Bulletin 2018

Department of Networked Systems and Services
Budapest University of Technology and Economics

“To build the foundation of a promising career or an industrial success you need three things: Quality, Quality and Quality!”

The **Department of Networked Systems and Services**, formerly known as the Department of Telecommunications, is focusing on the key areas of networking and networked systems: analysis and design of wired and wireless networks, new network architectures and protocols, mobile communication systems and services, multimedia networking and media distribution systems and services, cryptography and network security. Additional strengths that complement the key areas include quantum computing and communications, acoustics and studio technologies, signal processing, financial information systems.

The recent change of our name from Department of Telecommunications to **Department of Networked Systems and Services** reflects that our competences have shifted significantly during the last decades. This change has been driven by the convergence of telecommunication systems and the Internet, resulting in a global integrated network of heterogeneous devices, as well as by the widespread deployment of information technologies, and in particular the Web, resulting in innovative new network based services. While the 60 years of experience of the Department of Telecommunications in networking still provides a solid ground on which we can base our teaching, research and development activities, the new name of the department better describes what we are currently focusing on and how we are thinking of the future.

Our team of 7 professors, more than 60 staff members and 20 PhD students can dynamically respond to the ever-increasing and leading-edge competency demands from the field of **I**nformation and **C**ommunication **T**echnologies both at the national and the international levels.

Our courses, laboratory exercises, individual student projects and diploma projects create unique opportunities for undergraduate and graduate students to obtain high level knowledge and practical skills. Furthermore, the Department’s strong industrial cooperation provides excellent career opportunities for them. We always seek a balance among theoretical work, applied research and development. We are open to work with students eager to learn and to collaborate with industrial partners in different research and development projects.

If you are looking for quality and excellence in research and education, then you are welcome at the **Department of Networked Systems and Services**!

Prof. Sándor Imre
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preface

„Egy ígéretes karrier vagy egy ipari siker három tényezőn alapul: minőség, minőség, minőség!”

A BME **Hálózati Rendszerek és Szolgáltatások Tanszéke** – korábbi nevén Híradástechnikai Tanszék – a hálózatokkal és hálózati rendszerekkel kapcsolatos olyan kulcsterületekre koncentrál, mint a vezetékes és vezeték nélküli hálózatok analízise és tervezése, új hálózati architektúrák és protokollok, mobil kommunikációs rendszerek és szolgáltatások, multimédia hálózatok, médiaelosztó rendszerek és szolgáltatások, kriptográfia és hálózatbiztonság. Tanszékünk további erősségei, melyek jól kiegészítik a fenti fő tevékenységi területeinket: a kvantuminformatika és -kommunikáció, akusztika és stúdiótechnológiák, jelfeldolgozás, valamint üzleti információs rendszerek.

Tanszékünk nevének közelmúltbeli megváltoztatásával kompetenciáinknak az utóbbi évtizedekben bekövetezett jelentős elmozdulására reflektáltunk. Ezeknek a változásoknak a fő mozgatórugói egyfelől a távközlő hálózatok és az internet konvergenciája, mely különféle eszközök globális és integrált hálózatát eredményezte, másfelől az információs technológiák széleskörű elterjedése, mely új innovatív, hálózat alapú webes szolgáltatásokhoz vezetett. Miközben a Híradástechnikai Tanszék több mint 60 éves tapasztalata a hálózatok világában olyan biztos alapot jelent, amire bátran építhetjük oktatási, kutatási és fejlesztési tevékenységünket, tanszékünk új neve jobban tükrözi a jelenleg folyó tevékenységünket és a jövőre vonatkozó terveinket.

A tanszék 7 professzora, több mint 60 munkatársa és mintegy 20 doktorandusza dinamikus és minőségi választ képes adni az ICT szektor folyamatosan erősödő hazai és nemzetközi kihívásaira.

Különböző képzési formáink – kötelező és választható tárgyaink, az önálló laboratóriumi gyakorlatok, a szakdolgozat és a diplomatervezés – mind hallgatóink elméleti és gyakorlati tudásának bővítését célozzák, melyek ipari kapcsolataink révén kiváló karrierépítési lehetőségekkel egészülnek ki. Gondosan ügyelünk arra, hogy az elméleti és alkalmazott kutatás és fejlesztés között egyensúlyt tartsunk és ipari partnereinknek mindig a megfelelő megoldást nyújthassuk. Nyitottak vagyunk az olyan hallgatók felé, akik kutatási és fejlesztési projektek keretében szeretnének ipari tapasztalatra szert tenni.

Amennyiben Ön a minőség és kiválóság elkötelezett híve, bátran forduljon a **Hálózati Rendszerek és Szolgáltatások Tanszék** munkatársaihoz.

Analysis, Design and Development of ICT Systems Laboratory

The main activity of the AddICT laboratory covers the practical and theoretical aspects of ICT networks. Our profound theoretical competence in stochastic modeling, queueing theory and efficient performance evaluation algorithms is acknowledged by the Hungarian Academy of Sciences through the funding support for the MTA-BME Information Systems Research Group (led by Prof. Miklós Telek).

We are strong in the practical aspects related to development and the operation of ICT systems such as the design and analysis of telco networks and ICT systems, green networks, reliability studies, cloud computing, and the automatic testing solutions to enhance the reliability of networking software solutions. The research activities are carried out in collaboration with international institutes over the world and with the ICT industry. Our results (models, design and analysis methods, testing tools and techniques) have been used by national and international companies for three decades.

The researchers of the laboratory have been developing network design, performance and reliability analysis tools based on a flexible network model for more than three decades (initiated by Prof. László Jereb). The FLEXPLANET tool and its components have been used by Hungarian Telecom to plan and optimize multilayer networks, and analyze the reliability of Hungarian networks.

Apart from the ongoing research on network technology and Internet traffic modeling, the laboratory, in cooperation with Nokia Solutions and Networks, has been working on the development of automatic software testing solutions (Prof. Tien Van Do) and capacity dimensioning tools for future evolution (FE) traffic solutions.

Supported by our theoretical knowledge and practical experiences gained from the active research, our objective in education is to provide students with up-to-date and long lasting competences and skills in the aspects of network operation, network design, performance and reliability analysis. AddICT also hosts a Cisco training laboratory and offers hands-on lab courses, IPv6 and Cisco CCNA courses for our students and industrial partners.

laboratories

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medianets laboratory

The mission of the Laboratory of Multimedia Networks and Services (MEDIANETS) is to combine our traditional strengths in media technologies with our new research focus, the autonomous vehicles for smart cities. Research and development activities include Cooperative Intelligent Transport Systems (V2X communications), prediction of traffic and digital profiling for smart cities (using machine learning), coordination of multiple autonomous vehicles (flocking optimization), media communications, mobile healthcare technologies and benchmarking and security analysis of IPv6 transition technologies in smart cities.

MEDIANETS has been active in significant European and national projects. In a recent industrial R&D project, an intelligent parking system was developed for T-Systems to predict real-time parking space availability with machine learning and help the parking process with highly cooperative algorithms based on V2X communications. The laboratory also participated in the large-scale national initiative FIRST (Future Internet Research, Services and Technology) by contributing to the research of novel architectures and protocols for the Future Internet. Under the R&D cooperation with Nokia Bell Labs, the laboratory studies 5G V2X communication scenarios in telco cloud based systems where dynamic V2X communication / service provision environments are simultaneously available for connected/autonomous vehicles and other users with highly different communication characteristics and network usage profile.

MEDIANETS' teaching activity spans over the whole BSc-MSc-PhD structure. Along with basic courses in communication networks, it is responsible for two BSc and one MSc specializations in media technologies and media communications. Facilities for students include an Apple multimedia training laboratory and the Commsignia - BME HIT V2X Communication laboratory, where they can design and implement intelligent cooperative services for smart cities.

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MCL

Mobile Communications & Quantum Technologies Lab.

Since the foundation of the laboratory in 1997, the focus of its research and teaching activities is the evaluation of wireless communications and mobile networks. This research community released a large number of engineers in the last 20 years, while participating in numerous international and national research and development projects in the research fields of mobile and wireless communications and in the area of quantum communications and computing. The members of the laboratory have over 300 scientific publications. Moreover, our colleagues have been active in providing various lectures to our industrial partners, the latest of these include topics of 5G mobile systems and virtualization in networks. The other leg of research and lecturing activities of the lab is in quantum communications and quantum computing.

Our recent achievements include evaluation of the co-existence of LTE and legacy systems; analysis of capacity and throughput of LTE systems; evaluation of D2D communications' performance; evaluation of beamforming based backhauling solution to mass transportation networks; development of a passive indoor localization system; various developments on sensory and remote control networks, using the popular RPi platform and Arduino boards. Recently activities targeting 5G mobile networking areas in cloud RAN and edge computing as well as topics related to virtualization of network functions has been initiated in the lab. Besides wireless research and development, our members have actively participated in the construction of the first Hungarian quantum key distribution experiment, which allows for exchanging a secret key for symmetrical coding between two communication parties.

laboratories

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Laboratory of Cryptography and System Security

The Laboratory of Cryptography and System Security (CrySyS Lab) is committed to perform high quality research, teaching, and consulting activities in the fields of system and network security, as well as in applied cryptography. In terms of research, the laboratory's current focus is on the security of cyber-physical systems, including industrial control systems, modern vehicles, and the Internet of Things.

The CrySyS Lab has been active in research in security and privacy for 10+ years. It has participated in several EU and national projects (e.g., SeVeCom, UbiSec&Sens, EU-MESH, WSAN4CIP, and CHIRON), it maintains extensive collaborations with several industrial and academic partners in Europe and in the US, and its results are well-known and appreciated by the international security research community.

Activities of the CrySyS Lab in the recent past have been related to the analysis of targeted malware, such as Duqu, Flame, MiniDuke, Teamspy, and Duqu 2.0; to the security testing of APT detection tools and services; to the development of a large repository of signed code and certificates that can help detecting malicious programs, compromised keys, and fake certificates; to the development of a PLC honeypot for fast attack detection in industrial networks; and to attacking cars by compromising diagnostic equipment. Some of these activities received intensive media coverage.

In terms of teaching, faculty members of the laboratory teach base courses on IT Security in the BSc program, and they are also responsible for running an MSc minor specialization on IT Security. Members of the CrySyS Lab also perform consulting and auditing services in the field of security and privacy on a regular basis.

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laboratories

Laboratory of Acoustics and Studio Technologies

The **L**aboratory of **A**coustics and **S**tudio **T**echnologies is active both in the traditional fields of technical acoustics and in digital audio and video.

Electroacoustics is one of the traditional fields of the laboratory, which was extended later on towards various industrial fields such as vehicle and building acoustics, soil and building vibrations. The current activity of the lab ranges from numerical and statistical prediction of sound and vibration fields through sound recording and audio signal processing to video studio techniques and many aspects of digital media technologies.

The current staff consists of 9 employees, giving a number of undergraduate and graduate courses for students of two faculties, and at postgraduate level for PhD students and environmental engineers.

The laboratory equipment consists of a semi-anechoic room, a small but well equipped educational recording studio, wide range of software tools for numerical and statistical acoustic simulation as well as extended hardware for video signal recording, processing and measurements. The equipment has essentially been upgraded recently when 16 powerful iMac computers were installed, forming a new Apple educational studio.

The laboratory has been involved in many international research and national development projects. LAST is currently participating in the Batwoman EU project dealing with methodologies for various major fields of acoustics such as automotive, musical and room acoustics as well as their common perception methods.

The Lab is also active in national R&D projects. Our members and students participate in the design and quality control of the new metro line M4 in Budapest, in the vibro-acoustic design of the reconstruction of the concert halls of the Liszt Academy of Music, and in a number of other noise and vibration control projects throughout the capital and the country.

laboratories

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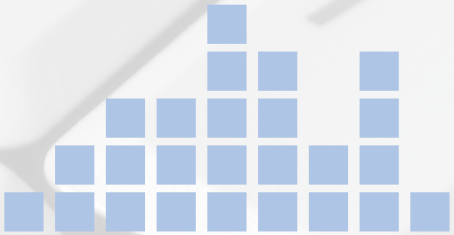

financial computing and signal processing

The main research and development activities of the laboratory focus on adaptive algorithms, optimization of communication protocols, statistical resource management and admission control, and time series analysis and prediction. Its expertise also includes the mathematical foundations of signal processing, statistical network reliability analysis and mobile gaming optimization.

Recent achievements include novel algorithms for identifying mean reverting portfolios, support vector machines and neural networks for efficient trading, new non-supervised channel equalization algorithms, optimal energy aware routing protocols for wireless sensor networks, adaptive server update strategies for mobile gaming, real-time network reliability analysis based on statistical sampling techniques, intelligent packet classification methods for internetworking based on computational geometry, blind equalization algorithms for radio channels corrupted by selective fading and additive Gaussian noise, novel scheduling algorithms by combinatorial optimization for telecommunication networks, hardware and software implementation of signal processing systems of QAM.

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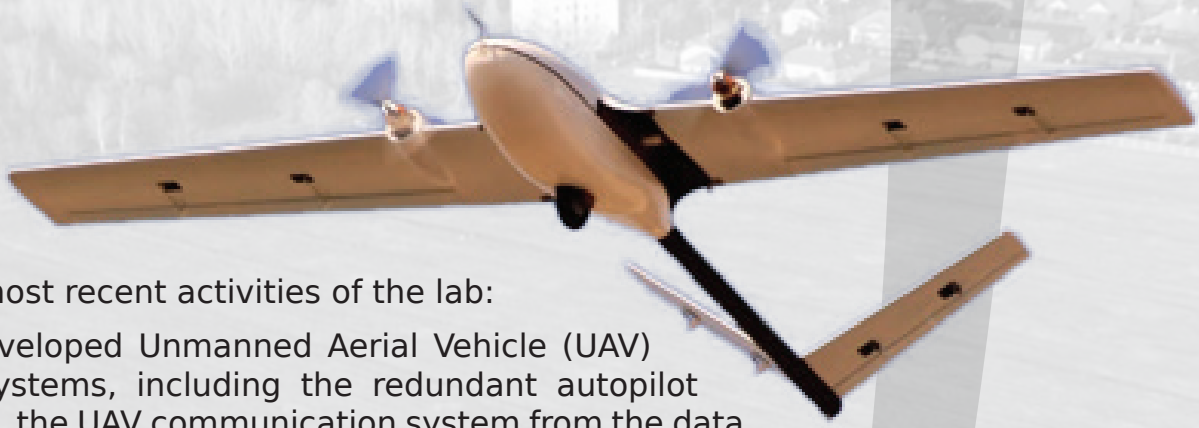
laboratories

Electronic System Design Laboratory

Our group at the department has been working on the electronic system development for decades.

At ESDlab we specialize in hardware, FPGA and software development of high-speed digital and analog systems. We have created communication devices, industrial computers and peripherals, like data acquisition boards, digital signal processor and FPGA boards, machine vision interfaces and many more. Most of these are available on the international market some of them are still in operation in 24/7 service. Our research and development activities also extend to synthesizing and analyzing digitally modulated signals, designing digital modulators and demodulators, utilizing DSPs, general purpose processors, FPGAs and GPUs. Generally, we work together with our international or national industrial partners on our development projects.

laboratories



Some of the most recent activities of the lab:

- We have developed Unmanned Aerial Vehicle (UAV) electronic systems, including the redundant autopilot with sensors, the UAV communication system from the data source to the antenna, video signal acquisition, compression and radio transmission from the UAV to the ground.
- Our team has been active in research of indoor navigation using Ultra Wide Band (UWB) technology, which is a promising solution to solve precise UAV navigation problem where Global Navigation Satellite System is not available.
- We have been involved in the design of a very high channel number, high-speed data acquisition system for multi-channel radio wave direction finding application in short wave radio band.
- We design a wideband (30MHz..6GHz) radio wave direction finding system for drone detection application.
- We cooperated with MCL laboratory in the HunQuTech quantum key distribution project where we design the electronic control circuits.

Our students can participate in real-world engineering activities in our well-equipped lab, where we help them reach their goals and be a successful engineer after taking a degree.

Besides R&D, our group also takes an active part in teaching Electronics 1. (BSc), Engineering Acoustics (MSc), Computer Architectures (BSc), and Integrated Design of High-frequency Digital Circuits (BSc/MSc) as well.

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Mobile Innovation Centre

The Mobile Innovation Centre was founded in 2005 at the Budapest University of Technology and Economics as a mobile communications research, development and innovation institution. It was established by a consortium of academic and industrial partners: among its founding members were various departments of three universities located in Budapest, an institution of the Hungarian Academy of Sciences, and industrial partners from the field of telecommunications (Hungarian subsidiaries of significant global companies).

Its first four-year operation was an incubation period with subsidized research and development projects. Since then it has become a self-sustaining technology institute: it successfully takes part in prestigious domestic and international research and development works in the field of mobile and wireless technologies and services, and has developed an operation model based on industrial cooperation.

The areas of our competition:

- Wireless, mobile and adhoc networks and services
- High speed heterogeneous networks
- Telecom software development and mobile applications

BME infokom INNOVATOR NONPROFIT LTD.

BME-Infokom Innovátor Ltd. is a nonprofit organization of technology research and development fulfilling market demands. Since our foundation in 2008 we have been carrying out activities that produce marketable results and solutions, like a product, a technology, an application, or a service. We carry research and development projects into execution in bilateral cooperations with industrial partners and we are highly interested in contributing to national and EU supported projects. The organization's goal is to provide an institutionalized opportunity for students and experts to get acquainted with market demands, so universities, manufacturers, and the whole industrial sector are able to cooperate in a synchronized way in fields of telecommunications and informatics.

Our main specialities are telecommunication service implementations; software solutions and mobile application development for every significant platform; IT security solutions; realization of sensor networks from circuit design and manufacture to server implementation; RFID systems; technical consulting. Our research is focused on indoor positioning, quantum informatics, and sensor networks.

EIT Digital
Budapest Node

is a consortium of two local universities - namely, Eötvös Loránd University (ELTE) and Budapest University of Technology and Economics (BME) - and their leading industrial partners (consortial partners: Ericsson Hungary, Magyar Telekom, OTP, MTA-SZTAKI, E-Group, evopro); and a cooperating partner, Cisco Systems Hungary. The Department of Networked Systems and Services is strongly involved in the EIT Digital Master and PhD education programs, and in the research action lines.

associated organizations

The Department is hosting a Training Laboratory equipped with Cisco networking devices. The laboratory was established in summer 2009, and the equipments were complemented with a new set of IPv6 capable devices under the umbrella of the 6DEPLOY-2 project funded by the European Union's 7th Framework Program in summer 2011.

This laboratory serves as the place of practical exercises linked with regular University courses, such as Administrating Computer Networks, Administrating Secure Computer Networks and IPv6-based Computer Networks. Besides that, the laboratory hosts also Cisco CCNA courses in close cooperation with the Hungarian headquarters of Cisco Networking Academy.

In 2014, with the support of the local Academy the Department initiated and launched the BME NetSkills Challenge student competition. After extending the organizing team with colleagues from the University of Pannonia in 2015, now this yearly competition is open for every Hungarian university students in the area of computer networking.

Apple Laboratory

By the financial support of the European Union and co-financing of the European Regional Development Fund a new audio-visual laboratory has been built. The laboratory has been equipped with 17 Apple computers, professional audio-video software by Apple and Adobe and the necessary informatics and educational infrastructure. The laboratory aims at getting the Apple Authorized Training Center for Education (AATCE) title, in order to allow students to get access to Apple's Pro Applications education materials and official certificates. The necessary knowledge will be taught by the members of the Laboratory of Acoustics and Studio Technologies (LAST) in the framework of regular university courses.

HSNLab
hsnlab.tmit.bme.hu

The High Speed Network Laboratory (HSNLab), as a strategic partner of the Ericsson Traffic Analysis and Network Performance Laboratory in Budapest, Hungary, focuses on high quality research and PhD education in the field of telecommunication networks. HSNLab integrates various research teams from more departments of the faculty.

HSNLab related activities of our department include the formal analysis of security protocols and security APIs, and the design of robust network topologies. Furthermore, our researchers are collaborating with Ericsson on green, i.e., energy efficient mobile networks.

The Department of Networked Systems and Services is devoted to providing high-quality education in electrical engineering and computer science for undergraduate, graduate, and PhD students. The department actively participates in two bachelor level specializations, as well as in two major and two minor specializations at the master level, where it offers courses in the area of wired and wireless networking, mobile communications and computing, communication system architectures and technologies, multimedia networks and services, cryptography and network security, video and audio studio technologies, and acoustics.

Undergraduate program

In the undergraduate program, our department is involved in the following two specializations:

- Infocommunications (BSc program in Computer Science)
- Infocommunication Systems (BSc program in Electrical Engineering)

Within the Infocommunication Systems specialization, our colleagues are responsible for the Multimedia Technologies and Systems branch.

Besides the specialized and elective courses, the students also complete several laboratory exercises, and carry out individual work in semester and BSc diploma projects. Every year, around 80 students earn their BSc degree at the department.

Graduate program

The master programs in the Department of Networked Systems and Services elaborate on the skills and enhance the knowledge of students through the following major and minor specializations:

- Integration of mobile networks and services (MSc major, Computer Science)
- IT security (MSc minor, Computer Science)
- Multimedia systems and services (MSc major, Electrical Engineering)
- Sound and studio technologies (MSc minor, Electrical Engineering)

Besides the specialized and elective courses, the students also complete several laboratory exercises, and carry out individual work in semester and MSc diploma projects. MSc level individual projects are very often related to our research activities and carried out in close cooperation with some of our industrial partners. Every year, around 30 MSc students graduate from the department.

Doctoral program

The doctoral training program enables students with an MSc degree to engage in independent research and research oriented postgraduate studies in the fields of wired and wireless networking, cryptography and network security, next generation communication systems, media technologies, and acoustics. Our PhD students and PhD candidates participate in the research and development projects of the department, and they also contribute to the department's teaching activities. On average, 4 PhD candidates defend their dissertation and obtain the PhD degree at our department every year.

Discovering and working with talented students

Our department pays special attention to discovering and attracting talented students. We established special Knowledge Clubs for students in the following fields: computer security, networking, mobile systems, numerical analysis, quantum communications, performance analysis of ICT systems. In these Knowledge Clubs, our leading researchers introduce exciting research topics to students, and in some clubs the students also perform self-study activities. In addition, we organize the CrySyS Security Challenge and the NetSkills Challenge, which are competitions where students are exposed to interesting problems. Futhermore, our department organizes the INNOversitas startup competition for university teams from all across Hungary, together with a team of mentors and business incubators.

Personal coaching

Our colleagues participate in the mentor program of our integrated MSc study program, where they advise individual students on their university studies and carrier opportunities.

PARIPA Program

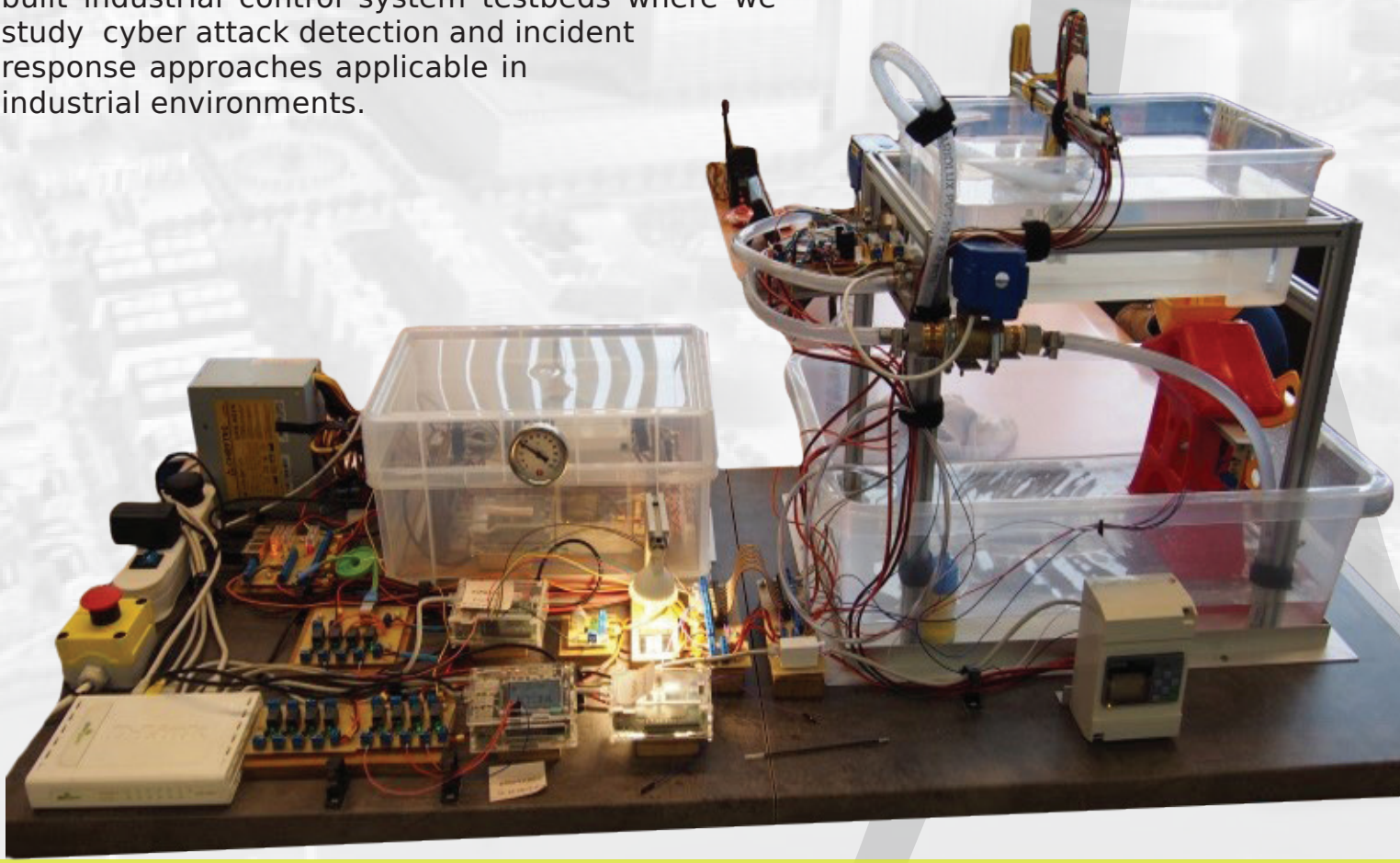
The PARIPA is a novel complex program, unique in Hungary, founded by the Department of Networked Systems and Services. The students work on R&D topics defined by the partner companies, together with an academic and industrial adviser, targeting a strong liaison between the department and the industry. There are very strict rules for the admission, therefore only extremely motivated and well progressing students are admitted to the program. All students are members of a Soft Skill Workshop, where they receive additional skill development in creativity, communication, cooperation and strategic thinking.

Vehicular networks are on the verge of becoming an essential part of our increasingly connected life. The success of the first generation large-scale V2X testbeds and the planned followers, manufacturers'/policy makers' activities aiming at applying cars with V2X communication solutions, and the maturing standards of cooperative intelligent transport systems (C-ITS) predict the inevitable and quick proliferation of vehicular networks. Three labs of our department joined to carry out research and development projects in the field of autonomous vehicles, focusing on cooperative intelligent transport systems (V2V and V2X communication), UAV design and development, urban mobility applications (mobile crowdsensing for intelligent transport) and coordination of multiple autonomous vehicles (flocking optimization). When cars are connected to each other and to the Internet, they become potential targets of cyber attacks. Therefore this team also focuses on new proof-of-concept cyber attacks against modern vehicles, analysing attack surfaces and testing security methods and testbeds for autonomous vehicles, also designing the security countermeasures against cyber attacks for autonomous vehicles and cryptographic algorithms and protocols for protecting vehicle communications.

The evolution of related technologies is still very far from finished: autonomous/automated vehicles, heterogeneous vehicular access environments, large scale deployment scenarios, application and service interoperability, security and privacy still pose serious challenges, however our team will be part of this evolution process.

Autonomous vehicles for smart cities

We are currently witnessing a revolution in industrial manufacturing, heading towards something called Industry 4.0. Smart factories of the future will not only use robots and automation, but they will heavily rely on communications between components and massive data collection. This will allow for the optimization of manufacturing processes, customization of products, and better maintenance of equipment. Our department contributes to the fourth industrial revolution by delivering research and development results in advanced wireless communications, high performance embedded computing, and security for cyber-physical systems. As part of this activity, we built industrial control system testbeds where we study cyber attack detection and incident response approaches applicable in industrial environments.



Activities on Industry 4.0

SOC4CI: Security Operation Center for Critical Infrastructures

SOC4CI integrates a wide range of public and private security information sources, and uses a real-time stream processing framework for event correlation and anomaly detection. The advanced technical solution is combined with an expert incident response team for providing a turnkey managed security monitoring service for utility service providers. The project is funded by EIT Digital. Project partners: KTH (Sweden), Engineering (Italy), F-Secure (Finland)

HunQuTech: A Hungarian Quantum Technology Flagship Project

Under the framework of HunQuTech, we are responsible for quantum-based communications. Our focus is on further development of our wired-based quantum key distribution system as well as on a technology demonstration of free-space quantum communications.

Intelligent Parking System

Two subsystems of it were developed by our department for T-Systems to predict real-time parking space availability and help the parking process with cooperative V2X communications. The system will be introduced all over Hungary in 2018.

Nokia Telco Cloud Simulator

An R&D cooperation between the Department of Networked Systems and Services and Nokia Bell Labs where our colleagues deal with specific tasks on simulation of multiple dynamic V2X communication / service provision environments in heterogeneous 5G telco cloud systems.

MEVICO: Mobile Networks Evolution for Individual Communications Experience

The project follows an end-to-end system approach on evolution of the Evolved Packet Core network of the 3GPP. The focus is on the connectivity layers of the system, for example on the part of the future LTE network which provides the efficient packet transport and mobility support for the applications and end-user services accessed over the LTE and LTE-Advanced radio systems.

X-Noise EV: Thematic networks on aircraft exterior noise reduction

The Laboratory of Acoustics and Studio Technologies acts as a national focal point for exchange of information in the field.

ARIADNE MtP

The project is focused on market oriented research and development, and is aimed at developing a network inventory based high level network design and analysis tool. The tool supports network operators' real business processes with failure impact, service availability and quality related analysis results, as well as network dimensioning, extension and consolidation related planning results. flexiton.hu/telecom/ariadne

BATWOMAN ITN

The project aims at structuring research training in basic and advanced acoustics and setting up a work program on methodologies for acoustics for skills development in a highly diverse research field offering multiple career options.

NMHH

Developments of methods to estimate user perceived mobile data network performance in locations where performance measurements are not available. Assessing network level performance based on limited number and location of measurements, evaluation of the effect of advanced radio solutions and user traffic.

Beamforming

This is a joint project with our industrial partner. Assessment of the mass transportation network of Budapest in terms of providing wideband backhauling connection to vehicles, using advanced beamforming solution. Advanced handover mechanisms were developed that exploit schedule and location information of vehicles.

Unmanned Aerial Vehicle communication

The communication subsystem of an unmanned aerial vehicle was created in cooperation with Bonn Hungary Electronics. The purpose of the project is to develop a reconnaissance system, which can follow a preprogrammed route while sending real time video and position information back to the ground control station. The role of MIK was to ensure the reliable communication between aircraft and ground unit.

Preloaded mobile software development for Samsung

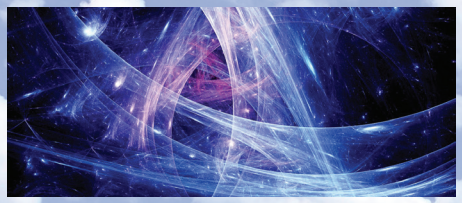
The goal of this project was to design and develop software components, that can be preloaded to phones in production. An universal game controller and a gesture framework and two games were developed during the second years of the cooperation.

recent projects

Green projects and activities

The Department of Networked Systems and Services is dedicated to supporting and seeking environmentally friendly solutions both as research targets and during the daily routine.

A good example of such an initiative is the former EARTH project whose aim was to reduce energy consumption and improve energy efficiency in mobile telecommunication systems by a factor of two. Furthermore, in the framework of the Research University project both our education and research activities were extended towards the ecological aspects of development, design and operation of wired and wireless telecommunication networks (so-called green networks). Currently, energy consumption issues are either directly or indirectly addressed in most of our research activities. As far as the daily routine is concerned, steps are being made towards introducing processes that are environmentally friendly (e.g. use of recycled paper, selective garbage collection, focus on reduced energy and resource consumption).



Quantum Communications

The quantum mechanics-based computing is one of the most promising subfield of the Information Technology due to the quantum-based algorithms and protocols. Although quantum computers are going to be the tools of the far future, there are already physical quantum devices to solve specific problems. Our researchers at Mobile Communications and Quantum Technologies Laboratory (MCL) focuses on quantum-based communications and quantum information theory. Our research group participated in the development of the first Hungarian quantum key distribution device. Due to the nature of the quantum mechanics, an eavesdropper is automatically detected during the key distribution process, which offers revolutionary solutions in the field of cryptography.

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