National Institute of Telecommunications (NIT)
Instytut Łączności – Państwowy Instytut Badawczy (IŁ–PIB)

Annual Report 2015
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1. General information

1.1. Legal status

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 27 of 23 September 2015, issued by the Minister of Administration and Digitization (Official Journal of Minister of Administration and Digitization, 2015, Item 60).

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.

1.2. Activities

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:

- scientific publications, possibly featured in leading international journals,
- technical expertise, opinions and consultancy,
- implementation and deployment of equipment and systems,
- services of accredited laboratories,
- national and international standardization,
- professional training and courses,
- publishing of periodicals and books,
- organization of seminars and conferences, etc.

NIT’s activities are concentrated mainly on the following subjects:

- intelligent environment networks – integrated telecommunication systems,
- optoelectronics and photonics for 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,
- 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 Basic NIT’s organizational partners
2. Structure of the Institute

2.1. Board of Directors

Director of the Institute
Jerzy Żurek, PhD

Deputy Director for Research
Zbigniew Jaroszewicz, Professor, PhD, DSc

Deputy Director for Finance
Mirosław Fereniec, MSc

Chief Accountant
Liliana Lejman, MSc

2.2. Scientific Council

Chairman of the Council
Marian Kowalewski, DSc, Associate Professor

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 (2015–2019), the Council consists of 24 members. At the end of 2015, the Council consisted of 7 professors and experts from outside of the Institute, nominated by the former Minister of Administration and Digitization, as well as 17 persons elected from among the Institute employees, including 14 professors, DSc and PhD holders and 3 employees without PhD degree.
List of Council members:
• Marian Kowalewski, DSc – Chairman
• Krzysztof Borzycki, PhD – Council Secretary
• Wojciech Burakowski, Prof
• Mariusz Czyżak, PhD – Office of Electronic Communications (UKE)
• Dariusz Dąbek, MSc – Ministry of Administration and Digitization (MAC)
• Piotr Durbajło, MSc – Office of Electronic Communications (UKE)
• Janusz Granat, PhD
• Zbigniew Jaroszewicz, Prof – NIT Scientific Director
• Mirosław Klinkowski, DSc
• Józef Lubacz, Prof – Warsaw University of Technology
• Marian Marciniak, DSc
• Józef Modelski, Prof – Warsaw University of Technology
• Ryszard Nikiel, MSc
• Rafal Niski, PhD
• Magdalena Olender-Skorek, PhD
• Ryszard Strużak, Prof
• Paweł Szczepański, Prof
• Anna Warzec, BSc
• Andrzej P. Wierzbicki, Prof
• Dariusz Więcek, PhD
• Józef Wożniak, Prof – Gdańsk University of Technology
• Andrzej Zieliński, Prof
• Ryszard Zieliński, Prof – Wrocław University of Technology

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.

2.3. Organization structure

The organization structure of the Institute is shown in Fig. 2. Apart from the Board of Directors and Scientific Council described above, it consists of the following basic units:
• Research Departments, where the majority of R&D activities are carried out. 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.
• Centres, which constitute research assistance units.
• Sections, being standard administrative and support units. Both Centres and Sections are described in Section 5.
organization chart of the National Institute of Telecommunications

Fig. 2 Organization chart
2.4. Financial results

Income total: PLN 37 690 000.73
Expenses total: PLN 37 613 631.62
Financial result gross in 2015: PLN 76 369.11

Income by category

- R&D projects and other R&D activity: 55.0%
- Commercial activity: 20.4%
- Government grant of statutory activity: 14.6%
- Other income: 10.0%

Expenses by category

- Supplies, equipment, energy: 37.9%
- Salaries: 36.4%
- External services: 9.6%
- Social benefits (including social security): 6.8%
- Other expenses (including taxes): 4.9%
- Depreciation: 4.4%
2.5. Employment structure

The following tables present the data for years 2014 and 2015.

Employment according to posts held

<table>
<thead>
<tr>
<th>Category</th>
<th>31 Dec 2014</th>
<th>31 Dec 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>In R&amp;D units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professors</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Associate Professors</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Assistant Professors</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Research Assistant</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>R&amp;D Specialists</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Others</td>
<td>96</td>
<td>102</td>
</tr>
<tr>
<td>In other units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support and administrative staff</td>
<td>73</td>
<td>81</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>219</td>
<td>232</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Category</th>
<th>31 Dec 2014</th>
<th>31 Dec 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>DSc</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PhD</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>MSc</td>
<td>74</td>
<td>80</td>
</tr>
<tr>
<td>BSc</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Others</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>141</td>
<td>147</td>
</tr>
</tbody>
</table>
3. Research Departments

The research in NIT is performed in the Departments described below and in the Institute Laboratories described in Section 4.

3.1. Equipment and Systems Testing Department (Z1)

Acting Head of Department

Aleksander Orlowski, MSc, Leading R&D Specialist

Staff

- Andrzej Chudziński, MSc, Senior R&D Specialist
- Małgorzata Felczak-Kostyra
- Krzysztof Kackiewicz, Specialist
- Arkadiusz Kalinowski, Student-trainee
- Dariusz Oleszczuk, MSc, Senior R&D Specialist
- Rafał Pawlak, MSc, Leading Specialist
- Elżbieta Tomaszuk, MSc, Leading Specialist
- Ewa Wielowieyska, Specialist
- Augustyn Wójcik, MSc, Junior Specialist

PROFILE

The Equipment and Systems Testing Department carries out research in the field of radiocommunications. An important part of the Department activity is related to the Telecommunications Equipment Testing Laboratory, which has accreditation certificate issued by the Polish Centre for Accreditation (Certificate AB 121). 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.

ACHEIEMENTS IN 2015

The most significant achievements of the Department in 2015 are:

- execution of a contract commissioned by the Warsaw Municipal Water and Sewerage Company in Warsaw (MPWiK) for technical support concerning implementation of digital trunking mobile communications system for the needs of MPWiK;
- execution of a contract commissioned by the Office of Electronic Communications (UKE) for testing and assessment of smartphones and tablets as part of market surveillance;
- execution of a contract commissioned by the Consumer Rights Protection Centre of Latvia for testing and assessment of radio controlled drone models (toys) as part of market surveillance;
- extension of accreditation scope in the field of radio equipment measurements (three items).

COMPETENCES AND OFFERS OF THE DEPARTMENT:

- cooperation in research programs dealing with radio equipment and systems;
- expert opinions concerning radio equipment and systems;
- support in planning of point-to-multipoint and point-to-point microwave networks;
- consultancy in radiocommunication requirements and standards;
- preparation of test plans for conformance assessment with essential requirements of Directive 1999/5/EC (as base for CE marking and 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;
- EMC and user safety tests of electronic and electrical devices;
- preparation of the Notified Body Expert Opinion regarding conformity to essential requirements of Directive 1999/5/EC on the basis of the submitted technical construction file;
- preparation of technical requirements and test methodology for ICT equipment.
3.2. Department of Networks and Services of Information Society (Z2)

Head of department

Dariusz Gacop, MSc, Leading Specialist

Staff

- Elżbieta Andrukiewicz, PhD, Leading Specialist
- Barbara Bartoszewska, MSc, R&D Specialist
- Krzysztof Bożentowicz, MSc, Leading Specialist
- Robert Czarnecki, MSc, R&D Specialist
- Stanisław Dziubak, MSc, Leading Specialist
- Urszula Figura, Specialist
- Paweł Gajewski, MSc, Leading Specialist
- Piotr Grajkowski, MSc, Senior R&D Specialist
- Zbigniew Kądzielski, MSc, Leading Specialist
- Tomasz Lewicki, MSc, Specialist
- Wojciech Michalski, MSc, Senior R&D Specialist
- Grzegorz Mitura, MSc, Senior R&D Specialist
- Ryszard Nikiel, MSc, Senior R&D Specialist
- Sylwester Nowak, BSc, Senior R&D Specialist
- Magdalena Olender-Skorek, PhD, Assistant Professor
- Jerzy Paczocha, MSc, Leading Specialist
- Andrzej Piekut, MSc, Senior R&D Specialist
- Anna Stolarczyk, MSc, Senior R&D Specialist
- Bartosz Surażyński, MSc, Junior Specialist
- Marek Sylwestrzak, MSc, Research Assistant
- Kazimierz Wilczek, BSc, Senior Specialist
- Włodzimierz Zalewski, MSc, Senior R&D Specialist
- Marcin Zasiewski, Student-trainee

PROFILE

The Department focuses on research and development related to infrastructure of telecommunication networks as well as information society services. These activities support the deployment of:

- broadband networks as well as information systems for public administration,
- security tools and methodology in public information systems,
- network convergence, network addressing, network testing, quality of services, telecommunication network management,
- digital, IP and interactive television, Hybrid Television (HbbTV), Second Screen services,
- small cinemas, projectors, audio equipment and related items.

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

PARTICIPATION IN PROJECTS AND OTHER IMPORTANT ACTIVITIES

The most important projects implemented in 2015 were:

- **Information System for Broadband Infrastructure and the “Broadband Poland” Portal (SIPS).** The Project conducted in co-operation with the Office of Electronic Communications and the Ministry of Administration and Digitization was continued and completed. As a result of the Project, version 5 of Broadband Infrastructures System was built and tested. Based on the developed System, the fourth report on telecommunications infrastructure in Poland was drafted in 2015. Moreover, special reports were released containing opinions on legal acts being prepared by the Parliament and government. A country-wide videoconferencing system was built to give better communication means to local governments.

- **Monitoring System for Telecom Infrastructure (SMIT).** This project was aimed at the development of versatile, centralized monitoring system for telecom plant (cable lines, manholes, street cabinets, base stations of mo-
bile networks, etc.), capable of automatic detection of cable cuts, facility break-ins and slowly-developing failures by means of advanced data analysis software. Events recorded by the system are displayed on maps and recorded in database. The system is being tested by Orange Polska and can be adapted to monitor other kinds of technical facilities as well. The project was executed jointly by Z2 and Z14 Departments.

- **Cinema Over the Corner (KzR).** The aim of the project is to revitalize small cinemas in the countryside as to give local citizens an opportunity to watch movies in a real cinematic environment.

See more about the Projects in Chapter 7.

Participation in other important activities:

- Research and resolution of problems concerning the construction of broadband access infrastructure;
- Creation of Business Intelligence system supporting the development of telecommunication infrastructure;
- Further deployment of SMOK-2U system for monitoring and anti-theft protection of copper cable networks. The system has been installed in the national network.

**ACHIEVEMENTS IN 2015:**

- IPTV and Interactive Television laboratory built along with IP streaming infrastructure for live streaming and testing of TV “smart” application;
- IPTV and videoconference laboratory built along with IP streaming infrastructure for live streaming testing.

**COMPETENCES AND OFFER:**

- development of broadband infrastructure of telecommunication networks and services – consulting services,
- support of public administration in the implementation of broadband projects,
- evaluation of innovativeness of projects financed by the European Union,
- monitoring and supervision of telecom infrastructures including anti-theft protection,
- digital sustainability development – systems and procedures,
- security of digital content – procedures, consulting and security audit,
- in the area related to IPTV technology:
- IPTV – streaming, VoD and studio infrastructure, systems for small operators, from consulting to complete solutions,
- live HDTV streaming with mobile HDTV studio – production services.
3.3. Department of Internet Architectures and Applications (Z3)

Head of Department

Jordi Mongay Batalla, PhD, Assistant Professor

Staff
- Wojciech Burakowski, Prof, Professor
- Mariusz Gajewski, MSc, Senior R&D Specialist
- Piotr Krawiec, PhD, Assistant Professor
- Waldemar Latoszek, MSc, Specialist
- Izabela Romak, Specialist
- Konrad Sienkiewicz, MSc, Senior R&D Specialist
- Maciej Sosnowski, MSc, Research Assistant
- Piotr Wiśniewski, MSc, Specialist

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 telecommunication 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) and cloud computing.

PROJECTS AND ACHIEVEMENTS IN 2015

The Department is responsible for technical coordination of the Eureka/Eurostar Project: Network-Aware Delivery Clouds for User Centric Media Events – DELTA (2014–2015). The Project’s objectives include developing an innovative and ready-to-market solution that synergistically combines Networked Media and Telecommunications Technologies with Cloud Computing assets into a unified digital ecosystem, enabling users to exploit OTT and Telco services with maximum possible QoE.

The Department is the leader of the IDSECOM project – ID-based SECure COMmunications system for unified access in IoT performed under PolLux International Research Program (2014–2016). The IDSECOM aims to build a secure communication platform for self-management of the Things and Services in the Internet of Things environment. It also investigates the effectiveness of M2M communication in various network architectures.

The Department plays a coordinating role in POIG project PL-LAB2020: Infrastructure for research and experimentation to support Horizon 2020 activities (2014–2015). The aim of the project is to extend functionality of the PL-LAB research and experimentation network, which has been designed and implemented in the scope of the Future Internet Engineering Project (2010–2013). The PL-LAB2020 Project will develop new laboratories to allow the research and experimentation in the main areas of the Horizon 2020 European Research Programme, such as: Network Virtualisation, Software Defined Networking, Information Centric Networks, Cloud Computing, Internet of Things, Wireless networks, Network Management.

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 which include the following issues, 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.
3.4. Advanced Information Technologies Department (Z6)

Staff

- Anna Bachman, MSc, Specialist
- Tomasz Bereda, MSc, Senior R&D Specialist
- Paweł Białor, PhD, Assistant Professor
- Artur Gertych, MSc, Junior Specialist
- Anna Kacpierzak, MSc, Specialist
- Edward Klimasara, MSc, Leading Specialist
- Krzysztof Malinowski, BSc, Specialist
- Anna Mościcka, MSc, Specialist
- Piotr Olejarcz, MSc, Senior R&D Specialist
- Pawel Olender, MSc, Leading Specialist
- Przemysław Opala, MSc, Senior R&D Specialist
- Ewa Stella Orłowska, Prof, Professor
- Sylwia Paczuska, MSc, Specialist
- Mariusz Pajer, MSc, Senior R&D Specialist
- Piotr Rzepakowski, PhD, Assistant Professor
- Marcin Sosnowski, BSc, Senior R&D Specialist
- Piotr Szczepański, MSc, Junior Specialist
- Wojciech Szymak, BSc, Leading Specialist
- Monika Tomczuk, BSc, Junior Specialist
- Piotr Tutak, BSc, Junior Specialist
- Andrzej P. Wierzbicki, Prof, Professor
- Grzegorz Zalewski, MSc, Specialist

Profile

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

Projects and Achievements in 2015:

- Participation in the research project Information System Concerning Broadband Infrastructure and the „Broadband Poland“ Portal (SIPS). As a result of the Project, the Broadband Infrastructures System was build and tested. In 2014 new modules were developed. This system is meant for gathering, processing, presentation of information about telecommunication infrastructures, public telecommunication network and buildings, making this information accessible, enabling its collocation, decision support etc.
- Participation in Infrastructure for research and experimentation to support Horizon 2020 activities – PL-LAB2020 project. The Z6 department focused on the development of Network Management Laboratory.
- The Z6 Department also participated in IT platform system of research, testing and diagnostics of electronic communications services – PIBUK project. Z6 has prepared the functionality specification of software that should be used in the project.

See more about the Projects in Chapter 7.

The statutory project of NIT performed at the Z6 Department was Logics, Algorithms and Knowledge Engineering for Telecommunications, including:

- research on application of multi-criteria ranking in network management
- publication of the book Dualities for Structures of Applied Logics by Ewa Orłowska, Anna Radzikowska, and Ingrid Rewitzky;
- preparation of an English version of the book The Future of Work in Information Society (at Springer Verlag) by Andrzej P. Wierzbicki,
3.5. Wireless Systems and Networks Department (Z8) (in Gdańsk)

Head of Department

Krzysztof Bronk, PhD, Assistant Professor

Staff

- Stefan Gencza, MSc, Senior R&D Specialist
- Adam Lipka, PhD, Assistant Professor
- Marcin Mazurowski, MSc, Junior Specialist
- Roman Nierebiński, MSc, Senior R&D Specialist
- Rafał Niski, PhD, Assistant Professor
- Dominik Rutkowski, Prof, Professor
- Teresa Szpaczyńska, Technician
- Błażej Wereszko, MSc, Specialist
- Kacper Wereszko, BSc, Junior Specialist
- Krzysztof Żurek, MSc, Specialist

PROFILE

The areas of scientific activities of the Department include:

- digital radio communication (cellular, trunked and WiFi systems) including marine communications,
- measurements of the mobile services quality in the cellular networks (2G, 3G, 4G and beyond),
- 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 2015

In 2015 Department was very active in the development of the new wireless communication standard for maritime environment – VHF Data Exchange System (VDES). Close cooperation with the International Association of Lighthouse Authorities (IALA) gave an opportunity to take an active role in this task and to share our knowledge and experience with this international community.

In 2015, the Department also continued the development of the mobile platform for testing the availability and quality of services offered in the 2G/3G/4G mobile networks. The platform uses the GSM/GPRS/EDGE/UMTS/HSD-PA/HSUPA/HSPA+/LTE modem, GPS module, FTP server and a specialized software application (see figure below) and it measures a wide range of quality and identification parameters of the mobile networks (e.g. maximum, minimum and average transmission rate, delays, jitter, SIR, Cell-ID, RSSI, Ec/Io and many more). The platform has been successfully used in many projects the Department was involved in (e.g. M-ISZCZ, netBaltic) and also in several commercial activities of the Z8 Department.
Throughout 2015, the Department was very active in the field of satellite communication and navigation systems. Close cooperation with the European Space Agency (ESA) and the European GNSS Agency (GSA) was continued. In the second half of the year, the Department made a proposal to ESA for the continuation of the Satellite AIS project.

In 2015, the Department was actively participating in the M-ISZCZ, netBaltic and EfficienSea 2 projects:

- In the M-ISZCZ project, the Department took an active part in the development of the necessary software modules dedicated to the digital map processing and the analysis of the antenna patterns. Additionally, the Z8 Department carried out an extensive measurement campaign in which the propagation of the VHF and TETRA signal were analysed.

- In the netBaltic project, the main activity of the Department in 2015 was dedicated to the analysis of the ranges of various radiocommunications systems (LTE, UMTS, WiFi) in maritime conditions. Beside the theoretical calculations, that analysis also included a 10-day measurement campaign carried out on the Baltic Sea. The results of that activity helped to determine usefulness of each system for the A, B and C maritime zones defined in the project.

- In the EfficienSea 2 project, the Z8 Department was mainly responsible for the development of the seamless roaming algorithm to be employed in the upcoming hybrid maritime communication system. By the definition, that system will utilize a novel concept of so-called Maritime Cloud and for this reason another responsibility of the Department is the development of the interface between the Maritime Cloud and the hybrid system.

More details about the projects can be found in Section 7.

In 2015, the Department also participated in several large commercial projects, including:

- The concept development of the VHF/AIS/DGPS radiocommunication system and wideband data transmission for the River Information System (RIS) on the Odra river.
- TETRA-related technical consultancy for the Energa-Operator S.A. company.
- Allocation of the frequency bands for the purpose of Polish telecommunications networks – the plan for the years 2015–2024.
- The analysis of the wind farm’s influence on the MSSR radar.

COMPETENCES

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

- preparing 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.
3.6. Department of Electronic Communication Applications and Power Systems (Z10)

Staff

- Bogdan Chojnacki, BSc, Leading Specialist
- Andrzej Binkiewicz, MSc, Senior R&D Specialist
- Paweł Godlewski, BSc, Leading Specialist
- Lech Jóźwik, Specialist
- Marian Kania, MSc, Senior R&D Specialist
- Piotr Karpeta, Specialist
- Mariusz Kłos, PhD, Senior R&D Specialist
- Ryszard Kobus, MSc, Leading Specialist
- Bolesław Kowalczyk, PhD, Assistant Professor
- Marian Kowalewski, DSc, Associate Professor
- Jakub Kwiecien, BSc, Junior Specialist
- Marek Maliszewski, MSc, Junior Specialist
- Zbigniew Mąkosza, MSc, Leading Specialist
- Kazimierz Niechoda, MSc, Leading Specialist
- Krzysztof Olechowski, MSc, Leading Specialist
- Anna Ołtarzewska, MSc, Senior R&D Specialist
- Henryk Papura, BSc, Leading Specialist
- Andrzej Pękalski, MSc, Leading Specialist
- Barbara Regulska, MSc, Leading Specialist
- Robert Samborski, PhD, Assistant Professor
- Tomasz Sędek, MSc, Senior R&D Specialist
- Arkadiusz Staszał, BSc, Senior R&D Specialist
- Grażyna Stolarska, Specialist
- Mikołaj Waszkiewicz, MSc, Senior R&D Specialist

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.

PARTICIPATION IN PROJECTS

The Department was engaged in 2015 in the following projects:

- **PCL effect early recognition in lead batteries for reliability improvement of backup power supply systems – AKUPCL.** Project execution time: 2012–2015. The project dealt with early symptoms of a phenomenon specified as premature capacity loss (PCL) in some lead battery cells. The main research target was to work out a new efficient diagnostic method of PCL effect. It shall drive to reliability extension of lead battery based backup power supply systems. Project was successfully finished in June 2015.

- **Computer system for radio frequency resources management as well as planning and inventory of radio networks for needs of services controlled by the Minister of the Interior – M-ISZCZ,** financed by the National Centre for Research and Development under defence and security facility. Project execution period was 2013–2016. The main purpose of the project was to build a demonstrator of a new computer system for design, coordina-
tion, analysis and services of radio networks, radio systems data bases and radio frequency resources in the Ministry units.

- **Energy reserve checking system for telecommunication objects** – SKOT project financed by the European Regional Development Funds through the Innovative Economy Operation Program under INNOTECH program, IN-TECH path. Project execution period was 2014–2015. The project was executed by the consortium of NIT (as a leader) and the Electronic Power & Market company. The Project was successfully completed in October 2015. The trial installation of SKOT was deployed and tested on the real telecommunications site while model equipment was tested in NIT laboratory.

- **Computer platform of the system for research and evaluation of electronic communication services properties** – PIBUUK financed by the European Regional Development Funds through the Innovative Economy Operation Program. Project execution period was 2014–2015. The purpose of the project was an investment in infrastructure and advanced computer applications, enabling the extension of research services of the Institute on the properties of electronic communication services. (See more in 7.3.1 and 9). The Project was successfully finished in December 2015 with the platform launched.

- Measurements and tests of electronic communication services quality (speech quality, electromagnetic radiation distribution, IP transmission quality), executed with Mobile Testing Laboratory, along highways and on traveller services sites, in planned radio stations sites.

- Author’s supervision on manufacturing, launching and servicing of TBA-IŁ equipment family for controlled discharging-charging of batteries in telecommunication sites.

- Works on assumptions and design of concept for National Security Management System orchestration.

See more about the Projects in Chapter 7.

Apart from the presented above Projects, the Department activities included:

- Continuation of works on **Intelligent Transport Systems** with several publications issued;

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

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

- Contribution to Polish standardization in telecommunications area.

**ACHIEVEMENTS IN 2015**

Among the 2015 achievements of the Department, the following can be mentioned as well:

- being granted three patents in the test and measurement of battery capacity for telecommunication power supply (see Chapter 10);

- implementation of two patents granted in 2014 via license agreement with manufacturers and their application in produced equipment/systems (TBA160-IŁ, SKOT);

- another patent application filed to the Polish Patent Office.

**COMPETENCES AND OFFERS**

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 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 telecommunication services quality inspection, based, among others, on own solutions of control and measurement systems and devices;

- implementation, maintenance and development of proprietary solutions.
Measurements of radio link signal with using spectrum analyzer
3.7. Central Chamber for Telecommunication Metrology (Z12)

Head of Department

**Anna Warzec**, BSc, Senior R&D Specialist

**Staff**

- Michał Gartkiewicz, MSc, Leading Specialist
- Bożena Główka, Specialist
- Elżbieta Hercan-Sereda, Specialist
- Paweł Klis, BSc, Leading Specialist
- Marcin Koba, PhD, Assistant Professor
- Karol Korszeń, MSc, Leading Specialist
- Tomasz Kossek, PhD, Assistant Professor
- Marzenna Lusawa, MSc, Senior R&D Specialist
- Michał Marszałec, MSc, Leading Specialist
- Bogdan Mucha, MSc, Senior R&D Specialist
- Dariusz Nerkowski, MSc, Leading Specialist
- Tomasz Osuch, PhD, Assistant Professor
- Marek Podowski, Specialist
- Wiesława Prokop-Knap, MSc, Senior R&D Specialist
- Bartosz Rynowiecki, MSc, Senior R&D Specialist
- Mateusz Sieński, MSc, Junior Specialist
- Andrzej Stułka, BSc, Senior R&D Specialist
- Agnieszka Szczepańska, BSc, Junior Specialist
- Paweł Szczepański, Prof, Professor

**PROFILE**

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

CCTM 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;
- Telecommunication Parameters Metrology Team, which works on the metrology of RF and microwave signals and also on transmission parameters of telecommunication 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 dispersion, optical attenuation and optical fibre length;
- Time and Frequency Metrology Team, which conducts works in the scope of time and frequency metrology, especially the implementation of atomic clocks comparison algorithms, and determines timescales, accurate measurements of frequency, time, phase time, interval, TIE.

CCTM cooperates with Warsaw University of Technology in the research related to fibre Bragg gratings for telecom and sensing applications, and with the Institute of Electronic Materials Technology in phase mask technology for FBG fabrication as well as with the Institute of Applied Optics 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)).

Within the Central Chamber for Telecommunications Metrology are the following units:

- Calibration Laboratory: Laboratory of Electrical, Electronic & Optoelectronic Metrology (LMEEiO), 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).
PARTICIPATION IN 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 Astrogeodynamic Observatory (CBK).

Energy backup of telecommunications sites supervision system (INNOTECH-K3/IN3/1/225684/NCBR/14) – implementation in power systems of TBA-ST32 converter, designed in NIT, dedicated to automatized control of capacity of batteries. Tests of constructed models.

ACHIEVEMENTS IN 2015:

• 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.

OFFERED SERVICES

CCTM 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.

CCMT 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. CCTM full-scale measurement facilities would be helpful in R&D activity performed for the clients.

In terms of R&D activity of Optoelectronic Metrology Group, CCTM 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) and their applications in telecommunication and sensing.
3.8. Transmission and Optical Technologies Department (Z14)

Head of Department

Marek Jaworski, PhD, Assistant Professor

Staff

• Krzysztof Borzycki, PhD, Assistant Professor
• Marian Marciniak, DSc, Associate Professor
• Hanna Skrobek, Specialist
• Mariusz Zdanowicz, PhD, Assistant Professor

PROFILE

The Department conducts research and implementation work on advanced optical communications. This includes research on ultra-fast transmission in optical transparent networks, wavelength multiplexing, optical fibre access (FTTH), nonlinear optical effects, application of innovative photonic crystal technologies, characterization of polarization mode dispersion (PMD), reliability of optical components and networks, design, modelling and optimization of optical networks, implementation of optical IP networks, research on elastic optical networks, energy efficiency, and assurance of Quality of Service (QoS).

The Department, since 1999, has annually organized the International Conference on Transparent Optical Networks (ICTON). ICTON2015 conference, which was held in Budapest, Hungary, with technical support of IEEE Photonics Society, attracted 427 participants with 456 scientific presentations. See more in Chapter 10.

PARTICIPATION IN PROJECTS:

• Industry Driven Elastic and Adaptive Lambda Infrastructure for Service and Transport Networks – EU FP7 IDEALIST (2012–2015). The project aims at designing and developing innovative transport solutions, compatible with new bandwidth consuming applications (e.g. 3D video, cloud, etc.) based on Elastic Optical Networks equipped with a multi-domain and multi-technology control plane enabling adaptive network and service interworking. Conducted by an international consortium. See more in Chapter 7.

ACHIEVEMENTS IN 2015:

• Models and algorithms were developed for several different network scenarios in Elastic Optical Networks:
  − path protection with the analysis of its effectiveness in disaster conditions,
  − optimization procedure generating optimum routing and optical spectrum allocation (RSA),
  − optimization based on the Tabu Search method for the RSA problem with unicast and anycast,
  − heuristic algorithm for the RSA problem.
• New functionalities were added to the Fibre Optic Communication System Simulator, to enable modelling of transmission impairments in physical layer of EON. The simulator will be available soon under the name SSS as an open source toolbox at http://atoms.scilab.org.
• Advanced research in the field of developing theoretical/numerical methods for investigation of plasmonic photonic structures was done, with a significant progress in understanding and applications of micro- and nanoscale optical phenomena. This research included in particular:
  − novel nano-photonic materials exhibiting reverse opal structure,
  − resonant scattering of visible light by periodic structures composed of silver nanowires,
  − plasmonic effects in periodic uni-dimensional structures,
  − double periodic gyrotropic layers,
  − nanostructures propagating surface plasmonic waves.
COMPETENCES AND OFFERS:

- Conformance and certification testing of optical fibre cables and passive components, in particular connectors and patch cords.
- Measurements of: attenuation, return loss, PMD, environmental tests, etc.
- Expertise in installation and testing of optical fibre local, access, metro and core networks.
- Consultancy and training services for operators and installers of fibre networks.
- Modelling, design and optimization of modern optical communication networks considering the quality of service, physical layer impairments, energy efficiency, and elastic spectrum assignment.
- Modelling of physical constrains in optical communication systems, fibre access networks (FTTH-PON), DWDM and ultra-fast terabyte transmission with self-developed Fibre Optic Communication System Simulator.
- Expertise in photonic crystal technologies, micro-structured fibres (PCF) and subwavelength photonics.

Endface of optical fiber connector contaminated with flakes of plastic, observed under microscope
3.9. Electromagnetic Compatibility Department (Z21) (in Wrocław)

Head of Department
Janusz Sobolewski, PhD, Assistant Professor

Staff
- Natalia Główka (Głuszczak), MSc, Specialist
- Maciej Grzybkowski, PhD, Assistant Professor
- Marek Jermakowicz, MSc, Senior R&D Specialist
- Krzysztof Maniak, PhD, Specialist
- Marek Michalak, MSc, Senior R&D Specialist
- Rafał Michniewicz, MSc, Specialist
- Tomasz Mróz, BSc, Junior Specialist
- Daniel Niewiadomski, MSc, R&D Specialist
- Anna Pinkiewicz, MSc, Specialist
- Przemysław Rogoż, Student-trainee
- Krzysztof Rzeźniczak, MSc, Junior Specialist
- Karolina Spalt, MSc, R&D Specialist
- Michał Stajszczyk, Specialist
- Ryszard Strużak, Prof, Professor
- Monika Szafranska, MSc, Senior R&D Specialist
- Tomasz Tomczyk, MSc, Specialist
- Dariusz Więcek, PhD, Assistant Professor
- Jacek Wroński, PhD, Leading R&D Specialist
- Dariusz Wypiór, MSc, Research Assistant

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.

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, DAB+, DRM, UKF FM, 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.;
- analysis of the availability of radio spectrum resources to radio applications, searching for radio frequency resources for new radio services;
- development of the computer systems for spectrum management, radio network planning, their optimization and propagation/interference/compatibility analyses;
• 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 Digitization, 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.

PARTICIPATION IN PROJECTS:
• Computer system for radio frequency resources management, as well as planning and inventory of radio networks for needs of services controlled by the Minister of the Interior – M-ISZCZ (2013–2015). The aim of the project is designing and building the demonstrator of a new computer software system, which is able to design, manage, coordinate and analyse and register the radio networks services used by the Minister of the Interior for public protection purposes.

• Single Frequency Network using DAB+ software emission platforms for local broadcasters in Poland – LokalDAB. 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 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.

• Collaboration with the Abdus Salam International Centre for Theoretical Physics (ICTP).

See more about the main Projects in Chapter 7.

ACHIEVEMENTS IN 2015
The major achievements of the Department in 2015 are as follows:
• Network planning and optimization analysis for broadcasters and operators (DVB-T, DAB+, etc.): optimized network plans in VHF band for MUx8 DVB-T and MUx1 DAB+.

• Available Frequency findings for broadcasters and network operators.

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

• Private Mobile Radio (PMR): networks planning and analysis for various operators.

• 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 medical and military equipment.

• Development of new measurement procedures for in-situ EMC measurements.

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, DAB+, DRM, DVB-H, UKF FM, TETRA, 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 using 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;
• electromagnetic environment investigation and research, including special electromagnetic environment research focused on underground mines;
• electromagnetic compatibility measurements, including measurements of large equipment on production site (in-situ measurements) (certificate AB 666);
• electromagnetic field measurement and analysis of their impact on people related to human safety and working environment protection;
• EMC testing equipment calibration (certificate AP 016).

EMC Testing Laboratory crew during mining roadheader tests
4. Laboratories

4.1. Testing laboratories

4.1.1. Telecommunications Equipment Testing Laboratory (LBUT) (in Warsaw)

**PROFILE**

The competences of the Telecommunications Equipment Testing Laboratory accredited 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,
  - 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.

- safety of radio and ICT equipment;
- coaxial cables and accessories for cable TV;
- symmetrical pairs cables for ICT applications;
- connectors, terminal blocks, surge protection devices.

**ACTIVITIES**

In 2015 the Laboratory carried out more than 100 commercial tasks.

**OFFER**

The Telecommunications Equipment Testing Laboratory offers testing and conformity assessment of wide range electronic equipment intended for introduction on the European market.
4.1.2. EMC Testing Laboratory (in Wrocław)

**Marek Michalak, MSc, Head of the Laboratory**

**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 offers *in-situ* measurements of industrial equipment, performed on its installation site or in place of manufacturing, including equipment for use in special environments.

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 (Z21).

**OFFER**

The National Institute of Telecommunications kindly invites manufacturers of electric and electronic equipment to test their products 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.

4.1.3. Laboratory of Electrical, Electronic & Optoelectronic Metrology (LMEEiO) (in Warsaw)

**Anna Warzec, BSc, Head of the Laboratory**

**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.

ACTIVITY

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 out-of LMEEiO premises calibration service is also offered.

In 2015, new calibration procedures were implemented in order to extend the LMEEiO scope of accreditation in relative humidity (hygrometers and climatic chambers).

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 9% increase in calibration services performed by LMEEiO in comparison with the previous year.

The Laboratory is located within the Central Chamber for Telecommunication Metrology (Z12).

OFFERS:

Calibration and test (also on site) of electrical, telecom, RF, time & frequency, optoelectronic, temperature and humidity measurement equipment, design and realization of electrical and electronic, RF as well as optoelectronic measurement systems.

4.1.4. Laboratory of EMC Measuring Apparatus (in Wrocław)

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

PROFILE

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 (Z21).

OFFER

The Institute of Telecommunications kindly invites all EMC testing laboratories and manufacturers to calibrate their measuring equipment in its Laboratory.

4.2. 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 2015, the Unit declared interlaboratory comparisons for calibration laboratories with these standards as proficiency test item.

ACTIVITY

In 2015, JPM activities were related to:
• leading the proficiency testing scheme for calibration and testing laboratories with standards of resistance as a proficiency test item,
• launching of the proficiency testing scheme for calibration and testing laboratories with the digital multimeter of voltage, current and resistance as a proficiency test item.
• initiation of organization and launching of proficiency testing scheme for international calibration laboratories with standards of capacitance as a proficiency test item.

The Unit is located within the Central Chamber for Telecommunications Metrology (Z12).

OFFERS

Organizing and conducting the interlaboratory programs and proficiency testing for calibration and testing laboratories.
4.3. Notified Body No 1471


In 2015, the Institute Notified Body issued 33 confirmations of conformity to essential requirements of R&TTE Directive. The Notified Body is located within Equipment & Systems Testing Department (Z1) and is supervised directly by the Director of the Institute.
5. Centres and Sections

5.1. Education Centre – OS

The Education Centre 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, signalling 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. See also in Chapter 10.

Education Centre cooperates with the International Telecommunications Union as the ITU Centre of Excellence.

For more information see: www.trainings.nit.eu

Head: Sylwester Laskowski, PhD

5.2. IT Centre – OI

The IT Centre 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.

Head: Grzegorz Wójcik, MSc
5.3. Scientific Information and Promotion Centre – OINP

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

- Running of the Institute’s library, which has the largest in Poland collection of printed books and journals in the field of telecommunications. In 2015, the library provided the Institute’s employees with 26 Polish and international journals in telecommunications, informatics, EMC etc. The library is open to the public free of charge.

- Enabling access to the IEEE xplore 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 2015, OINP added 26 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 2015. Information about 140 new records was added.

- OINP 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. In 2015, over 200 new records were added.

- Responsibility for running the editorial boards of two magazines continuously issued by NIT: *Journal of Telecommunications and Information Technology* and *Telekomunikacja i Techniki Informacyjne* (in Polish).

- Responsibility for the promotion of the Institute, so the Centre 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. Sections

The following sections make NIT’s organization scheme:

- Organization and Coordination Section
  Head: Danuta Latoszek, MSc

- Finance and Accounts Section
  Head: Liliana Lejman, MSc

- Human Resources Section
  Head: Kinga Bogus, MSc

- Administration and Equipment Management Section
  Head: Elżbieta Zabłocka
Wojciech Burakowski – received his MSc, PhD and DSc degrees in Telecommunications from Warsaw University of Technology in 1975, 1982 and 1992, respectively. Now he works as Full Professor for 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): www.iip.net.pl.

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Szymon Jaroszewicz – received his Master’s degree in Computer Science from the Department of Computer Science at Szczecin University of Technology in 1998 and his PhD from the University of Massachusetts, Boston in 2003. In 1998 and 1999, he was a Fulbright scholar at the University of Massachusetts, Boston. In 2010 he received his DSc degree from the Institute of Computer Science, Polish Academy of Sciences. His research interests include data analysis, data mining and probabilistic modelling. He is the author of several publications in those fields. In 2007 he received the best paper award at the PKDD’07 conference. He currently leads two research projects funded by the Polish Ministry of Science and Higher Education. He served as a programme committee member for major data mining conferences and is a member of the editorial board of Data Mining and Knowledge Discovery journal.

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Zbigniew Jaroszewicz – received his MSc degree from Warsaw University of Technology, Technical Physics and Applied Mathematics Faculty in 1980; later, from the same Faculty, he received PhD and DSc degrees in 1988 and 1998, respectively. In 2009 he got the title of Professor of Physical Sciences. From 1980 to 1984 he was employed at the Institute of Telecommunications as engineer-designer, and in 1984–1986 at Warsaw University of Technology, Institute of Physics. Since 1986 he has been with the Institute of Applied Optics, currently as the head of Physical Optics Division and Scientific Secretary of the Institute. Since 2004 he has been again with the National Institute of Telecommunications, holding the position of Deputy Director for Research since November 2014. In the years 1991–1995, he was associated with the University of Santiago de Compostela, Spain, first on his post-doctoral fellowship and then on sabbatical leave. From 1997 to 2000, he was a professor at the National University of Colombia in Medellin. His scientific interest concerns diffractive optics, including theory, design and applications of diffractive elements, especially in telecommunications and ophthalmology, as well as adaptive optics and didactics of optics. Professor Jaroszewicz is the author of approximately 230 scientific papers, among them 80 published in periodicals listed on Philadelphia List of Journals. He was the leader of 6 research projects granted by the State Committee for Scientific Research (KBN). He promoted 6 doctoral dissertations and reviewed another 16. He took part in 19 Scientific Committees of international conferences, being chairman of 7 of them. He is a member of The International Society for Optical Engineering SPIE, Optical Society of America OSA, Photonics Society of Poland, in which was elected a member of the management board. Moreover, he is a member of editorial boards of: Photonic Letters of Poland, Revista EIA (Columbia) and Optica Pura e Aplicada (Spain).

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Mirosław Klinkowski – received his Master’s degree in Telecommunications from the Faculty of Electronics and Information Technology at Warsaw University of Technology in 1999 and his PhD degree in Computer Architecture and Technology from the Department of Computer Architecture at Polytechnic University of Catalonia (UPC), Barcelona, Spain, in 2008. In 2008–2010 he was associated with UPC on his postdoctoral fellowship. In 2013, he received his DSc degree from the Faculty of Electronics and Information Technology at Warsaw University of Technology.
He is a co-author of several book chapters and over 120 publications presented in leading journals and conference proceedings. His research interests focus on optical networking with emphasis on network design, modelling, and optimization. He has participated in EU research projects: NOBEL, e-Photon/ONe, DICONET, BONE, IDEALIST and COST Actions.

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Marian Kowalewski – graduated from the Military Academy of Telecommunications in Zegrze (1975), academic teacher, research worker and vice-chancellor for education and research at the same Academy (1975–1997), deputy director for science and general matters in NIT (1997–2004). He is Professor at the National Institute of Telecommunications and at Warsaw University of Technology. Head of TETRA project in NIT (since 2002), scientific manager of the IT System of the State Protection Against Extraordinary Threats project (ISOK) in NIT (2011–2012), Intelligent Transport Systems (ITS) in NIT (2011–2013). Organizer and co-organizer of many seminars and scientific conferences, author of numerous textbooks, academic course books, articles and R&D works concerning telecommunications problems. His scientific interests are planning and developing of telecommunications, telematics systems, and their efficiency.

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Marian Marciniak – graduated in solid state physics from Marie Curie-Skłodowska University in Lublin, Poland, in 1977. He received a PhD degree in optoelectronics in 1989, and a Doctor of Sciences degree in physics-optics in 1997. He is a Professor at the National Institute of Telecommunications and at Kielce University of Technology. 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 structures in Poland. His current research interests include transparent and all-optical packet- and burst-switched telecommunication networks, ultrafast and nanoscale/sub-wavelength photonics, Terahertz 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-Chair in 2015), for European Cooperation in Science and Technology (COST) Domain Materials, Physics and Nanosciences (MPNS), for the European Science Foundation, and for national research funding agencies in the UK (Royal Society), Cyprus, Greece, Ireland, Switzerland, Slovenia, Qatar, Republic of Serbia, and Poland. He was the originator and chairman of COST Action MP0702: Towards Functional Sub-Wavelength Photonic Structures (2008–2012). In 2015 he served as a Co-Chair for SMMO2015 – 6th International Conference on Semiconductor Mid-IR Materials and Optics in Prague, and as Programme Committee Member for: ICFPAM 2015 – 13th International Conference on Frontiers of Polymers and Advanced Materials in Marrakesh; CLEO/Europe–EQEC 2015, Committee CH: Optical Sensing and Metrology in Munich; 16th IEEE International Conference on High Performance Switching and Routing (HPSR 2015) in Budapest; and last but not least “Micro-to Nano-Photonics IV – ROMOPTO 2015” in Bucharest. He is the originator of the Organising Committee for the International Conference on Transparent Optical Networks ICTON series and its Chairman since 1999. He has presented numerous guest lectures at national and foreign universities including: Bari (2001), Nottingham (2004), Wrocław (2005), Rome (2012), Trento (2012, 2013, 2014), Žilina (2013), Tunis (2014), Erevan (2014), Ostrava (2014, 2015), Graz (2015), Białystok (2015).

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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) and 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). 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 and reasoning with incomplete or uncertain information.

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**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 180 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 a Full Professor.

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**Pawel 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 Philadelphia List of Journals); 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.

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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 works as Full Professor at NIT. In 2015 he continued to serve also as a Co-director of schools series for young scientists on Wireless Networking and Applications convened at the ICTP in Trieste in collaboration with NIT from 1998. 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 co-founded in 1972 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 European one. 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 10 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, IUCF, UNOCHA, UNESCO, WB, PWC, and to government agencies and industry in the UK, USA, Switzerland, Turkey, Poland, and other countries. 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 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. In 2015 he has got the Honorary ITU 150 Award; in 2013, Wrocław University of Technology honored him with the Gold Badge with Diamond. Earlier 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.

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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.

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Andrzej Zieliński – received master’s degree in engineering from the Faculty of Telecommunications, 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. Currently Chairman of the NIT’s Scientific Council. In 1993–2000, President of Federation of Engineering Associations in Poland. Member of the Polish Academy of Engineering, member of IEE. 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.

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7. R&D Activity

7.1. European Projects


The project aims at designing and developing innovative transport solutions, compatible with new bandwidth consuming applications (e.g. 3D video, cloud, etc.) based on Elastic Optical Networks equipped with a multi-domain and multi-technology control plane enabling adaptive network and service interworking. The intention is easy industrialization of the IDEALIST network architecture. Therefore, feasibility studies and experimental implementation and demonstration of prototypes are the key activities.

The programme financed by European Commission Fund was executed in a consortium gathering 23 partners from Europe. NIT participated in the project jointly with Warsaw University of Technology and was involved in WP1 activities concerning network architecture and optimization. The project ended on 31 October 2015.

Responsible in NIT: Prof Mirosław Klinkowski, Z14

www.ict-idealist.eu


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

The developed DELTA system is a solution based on (re-)allocation of resources used for media transmissions to answer efficiently different users’ requests, exploiting existing servers’ infrastructures capabilities available in: Conventional Clouds (public or private computing infrastructure configurations, usually offered by Over-the-Top providers), Content Delivery Networks (CDNs) but also Home Media Gateway Clouds.

NIT is a technical coordinator of the project.

Responsible in NIT: Dr Jordi Mongay Batalla, Z3

www.delta-project.net/


The IDSECOM project aims to build a secure platform for self-management of the things and services in the Internet of Things environment. The proposed platform brings the functionalities of the so-called ID layer to the network structure and integrates self-management, mobility and security/privacy functionalities in order to create a network infrastructure that offers an easier (and intuitive) access to the IoT (Internet of Things) services.

The efforts of this project are directed to build an extended secure ID layer, which solves object and service access in the network itself. Moreover, IDSECOM system extends the current ID layer solutions by:

- addressing not only objects but also services,
- distributing and facilitating general process as registration and publication of objects/services,
• adding enhanced security and privacy mechanisms,
• introducing ID layer self-management functionalities in network level,
• improving flexibility in multicast/anycast communications at different levels, and
• optimizing information forwarding.

The NIT is a leader of the project execution in cooperation with Warsaw University of Technology.

Responsible in NIT: Dr Jordi Mongay Batalla, Z3
https://idsecom.itl.waw.pl/


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 countries in the Baltic Sea region and beyond – including the NIT.

Responsible in NIT: Krzysztof Bronk, Z8
http://efficiensea2.org

7.2. Participation in COST Actions

In 2015 the Institute participated in the following COST Action (European Cooperation in Science and Technology Action):


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.

Management Committee Member: Dr Dariusz Więcek, Z21
http://aapele.eu/
7.3. National projects and research programs

7.3.1. Projects granted from EU structural funds


The project was executed within the Innovative Economy Programme, Priority 7 The information society – establishment of electronic administration. The aim of the project is to create countrywide data communication infrastructure to support state and local authorities in the management and co-ordination of projects related to building regional broadband networks. It is related to both core and access networks, and areas where intervention of authorities is necessary. In the project, which is done in partnership, NIT (leader) was responsible for the development and maintenance of database containing information about existing national broadband infrastructure whereas the Office of Electronic Communications was organizing Broadband Poland portal, and the Ministry of Administration and Digitization coordinated the activity on establishing the necessary legal acts. As a result of the Project, the Broadband Infrastructure System was built and tested in NIT. The System serves for gathering, processing and making accessible information about telecommunications infrastructure, public telecommunications network and buildings, enabling its colocation as well.

Project leader: Dariusz Gacoń, Z2, cooperation Z6
www.sips.itl.waw.pl


The project granted by Structural Fund runs in a consortium with Warsaw University of Technology, Wrocław University of Technology, Poznań Supercomputing and Networking Center, Silesian University of Technology, Gdańsk University of Technology and the National Institute of Telecommunications as the leader. The aim of the project is to extend functionality of the current PL-LAB research and experimentation network, which was designed and implemented in the scope of the Future Internet Engineering project (2010–2013). In 2015 the PL-LAB2020 project new laboratories were developed to allow for research and experimentation in the main areas of the Horizon 2020 European Research Programme. The following new laboratories have been developed as a result of that project: Network Virtualisation, Software Defined Networking, Information Centric Networks, Cloud Computing, Internet of Things, Wireless networks and Network Management.

The project is co-financed by the European Union through the European Regional Development Fund under the Operational Programme Innovative Economy:
• Priority Axis 2 – R&D infrastructure
• Measure 2.3 – Investments connected with the development of IT infrastructure of science
• Measure 2.3.1 – Projects related with IT infrastructure development for scientific and academic communities.

Leader of the project: Dr Piotr Krawiec, Z3, cooperation Z6
www.pllab.pl


The purpose of the project was investment in infrastructure and advanced computer applications, enabling the extension of the Institute research offer on the properties of electronic communication services. The core of the computer platform, being an object of this project, is analytic software supplied by SAS Institute and the data warehouse based on the relational database. The data warehouse for the accumulation of details about electronic communication services is fitted with tools for feeding it with data, as well as for using the data in multidimensional analyses. Software and hardware purchase was connected with the extension of personnel readiness for new research services for government, business and scientific subjects. See also Chapter 9.

Project leader: Andrzej Pękalski, Z10, cooperation Z2, Z6, OI
www.itl.waw.pl/pibuk/

The purpose of the project is development as well as certification and operational testing of disposed capacity remote check system for 48 V/50 – 300 Ah batteries, basic energy reserve in telecommunication objects. The system includes centralized measurement management function.

The system SKOT consists of:

• the modified DC power supply system with automatic disconnection of checking battery from power supply system, interoperating with measurement devices TBA-ST;
• the innovative, fixed TBA-ST device, managed by power supply controller, for battery disposed capacity measurement by controlled discharging;
• the new software modules for test management and the result presentation, integrated with object infrastructure supervision system, applied by operators.

The Project successfully completed in October 2015. The trial installation of SKOT was deployed and tested on the real telecommunication site while model equipment was tested in NIT laboratory.

Project leader: Bogdan Chojnacki, Z10, in cooperation with the Electronic Power and Market Ltd.

http://www.itl.waw.pl/skot/

7.3.2. Projects granted by the National Centre for Research and Development (NCBR)


The project was aimed at development of versatile, centralized monitoring system for telecom plant (cable lines, manholes, street cabinets, base stations of mobile networks, etc.), capable of automatic detection of cable cuts, facility break-ins and slowly-developing failures by means of advanced data analysis software. SMIT system detects cable cuts or deterioration by repetitive measurements of selected twisted pair (R and C parameters) or optical fiber (OTDR trace) in each monitored cable line with remote test heads deployed in the network, communicating with Supervision Center over an IP data network. Current measurement results are compared to reference data obtained from calibration measurements. The system also includes electronic sensors deployed in unmanned facilities, used for the detection of opening, break-ins, attempts of cable theft, flooding, extreme temperature, explosive gas, etc. Events recorded by the system are displayed on maps and recorded in database. Reports with the data selected according to the criteria introduced by the operator (area, date, type of event, etc.) are also created. The system is being tested by Orange Polska for protection of copper access network and manholes and can be adapted to monitor other kinds of technical facilities as well. Further development of OTDR monitoring system for optical fiber plant continued at NIT following completion of this project.

The project was executed together with Asseco Poland SA and NIT as a Leader.

http://www.itl.waw.pl/projekt741


The subject of the Project relates to early symptoms of the phenomenon occurring in certain lead-acid battery cells known as the effect of premature capacity loss (PCL). The main goal of the investigations was to develop a new effective method of PCL effect diagnostics, which would help to increase the reliability of backup power systems based on lead-acid batteries. Electrical, electrochemical and physicochemical properties testing is included in this project, since they are presented in the literature as important for the PCL analysis. Battery packs, single batteries, single cells, cell components and the regions at the grid/active mass junction are being examined. This will allow clarification of complete correlation between electrical parameters of cell components and their properties. The investigation of the project will allow describing optimal methods for the battery electrical parameters tests, which further will lead to their application in technical supervision of backup power stations.

The Project was implemented by a consortium consisting of: NIT (Department Z10), Institute of Non-Ferrous Metals – Central Laboratory of Batteries and Cells (leader), AGH University of Science and Technology, Telzas Ltd. The project was successfully finished in June 2015.

Responsible in NIT: Dr Robert Samborski, Z10

www.itl.waw.pl/projekt745
Computer System for Radio Frequency Resources Management, as well as Planning and Inventory of Radio Networks for Needs of Services Controlled by the Minister of the Interior – M-ISZCZ (2013–2015)

The aim of the project is designing and building the demonstrator of a new computer software system which is able to manage, coordinate, analyse and register the radio networks services used by the Minister of the Interior for public protection purposes. Also, a new Terrain Research Laboratory demonstrator used for PPDR radio networks analysis is prepared. EMC analysis of the PPDR radio systems and propagation measurements are also performed. The results of the executed research analyses and measurements are incorporated in the software system.

The project is executed in the consortium: NIT, JAS Technologie Ltd and Medcore Ltd.

Project leader: Dr Dariusz Więcek, Z21

http://www.itl.waw.pl/m-iszcz/


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. In 2015 DAB+ network frequency was checked and established, preliminary network plans were analysed and proposed.

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

Project leader: Dr Janusz Sobolewski, Z21

http://www.itl.waw.pl/LokalDAB/


The purpose of the project is a development of novel mechanisms for wireless networks self-organization. Those mechanism are expected to be a 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 ship 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 a 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, Z8

www.netbaltic.pl
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.

<table>
<thead>
<tr>
<th>Person cooperating in NIT, Department</th>
<th>Foreign institution</th>
<th>Subject</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Jordi Mongay Batalla, Z3</td>
<td>University of Nicosia, Cyprus</td>
<td>Investigation on emerging applications for Internet of Things</td>
<td>Book edition; book chapters, journal papers, conference papers</td>
</tr>
<tr>
<td>Dr Jordi Mongay Batalla, Z3</td>
<td>Technical Electronic Institute of Crete, Greece</td>
<td>Investigation on emerging applications for Internet of Things</td>
<td>Book edition; book chapters, journal papers, conference papers</td>
</tr>
<tr>
<td>Dr Jordi Mongay Batalla, Z3</td>
<td>University of Bordeaux, France</td>
<td>Investigation on advanced multimedia streaming</td>
<td>Journal papers, conference papers</td>
</tr>
<tr>
<td>Dr Jordi Mongay Batalla, Z3</td>
<td>University Politehnica of Bucharest, Romania</td>
<td>Investigation on advanced multimedia streaming</td>
<td>International PhD student, Journal papers, conference papers</td>
</tr>
<tr>
<td>Prof Ewa Orłowska, Z6</td>
<td>Brock University, Department of Computer Science, Catharines, Ontario, Canada</td>
<td>Dualities of semantic structures in discrete logics (applied logics)</td>
<td>Publications: papers</td>
</tr>
<tr>
<td>Prof Ewa Orłowska, Z6</td>
<td>University of Stellenbosch, Matieland and University of Witwatersrand, Johannesburg, Republic of South Africa</td>
<td>Discrete dualities and their applications</td>
<td>Book edition</td>
</tr>
<tr>
<td>Dr Janusz Granat, Z6</td>
<td>Department of Electronics, Computer Science and Systems, University of Calabria, Cosenza, Italy</td>
<td>Multicriteria network optimization</td>
<td>Joint research and publication</td>
</tr>
<tr>
<td>Dr Krzysztof Bronk, Z8</td>
<td>International Association of Lighthouse Authorities (IALA), Saint-Germain-en-Laye, France</td>
<td>Development of the VHF Data Exchange System (VDES) standard</td>
<td>Publications: guidelines and recommendations</td>
</tr>
<tr>
<td>Dr Tomasz Kossek, Michał Marszałek, Marzena Lusawa, Anna Warzec, Z12</td>
<td>Bureau International des Poids et Mesures, Paris, France</td>
<td>International Atomic Time – TAI, Coordinated Universal Time – UTC</td>
<td>Cooperation in creation of TAI and UTC</td>
</tr>
<tr>
<td>Dr Marcin Koba, Z12</td>
<td>Photonic Research Center, Université du Québec en Outaouais, Gatineau, Québec, Canada</td>
<td>Optical Fiber Sensors and Sensor Systems</td>
<td>Joint research; Publications: scientific papers;</td>
</tr>
<tr>
<td>Prof Marian Marciniak, Z14</td>
<td>Sheffield Hall University, Materials and Engineering Research Institute – MERI, Sheffield, UK</td>
<td>Terahertz frequencies – applications in telecommunications</td>
<td>Joint research</td>
</tr>
<tr>
<td>Prof Marian Marciniak, Z14</td>
<td>School of Engineering, University of Warwick, Warwick, UK</td>
<td>Optical communications in free space</td>
<td>Joint research</td>
</tr>
<tr>
<td>Prof Marian Marciniak, Z14</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 within the frame of Polish-Italian research project</td>
</tr>
<tr>
<td>Prof Marian Marciniak, Z14</td>
<td>Université d’Angers, Angers, France</td>
<td>Nanophotonics and subwavelength photonics</td>
<td>Joint research</td>
</tr>
<tr>
<td>Prof Marian Marciniak, Z14</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>
</tr>
<tr>
<td>Prof Marian Marciniak, Z14</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>
</tr>
<tr>
<td>Prof Marian Marciniak, Z14</td>
<td>Institute for Radio-Physics and Electronics, National Academy of Sciences of Ukraine, Kharkov, Ukraine</td>
<td>Investigation on new optical effects in nanostructures</td>
<td>Joint research</td>
</tr>
<tr>
<td>Prof Mirosław Klinkowski, Z14</td>
<td>Universitat Politecnica de Catalunya (UPC), Barcelona, Spain</td>
<td>Industry-Driven Elastic and Adaptive Lambda Infrastructure for Service and Transport Networks</td>
<td>Joint research and publications as part of FP7 Project IDEALIST</td>
</tr>
<tr>
<td>Prof Mirosław Klinkowski, Z14</td>
<td>Universitat Politecnica de Catalunya (UPC), Barcelona, Spain</td>
<td>Optimization of content delivery-oriented elastic optical networks</td>
<td>Joint research and publications</td>
</tr>
</tbody>
</table>
7.5. Statutory activities

In the table below NIT’s research projects financed by the statutory fund of the Ministry of Science and Higher Education are presented.

<table>
<thead>
<tr>
<th>Name of the leader</th>
<th>Title of research project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleksander Orłowski, Z1</td>
<td>Assessment of radio networks suitability for M2M (Machine-to-Machine) communications purposes</td>
</tr>
<tr>
<td>Stanisław Dziubak, Z2</td>
<td>The concept and laboratory model of monitoring system for optical fiber cable networks</td>
</tr>
<tr>
<td>Dr Magdalena Olender-Skorek, Z2</td>
<td>Regulatory, economic and functional aspects of the development of the electronic communications and postal markets in view of the „Europe 2020” strategy</td>
</tr>
<tr>
<td>Dr Jordi Mongay Batalla, Z3</td>
<td>Methods for streaming multimedia content in 5G networks</td>
</tr>
<tr>
<td>Prof Andrzej Wierzbicki, Z6</td>
<td>Logic, knowledge engineering and algorithms in telecommunications and network management</td>
</tr>
<tr>
<td>Dr Krzysztof Bronk, Z8</td>
<td>The analysis of the cognitive radio applications in the area of e-navigation. Stage I.</td>
</tr>
<tr>
<td>Prof Marian Kowalewski, Z10</td>
<td>The use of radio networks ad-hoc (GeoNet working) ITS</td>
</tr>
<tr>
<td>Dr Robert Samborski, Z10</td>
<td>Hybrid power system with renewable energy power sources for cooperation with battery energy storage system</td>
</tr>
<tr>
<td>Ryszard Kobus, Z10</td>
<td>Expanding the operational functionality of control and measurement systems developed by NIT</td>
</tr>
<tr>
<td>Dariusz Nerkowski, Z12</td>
<td>The development of new services in the Laboratory of Electrical Electronic and Optoelectronic Metrology (LMEEIO) and in the Interlaboratory Comparisons Unit (JPM)</td>
</tr>
<tr>
<td>Prof Zbigniew Jaroszewicz, Z12</td>
<td>Theoretical and experimental studies on new photonic structures and diffractive optical elements for metrology, sensing, optics, fiber optic telecommunications as well as time and frequency</td>
</tr>
<tr>
<td>Dr Marek Jaworski, Z14</td>
<td>Improved design and simulation of optical networks and plasmonic structures</td>
</tr>
<tr>
<td>Dr Dariusz Więcek, Z21</td>
<td>New wireless technics increasing effective use of radio spectrum</td>
</tr>
<tr>
<td>Marek Michalak, Z21</td>
<td>Electromagnetic compatibility of complex systems and large objects</td>
</tr>
<tr>
<td>Prof Andrzej Zieliński, DN</td>
<td>On the telecommunications and electronic media convergence in Poland</td>
</tr>
</tbody>
</table>
The National Institute of Telecommunications, as one of a few in Poland, got the status of National Research Institute granted by the Prime Minister’s Council. It was qualified before by the Committee of Evaluation of Research Units as meeting all necessary requirements for performing duties especially important for planning and executing the State policy in its area.

Then, according to the record in its Statute, the NIT gives specialized expertise and consultancy services to the governmental and local public administration. This determines its role of an expert in Information and Communication Technologies, elaboration of technical opinions and participation in advisory committees.

In 2015 the following tasks were performed in NIT:

• elaboration of comments and opinions on legal acts and other documents directed to the Institute by national authorities, like the Ministry of the Administration and Digitization (since November 2015 Ministry of Digitization), the Office of Electronic Communications (UKE) and the Parliamentary Commissions;

• technical support to the Ministry of the Administration and Digitization and the Ministry of Regional Development in the Operational Program Digital Poland;

• managing and developing information systems for telecommunications infrastructure inventory, ICT and BB regional projects monitoring; the systems were elaborated to support e-administration solutions under the Operational Program for Innovative Economy;

• 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;

• technical revision and consultancy of ITU Radio Regulations translation into Polish language;

• technical support and assistance for Polish Governmental Delegation to the World Radiocommunication Conference Geneva 2016, Conference Preparatory Group and Meetings;

• preparation of technical expertise in radio-communication systems, radio-communication interferences, propagation of radio signals for local authorities, prosecution offices and courts of justice.
9. Commercial products

PIBUK is the cutting-edge unit of research and development infrastructure (R&D) at the National Institute of Telecommunications (NIT). PIBUK is a high-performance data centre, specialising in big data processing and analysis, equipped with the latest and the highest quality hardware and software.

The platform might serve both commercial and non-commercial projects and is prepared not only for tasks in the area of research and evaluation of electronic communication services properties, but also enables a wide range of R&D activities, including big data processing and event stream processing. Non-commercial projects could be carried out on PIBUK not only by NIT employees but also remotely or locally by people working for other research institutes or universities. Commercial projects could be carried out on PIBUK in cooperation with any kind of organisations (non-profit or enterprises) in Poland. Among others, the platform is equipped with the cluster of high performance blade servers, disk arrays, 10GB and 40GB network switches.

The platform software includes five main functional areas: virtualisation, software design and development, data storage, data computing and business intelligence (BI). The platform software could be used to create and operate virtual environments for any kind of non-commercial R&D (or other type) projects. Most of the software components might also be employed for virtual environments of commercial projects.

Virtualisation system uses enterprise level VMware vSphere and vCloude suites and acts as an intermediary between hardware and the rest of software components. This virtualisation system provides a computing cloud, which allows to create virtual environments for particular projects, users or groups of users. Virtual project environments could include single virtual machine or many virtual machines, which could be provided for users as separate servers, clusters or farms of servers. Virtual project environments could be replicated for a particular project in order to serve for different purposes of the single project zone: research, development, prototype, test, preproduction, production.

Software design and development area could provide various compilers and interpreters (C/C++, Python, Java), development environments, project and development management (e.g. Redmine) and continuous integration (e.g. Jenkins) software.

Data storage area includes source data repository (database tables, plain files), document repository (e.g. LogicalDOC), metadata repository, report repository, GIT version control system.

Data computing area includes enterprise level SAS (Statistical Analysis System) software suite by SAS Institute and public R software environment for statistical computing and graphics.

Business intelligence area includes data integration and processing modules (Extract-Transform-Load/ Extract-Load-Transform (ETL/ELT) and event stream processing engines), data warehouse, analysis and modelling modules (statistical analysis, numerical and text data exploration, multidimensional data analysis, on-line analytical processing (OLAP), geospatial analysis, data mining, text mining, forecasting, data modelling), visual reporting (texts, tables, charts, graphs, maps) and alert reporting for data and text processing, including event stream processing. Business intelligence functionality is provided mostly by SAS software products combined with some public products (PostgreSQL database and R system) and cooperating with typical office software tools and suites (personal computers, tablets, smartphones, web browsers, PDF documents, Microsoft Office suite).

The project was financed within the Innovative Economy Operational Programme.

In 2015, NIT completed a variety of tasks ordered by companies and institutions operating on telecommunications market. Selected examples of such works are listed in the table below:

<table>
<thead>
<tr>
<th>Client</th>
<th>NIT department</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office of Inland Navigation, Szczecin</td>
<td>Z8</td>
<td>Elaboration of the conception of integrated radiocommunication system YHF/AIS/DGPS and broadband data transmission system for Lower Oder river border region</td>
</tr>
<tr>
<td>Polish Sea Authorities, Gdynia</td>
<td>Z8</td>
<td>Radio projects for RTK system and ON monitoring</td>
</tr>
<tr>
<td>Ministry of Administration and Digitization, Warsaw</td>
<td>Z10</td>
<td>Conception of organization of telecommunications for the national security management</td>
</tr>
<tr>
<td>Company / Organization</td>
<td>Project Code</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>The State Forests National Forest Holding</td>
<td>Z10</td>
<td>Audit of radio frequencies</td>
</tr>
<tr>
<td>BKT Elektronik J. K. Kurkus Spółka Jawna, Białe Błota k/Bydgoszczy</td>
<td>Z14</td>
<td>Dielectric tests of fiber optics for outdoor installations</td>
</tr>
<tr>
<td>Polish Radio, Warsaw</td>
<td>Z21</td>
<td>Analysis of the possibility of the national DAB+ digital radio diffusion system construction in Poland</td>
</tr>
<tr>
<td>KPMG, Warsaw</td>
<td>Z21</td>
<td>Expertise on the influence of the change of the destiny of 700 MHz radio band on terrestrial digital TV and mobile communication markets</td>
</tr>
<tr>
<td>Various clients</td>
<td>Z1</td>
<td>Technical tests and conformity assessments of various radio equipment</td>
</tr>
<tr>
<td>Various clients</td>
<td>Z12</td>
<td>Calibration of different measurement equipment for telecommunications and electronics companies with the duties of LMMEiO Laboratory</td>
</tr>
<tr>
<td>Various clients</td>
<td>Z1, Z21</td>
<td>EMC tests of different electric and electronic equipment</td>
</tr>
</tbody>
</table>
10. Other activities

10.1. Publishing activity

10.1.1. Publications of NIT

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 2015, four issues of the periodical were published, containing 44 scientific papers in total. The leading subjects are as follows: in 1/2015 issue – quality of service associated with voice and video signals, in 2/2015 – important topics of biometrics, influence of the wind farms on radiocommunications, in 3/2015 – a broad range of topics related to cloud computing, network security and wireless networks applications, and finally in 4/2015 – sensor networks.

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

All published papers are subject to peer review.

Electronic version of the Journal can be accessed at: www.nit.eu/publications/journal-jtit

**Telekomunikacja i Techniki Informacyjne (TITI)** is a periodical of sci-tech character. The journal publishes in Polish (and occasionally in English) papers, either invited or submitted by the authors, and other materials presenting:

- information on current issues, research topics and scientific achievements in the areas of technology, economics and management of telecommunications and IT sectors, especially these related to the research carried out in the Institute,
- information on world developments and events related to telecommunications and IT,
- studies on inter-disciplinary scientific and technical problems, particularly relevant to information society,
- issues related to education and professional development.

Special attention is paid by the editors to presentation of research projects, run both in NIT and outside the Institute.

In 2015, one double issue of the TITI was published, containing 5 papers in total, four of them prepared by NIT’s authors.

Editor-in-Chief of the journal is Dr Andrzej Hildebrandt.

All published papers are subject to peer review.

Electronic version: www.itl.waw.pl/publikacje/kwartalnik-titi (in Polish)
10.1.2. Publications of NIT’s staff

In 2015, numerous publications were prepared by NIT’s researchers:

<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>26</td>
</tr>
<tr>
<td>Publications in journals listed by the Ministry of Science and Higher Education</td>
<td>38</td>
</tr>
<tr>
<td>Conference proceedings listed by the Web of Science</td>
<td>6</td>
</tr>
<tr>
<td>Publications in peer-reviewed journals in Poland and abroad</td>
<td>6</td>
</tr>
<tr>
<td>Books published in English</td>
<td>2</td>
</tr>
<tr>
<td>Books published in Polish</td>
<td>1</td>
</tr>
<tr>
<td>Chapters in books published in English</td>
<td>6</td>
</tr>
<tr>
<td>Chapters in books published in Polish</td>
<td>3</td>
</tr>
<tr>
<td>Editors-in-Chief of monographs in English</td>
<td>1</td>
</tr>
<tr>
<td>Conference proceedings</td>
<td>18</td>
</tr>
<tr>
<td>Number of publications</td>
<td>107</td>
</tr>
</tbody>
</table>

10.2. Patents

In 2015, three Polish patents were granted to the Institute, and two applications were filed to the Polish Patent Office.

Patents granted by the Polish Patent Office:

- **System for the protection of the additive-subtractive converter of real battery capacity meter**, inventors: Paweł Godlewski, Ryszard Kobus, Bogdan Chojnacki, Kazimierz Niechoda, Krzysztof Olechowski (all Z10), application No P.406359.
- **Test method of lead-acid battery cells**, inventors Andrzej Binkiewicz (Z10) Paweł Kliś (Z12), application No P.397660.
- **System for the automation of battery capacity measurement in telecommunications power station**, Inventors: Paweł Godlewski, Ryszard Kobus, Bogdan Chojnacki, Kazimierz Niechoda, Krzysztof Olechowski (all Z10), application No P.403118.

Applications filed to the Polish Patent Office:

- **Method and receiver for adaptive media streaming**: Inventors: Piotr Krawiec, Jordi Mongay Batalla, Piotr Wiśniewski (all Z3) Andrzej Bęben (PW), application No P.412498.
- **System for early remote diagnostics of the PLC phenomenon in VRLA storage batteries**, Inventors: Robert Samboński, Andrzej Binkiewicz (all Z10), application No P.415676.

A number of other NIT’s applications filed in earlier years to the patent offices are still under granting procedures.
10.3. Conferences, seminars and education

10.3.1. Conferences

17th International Conference on Transparent Optical Networks ICTON 2015 was held on 5–9 July in Budapest, Hungary. The Conference was organized by NIT’s Department of Transmission and Optical Technologies together with the Budapest University of Technology and Economics and the IEEE Photonic Society, Poland Chapter. The venue was Danubius Thermal Hotel Helia. ICTON 2015 was technically sponsored by the IEEE Photonics Society and Poland Chapter of that society.

The Conference General Chair was Prof Eszter Udvary from the Budapest University of Technology and Economics. Dr Piotr Nyga, IEEE Photonics Society Poland Chapter Chairman, was the Chairman of ICTON 2015 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 seven NIT’s employees with Prof Marian Marciniak as the Chairman, and Dr Marek Jaworski as the Publication Chair.

Two major events were co-located with ICTON 2015: the 7th Sub-Wavelength Photonics Conference SWP, and the 13th Colloquium on Microwave Communications.

In addition, there were several thematic workshops and sessions including:

- 14th European Symposium on Photonic Crystals (ESPC)
- 14th Workshop on All-Optical Routing (WAOR)
- 12th Global Optical & Wireless Networking Seminar (GOWN)
- 11th Reliability Issues in Next Generation Optical Networks Workshop (RONEXT)
- 11th Optical Wireless Workshop (OWW – former Free-Space Optics Session)
- 11th Photonic Integrated Components & Applications Workshop (PICAW)
- 10th Anniversary Nanophotonics for All-Optical Networking Workshop (NAON)
- 10th Anniversary Special Session on Photonic Atoms & Molecules (PAM – former MPM)
- 9th Special Session on Novel Glasses for photonic devices
- 8th Special Session on Market in Telecommunications (MARS)
- 7th COCONUT Workshop on Broadband Access (former ACCORDANCE)
- 6th Workshop on Communication in Transportation Systems (CTS)
- 5th Workshop on Green Optical Communications (GOC)
- 5th Special Session on Microwave Photonics (MWP)
- 2nd Workshop on Network Optimization (NeO)
- Workshop on Technology for Data Center Interconnects (DACINT)
- Workshop on Datacenter Networks (DCN)
- Workshop on 5G Transport Networks (5GT)
- FP7 IAPP GRIFFON Workshop on “Polarisation phenomena in fibre optics: Fundamentals & applications”.

During the four days of the Conference, 401 papers (including 3 plenary and 327 invited) were presented in as many as 81 oral sessions, and the programme was completed with two poster sessions involving 55 poster contributions in total. A total of 428 participants from 46 countries all over the world attended ICTON 2015.


The Workshop on Wireless Connectivity for African Islands focused on finding solutions to the communication issues faced by African Islands, such as transmission of meteorological data from field stations to national centres, last-mile connectivity, low speed Internet connections, intermittent energy availability and harsh environmental conditions. It was held from 31 August till 4 September 2015, at ICTP Headquarters in Trieste, Italy.

The participants, some 15 university- and government-employed experts, come from 10 African countries. Topics covered wireless solutions, traditional as well as state-of-the-art technologies, with emphasis on hands-on sessions to evaluate new technologies. Most time was devoted to discussions of specific problems related to collecting meteorological and hydrological data from inaccessible, or accessible with difficulties, sensors and automatic
stations. Some data require transmissions over the sea at distances of hundreds of kilometres or more (undersea cables are too expensive).

Lecturers come from Europe, America and Asia: Marco Zennaro (Workshop Director, Researcher at ICTP, Italy), Ermanno Pietrosemoli (Workshop Director, Consultant at ICTP, Italy), Ryszard Struzak (NIT, Poland), Sandor Marikon (Visiting Researcher at NICT, Japan), Marco Rainone (Consultant at ICTP, Italy). The lectures and discussions made it possible to establish plans of scientific collaborations and participation in joint efforts with experts in wireless technologies.

Apart from the above events, the Institute of Telecommunications had in 2015 the privilege of being the Honourable Patron of four meetings:

- **15th Symposium of World Telecommunications and Media Magazine** held in Warsaw on 24–25 March, jointly with Golden Antenna Gala Event, which constitute crucial meeting of telecommunications market and media people in Poland. All organized by MM Conferences SA.
- Conference and exposition Radio EXPO 2015 held in Warsaw on 10–11 October. The aim of the Conference was the presentation of products, systems, technologies, services and complex solutions for professional radio-communication.
- **8th Warsaw International Media Summit** held in Warsaw on 21–21 October, which constitutes a cyclic meeting where telecommunications branch representatives, firms and institutions debate on directions and consequences of the changes in telecommunications law. Organized by MM Conferences SA.
- **Think Big CEE Congress BIG DATA**, which was an intersectional meeting of decision makers from financial, telecommunications, media, retail and e-commerce sectors, organized on 28–29 November by MM Conferences SA.

### 10.3.2. Scientific seminars

In the table below the titles of 12 scientific seminars held in 2015 are listed.

<table>
<thead>
<tr>
<th>Title</th>
<th>Speaker</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>THz radiation, detection and areas of application</td>
<td>Prof Hovik Baghdasaryan</td>
<td>18.02</td>
</tr>
<tr>
<td>Fiber Bragg gratings in tapered optical fibers – modelling, technology, telecom and sensing applications</td>
<td>Konrad Markowski, Tomasz Osuch, PhD</td>
<td>11.03</td>
</tr>
<tr>
<td>Impact of information technologies on market and democracy</td>
<td>Prof Andrzej P. Wierzbicki</td>
<td>15.04</td>
</tr>
<tr>
<td>Low-power optical communication: approaching the quantum limit</td>
<td>Prof Konrad Banaszek</td>
<td>22.04</td>
</tr>
<tr>
<td>Ground Penetrating Radar: Mathematical Aspects of Subsurface Radio Probing</td>
<td>Igor Prokopovich</td>
<td>29.04</td>
</tr>
<tr>
<td>Terahertz radiocommunications – expectations, opportunities and limitations</td>
<td>Prof Yevhen Yashchyshyn</td>
<td>13.05</td>
</tr>
<tr>
<td>Ground Penetrating Radar: overview on the research activities carried out by the COST Action TU1208</td>
<td>Lara Pajewski, PhD</td>
<td>20.05</td>
</tr>
</tbody>
</table>
10.3.3. Education

The Education Centre leads technical and business trainings and courses. Trainings are organized in a public scheduled formula (open) or as closed, precisely tailored to customer requirements workshops. 31 commercial training and courses were conducted by the Centre in 2015.

List of events is shown below (o – open, t – tailored)

<table>
<thead>
<tr>
<th>Title</th>
<th>Formula</th>
<th>First date</th>
<th>Later repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries and other sources of backup power for telecommunications</td>
<td>o</td>
<td>18–19.03</td>
<td></td>
</tr>
<tr>
<td>Teletransmission system SDH, DWDM and CWDM</td>
<td>o</td>
<td>24–25.03</td>
<td></td>
</tr>
<tr>
<td>xDSL, FITL and SIP techniques</td>
<td>o</td>
<td>26–27.03</td>
<td></td>
</tr>
<tr>
<td>Unwanted optical effects in DWDM/ROADM systems</td>
<td>o</td>
<td>9–10.04</td>
<td></td>
</tr>
<tr>
<td>Formal and legal procedures in telecom investment</td>
<td>o</td>
<td>15–16.04</td>
<td>1</td>
</tr>
<tr>
<td>Installation of fiber and measurement optotelecommunication</td>
<td>o</td>
<td>28–29.04</td>
<td></td>
</tr>
<tr>
<td>IP-SIP telephony</td>
<td>o</td>
<td>20.05</td>
<td></td>
</tr>
<tr>
<td>SS7 signalling system</td>
<td>o</td>
<td>9–10.06</td>
<td>1</td>
</tr>
<tr>
<td>TCP/IP and ATM systems, integration with SDH</td>
<td>o</td>
<td>11–12.06</td>
<td>1</td>
</tr>
<tr>
<td>Construction Law in the investment process</td>
<td>o</td>
<td>16–17.06</td>
<td></td>
</tr>
<tr>
<td>SAP Business Objects Designer</td>
<td>o</td>
<td>17.06</td>
<td></td>
</tr>
<tr>
<td>Revised telecommunications law</td>
<td>o</td>
<td>18–19.06</td>
<td>1</td>
</tr>
<tr>
<td>SAP Business Objects Designer – object design</td>
<td>o</td>
<td>25.09</td>
<td></td>
</tr>
<tr>
<td>Multicast IP</td>
<td>o</td>
<td>29.09–02.10</td>
<td>1</td>
</tr>
<tr>
<td>Revised Construction Law</td>
<td>t</td>
<td>15–16.10</td>
<td>2</td>
</tr>
<tr>
<td>Building qualifications in telecommunications</td>
<td>t</td>
<td>29–30.10</td>
<td>2</td>
</tr>
<tr>
<td>Strategic Aspects in Internet Governance and Innovations</td>
<td>o</td>
<td>5–6.11</td>
<td></td>
</tr>
<tr>
<td>NGN networks</td>
<td>o</td>
<td>19–20.11</td>
<td></td>
</tr>
<tr>
<td>End to End QoS Network Design</td>
<td>o</td>
<td>19–20.11</td>
<td></td>
</tr>
<tr>
<td>VoIP</td>
<td>o</td>
<td>24–25.11</td>
<td></td>
</tr>
<tr>
<td>Measurements in packet networks</td>
<td>t</td>
<td>25.11</td>
<td></td>
</tr>
<tr>
<td>BGP – Border Gateway Protocol</td>
<td>o</td>
<td>14–17.12</td>
<td></td>
</tr>
</tbody>
</table>
Annex. Titles, degrees and posts

According to the Polish law, the 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.

**TITLES AND DEGREES**

<table>
<thead>
<tr>
<th>Name in Polish</th>
<th>Abbreviation</th>
<th>Description</th>
<th>Translated here as</th>
</tr>
</thead>
<tbody>
<tr>
<td>profesor</td>
<td>prof.</td>
<td>Academic title – awarded by the President of the Republic of Poland</td>
<td>Professor (Prof)</td>
</tr>
<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 in humanities</td>
<td>MA</td>
</tr>
<tr>
<td>magister inżynier</td>
<td>mgr inż.</td>
<td>Professional title – completed master-level university studies in technical field</td>
<td>MSc</td>
</tr>
<tr>
<td>inżynier</td>
<td>inż.</td>
<td>Professional title – completed university studies in technical field</td>
<td>BSc</td>
</tr>
</tbody>
</table>

In less formal chapters of this document only two titles: Prof and Dr are placed before the names, as it is commonly practiced.

**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>
<tr>
<th>Name in Polish</th>
<th>Requirements</th>
<th>Translated here as</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scientific Researchers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profesor zwyczajny</td>
<td>Professor title is required</td>
<td>Professor</td>
</tr>
<tr>
<td>Profesor nadzwyczajny</td>
<td>DSc or PhD degree is required</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>Profesor wizytujący</td>
<td>Used for persons employed in another institution, DSc degree is required</td>
<td>Visiting Professor</td>
</tr>
<tr>
<td>Adiunkt</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>
<td></td>
<td></td>
</tr>
<tr>
<td>Główny specjalista badawcze-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>
</tr>
<tr>
<td>Starszy specjalista badawcze-techniczny</td>
<td></td>
<td>Senior R&amp;D Specialist</td>
</tr>
<tr>
<td>Specjalista badawczo-techniczny</td>
<td></td>
<td>R&amp;D Specialist</td>
</tr>
<tr>
<td><strong>Specialists</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Główny specjalista inżynieryjno-techniczny</td>
<td>MSc or BSc is required</td>
<td>Leading Specialist</td>
</tr>
<tr>
<td>Starszy specjalista inżynieryjno-techniczny</td>
<td></td>
<td>Senior Specialist</td>
</tr>
<tr>
<td>Specjalista inżynieryjno-techniczny</td>
<td></td>
<td>Specialist</td>
</tr>
</tbody>
</table>