system for position, navigation and time purposes. Therefore, the project consortium accepts the challenge to develop solutions for so-called Ranging Mode, or R-Mode, transmitter and receiver prototypes, for independent time synchronizations of broadcasting stations and for a test bed concept and its deployment within the project life time of three years.

The R-Mode Baltic project installs and promotes the first worldwide operational test area for a new maritime system for PNT as a backup for Global Navigation Satellite Systems in the Baltic Sea. The reason to do this is induced by the fact, that all Global Navigation Satellite Systems are highly vulnerable to jamming and interference and that in time no other system can overtake the task for absolute positioning in case of a temporal loss of Global Navigation Satellite Systems.

As a first step towards the alternative usage of existing positioning systems, a user-driven testbed in the Baltic Sea shall be installed by the project based on broadcast signals transmitted via modified IALA beacons and AIS base stations. The great advantage of this approach is the evolution of the still existing maritime infrastructure without any handling and utilisation constraints and its potential for a world-wide use within the service vicinity of such stations.

The R-Mode Baltic project has 12 partners from the countries in the Baltic Sea region – including the NIT.

Responsible in NIT: Krzysztof Bronk, Z-8

[Project’s website](#)
7.2.
PARTICIPATION IN COST ACTIONS

In 2017 the Institute participated in the following COST Actions:

**COST Action TU1208**


This Action focuses on the exchange of scientific-technical knowledge and experience of Ground Penetrating Radar (GPR) techniques in Civil Engineering (CE). The project is being developed within the frame of a unique approach based on the integrated contribution of university researchers, software developers, geophysics experts, Non-Destructive Testing equipment designers and producers, end users from private companies and public agencies. In this interdisciplinary Action, advantages and limitations of GPR are highlighted to identify gaps in knowledge and technology. Protocols and guidelines for EU standards are being developed for effective application of GPR in CE. A novel GPR is being designed and realized: a multi-static system, with dedicated software and calibration procedures, able to construct real-time lane 3D high resolution images of investigated areas.

Advanced electromagnetic-scattering and data-processing techniques are being developed. The understanding of relationships between geophysical parameters and CE needs is being improved. Freeware software is being released for inspection and monitoring of structures and infrastructures, buried-object localization, shape reconstruction and estimation of useful parameters. A high level training program is organized. Mobility of early career researchers is especially encouraged. The project has attracted attention of key end users and excellent EU institutions. In 2016 NIT hosted two Short-Term Scientific Missions under the TU1208 Action:

- on Coupled WKB approach applied to Ground Penetrating Radar by Prof. Alexei Popov from Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Moscow, Troitsk, Russia, in April 2016;

- on Enhancement of GPR-Ground Matching by Chirped Multilayer Structure: Numerical Modelling by the Method of Single Expression by Prof. Tamara Knyazyan from The National Polytechnic University of Armenia in August 2016.

The Chairman of The Action is Prof. Lara Pajewski from Sapienza University of Rome, Italy.

Prof. Marian Marciniak from NIT is one of the initiators and active contributors to The Action, as well as a Short-Term Scientific Missions (STSM) Manager.

[Action’s website](http://example.com)
7.2. Participation in COST actions

**COST Action MP1302**

This Action aims at consolidating European expertise on all aspects of UV/Vis/NIR nanospectroscopy (modelling, experiment, nanostructures, materials, equipment, applications) into one coherent Action. The COST networking approach is particularly well suited for this purpose. A training program is being established to spread the know-how of applying nanospectroscopic techniques and the gained insight. In dialogue with European industry, nanospectroscopic techniques are being further developed, e.g. as applied techniques for non-specialists.

Professor Monika Fleischer from Eberhard Karls Universität Tubingen, Germany is the Chair of The Action.

Prof. Marian Marciniak from NIT is a Member of the Management Committee.

[Action’s website](#)

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**COST Action MP1401**
**Advanced fibre laser and coherent source as tools for society, manufacturing and lifescience (2014–2018)**

This Action is the first arena where experts in fundamental material science, established laser and component groups, fibre laser manufacturers and end-users are able to actively interact, share know-how and focus on common goals. The Action aims to cover the 3–6 micron wavelength interval, and beyond, to support mid-infrared applications and to enhance fibre performance to cover more efficiently visible and ultra-violet wavelength generation for biophotonics and healthcare. The Action investigates glass materials and fibre design to overcome the actual limitation in output power of fibre lasers. The Action mentors a new generation of researchers by providing Early Stage Researchers with an opportunity to develop both scientific and management skills. At the same time the Action actively promotes gender balance and women researchers to management positions.

The Chairman of The Action is Prof. Stefano Taccheo from Swansea University in Wales, UK.

Prof. Marian Marciniak from NIT is one of the initiators and active contributors to The Action, as well as a Co-Chairman of Working Group 2. New laser and amplifier devices.

[Action’s website](#)
COST Action MP1403

The Action aims at promoting and coordinating forefront research in nanoscale quantum optics (NQO) through a competitive and organized network, which will define new and unexplored pathways for deploying quantum technologies in nanophotonics devices within the European Research Area. The main vision is to establish a fruitful and successful interaction among scientists and engineers from academia, research centers and industry, focusing on quantum science and technology, nanoscale optics and photonics, and materials science. The Action addresses fundamental challenges in NQO, contributes to the discovery of novel phenomena and defines new routes for applications in information and communication technology, sensing and metrology, and energy efficiency. Gathering a critical mass of experts, the Action serves as a platform in NQO and as such it cooperates with industry and academia to promote innovation and education in a forefront research field.

The Chairman of The Action is Prof. Mario Agio from the University of Siegen, Germany.

Prof. Marian Marciniak from NIT is one of the initiators and active contributors to The Action, as well as a Member of the Management Committee of The Action.

Action’s website

COST Action IC1303

The main subject of the Action is Ambient Assisted Living (AAL), which is an area of research based on Information and Communication Technologies (ICT), medical research, and sociological research. AAL is based on the notion that technology and science can provide improvements in the quality of life for people in their homes. This Action aims to promote interdisciplinary research on AAL through the creation of a research and development community of scientists and entrepreneurs, focusing on AAL algorithms, architectures and platforms, having in view the advance of science in this area and the development of new and innovative solutions. Discussions on new solutions for wireless communications (e.g. Cognitive Radio, other than ISM bands) for AAL area were performed.

Management Committee Member: Dr Dariusz Więcek, Z-21

Action’s website
7.2. Participation in COST actions

COST Action 16220
European Network for High Performance Integrated Microwave Photonics (2017–2021)

Next generation global telecommunication platforms and emerging massive take-up applications in radar, communications and space industries will require entirely new technologies to address the current limitations of electronics for massive capacity and connectivity. Multigiga-bit-per-second 5G wireless communications, the Internet of Things, the upcoming Smart Car scenarios and satellite payloads will require a full convergence between optical fibre and wireless segments.

Microwave photonics (MWP) combines RF and photonics and is the best positioned technology to carry out this convergence. Current MWP systems, however, are fiber and discrete-component based, which limits energy-efficiency, flexibility and scalability, and, as a result, high volume application. Integrated Microwave Photonics (IMWP) seeks to address these limitations by incorporating these systems into photonic integrated circuits (PICs). IMWP is still at its infancy and a considerable body of knowledge, technical and scientific roadmapping and interactions between industry academia need to be developed during the next years.

The European Network for High Performance Integrated Microwave Photonics (EUMWP) Action aims to shape and bring the relevant IMWP community supporting coordination and networking actions to consolidate this new IMWP ecosystem, providing exchange of knowledge, ideas and delivering a portfolio of technological benchmarkings to establish performance indicators defining future technological requirements in high performance scenarios such as 5G, automotive and aerospace technologies.

The action brings together groups from academia, industry and transnational organizations with complementary competences and on a global scale including PIC and MWP experts, microwave system application designers and end-users to fully develop the synergies required by this new paradigm.

The Chairman of The Action is Prof. Jose Campany from ITEAM Research Institute, Spain.

Prof. Marian Marciniak from NIT is a Member of the Management Committee.

COST Action 15127
Resilient communication services protecting end-user applications from disaster-based failures (RECODIS) (2016–2020)

Disaster-based disruptions seriously degrading the performance of any communication network (following from natural disasters, technology-related disasters, or malicious attacks) are now gaining importance due to observed increase of their intensity and scale. The problem is of utmost importance due to lack of appropriate mechanisms deployed in practice in Europe. Each time, unavailability of communication networks services, considered as an important part of critical infrastructure, in the presence of disasters implies evident societal problems for people desperately seeking for information, or trying to communicate with each other.

The Action will fill this gap by offering the respective solutions to provide resilient communications in the presence of disaster-based disruptions of all types for existing communication networks (e.g., IPv4-based, current Internet), as well as emerging architectures of the global communications infrastructure (i.e., the Future Internet).

Geographical diversity characteristics of disaster-based disruptions across Europe requires creation of an international and geographically diverse group of researchers to provide the proper solutions. Therefore, COST Action is viewed as the best way to address this issue.

This output-oriented Action will be driven by researchers from academia and industry in strong cooperation with governmental bodies. The aim is to introduce the set of techniques of resilient communications, as well as recommendations on how to deploy/update topologies of communication networks to make them resistant to disruptions that can be applied in practice by network equipment operators and national/international network providers at the European level.

The Chairman of The Action is Prof. Jacek Rak from Gdansk University of Technology, Poland.

Prof. Mrosaw Klinkowski from NIT is a Management Committee Substitute.

Action’s website
7.3. DOMESTIC PROJECTS AND RESEARCH PROGRAMS


Full name of the project: Single Frequency Network Using DAB+ Software Emission Platforms for Local Broadcasters in Poland.

The basic and crucial aim of the project is to elaborate a single-frequency (SFN) demonstrator based on a set of three transmission platforms operating in DAB+ standard, with the use of universal programmable circuits and an open source software. An indirect aim will consist in encouraging and propagating the digital radio concept in the community of local broadcasters, owing to the constructed, relatively inexpensive, complete transmission platform as well as due to the demonstrated feasibility and tests of the SFN networks created with its use.

The project is executed in the consortium: NIT, Wrocław University of Technology, Radio Wrocław.

Project leader in NIT: Janusz Sobolewski, Z-21

Project’s website


Full name of the project: Internet on the Baltic Sea – A Multisystem, Self-Organizing Teleinformatic Network at Sea to Improve Maritime Safety Through E-Navigation Services Development.

The purpose of the project is the development of novel mechanisms for wireless networks self-organization. Those mechanism are expected to be the background for an infrastructure that would cover a number of systems (UMTS, LTE, WiFi, WiMAX, AIS, VDES, etc.) and would provide fast data transmission:

- between ships,
- between ships and data storage/data processing centers,
- between ships and the Internet.

The wireless communications at sea will improve maritime safety through the provision of e-navigation services. The outcome of the project will be technical specification, implementation and verification of the proposed solutions in real conditions. The devices as well as applications will be tested in a pilot installation set up in the Baltic Sea region.

The netBaltic project has five partners: Gdansk University of Technology, National Institute of Telecommunications, Institute of Oceanology – Polish Academy of Sciences, DGT Lab S.A., NavSim Polska Sp z o.o.

Responsible in NIT: Krzysztof Bronk, Z-8

Project’s website
SIMFREE (2017–2018)

Full name of the project: Open-source freeware for fiber optic communication and sensing simulations.

To meet the constantly increasing traffic in optical networks due to ever growing requirements of society spectral efficiency should be increased by using, an advanced modulation formats and reduced channel spacing. This results in increased spectral power density and interferences with an adjacent channels. The application of Raman amplifiers enables reduction of these interferences through more even distribution of power along the entire length of a fibre optic cable.

The goal of SIMFREE project is to develop intuitive open-source software to simulate new generation of fiber optic systems, which can be used as a support for research projects and most importantly in education.

Responsible in NIT: Marian Marciniak, Z-12

Project's website

MONALIS (2017–2019)

Full name of the project: Monitoring and control QoE in large scale media distribution architectures.

The main goal of the MONALIS project is to develop and create measurement and monitoring system of QoE (Quality of Experience) in telecommunications networks using Big Data analytics. The system will be used to build a network services quality (QoE) management platform that will enable to control the network resources and obtain services with diversified QoE levels. It will make possible to introduce a new type of measurement systems and to offer a variety of services with different level of QoE.

The project is executed in the consortium:
NIT, Mint Media Sp. z o.o. (leader), Orange Polska S.A..

Project leader in NIT: Jordi Mongay Batalla, Z-3

Project's website

NPC (2017–2020)

Full name of the project: National Cybersecurity Platform.

Responsible in NIT: Janusz Granat, Z-6

Project's website
IDSoC (2017–2020)

Full name of the project: *Innovative, hardware – software component, based on a dedicated integrated circuit and software to perform various cryptographic application, with the particular attention paid to electronic identification systems with the high level of confidence.*

The aim of the project is to develop and manufacture an innovative single-chip secure processor – IDSoC. The developed system on chip will be composed of a proprietary application processor with an increased fault tolerance and security level. The processor will include a non-volatile memory area dedicated to storing both embedded software and sensitive user data, such as biometric data. Thanks to the appropriate error detection and correction systems as well as hardware encryption, the non-volatile memory will ensure data integrity and confidentiality. In addition, the integrated IDSoC system will be equipped with a set of peripherals for hardware cryptographic support. During the project, it is planned to develop a true random number generator (TRNG) and to carry out research on the possibility of the physical unclonable function (PUF) utilization for the purpose of identification and authentication. It is also anticipated to develop a set of sensors for the monitoring of the integrated circuit’s environmental conditions (e.g. temperature, supply voltage, clock frequency). The mechanisms of the external interference detection in the system’s physical structure will also be employed, which will significantly protect the system features against unauthorized access attempts and will prevent from the acquisition of sensitive data. The IDSoC system, to be developed during the project, might be utilized in the applications in which the storage and processing of sensitive data is required, e.g. in electronic identification systems (electronic identity card, e-passport).

The inherent part of the IDSoC system will be its dedicated firmware, developed in the course of the project. The firmware will support and enable all the system’s functions, most notably the electronic identification with high level of confidence and other advanced cryptographic procedures.

Project leader in NIT: Krzysztof Bronk, Z-8

Project’s website

SDM (2017–2020)

Full name of the project: *Modeling and optimization of elastic optical networks with space division multiplexing.*

The communication networking is undergoing immense changes which are governed by the development and integration of diverse network technologies and applications. The current trends result in an exponential increase of traffic on the level of 30–90% per year (depending on application and traffic type). However, this trends are not followed by an adequate growth of capacity of conventional dense WDM (DWDM) transmission systems (20% per year). The disparity between the foreseen increase in traffic demands and capacity growth in core networks, sometimes referred to as optical networks capacity crunch, leads to the need for new solutions ensuring very high bit-rate connectivity (up to 10 Tbit/s) and increase of optical fiber capacity up to 1 Pbit/s (in 2010, it was ~100 channels × 100 Gbit/s = 10 Tbit/s) in the next few or several years. In this context – and according to the research agenda of the European Commission (EU) under the program ‘H2020 5G Infrastructure PPP’ – optical networks are considered a key technology for building transport infrastructure for future Internet networks based on the fifth-generation (5G) wireless networks. Capacity requirements of such networks, up to 100× more than currently available in the core, necessitate new solutions, more scalable than the current ones. Spectral division multiplexing (SDM), combined with elastic optical networking (EON), is foreseen as breakthrough technology and the only long-term solution that could satisfy such requirements. For efficient design and operation of SDM elastic optical networks dedicated optimization models and methods are needed.

The main concern of the Project is modeling and optimization of SDM elastic optical networks. Modeling and optimization of communication networks is a well-established and important area of research. Mathematical programming methods, such as mixed-integer programming (MIP), are a basic tool in modeling and solving optimization problems. Optimization problems that arise in network design (e.g., network planning, resource placement) and operation/control (e.g., network re-optimization, resource allocation) can be formulated as MIP problems. Most of these problems are NP-hard, which means that there are no known algorithms that could deterministically solve them in polynomial time. To generate solutions, both exact algorithms, based on a branch-and-bound method, and heuristics are applied.
SDM introduces a new dimension in network optimization by enabling parallel transmission in optical fiber modes and cores, or in fiber bundles. Indeed, the application of spatial division multiplexing, along with wavelength division multiplexing technologies (which are also utilized in DWDM and EON networks), increases network capabilities, since optical carriers forming high-capacity 'super-channels' are not carried just on adjacent frequencies in the frequency domain (spectral elasticity), but they can also be distributed over different modes, cores or fibers (spatial elasticity). This extends the set of decision variables in network optimization and leads to the routing, space, and spectrum allocation (RSSA) problem – a basic problem in planning and operating SDM elastic optical networks. The RSSA optimization problem is more complex than the routing and spectrum allocation (RSA) problem in EONs. Consequently, previous RSA solutions cannot be applied directly and new methods and algorithms have to be developed for solving RSSA. Optimizing the network beyond the basic RSSA scenario is yet more challenging. Here, additional problem constraints and variables resulting from consideration of network survivability, signal regeneration, traffic grooming, or multi-layer design, are involved and have to be taken into account in the optimization problem and its resolution methods.

In multi-core fiber and few-/multi-mode fiber transmission systems, the impact of crosstalk between adjacent fiber modes and cores on transmission quality needs to be investigated in order to develop models for its estimation in core networks, in which provisioning of quality of transmission (QoT) guarantees is particularly critical due to large transmission distances. Such models are indispensable in physical layer impairment (PLI)-aware network planning and operation; we will focus on developing them in this Project.

So far, most of the research efforts have targeted mainly physical-layer aspects related to the realization of SDM transmission, in particular, development of dedicated optical fibers, system components and transmission devices. At the same time, to the best of our knowledge, there are only a few papers concerning modeling and optimization of such networks, including the development of adequate methods and algorithms for the RSSA problem, even though the potential scope of research is very extensive if we consider its similar context as in WDM and EON networks. Due to these reasons, among others, the studies undertaken in this Project have a pioneering character and will contribute to the development of scientific discipline (communication networking).

An important goal of the Project is to build a unique research methodology and increase the competencies of the Research Team in the emerging area of SDM elastic optical networks. It is a timely and still not deeply explored direction of research in the field of communication networks.

Responsible in NIT: Mirosław Klinkowski, Z-12

Project’s website

HYPERMAT (2017–2020)

Full name of the project: Tunable hyperbolic metamaterials for the new generation of photonic appliances.

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.

We expect that project results 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 modeling, technology and characterization of photonic devices including nanostructures based on THMMs.

Responsible in NIT: Mariusz Zdanowicz, Z-12
### 7.4. BILATERAL COOPERATION

Apart from the participation in the international projects listed above, the Institute researchers cooperated on a bilateral basis with foreign research organizations and teams. The most important examples below.

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<th>Person cooperating in NIT</th>
<th>Foreign Institution</th>
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<td>Elżbieta Andrukiewicz, DRP</td>
<td>The European Union Agency for Network and Information Security (ENISA)</td>
<td>ICT Security Certification</td>
<td>'Overview of the practices of ICT Certification Laboratories in Europe (Co-author)'</td>
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<tr>
<td>Ewa Orłowska, Z-6</td>
<td>Brock University, St Catharines, Ontario, Canada</td>
<td>mixed algebras, non-classical logic</td>
<td>Articles</td>
</tr>
<tr>
<td>Ewa Orłowska, Z-6</td>
<td>Department of Computer Science and Engineering, University of Applied Sciences of Thessaly, Greece</td>
<td>non-classical logic</td>
<td>Articles</td>
</tr>
<tr>
<td>Ewa Orłowska, Z-6</td>
<td>Fachbereich Wirtschaft, Berner Fachhochschule, Bern, Switzerland</td>
<td>non-classical logic</td>
<td>Articles</td>
</tr>
<tr>
<td>Dr Krzysztof Bronk, Z-8</td>
<td>IALA (International Association of Lighthouse Authorities) and ITU (International Telecommunication Union)</td>
<td>Development of the VDES (VHF Data Exchange System) standard</td>
<td>ITU-R Recommendation M.2092-1 Technical characteristics for a VHF data exchange system in the VHF maritime mobile band</td>
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<tr>
<td>Prof Miroslaw Klinkowski, Z-12</td>
<td>Universitat Politecnica de Catalunya (UPC), Barcelona, Spain</td>
<td>Optimization of elastic optical networks</td>
<td>Joint research and publications</td>
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<tr>
<td>Marcin Koba, Z-12</td>
<td>Université du Québec en Outaouais, Canada</td>
<td>Optical fiber sensors and biosensors</td>
<td>Scientific publications, book chapter, conference papers and talks</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>Research Foundation – Flanders (FWO-Vlaanderen), Belgium</td>
<td>optical fibre technology</td>
<td>research grant evaluation</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>the National Research, Development and Innovation Office of Hungary</td>
<td>Mathematics and Computer Science</td>
<td>research grant evaluation</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>European Science Foundation</td>
<td>physics and nanoscience</td>
<td>research grant evaluation</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>the Swedish Research Council (Vetenskapsrådet)</td>
<td>telecommunications and signal processing</td>
<td>research grant evaluation</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>European Commission – Research Executive Agency</td>
<td>nanotechnology and material science</td>
<td>research grant evaluation</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>Greek Ministry of Education</td>
<td>electronics and communications</td>
<td>research grant evaluation</td>
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<td>Prof Marian Marciniak, Z-12</td>
<td>Slovenian Research Agency</td>
<td>electronics and communications</td>
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<tr>
<td>Person cooperating in NIT</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>UPC Barcelona, Catalonia, Spain</td>
<td>optical communications</td>
<td>joint organisation of ICTON 2017 conference</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>Universitat de Girona (UdG), Catalonia, Spain</td>
<td>optical communications</td>
<td>joint organisation of ICTON 2017 conference</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>Institut für Hochfrequenztechnik / Institute of Microwave and Photonic Engineering, Graz University of Technology, Austria</td>
<td>Optical communications in free space</td>
<td>Joint research</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>Consiglio Nazionale delle Ricerche CNR-IFN, Istituto di Fotonica e Nanotecnologie, Trento, Italy</td>
<td>Nanostructured systems in opal configuration for the development of photonic devices</td>
<td>Joint research in the frame of Polish (PAN) – Italian (CNRS) agreement</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>Université d'Angers, Angers, France</td>
<td>Nanophotonics and subwavelength photonics</td>
<td>Joint research</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>State Engineering University of Armenia, Yerevan, Armenia</td>
<td>New types of optoelectronic plasmonic structures – application in telecommunications</td>
<td>Joint research</td>
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<td>Prof Marian Marciniak, Z-12</td>
<td>University of Nottingham, Dept of Electrical and Electronic Engineering</td>
<td>Electromagnetics – theory, modelling, and applications</td>
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<td>Prof Marian Marciniak, Z-12</td>
<td>Swansea University, United Kingdom</td>
<td>Fibre lasers – theory, modeling, and applications</td>
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<td>Prof Marian Marciniak, Z-12</td>
<td>Universita Di Roma I 'La Sapienza', Italy</td>
<td>Ground Penetrating Radar and electromagnetic phenomena involved</td>
<td>Joint research</td>
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<td>Prof Marian Marciniak, Z-12</td>
<td>Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation IZMIRAN, Russian Academy of Sciences, Troitsk, Russian Federation</td>
<td>Electromagnetic wave propagation – theory, modelling, and applications</td>
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<td>Prof Marian Marciniak, Z-12</td>
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<td>Advanced telecommunication infrastructure and services</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>Institute for Command Engineers of the Ministry of Emergencies of the Republic of Belarus, Minsk, Belarus</td>
<td>Investigation on new types of microstructured multicore fibres</td>
<td>Joint research</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>International Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS), Tsukuba, Ibaraki, Japan</td>
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<tr>
<td>Prof Marian Marciniak, Z-12</td>
<td>Institute of Radio-Physics and Electronics, National Academy of Sciences of Ukraine, Kharkov, Ukraine</td>
<td>Investigation on new optical effects in nanostructures</td>
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<td>Dr. Dariusz Więcek, Z-21</td>
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<td>Dr. Dariusz Więcek, Z-21</td>
<td>Czech Metrology Institute, Hungarian Scientific Association for Infocommunications, Research Institute of Posts and Telecommunications Slovakia</td>
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<td>Jordi Mongay Batalla, Z-3</td>
<td>La Trobe University, Melbourne, Australia</td>
<td>Telecommunications – Smart Cities</td>
<td>Joint publication, Feature Topic in IEEE ComMag</td>
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<td>Jordi Mongay Batalla, Z-3</td>
<td>University of Nicosia, Cyprus</td>
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<td>Scientific internship, joint publications, featured publications in magazines and joint research</td>
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<td>Jordi Mongay Batalla, Z-3</td>
<td>University Politehnica of Bucarest, Bucharest, Romania</td>
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<td>Jordi Mongay Batalla, Z-3</td>
<td>University at Buffalo, Buffalo, USA</td>
<td>Cybersecurity – blockchain</td>
<td>Joint feature article in magazine application (currently reviewed)</td>
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<td>Jordi Mongay Batalla, Z-3</td>
<td>University of Bordeaux, Talence, France</td>
<td>Multimedia streaming</td>
<td>Joint research and publications, joint PhD candidate promotion</td>
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<td>Jordi Mongay Batalla, Z-3</td>
<td>University College of London, London, Great Britain</td>
<td>5G, Smart Cities, Internet of Things</td>
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<td>Jordi Mongay Batalla, Z-3</td>
<td>Alpen-Adria-Universität Klagenfurt, Klagenfurt, Austria</td>
<td>Multimedia streaming</td>
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<td>Jordi Mongay Batalla, Z-3</td>
<td>Cisco Systems, California, USA</td>
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<tr>
<td>Jordi Mongay Batalla, Z-3</td>
<td>Ecole Nationale Supérieure des Techniques Avancées (ENSTA ParisTech), France</td>
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<td>Jordi Mongay Batalla, Z-3</td>
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<td>Regulatory, economic and functional aspects of the development of the electronic communications and postal markets in view of the 'Europe 2020' strategy</td>
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<td>Wojciech Michalski, Z-2</td>
<td>Developing the dictionary of technical, legal and economic telecommunication terms for on-line publication</td>
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<td>Paweł Godlewski, Z-10</td>
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<td>Robert Samborski, Z-10</td>
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<td>Mikołaj Waszkiewicz, Z-10</td>
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<td>Michał Marszałec, Z-12</td>
<td>Works on the development of remote time transfer methods, and research on methods for consistency of measurement of optical frequency standards</td>
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<td>Methods and techniques increasing radio spectrum efficiency including also second generation of the digital terrestrial television broadcasting DVB-T2</td>
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<td>Marek Michalak, Z-21</td>
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<td>Andrzej Zieliński, BD</td>
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<td>Organizational, technical and procedural aspects of ICT security and information security in organizations from the Poland cyberspace protection needs' perspective – cont.</td>
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<td>Stanisław Dziubak, DRP</td>
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</table>
8. SUPPORT FOR PUBLIC ADMINISTRATION
As National Research Institute, the Institute gives specialized expertise and consultancy services to the Government and other public administrations, esp. to the Ministry of Digital Affairs (MC), the supervisor of the Institute. This determines the Institute’s role of an expert in Information and Communication Technologies, elaboration of technical opinions and participation in advisory committees.

In June 2017 the Institute has signed, with the Ministry of Digital Affairs and the President of the Office of Electronic Communication, the Agreement for the Strategy ‘5G for Poland’. The Agreement is open to other parties and all main players in Polish telecommunication sector have acceded and signed it. The role of the Institute is the organizer of the collaboration between Parties to deliver the actions associated with the creation and realization of the Strategy ‘5G for Poland’. These actions should make Poland a front runner for introducing 5G technology and allow for the delivery of the associated economic benefits for the country, also known as Industry 4.0. At the turn of 2017/2018 the Strategy was published by the Ministry and open for public consultations.

Beside the above, in 2017 the Institute performed the following tasks for the MC and other public institutions:

- elaboration of comments and opinions on legal acts and other documents directed to the Institute by national authorities like the Ministry of Digital Affairs, the Office of Electronic Communications (UKE) and the Parliamentary Commissions,
- technical support to the Ministry of Digital Affairs and the Ministry of Development in the Operational Program of Digital Poland,
- management and development of information systems for telecommunications infrastructure inventory (SISI), governmental ICT infrastructure inventory (SIST) and e-administration services usage and quality monitoring system and portal (www.widok.gov.pl),
- elaboration of several analyses and reports: on new 5G technologies and Smart Cities concept, on technical requirements for DVB-T2 TV sets, on common-channel allowed interference level between DVB-T2 and LTE stations, on Short Messages System solutions for 112 emergency number, on buildings and locations addressing system for geospatial purposes etc.,
- measurement campaigns of the level of electromagnetic fields emissions from GSM, UMTS, LTE and WiFi base stations in 67 locations in main cities in Poland, elaboration of the report and conclusions for the consideration of the Ministry of Digital Affairs,
- review and analysis of cybersecurity standardization in Poland, experts support to the National Frames of Cybersecurity Policy for 2017–2022 and participation in SOGIS MRA (Senior Officials Group Information Systems Security) works on the evaluation and certification of the ICT Products and in the Horizontal Working Party (HWP) on Cyber Issues (E.30) works on the proposal for a Regulation of the European Parliament and of the Council on ENISA, the ‘EU Cybersecurity Agency’, and repealing Regulation (EU) 526/2013, and on Information and Communication Technology cybersecurity certification (‘Cybersecurity Act’),
- elaboration of Polish revised text of all 4 volumes of the ITU Radio Regulations last edition, published in Geneva in 2016,
- conference and ITU Workshop organization on the medical, biologic, technical and legal aspects of the electromagnetic field influence on the environment, 5–6 December 2017, Warsaw,
- technical support and assistance for Polish Governmental Delegations to the meetings of CEPT-ECC, CPG and WG-FM and also to ESA JCB and PB-NAV,
- inter-laboratory comparison testing for calibration laboratories in Poland, under the auspice of Polish Centre of Accreditation and Central Office of Measures,
- preparation of technical proposals for Polish Committee for Standardization (PKN), especially for Technical Committee No 11 for Telecommunications,
- preparation of technical expertise in radio-communication systems, radio-communication interferences, propagation of radio signals for local authorities, prosecution offices and courts of justice,
- video and streaming services for a dozen of public events organized by MC and UKE (conferences, workshops, public consultations, meetings etc.).
9. OTHER ACTIVITIES
9.1. PUBLISHING ACTIVITY

The Institute is a publisher of two printed periodicals (with electronic copies on www) as described below. *Journal of Telecommunications and Information Technology (JTIT)* is a periodical published quarterly in English. It comprises original contributions, dealing with a wide range of topics related to telecommunications and information technology. All papers are subject to peer review. Topics presented in the JTIT report on primary and/or experimental research results, which advance the base of scientific and technological knowledge about telecommunications and information technology. JTIT is dedicated to publishing research results which advance the level of current research or add to the understanding of problems related to modulation and signal design, wireless communications, optical communications and photonic systems, voice communications devices, image and signal processing, transmission systems, network architecture, coding and communication theory, as well as information technology.

The **Journal** is indexed, among others, by: SCOPUS, INSPEC, ProQuest. In 2017, four issues of the periodical were published, containing 49 scientific papers in total. The leading subjects are as follows: in QoS in telecommunication networks, security and monitoring in mobile sensor networks, electromagnetic compatibility, intelligent algorithms used in ad hoc networks management.

Editor-in-Chief of the Journal is Prof. Paweł Szczepański.

All published papers are subject to peer review.

## Publications of NIT's staff

<table>
<thead>
<tr>
<th>Publication by category</th>
<th>Number of publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papers published in journals listed by the Journal Citation Reports (JCR)</td>
<td>33</td>
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<tr>
<td>Publications in journals listed by the Ministry of Science and Higher Education</td>
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<tr>
<td>Conference proceedings listed by the Web of Science</td>
<td>10</td>
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<tr>
<td>Publications in peer-reviewed journals in Poland and abroad</td>
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<tr>
<td>Books published in English</td>
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<tr>
<td>Chapters in books published in English</td>
<td>11</td>
</tr>
<tr>
<td>Editors-in-Chief of monographs in English</td>
<td>2</td>
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<tr>
<td>Conference proceedings</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total number of publications</strong></td>
<td><strong>120</strong></td>
</tr>
</tbody>
</table>
9.2. PATENTS

In 2017 three patents were granted to the Institute, and two applications were filed to the Polish Patent Office.

**Patent granted by the EPO:**

- **System for automation of measurement of the batteries capacity in the telecommunications power station.**

  Inventors: Paweł Godlewski, Ryszard Kobus, Krzysztof Olechowski, Bogdan Chojnacki, Kazimierz Niechoda (Z-10).

  Application No. EP13796171.0, patent No. EP2972433 (B1).

**Patents granted by the Polish Patent Office:**

- **Method and the receiving device for adaptive receiving of multimedia content.**

  Inventors: Andrzej Bęben (PW), Piotr Krawiec, Jordi Mongay Batalla, Piotr Wiśniewski (Z-3).

  Application No. P.412498.

- **System for early diagnostics of PCL phenomenon in VRLA batteries.**

  Inventors: Paweł Godlewski, Ryszard Kobus, Marian Kania, Lech Jóźwik (Z-10).

  Application No. P.415676.

**Applications filed to the Polish Patent Office:**

- **Transistor circuit for battery disconnect/connect**

  Inventors: Paweł Godlewski, Ryszard Kobus, Krzysztof Olechowski, Bogdan Chojnacki, Kazimierz Niechoda (Z-10).

  Application No. P.423626.

- **Remote control circuit available battery capacity in already operating power systems.**

  Inventors: Paweł Godlewski, Ryszard Kobus, Krzysztof Olechowski, Bogdan Chojnacki, Kazimierz Niechoda, Barbara Regulska (Z-10).

  Application No. P.424106.
9.3. CONFERENCES, SEMINARS AND EDUCATION

9.3.1. CONFERENCES

19th International Conference on Transparent Optical Networks ICTON 2017

19th International Conference on Transparent Optical Networks ICTON 2017 was held at the Girona Conference Centre in Girona, Catalonia, Spain on 2–6 July 2017. The Conference was organized by members of the former NIT’s Department of Transmission and Optical Technologies together with the The Universitat de Girona (UdG) and the Universitat Politècnica de Catalunya (UPC). That was the third time ICTON was hosted in Spain, and the second one in Catalonia. The previous events were celebrated in Barcelona (ICTON 2005), and in Cartagena (ICTON 2013). ICTON 2017 was technically co-sponsored by the IEEE Photonics Society and Poland Chapter of that society.

The Conference General Chair was Prof. José L. Marzo (UdG), and Prof. Ramon Vilaseca (UPC) was the Honorary Chair, Prof. Dominik Dorosz, IEEE Photonics Society Poland Chapter Chairman, was the Chairman of ICTON 2017 Scientific Committee, and Professor Hans-Georg Unger, a pioneer of optical fibre technology, is the Honorary Chair of that Committee. ICTON Organizing Committee consisted of eight NIT’s employees with Prof Marian Marciniak as the Chairman, and Dr. Marek Jaworski as the Publication Chair.

The Technical Programme of the Conference consisted of, 488 papers (including 2 plenary and 350 invited) were presented in as many as 79 oral sessions, and the programme was completed with two poster sessions involving 58 poster contributions in total. A total of 418 participants from 42 countries all over the world attended ICTON 2017.

The 9th Sub-Wavelength Photonics Conference SWP was co-located with ICTON 2017. In addition, there were several thematic workshops and sessions including:

- 16th European Symposium on Photonic Crystals (ESPC)
- 16th Workshop on All-Optical Routing (WAOR)
- 14th Global Optical & Wireless Networking Seminar (GOWN)
- 13th Reliability Issues in Next Generation Optical Networks Workshop (RONEXT)
- 13th Optical Wireless Workshop (OWW – former Free-Space Optics Session)
- 13th Photonic Integrated Components & Applications Workshop (PICAW)
- 12th Nanophotonics for All-Optical Networking Workshop (NAON)
- 12th Special Session on Photonic Atoms & Molecules (PAM – former MPM)
- 11th Special Session on Novel Glasses for photonic devices
- 10th Anniversary Special Session on Market in Telecommunications (MARS)
- 9th Workshop on Broadband Access (former ACCORDANCE)
- 8th Workshop on Communication in Transportation Systems (CTS)
- 7th Workshop on Green Optical Communications (GOC)
- 7th Special Session on Microwave Photonics (MWP)
- 4th Workshop on Big Data Analytics and Network Optimization (BigNeO – former NeO)
- 3rd Workshop on Technology for Data Center Interconnects (DACINT)
- 3rd Workshop on Datacenter Networks (DCN)
- 3rd Workshop on 5G Transport Networks (5GT)
- 2nd Workshop on Fiber-Wireless Network Technologies and Architectures towards 5G and Beyond (FiWiN5G)
- 2nd Workshop on Quantum Photonics (QPhot)
- 2nd Workshop on Multi-Layer Network Orchestration (NetOrch)
- 1st Workshop on High Capacity SDM-WDM Optical Networking (SDM-WDM)
- 1st Workshop on Flexible and High-Capacity Optical Networks (Flex-ON)
- 1st Workshop on Novel Optical Amplifiers (NOA)
- 1st Workshop on Label-Free Super-Resolution (LFSR)
- Session on EU-Project (EU-P)
Organized by NIT and fostered by the Ministry of Digital Affairs, the international conference *Electromagnetic Field and Its Influence on Environment* was held in Warsaw on 6 December 2017. The thematic scope covered:

- biological, physical and medical fundamentals of bio-electromagnetism;
- electromagnetic field measurement and normative policy;
- telecommunication of the future – hopes and fears.

The total of 9 lectures were given by the acclaimed EMF specialists from Poland and other countries. The presentations were followed by panel discussion.

The 2017 conference was the second edition of the event that is planned to be organized annually.

The video recordings of the conference together with all basic information are available at pem.itl.waw.pl
Final Conference of the COST Action TU1208

The Final Conference of the COST Action TU1208 Civil engineering applications of Ground Penetrating Radar was hosted by the National Institute of Telecommunications on 25—27 September 2017.

General Chairs of the event were Prof. Marian Marciniak (TU1208 MC Member and Short-Term Scientific Mission Manager) and Prof. Lara Pajewski (TU1208 Chair).

The Members of the COST Action TU1208 presented and widely discussed the results of the research activities carried out during the past five years (since the approval of the Action in November 2012) and celebrated the achievements. Each day of the conference was concluded with a session dedicated to organizing follow-up activities and to designing the future of the TU1208 scientific network.

The conference programme included two invited lectures. Prof. Cristina Pronello talked about Intelligent Transport Systems and provided a very interesting overview on the research activities, recent advancements and trends in this area. Prof. Pronello is a Full Professor at Sorbonne Universités, France; she is the President of the Mobility Agency of the Piemonte Region, Italy. In 2006, she was appointed by the Italian Ministry of University and Research as National delegate of the COST Domain Committee Transport and Urban Development (TUD) and from May 2006 to September 2014 she was the TUD Chair.

Dr Thierry Goger gave an inspiring talk on the future of transport infrastructure. Since January 2014, Dr Goger is the Secretary General of FEHRL, the Forum of European National Highway Research Laboratories. He was a very active Member of the COST Actions 350 Integrated assessment of environmental impact of traffic and transport infrastructure and 356 Towards the definition of a mea-

The papers related to COST Action TU1208 were published by NIT in a special issue 3/2017 of Journal of Telecommunications and Information Technology quarterly.
## 9.3.2. SCIENTIFIC SEMINARS

Scientific seminars held in 2017.

<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.03.2017</td>
<td>The transformation of the polish telecommunication network from TDM to IP in aspects: service, regulatory, technical and security</td>
<td>Jerzy Paczocha</td>
</tr>
<tr>
<td>29.03.2017</td>
<td>Telecommunications fraud in the aspect of operators and clients</td>
<td>Jerzy Paczocha</td>
</tr>
<tr>
<td>12.04.2017</td>
<td>e-VAT – simplification and tightening up of VAT tax system</td>
<td>Piotr Grajkowski</td>
</tr>
<tr>
<td>26.04.2017</td>
<td>Modeling of urban scenarios for the digital broadcasting systems radio planning process</td>
<td>Dariusz Wypiór</td>
</tr>
<tr>
<td>17.05.2017</td>
<td>Sorting alternatives using preference profiles aggregation method</td>
<td>Anna Mościcka</td>
</tr>
<tr>
<td>6.09.2017</td>
<td>Technical examination of the public telephone service in the aspect of the transformation of the ALL IP network and network neutrality</td>
<td>Jerzy Paczocha</td>
</tr>
<tr>
<td>30.11.2017</td>
<td>The postal services market in 2012-2017</td>
<td>Anna Stolarczyk Marek Sylwestrzak</td>
</tr>
</tbody>
</table>
### EDUCATION

Training Centre of the NIT has organised in 2017 the following trainings and courses:

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<tr>
<th>Date</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>17–18.01.2017</td>
<td>Land mobile radiocommunication systems</td>
</tr>
<tr>
<td>21–22.02.2017</td>
<td>Land mobile radiocommunication systems</td>
</tr>
<tr>
<td>21–22.03.2017</td>
<td>5G systems</td>
</tr>
<tr>
<td>20–21.04.2017</td>
<td>Solving intermodulation problems</td>
</tr>
<tr>
<td>9–10.05.2017</td>
<td>Solving intermodulation problems</td>
</tr>
<tr>
<td>17–18.07.2017</td>
<td>Linux – Bash programming</td>
</tr>
<tr>
<td>24–25.07.2017</td>
<td>Linux – Bash programming</td>
</tr>
<tr>
<td>4–10.04.2017</td>
<td>TU e-learning course on ‘Strategic aspects for internet governance and innovations’</td>
</tr>
<tr>
<td>3–4.10.2017</td>
<td>Aspects of Polish and European telecommunications law</td>
</tr>
<tr>
<td>9–11.10.2017</td>
<td>The basics of local computer network – LAN</td>
</tr>
<tr>
<td>11.10.2017</td>
<td>Passive Intermodulation (PIM) in transmission lines</td>
</tr>
<tr>
<td>18.10.2017</td>
<td>Safety of staying in the electromagnetic field</td>
</tr>
<tr>
<td>25.09 – 21.10.2017</td>
<td>ITU e-learning course on ‘Wireless access technologies to Internet Network’</td>
</tr>
<tr>
<td>23–25.10.2017</td>
<td>Introduction to routing in TCP/IP networks</td>
</tr>
<tr>
<td>23–25.10.2017</td>
<td>ITU face-to-face workshop on ‘Security and QoS in Internet Network’</td>
</tr>
<tr>
<td>30–31.10.2017</td>
<td>Satellite communication systems</td>
</tr>
<tr>
<td>13–15.11.2017</td>
<td>The basics of local computer network – LAN</td>
</tr>
<tr>
<td>27–28.11.2017</td>
<td>GNSS systems and satellite communications</td>
</tr>
<tr>
<td>29.11.2017</td>
<td>IP SIP telephony</td>
</tr>
<tr>
<td>7–8.12.2017</td>
<td>Metro-Ethernet – NGN network access system</td>
</tr>
<tr>
<td>11–13.12.2017</td>
<td>Network implementation based on CISCO switches</td>
</tr>
<tr>
<td>14–15.12.2017</td>
<td>ITU face-to-face course on ‘Legal and regulatory barriers to the introduction of cloud services in the EU’</td>
</tr>
<tr>
<td>18–19.12.2017</td>
<td>Modern FTTH networks</td>
</tr>
<tr>
<td>19–20.12.2017</td>
<td>Amended telecommunications law</td>
</tr>
</tbody>
</table>
ANNEX 1
LIST OF PUBLICATIONS
### Papers published in journal listed by the Journal Citation Reports (JCR)

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<thead>
<tr>
<th>Journal title</th>
<th>Authors</th>
<th>Paper title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical and Quantum Electronics</td>
<td>Jaroszewicz Z., Umamageswari N., Udhayakumar M., Rajesh K. B.</td>
<td>Focal properties of cylindrically polarized axisymmetric Bessel-modulated Gaussian beams by a high NA parabolic mirror, 2017, nr 5, t. 49, s. 2–7</td>
</tr>
<tr>
<td>Optics Communications</td>
<td>Udhayakumar M., Prabakaran K., Rajesh K. B., Jaroszewicz Z., Belafhel A.</td>
<td>Generating sub wavelength pure longitudinal magnetization probe and chain using complex phase plate, 2017, t. 407, s. 275–279</td>
</tr>
<tr>
<td>Optics Communications</td>
<td>Osuch T., Jaroszewicz Z.</td>
<td>Influence of optical fiber location behind an apodized phase mask on Bragg grating reflection efficiencies at Bragg wavelength and its harmonics, 2017, vol. 382, pp. 36–41</td>
</tr>
<tr>
<td>Optics Express</td>
<td>Śmietana M., Janik M., Koba M., Bock W. J.</td>
<td>Transition between bulk and surface refractive index sensitivity of micro-cavity in-line Mach-Zehnder interferometer induced by thin film deposition, 2017, nr 21, t. 25, s. 26118–26123</td>
</tr>
<tr>
<td>Applied Optics</td>
<td>Marciniak M., Goncharenko I., Reabtsev V.</td>
<td>Electric field sensing with liquid-crystal-filled slot waveguide microring resonators, 2017, no. 27, vol. 56, pp. 7629–7635</td>
</tr>
<tr>
<td>Journal title</td>
<td>Authors</td>
<td>Paper title</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Optical Switching and Networking</td>
<td>Klinkowski M., Lechowicz P., Walkowiak K.</td>
<td>Survey of resource allocation schemes and algorithms in spectrally-spatially flexible optical networking, 2017, t. 27, s. 58–78</td>
</tr>
<tr>
<td>Optics Communications</td>
<td>Osuch T., Jaroszewicz Z.</td>
<td>Influence of optical fiber location behind an apodized phase mask on Bragg grating reflection efficiencies at Bragg wavelength and its harmonics, 2017, vol. 382, pp. 36–41</td>
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<tr>
<th>Journal title</th>
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<th>Paper title</th>
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<tbody>
<tr>
<td>Fundamenta Informaticae</td>
<td>Orlowska E., Dünshl L., Kwuida L.</td>
<td>A Discrete Representation for Dicomplemented Lattices, 2017, no. 156, pp. 1–15</td>
</tr>
<tr>
<td>Fundamenta Informaticae</td>
<td>Orlowska E., Niwiński D.</td>
<td>Helena Rasiowa’s Heritage in Mathematical Logic, 2017, no. 3-4, vol. 156, pp. i–ii</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Zieliński A.</td>
<td>Aktualne kierunki rozwoju rynku usług telewizyjnych w Polsce, Warszawa 2017, nr 5, s. 144–150</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Zieliński A.</td>
<td>Uwarunkowania procesu rozwoju i konwergencji rynku telekomunikacji i mediów w Polsce, Warszawa 2017, nr 10, s. 1132–1137</td>
</tr>
<tr>
<td>Photonics Letters of Poland</td>
<td>Henao R., Kakarenko K., Mira-Agudelo A., Petelczyc K., Sypek M., Kołodzieczyk A.</td>
<td>Imaging with an extended depth of field by means of the peacock eye optical element, 2017, nr 4, t. 9, s. 128–130</td>
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## Annex 1 List of publications

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<thead>
<tr>
<th>Journal of Telecommunications and Information Technology</th>
<th>Authors</th>
<th>Paper title</th>
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</thead>
<tbody>
<tr>
<td>Journal of Telecommunications and Information Technology</td>
<td>Frezza F., Marciniak M., Pajewski L.</td>
<td>The optimum-efficiency beam multiplier for an arbitrary number of output beams and power distribution, Warszawa 2017, nr 3, s. 94–98</td>
</tr>
<tr>
<td>Economic Problems</td>
<td>Stolarczyk A.</td>
<td>Wykorzystanie e-usług – społeczne potrzeby i ograniczenia, Szczecin 2017, nr 1 (126), t. 2, s. 259–267</td>
</tr>
<tr>
<td>Nierówności Społeczne a Wzrost Gospodarczy</td>
<td>Stolarczyk A.</td>
<td>Kapitał ludzki – szanse i wyzwania w kontekście rozwoju koncepcji Industrie 4.0, Rzeszów 2017, nr 51 (3/2017), s. 73–81</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Michalski W.</td>
<td>Integrowanie chmur obliczeniowych na przykładzie wybranych rozwiązań firmowych, Warszawa 2017, nr 11, s. 1161–1166</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Michalski W.</td>
<td>Tworzenie chmury obliczeniowej na podstawie centrum przetwarzania danych, 2017, nr 10, s. 1138–1141</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Michalski W.</td>
<td>Wybrane aspekty wdrożenia usług e-administracji w modelu chmury obliczeniowej, 2017, nr 7, s. 627–631</td>
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<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Michalski W.</td>
<td>Modele chmury obliczeniowej, Warszawa 2017, nr 4, s. 110–115</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Grajkowski P.</td>
<td>Patriotyzm gospodarczy w społeczeństwie informacyjnym, Warszawa 2017, nr 4, s. 116–119</td>
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<tr>
<td>Zeszyty Naukowe Uniwersytetu Szczecińskiego</td>
<td>Stolarczyk A., Sylwestrzażak M.</td>
<td>Elektroniczne usługi pocztowe świadczone przez operatorów wyznaczonych w krajach UE, stan zaawansowania według wskaźników UPU, Szczecin 2017, nr 126/2, s. 427–437</td>
</tr>
<tr>
<td>Zeszyty Naukowe Uniwersytetu Szczecińskiego</td>
<td>Olender-Skorek M., Sylwestrzażak S., Bartoszewska B., Czarnecki C.</td>
<td>Rozwój ICT w krajach Grupy Wyszehradzkiej – w poszukiwaniu przewag polskiego rynku telekomunikacyjnego, Szczecin 2017, nr 126/1, s. 267–276</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Wypior D., Rzeźniczak K., Więcek D., Niewiadomski D.</td>
<td>Analiza zasięgu stacji radiofonii DAB+ z wykorzystaniem numerycznych modeli pokrycia terenu o bardzo dużej rozdzielczości, Warszawa 2017, s. 561–564</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomości Telekomunikacyjne</td>
<td>Grzybkowski M.</td>
<td>Europejskie regulacje odnoszące się do urządzeń wykorzystujących technikę ultraszerokopasmową UWB, Warszawa 2017, nr 7, s. 191–199</td>
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</tr>
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<tr>
<td>Przegląd Telekomunikacyjny + Wiadomosci</td>
<td>Grzybkowski M.</td>
<td>Przeznaczenie widma częstotliwości radiowych dla systemów bezprzewodowych 5G, Warszawa 2017, nr 6, s. 189–192</td>
</tr>
<tr>
<td>Przegląd Telekomunikacyjny + Wiadomosci</td>
<td>Wroński J.</td>
<td>Wyznaczanie konturów obszarów pokrycia sygnałem z wykorzystaniem biblioteki przetwarzania obrazów OpenCV, Warszawa 2017, nr 6, s. 573–576</td>
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<tr>
<td>Zeszyty Naukowe Instytutu Gospodarki Surowcami Mineralnymi i Energią Polskiej Akademii Nauk</td>
<td>Maniak K., Mydlkowski R., Wójtowicz S.</td>
<td>Metoda pomiaru promieniowania EM do oceny rozwoju procesu niszczenia w górotworze, Kraków 2017, nr 101, s. 303–312</td>
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<tr>
<td>Przegląd Telekomunikacyjny + Wiadomosci</td>
<td>Burakowski W., Sosnowski M.</td>
<td>Synchronizacja łączy wirtualnych zarządzanych metodą szeregowania opartą na cyklu, Warszawa 2017, nr 8–9, s. 969–973</td>
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<tr>
<td>Przyszłość: Świat, Europa, Polska</td>
<td>Wierzbicki A. P.</td>
<td>Wpływ rewolucji informacyjnej na stosunki społeczne w Polsce w następnych dekadach XXI wieku, Warszawa 2017, nr 1, t. 37, s. 11–25</td>
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<td>Przegląd Telekomunikacyjny + Wiadomosci</td>
<td>Bronk K., Rutkowski D., Wereszko B.</td>
<td>Badania zajętości morskiego pasma VHF z wykorzystaniem detekcji cyklostacjonarności sygnału, Warszawa 2017, nr 6, s. 372–375</td>
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<td>Przegląd Telekomunikacyjny + Wiadomoci</td>
<td>Bronk K., Lipka A., Niski R., Wereszko B., Zurek K.</td>
<td>Metody oceny jakości łącza WiFi na potrzeby sieci łączności bezprzewodowej na morzu, Warszawa 2017, nr 6, s. 239–242</td>
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<td>Przegląd Telekomunikacyjny + Wiadomoci</td>
<td>Bronk K., Niski R., Wereszko B.</td>
<td>Weryfikacja dostępności sygnału Galileo w wybranych środowiskach propagacyjnych w Polsce, Warszawa 2017, nr 6, s. 283–286</td>
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<td>Przegląd Telekomunikacyjny + Wiadomoci</td>
<td>Nierebiński R.</td>
<td>Wskaźnik cyfryzacji gospodarki i społeczeństwa w 2016 r., Warszawa 2017, nr 7, s. 632–635</td>
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### Papers published in peer-reviewed journals

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<tr>
<th>Journal title</th>
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<tr>
<td>Optica Pura y Aplicada</td>
<td>Jaroszewicz Z., Osuch T.</td>
<td>Harmonic analysis of fiber Bragg gratings written using apodized phase and amplitude masks, 2017, nr 3, t. 50, s. 259–266</td>
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### Conference proceedings listed by the Web of Science

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<tr>
<td>Optical Fiber Communications Conference and Exhibition (OFC), Los Angeles, USA, 19-23 March 2017</td>
<td>Klinkowski M., Walkowiak K.</td>
<td>Performance analysis of flexible regeneration and modulation conversion in elastic optical networks, 2017, pp. 1–3</td>
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<tr>
<td>19th International Conference on Transparent Optical Networks ICTON 2017, Girona, Spain, 2-6 July 2017</td>
<td>Marciniak M., Goncharenko I. A., Reabtsev V. N.</td>
<td>Electric field sensor on the base of horizontal and vertical slot waveguide ring microresonators with, 2017, pp. 1–5</td>
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<td>19th International Conference on Transparent Optical Networks ICTON 2017, Girona, Spain, 2-6 July 2017</td>
<td>Klinkowski M., Walkowiak K., Lechowicz P.</td>
<td>Spectrum usage for various SDM scenarios, 2017, pp. 1–4</td>
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## Annex 1 List of publications

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<td>COST Action MP1401, 'Advances fibre laser and coherent source as tools for society, manufacturing and lifescience', 4th MC meeting &amp; 3rd Annual conference, Jena, Germany, 18-20 September 2017</td>
<td>Marciniak M., Baghdasaryan H., Hovhannisyan T., Knyazyan T.</td>
<td>Wavelength-scale electrodynamical modelling of optical characteristics of DFB fiber laser by the method of single expression</td>
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<td>EOS Topical Meeting on Optics at the Nanoscale, Special Session: COST Action MP1403, Nanoscale Quantum Optics Work Group 2 Meeting</td>
<td>Marciniak M., Baghdasaryan H., Hovhannisyan T., Knyazyan T.</td>
<td>Method of single expression – an alternative approach for boundary problems solution in intensity-dependent nanooptics and quantum mechanics</td>
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<td>Polish Network Operators Group 18, Warsaw, Poland, 6-7 March 2017</td>
<td>Pączocha J.</td>
<td>Transformacja krajowej sieci telekomunikacyjnej z technologii TDM na IP w aspekcie usługowym, regulacyjnym, technicznym i bezpieczeństwa, 2017, s. 1–24</td>
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### Authorship of books in English

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<tr>
<td>LAP Lambert Academic Publishing</td>
<td>Zieliński A.</td>
<td>Mobile telecommunication systems changed the electronic communications, Berlin 2017, 52</td>
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### Chapter authorship in books in English

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### Editors of monographs in English

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<td>Jaworski M. (ed.), Marciniak M. (ed.)</td>
<td>19th International Conference on Transparent Optical Networks (ICTON)</td>
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ANNEX 2
TITLES, DEGREES AND POSTS
Titles and degrees

According to the Polish law, following terms are used for academic and professional titles, degrees and posts held by staff members in Polish Research Institutes.

The English equivalents are shown as applied in NIT. No official English equivalents exist in Poland.

<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>profesor</td>
<td>prof.</td>
<td>Academic title – awarded by the President of the Republic of Poland</td>
<td>Professor (Prof.)</td>
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<tr>
<td>doktor habilitowany</td>
<td>dr hab.</td>
<td>Degree – defended a habilitation dissertation</td>
<td>DSc (Prof.)</td>
</tr>
<tr>
<td>doktor</td>
<td>dr</td>
<td>Degree – defended a doctoral thesis</td>
<td>PhD (Dr)</td>
</tr>
<tr>
<td>magister</td>
<td>mgr</td>
<td>Professional title – completed master-level university studies MA</td>
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<tr>
<td>magister inżynier</td>
<td>mgr inż.</td>
<td>Professional title – completed master-level university studies in technical field</td>
<td>MSc</td>
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<tr>
<td>inżynier</td>
<td>inż.</td>
<td>Professional title – completed university studies in technical field</td>
<td>BSc</td>
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In less formal chapters of this document only two titles: Prof. and Dr are placed before the names, as it is commonly practiced. See titles in brackets in the table behind.
### Posts

In research institutes three parallel paths of professional carriers exist, namely more scientific and more application oriented, so corresponding three groups of posts: Scientific Researchers, R&D Specialists and Specialists are shown below.

<table>
<thead>
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<td>profesor zwyczajny</td>
<td>Professor title is required</td>
<td>Professor</td>
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<tr>
<td>profesor nadzwyczajny</td>
<td>DSc or PhD degree is required</td>
<td>Associate Professor</td>
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<tr>
<td>profesor wizytujący</td>
<td>Used for persons employed in another institution, DSc degree is required</td>
<td>Visiting Professor</td>
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<tr>
<td>adlunkt</td>
<td>PhD degree is required</td>
<td>Assistant Professor</td>
</tr>
<tr>
<td>asystent</td>
<td>MSc or equivalent title is required</td>
<td>Research Assistant</td>
</tr>
<tr>
<td><strong>R&amp;D Specialists</strong></td>
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<td></td>
</tr>
<tr>
<td>główny specjalista badawczo-techniczny</td>
<td>University diploma and additional requirements defined by the Director of the Institute should be met</td>
<td>Leading R&amp;D Specialist</td>
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<tr>
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<td>Senior R&amp;D Specialist</td>
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<td>młodszy specjalista badawczo-techniczny</td>
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<tr>
<td><strong>Specialists</strong></td>
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<tr>
<td>główny specjalista inżynieryno-techniczny</td>
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<td>MSc or BSc is required</td>
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