developing the
science of networks

imdea **networks** institute

annual report

2018

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networks

foreword

Arturo Azcorra
Director of the IMDEA Networks Institute
April 2017

annual report
2016

IMDEA Networks Institute is a top worldwide research institute in the Science of Networks. In 2016, the Institute has continued to boost Madrid's competitiveness as a technology-oriented region. The Institute not only strengthens the technology profile of the region, but its collaboration with local companies also helps to enhance Madrid's high-tech output with cutting edge research. Our ultimate goal is to help Madrid make its mark on the 21st Century by focusing on the development of products and services that incorporate the most advanced network and communication technologies.

IMDEA Networks focuses on an area that has a profound impact on people's lives, and has transformed society and the economy over the last decades. Far from stabilizing, this area continues to transform our lives at an amazing pace. As a matter of fact, the Institute is currently engaged in the development of a new disruptive technology that is going to change the way we perceive and communicate with the surrounding world: 5G. With 5G, current reality will become a "connected reality", where all people and objects are connected to each other, forming a single "whole". Not only each of us will be permanently connected to our doctor, friends, work colleagues, clients/providers, security service, etc., but additionally we will also be connected to our car, fridge, favorite bakery, leisure shops, metro, airport, home, … any object that can be of our interest. And objects will be

also connected to each other: a package may "complain" to its delivery company that the route taken is not right, or the heater may download a new software to become more efficient.

In order to realize this vision, we are working on extremely complex technological challenges. 5G will not only have to connect more than 7 billion of people (all people on Earth), but also around 1,000 objects for each one of them. Network capacity will have to increase by three orders of magnitude, as 5G networks will carry a volume of data 1,000 larger than 4G networks being deployed today. Energy consumption will also play a key role: if we increased capacity by a factor of 1,000 with current technology, energy consumption would be unaffordable. At the same time, 5G will have to satisfy extremely demanding service requirements. Massive uptake of machine-type traffic requires an unprecedented level of availability and reliability, of up to five nines (i.e., 99,999%). Furthermore, applications such as tactile Internet and vehicular communications require extremely low latencies and high data rates, several orders of magnitude beyond those provided by today's network.

To satisfy all these requirements while providing the necessary levels of flexibility and efficiency, control plane functions (beyond traditional radio-centric functions) will play a key role in 5G. In the 5G network architecture, computing and networking will converge to single framework that virtualizes the control, management and even the data plane functionality while building on cloud, edge and fog computing. In this new architecture, software will play a much more relevant role than in current networks, and a substantial part of today's hardware will be replaced by general purpose platforms that provide communications services through software. The flexibility gained through the new, software-based, architecture will allow for a much more fine-grained control, drastically reducing the deployment time of a new service and enabling much more dynamic services that can be customized to satisfy the user needs (including the extreme requirements mentioned above).

With the goal of bringing Madrid and Spain to the forefront of such a strategic technology, the Institute is currently leading one of the most exciting entrepreneurial initiatives that our country has seen over the last decade: the 5TONIC laboratory. This initiative, founded by Telefonica and IMDEA Networks, provides an open research and innovation ecosystem in which industry and academia come together to boost technology and business innovative ventures. It serves to showcase the capabilities and interoperation of pre-commercial 5G equipment, services and applications by leading global companies in the 5G arena.

We are very proud of this initiative, which is being a great success. It already counts a number of major stakeholders (Ericsson, Intel, Commscope, Cohere, Artesyn and UC3M, in addition of the two founding members mentioned before), covering all the key roles of the future 5G ecosystem. We are currently working on the deployment of pioneering experimental platforms that build on 5G to showcase the potential of this technology through some groundbreaking services. The initiative is contributing to make Spain become one of the leading sites in the development of the 5G technology. The ultimate goal is to secure for Spain a substantial fraction of the huge revenues expected for 5G, estimated to be of around $247 billion/year worldwide and €113.1 billion/year in Europe.

In addition to the above, 2016 has also been a great success on many other fronts including the quality and international recognition of the publications authored by our researchers, the attraction of new talent to the team, the launch of new research projects and grants, as well as the effective transfer of technology, amongst others. All these achievements contribute to make the Institute one of the leading networking research laboratories in the world.

As every year, my gratitude goes to the Regional Government of Madrid for its continued support to our economy-transforming initiative, as well as to all those who are contributing to make this exciting project a great international success.
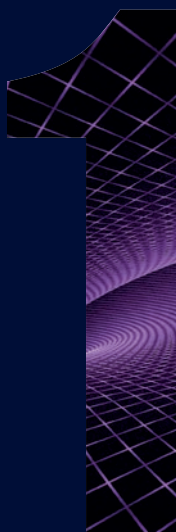
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executive summary

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IMDEA Networks Institute is a top international research centre in the area of computer networks. *2016 has been a great year for us in a number of ways. Our strategy to transfer scientific and technological developments to industry has led to various new collaborations in addition to strengthening the existing partnerships with some of our key industrial collaborators. We have also been very successful in several highly competitive public calls for funding to conduct new research projects. Through a very selective recruitment process we have continued to strengthen our research team. Our research work - focused on innovative technological solutions to real-world problems - has been published in the most prestigious venues in our field. All these achievements have received the recognition of the international scientific community along with other stakeholders.*

The **research team** of IMDEA Networks consists of preeminent technical leaders. All IMDEA Networks researchers have a **meritorious research record** that includes publications in the most influential venues in our area of research, and they have graduated from, or worked for, top-level international universities, such as MIT, UC Berkeley, Columbia University, ETHZ, EPFL, Politecnico di Torino or Rice University. Additionally, many of our researchers have received important **awards and prizes** for their research work and achievements.

Our scientists not only have an excellent research record, they also possess an **extensive industry background.** Most of them have been employed at leading industry research laboratories, such as NEC, Telefónica, AT&T, Cisco, Alcatel, Philips, NTT Docomo or Disney Research Labs. What is more, they have been granted **over 50 patents** during their professional careers. This background is essential to carry out **research that can be transferred to companies** and in turn be transformed into profitable products that will **stimulate economic growth and job creation.**

In addition to experienced world-renowned researchers, an essential part of the Institute's research team is composed of **highly motivated pre-doctoral researchers,** keen to explore new ideas, who are pursuing their Ph.D. theses at IMDEA Networks. These researchers form the life-blood of any research team and are essential to conduct many project-related research tasks, such as the development of prototypes. We are proud that in 2016 the Institute graduated 9 new PhD Students: Angelos Chatzipapas, Elli Zavou, Syed Anwar Ul Hasan, Qing Wang, Juan Camilo Cardona, Pablo Salvador, M. Isabel Sánchez, Gek Hong Sim and Arash Asadi. It is worth highlighting that many of our PhD Students have received important distinctions and have been awarded very selective scholarships. For instance, this year Vincenzo Sciancalepore received the award for the best PhD Thesis in the field of Communication Technologies, granted by the Association of Telecommunications and Information Technology in Italy and awarded only to the best three PhD thesis in the field across the whole Italy.
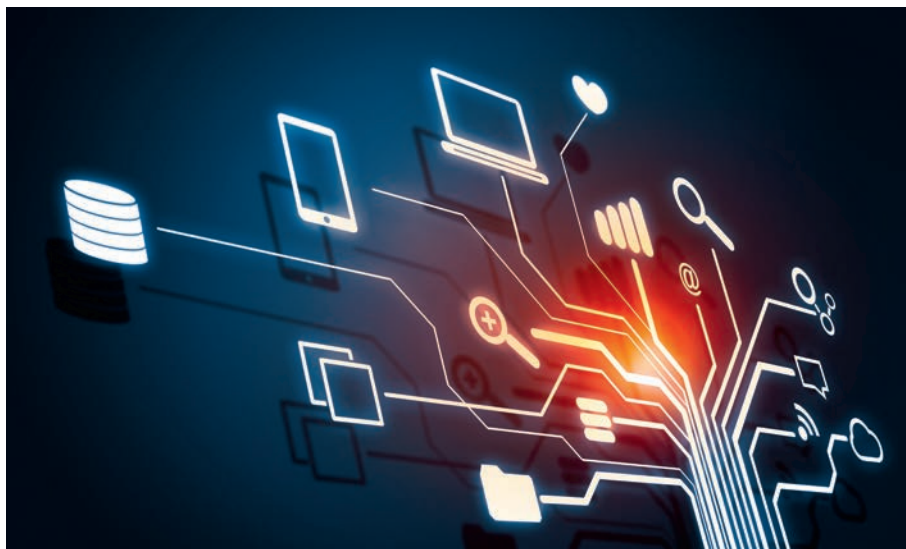
In 2016, **the Institute has continued to reinforce its research team.** This year we incorporated to the Institute one of the most promising researchers in the area of network measurements, Narseo Vallina, who got his PhD at the University of Cambridge and was previously at ICSI, UC Berkeley. Narseo does not only bring to the Institute substantial industrial experience (having worked in Vodafone Research and interned in industrial research labs such as Deutsche Telekom and Telefonica), but also a very exciting research line focused on Internet measurements, as he is the Principal Investigator for the NSF-funded ICSI Haystack project. We also enjoyed the visit of two reputed professors, Roberto Battiti from University of Trento (Italy) and Sungoh Kwon from of University of Ulsan (South Korea). Last but not least, during this period the also team experienced a substantial increase in the number of Pre-doc and Post-doc Researchers, hired for (and funded by) the various projects and contracts in which the Institute is involved.

A key accomplishment of 2016 has been our participation in research projects. These projects bring to the Institute external funding, highly productive collaborations with prominent research institutions and industrial partners, and the opportunity to transform our research ideas into practical deployments. IMDEA Networks **ran 16 projects in 2016,** which is a notable quantity considering the size of the Institute. Out of these 16 projects, 11 are European, 1 is funded by the National Science Foundation of China, 1 is national and 3 have a regional scope. During 2016, 2 new European projects (NOTRE & RECAP) were awarded to the Institute in highly competitive calls.

In addition to research projects funded by public institutions, a substantial part of the external funding attracted by IMDEA Networks originates from **direct contracts with industry.** During 2016 IMDEA Networks completed 3 projects funded by industry. While IMDEA Networks has strong ties with the international private sector, collaboration with local companies is at least as crucial (if not more) due to the value that it brings to the Madrid region. A noteworthy example of such local alliances is the **strategic partnership** with **Telefonica I+D**, which provides a stable long-term framework to conduct joint research work. The Institute maintains a Joint Research Unit (JRU) in 5G technologies with Telefonica I+D. The two institutions not only share the 5TONIC initiative, but are also collaborating in many other fronts such as the TALENTUM program.

The efforts made by our team to produce outstanding scientific work led to a large number of scientific publications in 2016. However, rather than their quantity, we would like to emphasize their quality. In 2016 IMDEA Networks has continued to publish at top conferences. For instance, IMDEA researchers got 10 papers accepted at IEEE INFOCOM 2017, being one of the very few institutions worldwide with so many papers at such a prestigious conferences. According to Web of Science, IMDEA Networks is the Spanish organization with the highest number of publications in IEEE/ACM Transactions on Networking, the top journal in our area. This is a remarkable achievement, especially when taking into account the youth of the Institute compared to most Spanish organi-

zations. Another indicator of the quality and impact of our publications is the citation data provided by Google Scholar. According to this data, the Institute's researchers have received more than **53000 citations** in total, which corresponds to an **H index of 103** (meaning that 103 of the articles published by researchers of the Institute have received 103 citations or more).

These figures place the Institute not only ahead of other Spanish organizations, but also at the forefront of European networking research.

One of the main highlights of this period has been the **large number of prestigious awards granted to IMDEA Networks' researchers**. Such awards witness the quality of the research being conducted at the Institute, and the reputation of its researchers. Joerg Widmer received the prestigious Friedrich Wilhelm Bessel Research Award from the Alexander von Humboldt Foundation, given to internationally renowned academics who work outside of Germany in recognition of their outstanding accomplishments in research. Qing Wang was ranked in the first position of the European Region in the 1st Innovation Competition of International Talents of Shenzhen China. Our researchers also received the I-COM 2016 Data Science Hackathon Award, the 2nd Place at the Cyber Award, the Most Entertaining Video Award of the 10th AAAI Video Competition 2016, the 1st Prize at the Accenture Digital Connected Hackathon 2016 Madrid, the Award for the Best Solution Approach at the Artificial Intelligence Hackathon 2016 and the Honorable Mention at the Data Science Awards Spain 2016, in addition to several awards at conferences.

Another highlight of the period has been the **exposure of the Institute and its achievements to the media.** IMDEA Networks was mentioned by El Mundo in its list of the 25 news items that revolutionized the Internet in 2015. The multilateral agreement signed on

5G technology by the Institute with the regional government of Madrid, the Ministry of Industry, Energy & Tourism, Telefonica I+D, Ericsson and AMETIC was featured by 15 news agencies (Efe, Europa Press, Servimedia) and several newspapers, and was published on 70 high impact websites such as Expansión, El Economista, El Confidencial, ABC, etc. Our work on 5G has been echoed on the radio (SER, rne) as well as on the newspapers (e.g., La Vanguardia) and rtve. This visibility is very important to spread the knowledge of the IMDEA initiative and its benefits to the general public.

Last, but not least, another major activity over the past year concerns **the extension of our infrastructure.** Networking science requires the rigorous validation of new algorithms and protocols, which makes the **infrastructure for experimentation** in the form of fully equipped laboratories an essential working tool. The building of IMDEA Networks has a total of 4,000 square meters, out of which 1,500 have been completely refurbished. These facilities host the most advanced equipment to evaluate and emulate the performance of the algorithms, protocols and systems developed by the Institute, including laboratories on Interdomain Routing, Wireless Communications, Millimeter Wave, 5G Networks and Underwater Networks. In 2016, we started the refurbishing of the 5TONIC laboratory and the transformer substation, which are two essential infrastructures for the Institute. We are also planning to refurbish 400 additional square meters of offices and laboratory spaces, to cover the needs for new personnel and equipment for the projects we are running.

In **summary,** the Institute's **research output in 2016** comprises publications in book chapters (3), peer-reviewed international journals and magazines (40), presentations in international conferences (53), funded research projects (16) and industry contracts (3). Since its creation, the Institute has been awarded a total of € 8,761,801 from competitive funds, of which € 2,402,233 correspond to 2016. We believe that all these data show the excellence of the Institute in research and technology transfer, and provide the basis to achieve ever growing success in the years to come. If we consider the Institute's **output in relative terms to the number of faculty researchers** (i.e., performance per faculty member and per year), the outcome is even more remarkable: in 2016 the Institute raised € 230,000/researcher*year, published 11,14 papers/researcher*year and had 2,95 ongoing projects/researcher*year.

about us

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2.1. Profile

IMDEA Networks Institute is a networking research organization whose multinational team is engaged in cutting-edge fundamental science. As a growing, English-speaking Institute located in Madrid, Spain, IMDEA Networks offers a unique opportunity for pioneering scientists to develop their ideas. IMDEA Networks is establishing itself internationally at the forefront in the **development of future Internet technologies** and has already incorporated highly-reputed scientists. Our researchers will contribute to shaping **the future of networking science** over the coming years.

2.2. Our Strategic Goals

- Conduct first class research on an international level in the area of computer networking
- Transfer technology to the industrial sector, in order to improve its capacity for innovation and competitiveness
- Transfer technology to spin-off-companies in order to promote the release of new products and services to the global market
- Attract and retain human capital of excellence with the aim to internationalize research in the Madrid region
- Collaborate with Madrid's industrial sector, research centers and educational institutions

2.3. Our Mission

Our mission is to create value by **leading research in protocol, algorithm and systems development** that enable the **Future Internet**. We do this by conducting research and developing innovative and useful scientific and technical advances in the above areas, while actively **promoting their successful transfer to market**. The Institute strives to provide the best working conditions and the most attractive and best-equipped environment in which researchers can focus on this process of innovation and scientific advance.

2.4. Our Values

A culturally-diverse team, such as IMDEA Networks', needs goals, but it also has to share values that transcend our social, religious and other cultural differences. These values serve to unify us by defining how we conduct ourselves, both within the team and in our dealings with others. Our core values will remain constant and will be promoted actively within the Institute:

- To be open to the new
  To be constantly adapting to our changing environment

- To value diversity
  We seek out and cherish different perspectives and diversity. We understand the value of diversity

- To be positive
  We encourage positive critical thought with a view to addressing the issue of generating better solutions, not simply identifying problems

- To act with integrity
  We act with integrity and honesty, delivering on our commitments in all our interactions. The trust this engenders provides the foundations for productive partnerships

- To listen well and speak clearly
  We listen actively to other people and take responsibility for explaining ourselves as we wish to be understood

- To respect individual brilliance
  We respect, honor and reward exceptional individual contributions

- To work collaboratively
  Our individual contributions are more fruitful when performed in a team environment. We work in a spirit of partnership in all our activities with others. We achieve this by identifying and pursuing shared objectives in an open and honest way

- To innovate always
  We always look at problems from different points of view. We aim to do breakthrough research, not incremental research

- To compete sportingly across the globe
  We compete fairly but intensely, according to the letter and spirit of accepted standards.
  Competition drives us to be the best and most successful in our field

- To enjoy our work
  We enjoy what we do and share our enjoyment with each other

2.5. Our Credo

- We believe in group discussion and in bright individual ideas
- *"We do not believe in voting and committees. We believe in running code and rough consensus"* (David D. Clark)
- Demo or die (in addition to publish or perish)
- *"Genius is 1% inspiration and 99% perspiration"* (T.A. Edison)

research
areas
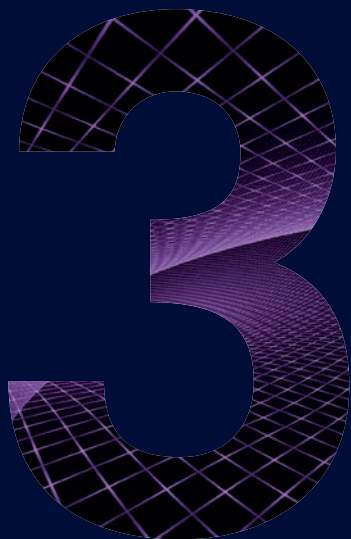
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As illustrated by **our motto** – **Developing the Science of Networks** – IMDEA Networks identifies and addresses major scientific and engineering challenges in communications and computer networks, and also aims to develop these results by bringing them into practical deployments. The nature of these challenges varies with ever-greater rapidity. To ensure the relevance of our research activities, we continuously adjust our research agenda to stay at the forefront of technological innovation. We organize our scientific activities into research areas that reflect our current working priorities, ensuring sufficient flexibility to allow us to respond to emerging technological challenges. The research mission of our Institute also adapts to the strengths of our growing research team and our external collaborators.

The research work at IMDEA Networks is led by **Joerg Widmer,** who is the **Research Director** of the Institute and therefore responsible for its research direction.

Currently, our scientific work focuses on the following three general areas:

3.1. Networked Systems and Algorithms

Scientific Director of "Networked Systems and Algorithms": Arturo Azcorra.

Any network has a structure and needs protocols to achieve its objectives. The researchers of IMDEA Networks Institute have an extensive expertise in architectures and protocols for communication networks, e.g., for network topology design, routing, forwarding, packet classification, in-network storage, congestion control, and media access control. Besides, we have research interests in other networking domains such as social networks, energy networks, and transportation networks.

Our research takes a multi-disciplinary approach to the design and understanding of network protocols and architectures. We go beyond technological constraints and account also for social and economic factors. For example, our research on Internet routing and forwarding accounts for the multitude of Internet service providers and their individual economic interests. In working on either centralized or decentralized solutions to problems, we assume that perfect information is never available. To deal with such uncertainty as well as selfishness of individual entities, our analysis adopts game-theoretic techniques and online algorithms. Our protocol design assumes that behavior of counterparts is always unpredictable to some extent. Hence, the designed protocols rely on continuous learning and adaptation as the main modes of operation.

Practicality is another distinguishing aspect of our research. Real data serves as a departing point for our analytical efforts as well as a basis for validating our analytical conclusions. For instance, our large-scale simulation studies of Internet routing rely on

real Internet topologies. Furthermore, we implement our theoretical ideas and make the prototypes available to the public, either directly or through our commercial partners.

An important focus of our work is on the systems side of networks. For example, we explore tradeoffs between simplicity and expressiveness of packet processing engines, new abstractions for heterogeneous control planes, and network virtualization techniques. We also work on networking aspects that pertain to cloud computing.
This research area targets the following **objectives**:

- **Novel architectures and protocols for behavioral networking**
  - · The Internet is modeled as an association of independent entities
  - · Behavior of counterparts is not taken for granted
  - · Continuous learning and adaptation are main modes of operations

- **Bridging the gap between network economics and networking**
  - · Deployment of innovative designs becomes the primary concern
  - · Economic and political landscapes of the Internet are analyzed with higher fidelity
  - · Economic-political knowledge guides the technical design

- **Making it easy to develop and deploy reliable, high-performance networked systems**
  - · Correct functioning of networks is paramount
  - · SDN (Software Defined Networking) revolutionizes networking, and carries a lot of risk
  - · New abstractions are developed to simplify network management and utilize the underlying network infrastructure more effectively

3.2. Wireless Networking

Scientific Director of "Wireless Networking": Joerg Widmer.

Given the scarcity of wireless spectrum resources and the rising demand for mobile applications, optimizing wireless communication and improving wireless network architectures is currently one of the most important and challenging research topics in networking. The proliferation of inexpensive, high-rate mobile devices and ubiquitous connectivity opens up a vast spectrum of possible new services but also poses unique challenges concerning scalability, interference and the unpredictability of the wireless medium.

IMDEA Networks is involved in a number of different wireless research areas. We are investigating emerging wireless technologies such as extremely high frequency communication for 5G and wireless LAN and Visible Light Communication, which promise to increase wireless data rates by an order of magnitude or more. Our work on capacity improvements aslo focuses on topics such as ultra-dense networks, intelligent interference management, cooperative coding and network coding, improved medium access control mechanisms that make use of advanced physical layer technologies such as MIMO, successive interference cancellation, etc.

At the same time, mobile network architectures need to support these new technologies as well as new use cases, and thus become more flexible. We perform research on network architectures for 5G and beyond, specifically focusing on software-defined networks (SDN)-based architectures and network function virtualization (NFV). In addition, wireless networks are becoming more heterogeneous as they are gaining traction in more diverse use cases such as the Internet of Things (IoT) and intermittently connected or delay-tolerant networks, unmanned aerial vehicular networks and underwater networks. The research activities span medium access control (MAC), routing, error control and transport protocols, both as standalone entities and as part of cross-layer design frameworks. To improve

the flexibility and programmability of future wireless technologies, we also explore novel programmable interfaces that expose low-level operations to foster network evolution and enable performance optimization and service customization. For a number of the above use case scenarios, efficient and accurate device localization is highly useful.

We recognize the importance of bridging the gap between theoretic results and applied wireless research and have deployed a range of wireless testbeds (for mm-wave, visible light communication, 5G, IEEE 802.11, and others) on which we implement and evaluate our ideas.

This research area targets the following **objectives**:

- **Increasing wireless network capacity**
  - Millimeter wave networking and visible light communication networks to support very wideband ultra-high speed communication
  - Extremely dense networks, small cells, and wireless backhauling
  - Interference management, opportunistic scheduling, adaptive coding and modulation, and traffic offloading

- **Improving mobile network architectures**
  - Software defined networking (SDN) for mobile networks, wireless virtualization
  - Network function virtualization (NFV), NFV layered architectures, interoperability of NFV solutions, and NFV infrastructure federation
  - Energy-efficient, robust, fair and high-throughput communication protocols for SDN/SDR-based cellular networks, context-aware services, and cloud-based data centers.
  - Cloud RAN concepts, with flexible split of the radio access

- **Supporting heterogeneous wireless networks**
  - Mobile indoor localization for network optimization as well as location based services
  - Support of vehicular and aerial networks, as well as intermittently connected networks, delay-tolerant networks and underwater networks
  - Collaborative wideband spectrum monitoring

3.3. Network Measurements and Analytics

Scientific Director of "Network Measurements and Analytics": Albert Banchs.

network measurements**&**analytics

The rapid evolution of mobile portable systems and the Internet of Things (IoT) has given birth to a rich ecosystem of applications, personalization and services that is changing the way billions of users communicate and interact with their environment. This digitalization of the world has allowed new innovative applications with new levels of personalization

and the ability to interact the environment. However, this trend is also producing large volumes of data which may raise privacy and security threats unseen in previous networked technologies while also generating unknown traffic patterns and performance bottlenecks which can have a negative impact on the network and user experience.

At IMDEA Networks, we are involved in novel research efforts to empirically illuminate how users, networks, devices and applications interact, behave and perform in the wild.

Our research is particularly focused on conducting analytical measurements of real-world networked systems, with a strong interest in understanding their use (and abuse) as well as the performance, privacy and security challenges present in emerging networking technologies. Our research team also develops Big Data solutions to analyse and process large-scale traffic, network- and application-generated data fast and correctly.

At IMDEA Networks we engage and collaborate with users, cyber-activists, industry and regulators to identify and address important problems of societal, industrial and academic interest from a practical angle. Often times, our researchers are responsible for developing practical tools to assist the different stakeholders to understand how users, devices, networks, services, and applications interconnect, perform and behave behind the scenes.

Specifically, this research area targets the following **objectives**:

- **Network measurements**
  · Active and Passive measurements
  · Network and traffic characterization
  · Troubleshooting and performance evaluation
  · Social network analysis
  · Cloud-mobile integration

- **Big Data**
  · Applied machine learning and pattern recognition
  · Data analytics for cybersecurity and anomaly detection
  · Human-data interaction (HDI) and visualization

- **Privacy and Security**
  · IoT, cyber-physical systems and mobile computing
  · Online tracking, advertising and ad-blocking
  · Fraud prevention
  · Mobile malware and threat detection
  · Data transparency and privacy-preserving tools

research projects, grants and fellowships
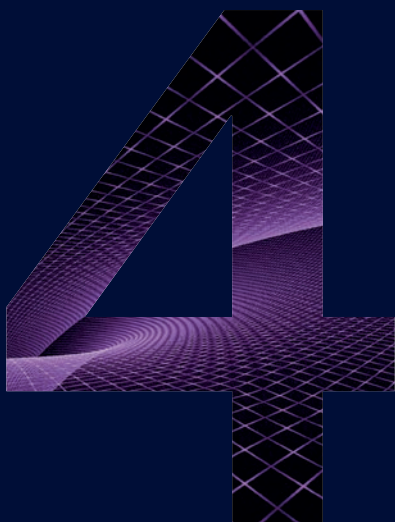
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4.1. Funding awards

We dedicate extensive resources to obtaining external funding to support our research team and in particular those members who excel in their capacities, with the objective to promote the scientific and technical potential of our human capital and, as a direct result, the outreach of the Institute's activities.

The funding of our individual researchers takes the form of awarded grants, scholarships and fellowships from international, national and regional funds. These awards are similar to externally-funded research in their openness and the strict selection processes used, and they confer prestige on the awardee as well as on the organization he is affiliated to.

ERC Grants

Awardee

- Dr. Joerg WIDMER, Research Professor **(ERC Consolidator Grant)**
  Principal Investigator of the **SEARCHLIGHT** research project. *This project is executed by IMDEA Networks and runs from April 2014 to March 2019.*

Funded by

European Union. European Research Council (ERC Grants)

European Research Council
Established by the European Commission

"MARIE CURIE" AMAROUT II Europe Programme

Awardees

- Dr. Paolo CASARI, Research Assistant Professor
- Dr. Domenico GIUSTINIANO, Research Associate Professor
- Dr. Kirill KOGAN, Research Assistant Professor

Funded by

European Union. Marie Curie Action (PEOPLE COFUND)

SEVENTH FRAMEWORK PROGRAMME

MARIE CURIE ACTIONS

"MARIE CURIE" Intra-European Fellowships (IEF) for Career Development

Awardees
- **Scientist in charge** Dr. Antonio FERNÁNDEZ ANTA, Research Professor
- **Name of researcher** Dr. Nicolas NICOLAOU, Post-Doc Researcher

Research project
ATOMICDFS

Funded by
European Union. FP7-PEOPLE-IEF

TEAM Erasmus Mundus Programme Scholarships

Awardee
- Foivos MICHELINAKIS, Pre-Doc Researcher

Funded by
European Union - ERASMUS Mundus Action 2 Programme

Ramón y Cajal Grants
(Programa Ramón y Cajal)

Awardees
- Dr. Joerg WIDMER, Research Professor
- Dr. Vincenzo MANCUSO, Research Associate Professor

Funded by
Spanish Ministry of Economy, Industry and Competitiveness *(Ministerio de Economía, Industria y Competitividad - MINECO)*

Grant to promote youth employment and the implementation of the Youth Guarantee system in R&D+I

(Ayudas para la promoción de empleo joven e implantación de la garantía juvenil en I+D+i)

Awardees
- Alejandro REYES, Junior Software Developer
- Carlos CONTRERAS, Junior Software Developer

Funded by
National Programme for the Promotion of Talent and Its Employability in R&D+I. Spanish Ministry of Economy, Industry and Competitiveness *(Ministerio de Economía, Industria y Competitividad - MINECO)*

Grants for training university teachers - FPU

(Ayudas para la Formación de Profesorado Universitario)

Awardees
- Edgar ARRIBAS, Pre-Doc Researcher
- Evgenia CHRISTOFOROU, Pre-Doc Researcher
- Elli ZAVOU, Pre-Doc Researcher

Funded by
Spanish Ministry of Education, Culture and Sports (*Ministerio de Educación, Cultura y Deporte - MECD*)

Supplementary grants for beneficiaries of the subprogram for university teacher training (FPU)

Temporary Relocation

Awardee
- Elli ZAVOU, Pre-Doc Researcher (21/02/2016 – 20/08/2016)

Supplementary grants for beneficiaries of the subprogram for university teacher training (FPU)

Temporary Stay

Awardee

- Evgenia CHRISTOFOROU, Pre-Doc Researcher (10/04/2016 – 09/07/2016)

Mobility stays for professors and researches in foreign research and higher education centers

Awardee

- Dr. Antonio FERNÁNDEZ ANTA, Research Professor
- Country of stay: USA (MIT Media Lab)
- Duration of the stay: 6 months

Funded by

Spanish Ministry of Education, Culture and Sports *(Ministerio de Educación, Cultura y Deporte - MECD)*

"La Caixa" scholarships for doctorates at Spanish universities and research centres (2016)

Awardee

- Ander GALISTEO ZABALO, Pre-Doc Researcher

Funded by

Fundación «la Caixa» (Fundación Caja de Ahorros y Pensiones de Barcelona)

4.2. Externally-funded research projects, attracting European Union, National or Regional funds

Externally-funded research projects enable us to collaborate with researchers from other organizations and backgrounds. Research funding is awarded following an open competitive selection process in which project proposals, and the private or public sector organizations presenting them, are subject to rigorous scrutiny. Such thoroughness helps to ensure that research undertaken with those funds is relevant, well-managed and with high probability of success in achieving its stated goals.

4.2.1. Ongoing projects

Datacenter with High Efficiency
Optimizing Organization and Scheduling of Datacenter Resources

Funded by: The National Science Foundation of China (NSFC)
Duration: January 2016 to December 2020
Project partners: Institute of Computing Technology, Chinese Academy of Sciences (ICT), IMDEA Networks Institute, Temple University (USA), Florida International University (USA), Huazhong University of Science and Technology (China)

The number of **data centers** is rapidly growing, and the use of datacenters are increasingly widespread. However, the **efficiency** of the datacenters is very low. Typical resource utilization is about 5% to 25% according to some statistics. Also, the **power consumption** is very high and inefficient. This inefficiency of datacenters wastes hardware and software resources as well as energy, which may hinder further development and usage of datacenters themselves, and also is harmful to the environment. This research investigates techniques that improve efficiency of datacenters through resource organization, allocation, and scheduling. In particular multi-objective optimization models and algorithms will be developed for improving efficiency of datacenters. The objective of this research is to meet the service demands of datacenters while decreasing their resource consumption

SEARCHLIGHT
A new communication paradigm for future very high speed wireless networks

Funded by: European Union. European Research Council (Consolidator Grant)
Duration: April 2014 to March 2019

The ubiquity and flexibility of wireless access to the Internet played a very significant role in the tremendous growth in mobile devices such as smartphones, tablet PCs, and laptops over the past years. As a consequence, **a larger and larger fraction of Internet traffic is delivered wirelessly.** How to deal with this growth is one of the most important challenges for future wireless networks. State-of-the-art wireless communication already operates close to Shannon capacity and **the only viable option to further increase data rates is to increase the communication bandwidth**. Very high bandwidth channels are only available in the extremely high frequency part of the radio spectrum, the millimeter wave band (mm-wave). Upcoming communication technologies, such as the IEEE 802.11ad standard operating at 60GHz, are already starting to exploit this part of the radio spectrum. However, this part of the spectrum suffers from high attenuation and signal absorption, restricting communication primarily to line-of-sight (LOS) scenarios.

This in turn requires **a radical rethinking of wireless networking** in the mm-wave band from 30 to 300GHz. In analogy to the evolution of wired Ethernet from a shared medium to a fully switched network, we envision that future wireless networks will consist of many highly directional LOS channels for communication between access points (APs) and end devices. Such an environment is extremely dynamic and channels may appear and disappear over very short time intervals, in particular for mobile devices when persons move about in their vicinity. At the same time, such channels experience very little interference and resources (time, frequency, signal processing, etc.) that would otherwise be used to handle interference can now be used to further increase achievable data rates between sender and receiver. To provide sufficiently many LOS channels, APs may have to be deployed ubiquitously and may vastly outnumber mobile devices.

We propose to design and build a wireless network architecture that maintains a number of directional LOS channels between several APs and (mobile) end devices through transmit beamforming and beam steering. Data is transmitted simultaneously via all of these channels. An end device uses multiple antennas to receive and decode several such data streams, and the higher the number of received streams, the higher the data rate achieved at the receiver. The main complexity of the design lies in the selection of AP s as well as the beamforming directions of their antennas, given the large number of end devices that future wireless networks will have to support. To aid and speed up this decision process, the system maintains an up-to-date map of the radio environment and learns likely sequences of beamforming patterns and succession of APs. This further allows to intelligently switch off APs to improve energy efficiency. We believe that **such a design is the key element for the scalability of future wireless networks.**

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NOTRE

Network for sOcial compuTing REsearch

Project website: http://notre.socialcomputing.eu/
Funded by: European Union. H2020-Twinn 2015
Duration: January 2016 to December 2018
Project partners: Cyprus University of Technology (CUT), Foundation for Research and Technology - Hellas (FORTH-ICS), IMDEA Networks Institute, Université de Genève (UNIGE), Heinrich Heine - Universität Düsseldorf (UDUS)

The vision of NOTRE is to develop a network that will strengthen and enhance the potential of the newly established **Social Computing Research Centre (SCRC) at the Cyprus University of Technology (CUT)** for stimulating scientific excellence and innovation capacity in the area of **social aspects of computing**. NOTRE proposes an interdisciplinary approach towards the close network collaboration between SCRC of CUT, a research active university in a low-performing member state, and four internationally-leading counterparts specializing in: (a) online social networks and their analysis; (b) entertainment, games, virtual reality and educational technologies; (c) Social Computing for social inclusion; and (d) Social Computing and social change.

SCRC through this proposal does not only aim to access the core research groups of the leading counterparts, and their collaborators, but also recognizes the **multidisciplinarity** of the field and will try to establish itself as an intermediary between them.

The NOTRE network will follow a series of interlinked activities, such as short term staff exchanges, expert visits and short-term on-site training, workshops, conference attendance, organization of joint summer school type activities, and dissemination and outreach activities. Such activities with world-renowned EU partners (IMDEA Networks; MIRALab of Universite de Geneve; Institute of Computer Science of the Foundation for Research and Technology Hellas -FORTH-ICS; and the Department of Political Science of the University of Dusseldorf - UDUS), will be instrumental for significantly strengthening SCRC's research efforts, enhancing the network's innovation capacity and research profile, and stimulating scientific excellence in the emerging multidisciplinary field of Social Computing. The effective knowledge transfer and sharing through NOTRE will also push for research advancements linked to the Smart Specialization Strategy of Cyprus. **IMDEA Networks participates in NOTRE as a leading institution in the research and study of online social networks.**

Cloud4BigData

Efficient Cloud and BigData Infrastructure

Project website: lsd1.ls.fi.upm.es/cloud4bigdata/
Funded by: Department of Education, Youth and Sports of the Regional Government of Madrid, through the 2013 R&D technology program for research groups, co-financed by Structural Funds of the European Union
Duration: October 2014 to September 2018
Project partners: IMDEA Networks Institute, Universidad Politécnica de Madrid (UPM), Universidad Rey Juan Carlos

Big Data is an emerging paradigm for large scale distributed data management that aims at being able to process large amounts of data beyond the possibilities of traditional database technologies. Big Data leverages cloud computing to attain a highly scalable infrastructure for both computing and storage. The Cloud4BigData project will **enhance Big Data technologies and also their underlying cloud infrastructure** to attain high levels of efficiency, flexibility, scalability, high availability, QoS, ease of use, security and privacy.

Big Data is already attaining good results with batch analytical processing technologies such as MapReduce, but it has important gaps. The most important issue is the lack of support for other data management needs, namely, Online Transactional Processing (OLTP), Online Analytical Processing (OLAP) and Complex Event Processing (CEP). In Cloud4BigData we aim at providing full Big Data support for OLTP, OLAP and CEP. This implies overcoming important challenges such as scaling transactional processing, analytical query processing and complex event processing as well as the integration of these technologies in a single unified platform. What is more, many Big Data applications require the use of a combination of cloud Big Data technologies specialized for different purposes such as graph databases, key-value data stores, document-oriented databases, SQL databases, in-memory databases, column-oriented data stores, CEP, etc. **Cloud4BigData aims at providing holistic support to ease the development of Big Data applications on top on diverse cloud Big Data stores.**

BRADE-CM

BRAin inspired Data Engineering

Project website: http://www.brade-cm.es

Funded by: Department of Education, Youth and Sports of the Regional Government of Madrid, through the 2013 R&D technology program for research groups, co-financed by Structural Funds of the European Union

Duration: October 2014 to September 2018

Project partners: IMDEA Networks Institute, Universidad Carlos III de Madrid, Universidad Complutense de Madrid, Fundación para la investigación Biomédica del Hospital Gregorio Marañón

In recent years there have been multiple examples of **bio-inspired systems**, which have eased progress in different ICT areas. Some examples are neuronal networks for learning systems or ant algorithms used to trace optimal paths in communication networks. In this context, recent advances in data acquisition techniques about the brain's anatomic-functional organization (for both humans and animals) have allowed the scientific community to start analyzing and understanding the brain's structure and its cognitive and transmission processes. This offers a unique opportunity for the **design of novel ICT systems inspired by the brain's structure, as well as by its cognitive and adaptive processes.** Recently, some of the main companies in the ICT sector such as IBM, Qualcomm or Intel have launched pioneering projects for the design of brain-inspired ICT systems, which indicates the importance of this research line for the ICT sector.

The current project represents an effort in this research line, which is both characterized by being ground-breaking and multidisciplinary. In particular, the BRADE consortium aims to contribute to it through the development of tools that promote an advance towards the **design of computation and information processing systems for large-scale datasets (i.e., Big Data), based on the processing mechanisms used by the brain**. In order to achieve this objective, novel experimental techniques, specific instrumentation and sophisticated software will be used in order to extract and process information about the brain's anatomic-functional organization and its cognitive processes. Subsequently, complex networks theory will be applied to the analysis of the processed data in order to elaborate analytical and simulation models of the brain's organizational structure and functional processes. These models will constitute the basis for the study and design of the aforementioned brain-inspired computation and information processing systems. In addition, these models will be a contribution of great interest and with direct application in neuroscience, contributing to expand current knowledge about the brain's organizational structure and cognitive processes.

It should be highlighted that the research teams from the different institutions making up the BRADE consortium present a combination of knowledge and strongly multidisciplinary experience in the fields of neuroscience, the development of imaging instrumentation, the modeling of complex systems and networks, and the design of information processing ICT systems. This background provides serious guarantees for the successful completion of the BRADE project.

Furthermore, the project counts with the support and collaboration of well-known national and international companies as well as universities within the ICT sector. These companies provide experience in the design of information processing systems (Alcatel Lucent Bell Labs, IBN, ZED Worldwide and Medianet), the modeling of complex systems and networks (Telefonica R&D, Orange Labs and the Computer Lab at the University of Cambridge), and the development of imaging instrumentation (4DNature). Moreover, the Network for Biomedical Mental Health Research (CIBERSAM - Centro de Investigación Biomédica en Red en Salud Mental), which brings together some of the most prestigious Spanish research groups in the field of neuroscience, also collaborates on this project.

The research groups that are working on this project are the BDA group from IMDEA Networks Institute, the NETCOM Group from University Carlos III of Madrid, the NEUROCOM group from the Complutense University of Madrid and the BiiG group from the Foundation for Biomedical Research of the Gregorio Marañón Hospital (Fundación para la investigación Biomédica del Hospital Gregorio Marañón).

TIGRE5-CM

*Tecnologías Integradas de gestión y operación de REd 5G **(Integrated technologies for management and operation of 5G networks)***

IMDEA Networks Institute is the Project Coordinator

Project website: http://www.tigre5-cm.es
Funded by: Department of Education, Youth and Sports of the Regional Government of Madrid, through the 2013 R&D technology program for research groups, co-financed by Structural Funds of the European Union
Duration: October 2014 to September 2018
Project partners: IMDEA Networks Institute, Universidad Carlos III de Madrid, Universidad de Alcalá

The aim of the TIGRE5-CM project is **to design an architecture for future generation mobile networks, based on the SDN (Software Defined Networking) paradigm**, which simplifies the deployment, configuration and management of the network while integrating the latest technologies, both in the access network (reaching the end-user's terminal) and in the core network.

Having first identified the requirements of mobile network operators (basically lower operating costs, higher performance, flexibility, resiliency and network interoperability), the TIGRE5-CM project aims to tackle these issues through **a combination of the state of the art in wireless technologies with the SDN paradigm**. The technical and scientific challenges to be addressed are various and multidisciplinary, and they include: wireless networks, switched and data transportation networks, and next-generation optical network technologies. In order to better meet these demands, the project team is composed of four research groups with complementary knowledge of the technologies needed to complete the project.

The objectives addressed by TIGRE5-CM are the following:

- The design of an SDN network controller, including its interfaces, for 5G networks
- The design of mechanisms for the monitoring, supervision, and protection of the control network
- The development of mechanisms to optimize network resource efficiency, based on traffic measurement and predictions of traffic demand
- The development of advanced switching and transportation technologies based on generic multilayer Ethernet switches and on "all optical" transport networks with quality of service support

The flexibility and controllability of the user terminal by the network.
This will result in **a high performance integrated architecture**, with a control plane and a data plane that support a flexible, high performing network, at moderate cost, which is also configurable and programmable, robust and interoperable, and preferably built from open source hardware and software.

Upon completion, the main results of the project are expected to be:

1. Contributions to the state of the art with publications in top journals and conferences
2. Contributions to standardization activities on new 5G network technologies at organizations such as the IEEE, the IETF, etc.
3. Development of testbeds that highlight the main contributions of TIGRE5-CM as well as future improvements that go beyond the project's end date
4. Collaboration with regional industrial partners to foster their leadership in 5G technologies

The research groups that are working on the TIGRE5-CM project are the WNG group from IMDEA Networks Institute, the WNL Group and the ADSCOM Group from University Carlos III of Madrid and the GIST group from the University of Alcalá.

TEAM

Technologies for information and communication, Europe – east Asia Mobilities

IMDEA Networks Institute is an Associated Partner in this project

Project website: http://www.team-mundus.eu/
Funded by: European Union – ERASMUS Mundus Programme
Duration: July 2014 to July 2018
Project partners: Aalto-Korkeakoulusaatio, Chungnam National University, Eotvos Lorand Tudomanyegyetem, Gwangju Institute of Science and Technology, Keio University, Korea Advanced Institute of Science and Technology, Nara Institute of Science and Technology, Technische Universität Berlin (TUB), Universidad Carlos III de Madrid, Universita Degli Studi Di Trento, The University of Tokyo - Graduate School of Information Science and Technology
Associated partners: Centre National de la Recherche Scientifique, Fraunhofer-Gesellschaft Zur Foerderung Der Angewandten Forschung E.V., IMDEA Networks Institute, INRIA - Institut National de Recherche en Informatique et en Automatique, Inter-University Research Institute Corporation Research Organization of Information and Systems, Korea Institute of Science and Technology Information, NICT - National Institute of Information and Communications Technology, Netvision Telecom, Technicolor R&D, Teknologian Tutkimuskeskus VTT, Virtual I Tech Inc.

The objective of the **International Cooperation between East Asia and Europe project**, known as TEAM (Technologies for Information and Communication, Europe – East Asia Mobilites), is to **promote institutional cooperation and mobility activities between European and East Asian Higher Education Institutions** (HEIs). The project is coordinated by Université Pierre et Marie Curie (France).

The TEAM partnership brings together world class institutions with complementary experiences and knowledge in Information and Communication Technologies (ICT) with the common goal of creating a network of excellence in ICT between Europe, Japan and Republic of Korea, as well as to innovate in doctoral training. Through academic cooperation and exchanges, the partnership endeavors to work together as a team to develop new and innovative technologies, to enhance career prospects of young researchers and competitiveness of researchers, to promote intercultural understanding and to increase the attractiveness of European higher education.

ICT is an ever developing field of research and innovation and a key factor for economic growth. Therefore, strong expectations are placed on research and innovation in ICT to deliver solutions for societal challenges, ensuring our future. Nevertheless, the participating countries, all leaders in ICT, recognize a present and upcoming deficit of skilled and internationally oriented young talents for academia and industry. This Erasmus Mundus project will create the TEAM community of individuals and partners of higher education, research and industry, capable of adapting and working as an international TEAM. Thus it will enjoy an undeniable advantage in today's rapidly changing world.

ReCRED

ReCRED

From Real-world Identities to Privacy-preserving and Attribute-based CREDentials for Device-centric Access Control

IMDEA Networks Institute participates as a third party of Universidad Carlos III de Madrid

Project website: http://www.recred.eu/
Funded by: European Union. ICT Programme H2020
Duration: May 2015 to April 2018
Project partners: University of Piraeus Research Center, Telefónica Investigación y Desarrollo SA., Verizon Nederland B.V., certSIGN S.A., Wedia Ltd., Exus Software Ltd., Upcom BvBa, De Productizers B.V., Cyprus University of Technology, Universidad Carlos III de Madrid, Consorzio Nazionale Interuniversitario per le Telecomunicazioni, Studio Professionale Associato a Baker & McKenzie, IMDEA Networks Institute

ReCRED's ultimate goal is to promote the user's personal mobile device to the role of a unified authentication and authorization proxy towards the digital world. ReCRED adopts an incrementally deployable strategy in two complementary directions: extensibility in the type and nature of supported stakeholders and services (from local access control to online service access), as well as flexibility and extensibility in the set of supported authentication and access control techniques; from widely established and traditional ones to emerging authentication and authorization protocols as well as cryptographically advanced attribute-based access control approaches.

Simplicity, usability, and user privacy is accomplished by: i) hiding inside the device all the complexity involved in the aggregation and management of multiple digital identifiers and access control attribute credentials, as well as the relevant interaction with the network infrastructure and with identity consolidation services; ii) integrating in the device support for widespread identity management standards and their necessary extensions; and iii) controlling the exposure of user credentials to third party service providers.

ReCRED addresses key security and privacy issues such as resilience to device loss, theft and impersonation, via a combination of: i) local user-to-device and remote device-to-service secure authentication mechanisms; ii) multi-factor authentication mechanisms based on behavioral and physiological user signatures not bound to the device; iii) usable identity management and privacy awareness tools; iv) usable tools that offer the ability for complex reasoning of authorization policies through advanced learning techniques. ReCRED's viability will be assessed via four large-scale realistic pilots in real-world operational environments. The pilots will demonstrate the integration of the developed components and their suitability for end-users, so as to show their TRL7 readiness.

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MONROE
Measuring Mobile Broadband Networks in Europe

Project website: https://www.monroe-project.eu/
Funded by: European Union. ICT Programme H2020
Duration: March 2015 to February 2018
Project partners: Simula Research Laboratory AS, IMDEA Networks Institute, Karlstads Universitet (KAU), Politecnico di Torino (PoliTO), Celerway Communication AS, Telenor ASA, Nextworks

There is a strong need for **objective data about stability and performance of Mobile Broadband (MBB) networks**, and for tools to rigorously and scientifically assess their performance. In particular, it is important to measure and understand the quality as experienced by the end user. Such information is very valuable for many parties including operators, regulators and policy makers, consumers and society at large, businesses whose services depend on MBB networks, researchers and innovators.

MONROE proposes to design, build and operate an open, European-scale, and flexible platform with multi-homing capabilities to run experiments on operational 3G/4G Mobile Broadband networks. One of the main objectives of MONROE is to use the platform for the identification of key MBB performance parameters, thus enabling accurate, realistic and meaningful monitoring and assessment of the performance of MBB networks. MONROE also provides Wi-Fi connectivity mimicking multi-homing in smartphones with both MBB and Wi-Fi interfaces, to allow experimenting on different access technologies as well as explore new ways of combining them to increase performance and robustness.

The users of the platform are in the core of the MONROE project. First, following **FIRE*'s** philosophy, MONROE offers a user-oriented closed-loop system design in which the experimental platform is open to external users, and where users are incorporated early on in the experimental design process. Second, MONROE will provide Experiments as a Service (EaaS), thus lowering the barrier for using the platform to external experimenters and users, by providing well-documented tools and adjustable, flexible, high-level scripts to execute experiments, collect results, and analyze data.

Interoperability with existing FIRE and FP7 measurement platforms, jointly with the MONROE's effort to develop business and funding models, will guarantee sustainability and usefulness of the platform.

** **FIRE (Future Internet Research and Experimentation)** was an initiative within the Seventh Framework Programme of the European Union (FP7) (see http://www.ict-fire.eu/home/the-fire-landscape.html). FIRE projects were aimed to develop an experimental platform to be directly used by third parties (i.e. not only by project participants). In H2020 FIRE+ been introduced to build upon the previous FIRE initiative. MONROE is a FIRE+ project.*

TYPES

Towards transparencY and Privacy in the onlinE advertising business

Project website: www.types-project.eu
Funded by: European Union. ICT Programme H2020
Duration: May 2015 to October 2017
Project partners: Telefónica I+D, NEC Europe Ltd., Wedia Ltd., IMDEA Networks Institute, The Open University of Israel, Universidad Carlos III de Madrid, Internet Advertising Bureau (IAB) Europe, UPCOM Bvba, Asociación de Usuarios de Internet (AUI), Eurecat – Technology Centre of Catalonia

Online advertising generated in 2013 $42B worth of revenue and more than 3.4 million direct and indirect jobs in Europe in 2012 alone. **It supports some of the most important Internet services such as search, social media and user generated content sites**. However, the lack of transparency regarding tracking techniques and the type of information companies collect about users is creating increasing concerns in society. Software tools for implementing total mitigation (e.g., ad blocker or cookies blocker) have been released to block any transfer of information from end users towards the online advertising ecosystem. A massive adoption of these tools by end users may cause disruptions in the digital economy by affecting the online advertising sector and leading to consequences such as losing of a large number of employments. TYPES aims to cope with this challenge by defining, implementing, and validating in pre-market status a holistic framework of technologies and tools that guarantees both transparency and privacy preservation, gives the end user control upon the amount of information he/she is willing to share, and defines privacy-by-design solutions. In particular, these tools should enable the end user: i) to configure the privacy settings so that only the information allowed by the

end-user is collected by online advertising platforms; ii) to understand the flow of their information within the online advertising ecosystem and how it is being used; iii) to detect episodes of information collection occurring without consent and identify the offender; iv) to know the value of their data. **TYPES will demonstrate solutions that protect user's privacy while empowering them to control how their data is used by service providers for advertising purposes.** At the same time, TYPES will make it easier to verify whether users' online rights are respected and if personal data is exchanged for a reasonable value-added to users.

Flex5GWare

Flexible and efficient hardware/software platforms for 5G network elements and devices

IMDEA Networks Institute participates as a third party of Universidad Carlos III de Madrid

Project website: https://5g-ppp.eu/flex5gware
Funded by: European Union. ICT Programme H2020
Duration: July 2015 to June 2017
Project partners: INTEL Mobile Communications GmbH, Alcatel-Lucent Deutschland AG, Commissariat à l'Energie Atomique et aux Energies Alternatives, Consorzio Nazionale Interuniversitario per le Telecommunicazioni, Fundació Centre Tecnológic de Telecomunicacions de Catalunya, Fraunhofer Institute for Applied Solid State Physics IAF, IMINDS VZW, Katholieke Universiteit Leuven, NEC Europe Ltd., Sequans Communications, Telecom Italia S.p.a., Tecnologías, Servicios Telemáticos y Sistemas S.A, Universidad Carlos III de Madrid, Teknologian Tutkimuskeskus VTT, WINGS ICT Solutions, Ericsson AB, Lunds Universitet, Università di Pisa

The overall objective of Flex5Gware is to **deliver highly reconfigurable hardware (HW) platforms together with HW-agnostic software (SW) platforms** targeting both network elements and devices and taking into account increased capacity, reduced energy footprint, as well as scalability and modularity, to enable a smooth **transition from 4G mobile wireless systems to 5G**. This approach is necessary so that **5G HW/SW platforms** can meet the requirements imposed by the anticipated exponential growth in mobile data traffic (1000 fold increase) together with the large diversity of applications (from low bit-rate/power for M2M to interactive and high resolution applications).

Flex5Gware will adopt a holistic approach performing research and implementations on key building blocks of 5G (and co-operations among them) to provide versatile, flexible, reconfigurable, efficient operations for HW/SW platforms. The development of this concept entails many system design challenges that will be solved through disruptive technologies. E.g., analogue components to enable massive MIMO for mmWave, full duplex (simultaneous transmission and reception) for 5G waveforms, or reconfigurable SW architectures with interface abstractions for flexible control and management mechanisms across heterogeneous wireless devices and access networks.

Flex5Gware will evaluate and demonstrate the developed 5G technologies in terms of proofs-of-concept, which will be showcased in a demonstration event where all the partners in the consortium will participate. The Flex5Gware consortium includes large industry leaders from infrastructure providers (ALUD, EAB and NEC), semiconductor manufacturers (IMC) and network operators (TI) as well as leading research institutions and academia and is reinforced with the participation of three SMEs. This powerful consortium ensures a huge impact of the Flex5Gware results**.**

mmMAGIC

Milimetre-Wave Based Mobile Radio Access Network for Fifth Generation Integrated Communications

Project website: https://5g-ppp.eu/mmmagic/
Funded by: European Union. ICT Programme H2020
Duration: July 2015 to June 2017
Project partners: Samsung Electronics Ltd. (UK), Ericsson AB, Aalto University (Aalto Korkeakoulusaatio), Nokia Bell Labs Deutschland AG, Commissariat à l'Energie Atomique et aux Energies Alternatives, Fraunhofer-Gesellschaft Zur Foerderung Der Angewandten Forschung E.V., Huawei Technologies Dusseldorf GmbH (HWDU), INTEL Mobile Communications GmbH, IMDEA Networks Institute, Nokia Solutions and Networks Sp. z o.o., Nokia Solutions and Networks Oy, Orange, Telefónica I+D, University of Bristol, Qamcom Research and Technology AB, Chalmers University of Technology, Keysight Technologies Denmark Aps, Rohde & Schwarz GmbH & Co. KG, Technische Universität Dresden

The mmMAGIC (Millimetre-Wave Based Mobile Radio Access Network for Fifth Generation Integrated Communications) project will **develop and design new concepts for mobile radio access technology (RAT) for mmwave band deployment**. This is envisaged as a key component in the 5G multi-RAT ecosystem and will be used as a foundation for global standardization. The project will thus enable ultrafast mobile broadband services for mobile users, supporting UHD/3D streaming, immersive applications and ultra-responsive cloud services.

The consortium brings together major infrastructure vendors (Samsung, Ericsson, Nokia Bell Labs Deutschland AG, Huawei, Intel and Nokia), major European operators (Orange, Telefonica), leading research institutes and universities (Fraunhofer HHI Institute, CEAL-ETI, IMDEA Networks, Universities Aalto, Bristol, Chalmers and Dresden), measurement equipment vendors (Keysight Technologies, Rohde & Schwarz) and one SME (Qamcom). To complement its strong industry leadership and academic excellence, the project has an Advisory Board drawn from major European telecommunications regulators in Germany, France, Finland, Sweden and the UK.

A new radio interface, including novel network management functions and architecture components will be proposed, taking as guidance 5G PPP's KPI and exploiting the use of novel adaptive and cooperative beam-forming and tracking techniques to address the specific challenges of mm-wave mobile propagation. The project will undertake extensive radio channel measurements in the 6-100 GHz range, and will develop and validate advanced channel models that will be used for rigorous validation and feasibility analysis of the proposed concepts and system, as well as for usage in regulatory and standards fora. **The ambition of the project is to pave the way for a European head start in 5G standards, including 3GPP, and to secure essential IPRs to European industry, strengthening European competitiveness.**

HyperAdapt

Modeling and Online Performance Optimization of Adaptive Networks

While the origins of **Software-Defined Networking (SDN)** date back to the 90s, this research area has not gained popularity until recently. The definitive impulse to SDN has been given with **the creation of the Open Networking Foundation (ONF) in 2011, dedicated to the promotion and adoption of SDN**. Among other activities, the ONF has created and manages the OpenFlow standard. OpenFlow is a protocol that allows a controller to access and modify the forwarding plane (i.e., the routing tables) of routers and switches of a network.

In this project we will explore the intensive **use of SDN for making the Internet scalable, manageable, and adaptable at an industry-grade level**. To achieve this goal we will advance along three lines of research. Firstly, we will evaluate the potential impact of SDN concepts at a fundamental level, working with idealized models of networks and traffic patterns that allow providing provable guarantees. This first line will provide the theoretical foundations that can then be applied to the other two areas we plan to explore. These are intra-domain routing and wireless access solutions. We find these two areas extremely interesting and of high potential impact, because they are the building blocks of the mobile Internet architecture whose traffic demand is currently growing exponentially.

It is worth mentioning that this project considers much richer SDN models than those offered by current versions of OpenFlow. In our models, by means of the SDN underlying protocol, the controller has essentially complete information of the state of all the network elements, and has full control to change them. **One expected outcome of this project is the identification of extensions worth to be added to OpenFlow or any other SDN system.**

NetIDE

An integrated development environment for portable network applications

Project website: http://www.netide.eu/
Funded by: European Union. ICT Programme FP7
Duration: January 2014 to December 2016
Project partners: CREATE-NET: Center for REsearch And Telecommunication Experimentation for NETworked communities, IMDEA Networks Institute, Universität Paderborn, Telefónica I+D, Thales, Fujitsu Technology Solutions (FTS), INTEL Corporation, Fraunhofer IPT, Telcaria

Nowadays, while most of the programmable network apparatus vendors support OpenFlow, a number of fragmented control plane solutions exist for proprietary software-defined networks (SDN). Thus, network application developers need to re-code their solutions every time they encounter a network infrastructure based on a different controller. Moreover, different network developers adopt different solutions as abstract control plane programming languages (e.g. Frenetic, Procera), leading to not reusable and shareable source code for network programs.

Despite having OpenFlow as the candidate for a standard interface between the controller and the network infrastructure, interworking between different controllers and network devices is hindered and walled gardens are emerging. **NetIDE will deliver a single integrated development environment to support the whole development lifecycle of network controller programs in a vendor-independent fashion.**

NetIDE will approach the problem by proposing an architecture that will allow the different representation to be used to program the network and different controllers to execute the network programs. In this respect, **the core work will be the definition of a common language able to cover different network programming styles: the NetIDE IRF (Intermediate Representation Format)**. Around IRF we will explore fundamental research topics, such as: development of controller agnostic Network Apps (applications that control network behavior) and Network Services (services that support the task of network controllers); cross-controller debugging and profiling of network programs; heterogeneous network programming; network programming with simulators in the loop.

NetIDE IRF will be supported by a developer toolkit to allow creation of Network Apps and by a Network App Engine supporting the execution and testing of NetIDE IRF-based applications. **NetIDE will result in one-stop solution for the development of SDN applications that covers all the development lifecycle.**

ATOMICDFS

Seeking Efficient Atomic Implementations of Distributed Data Storage

Distributed Storage Systems provide availability and survivability of data by replicating them in geographically dispersed network locations. A major problem with data distribution is consistency. How the system detects the latest-value of the replicated data? The most natural and easy to understand consistency guarantee is **atomicity**. Atomicity ensures that a read operation returns the value of the preceding write operation and that value is at least as recent as the value returned by any preceding read operation.

Researchers, over the last two decades, have developed numerous atomic implementations for the asynchronous message passing environment considering the simplest form of **data storage**: a **read/write** register. In this proposal we aim to elevate the applicability of the proposed solutions by using them for the **development of an atomic distributed file system (ADFS)** for the asynchronous, message passing crash prone environment. Large-scale objects, like files, degrade the operation latencies of the proposed algorithms when data are replicated and delivered over asynchronous channels to the replica hosts. On the other hand segmenting files into very small pieces and running an instance of the atomic implementation over each segment object may increase the request load on the replica hosts.

So this project will investigate the trade-offs between file fragmentation, fragment distribution, and operation latency. We need to specify precisely how file replication will be carried out and how clients will locate and retrieve the latest version of the file they desire. For this purpose we need to develop efficient fragmentation algorithms that minimize the read and write operation latency while at the same time do not incur excessive overhead on server requests.

We plan to implement and deploy our developed algorithms both in single processor simulation environments as well as in planetary-scale real time networks.

RECAP

Reliable Capacity Provisioning and Enhanced Remediation for Distributed Cloud Applications

Project website: http://recap-project.eu/
Funded by: European Union. ICT Programme H2020
Duration: January 2017 to December 2019
Project partners: Universitaet Ulm, Umea Universitet, Dublin City University, IMDEA Networks Institute, Tieto Sweden Support Services AB, Linknovate Science SL, Intel Research and Development Ireland Limited, Sistemas Avanzados de Tecnología SA (SATEC), British Telecommunications Public Limited Company (BT).

Large-scale computing systems are today built as distributed systems (for reasons of scale, heterogeneity, cost and energy efficiency), where components and services are distributed and accessed remotely through clients and devices. In some systems, in particular latency-sensitive or high availability systems, components are also placed closer to end-users (in, e.g., radio base stations and other systems on the edge of access networks) in order to increase reliability and reduce latency - a style of computing often referred to as edge or fog computing.

However, while recent years have seen significant advances in system instrumentation as well as data centre energy efficiency and automation, computational resources and network capacity are often provisioned using best effort provisioning models and coarse-grained quality of service (QoS) mechanisms, even in state-of-the-art data centres. These limitations are seen as a major hindrance in the face of **the coming evolution of IoT and the networked society**, and have even today manifested in, e.g., a limited cloud adoption of systems with high reliability requirements such as telecommunications infrastructure and emergency services systems.

RECAP goes beyond the current state of the art, aiming to **develop the next generation of cloud/edge/fog computing capacity provisioning and remediation via targeted research advances in cloud infrastructure optimization, simulation and automation**. The project will build on advanced machine learning, optimization and simulation techniques to achieve this. The overarching result of RECAP is the **next generation of agile and optimized cloud computing systems**. The outcomes of the project will pave the way for a radically novel concept in the provision of cloud services, where services are instantiated and provi-sioned close to the users that actually need them by self-configurable cloud computing systems.

scientific
activities

5

annual report
2016

IMDEA Networks Institute monitors and evaluates its scientific results in order to obtain a sound appraisal of the degree of fulfillment of its strategy and objectives, optimizing the management of its resources and maximizing its impact. The pursuit of excellence is at the core of all of our activities.

5.1. Awards

5.1.1. Paper Awards

In January 2017, IEEE COMSOC published a list of **"BEST READINGS TOPICS ON DEVICE-TO-DEVICE COMMUNICATIONS"** 🎗. The list covers works published over the last 10 years. A testimony to the international acknowledgment of the impact and the quality of research carried out in IMDEA Networks in recent years is the inclusion of the following articles published by our scientists:

- **A. Asadi, Q. Wang, V. Mancuso**
  A Survey on Device-to-Device Communication in Cellular Networks
  In: IEEE Communications Surveys & Tutorials, 16 (4), pp. 1801-1819, ISSN 1553-877X (April 2014).

- **A. Asadi, V. Mancuso,** R. Gupta
  An SDR-based Experimental Study of Outband D2D Communications
  In: Proc. IEEE INFOCOM 2016 - The 35th Annual IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, CA, USA (April 2016).

- **V. Sciancalepore, D. Giustiniano, A. Banchs,** A. Hossmann-Picu
  Offloading Cellular Traffic Through Opportunistic Communications: Analysis and Optimization
  In: IEEE Journal on Selected Areas in Communications, 34 (1), pp. 122-137, ISSN 0733-8716 (January 2016).

- Special Issue on "Device-to-Device Communications with Social Awareness," IEEE Wireless Communications, 23 (4), pp. 10-11, ISSN 1536-1284 (August 2016). *Device-to-device communications with social awareness [Guest Editorial]* [Guest Editorial co-editors: Qing Yang; Kejie Lu; **Vincenzo Mancuso**; Chan-Hyun Youn].

Q. Wang, M. Zuniga, **D. Giustiniano**
RUNNER UP TO THE BEST PAPER AWARD 🎖
Passive Communication with Ambient Light
In: The 12th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2016) 12-15 December 2016, Irvine, California, USA

awards

Francesca Meneghello, Filippo Campagnaro, Roee Diamanto, **Paolo Casari,** Michele Zorzi
BEST STUDENT PAPER AWARD WITH EXPERIMENTS IN MEMORY OF GIOVANNI TOSO
Design and Evaluation of a Low-Cost Acoustic Chamber for Underwater Networking Experiments
In: The 11th ACM International Conference on Underwater Networks & Systems (ACM WUWNet 2016) 24-26 October 2016, Shanghai, China

J. Palacios, D. De Donno, D. Giustiniano, J. Widmer
BEST STUDENT PAPER AWARD
Speeding Up mmWave Beam Training through Low-Complexity Hybrid Transceivers
In: The 27th Annual IEEE International Symposium on Personal, Indoor, and Mobile Radio Communications (IEEE PIMRC 2016) 4-7 September 2016, Valencia, Spain

Ö. Alay, A. Lutu, **R. García, M. Peón-Quirós, V. Mancuso,** T. Hirsch, T. Dély, J. Werme, K. Evensen, A. Fosselie Hansen, S. Alfredsson, J. Karlsson, A. Brunstrom, A. Safari Khatouni, M. Mellia, **M. Ajmone Marsan,** R. Monno, H. Lønsethagen
BEST DEMO AWARD
Measuring and Assessing Mobile Broadband Networks with MONROE. **(Demo)**

In: The 17th International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM 2016) 21-24 June 2016, Coimbra, Portugal

J. A. Ruipérez-Valiente, G. Alexandron, Z. Chen, D. E. Pritchard
HONORABLE MENTION
Using Multiple Accounts for Harvesting Solutions in MOOCs
In: The 3rd ACM Conference on Learning @ Scale (L@S 2016) 25-26 April 2016, Edinburgh, Scotland, UK

A. Asadi, V. Mancuso, R. Gupta
BEST-IN-SESSION PRESENTATION AWARD
An SDR-based Experimental Study of Outband D2D Communications
In: The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016) 10-15 April 2016, San Francisco, USA

- This article was selected for **IEEE COMMUNICATION SOCIETY'S TECH FOCUS OF 1 DECEMBER 2016. FEATURED TOPIC: MAC/ PHY PROTOTYPING PLATFORM**

5.1.2. Researcher Awards

Arash Asadi, Pablo Salvador, M. Isabel Sánchez, Qing Wang
OUTSTANDING DOCTORAL THESIS AWARD UNIVERSITY CARLOS III OF MADRID - ACADEMIC YEAR 2015/2016 | PH.D. PROGRAM IN TELEMATIC ENGINEERING 🎖

Premio extraordinario de doctorado Universidad Carlos III de Madrid - Convocatoria 2015/2016 | Programa de Doctorado en Ingeniería Telemática

- **Arash Asadi:** *Opportunistic Device-To-Device Communication In Cellular Networks: From Theory To Practice,* PhD Thesis defended on March 8th, 2016, in Madrid, Spain.
- **Pablo Salvador:** *Efficient voice and video traffic delivery in IEEE 802.11 WLANs: design, implementation and experimental evaluation,* PhD Thesis defended on April 8th, 2016, in Madrid, Spain.

- **M. Isabel Sánchez:** *Analysis, Design and Experimental Evaluation of Connectivity Management in Heterogeneous Wireless Environments,* PhD Thesis defended on March 8th, 2016, in Madrid, Spain.
- **Qing Wang:** *Visible Light and Device-to-Device Communications: System Analysis and Implementation,* PhD Thesis defended on May 19th, 2016, in Madrid, Spain.

The above prizes were awarded on December 2016.

Héctor Cordobés de la Calle
HONORABLE MENTION AT DATA SCIENCE AWARDS SPAIN 2016 🎖

Research engineer at IMDEA Networks Institute receives an Honorable Mention at the «Data Science Awards Spain 2016» in the category of Best Data Scientist in Data Engineering. He is one of over 300 data

scientists to have participated in the first Big Data awards in Spain to acknowledge the best initiatives in the area of Big Data by individuals, companies and data journalism. Big Data Week, Madrid, Spain, 24 October 2016.

Adrian Loch
ACM SIGCOMM 2016 TRAVEL GRANT

Adrian Loch, a Post-Doc Researcher at IMDEA Networks working in the Wireless Networking Group led by Joerg Widmer, receives a Travel Grant to attend a top tier 1 event in the area of data communication: the 2016 edition of the ACM SIGCOMM conference. This is the flagship annual conference of the ACM Special Interest Group on Data Communication (SIGCOMM) on the applications, technologies, architectures, and protocols for computer communication. Florianópolis, Brazil, 22-26 August 2016.

Vincenzo Sciancalepore
GTTI AWARD FOR PHD THESES IN THE FIELD OF COMMUNICATION TECHNOLOGIES

GTTI is the National Telecommunications and Information Theory Group in Italy. PhD thesis: *Enhancements in spectrum management techniques for heterogeneous 5G future networks.* Universidad Carlos III de Madrid. PhD thesis director: Prof. Dr. Albert Banchs. PhD thesis defended on November 26th 2015, in Madrid, Spain. The prize was awarded on June 15th 2016, in Geneva, Italy.

Adrian Loch
BEST PHD DISSERTATION AWARD FROM TU DARMSTADT

Adrian Loch, a Post-Doc Researcher at IMDEA Networks working in the Wireless Networking Group led by Joerg Widmer, has received the Best Dissertation Award for a doctoral thesis within the Computer Science Department at the Technical University of Darmstadt, in Germany. The award is given in recognition of his outstanding academic achievement in the area of Computer Science. Darmstadt, Germany, May 2016.

Joerg Widmer

FRIEDRICH WILHELM BESSEL RESEARCH AWARD FROM THE ALEXANDER VON HUMBOLDT FOUNDATION 🎗

Granted in recognition of Dr. Widmer's achievements in the field of wireless networking.

The Humboldt Foundation grants about 20 such Awards annually to internationally renowned academics in all academic fields, who work outside of Germany, in recognition of their outstanding accomplishments in research to date and their exceptional potential for the future. Bonn, Germany, April 2016.

Qing Wang

IPSN 2016 STUDENT TRAVEL GRANT 🎗

The 15th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN 2016) (CPSWeek). Vienna, Austria, 11-14 April 2016.

5.1.3. R&D Awards

Philipp Richter (Technische Universität Berlin) was awarded a 2017 IETF/IRTF Applied Networking Research Prize (ANRP) for a scientific study authored in collaboration with an international research team of 9 including Dr. Narseo Vallina-Rodriguez, a Research Assistant Professor at IMDEA Networks:

- P. Richter, F. Wohlfart, **N. Vallina-Rodriguez,** M. Allman, R. Bush, A. Feldmann, C. Kreibich, N. Weaver, V. Paxson
IETF/IRTF APPLIED NETWORKING RESEARCH PRIZE - ANRP 2017 🎗
A Multi-perspective Analysis of Carrier-Grade NAT Deployment
Prize awarded by the Internet Engineering Task Force (IETF) and the Internet Research Task Force (IRTF).
This paper was published in the proceedings of the ACM Internet Measurement

Conference 2016 (ACM IMC 2016), 14-16 November 2016, Santa Monica, California, USA. Pages 215-229. December 2016.

Maurizio Rea, Aymen Fakhreddine, Domenico Giustiniano

2nd Place at the **CYBER AWARD 2016** competition for outstanding scientific contributions in the Cyberspace and Information research program of Armasuisse Science and Technology. Switzerland, 2016.

Héctor Cordobés de la Calle, Luis Felipe Chiroque

1ST PRIZE AT THE ACCENTURE DIGITAL CONNECTED HACKATHON 2016 MADRID

Organized by Accenture Digital, Google Cloud, Adobe and Expo 2020 Dubai UAE. Madrid, Spain, 26-27 November 2016.

Narseo Vallina-Rodriguez

DATA TRANSPARENCY LAB (DTL) GRANTEE

Tool: «Characterizing Indirect Privacy Leaks in Mobile Apps»

Researchers: Narseo Vallina-Rodriguez (ICSI & IMDEA Networks Institute); Mark Allman (ICSI); Christian Kreibich (ICSI/Lastline); Vern Paxson (ICSI-UC Berkeley) This DTL grant is awarded for the pursuit of research that will lead to the development of software tools on the topics of privacy, reverse engineering efforts for transparency and discrimination. Researchers are expected to produce software tools and platforms that enable end-users to better understand or control how their personal information is being collected and used in deployed online services. USA, 2016.

Héctor Cordobés de la Calle, Luis Felipe Chiroque

AWARD TO THE BEST SOLUTION APPROACH (PREMIO AL MEJOR ENFOQUE DE SOLUCIÓN), ARTIFICIAL INTELLIGENCE HACKATHON 2016

Organized by Accenture Digital, Google Cloud and the Madrid City Council *(Ayuntamiento de Madrid)*. Madrid, Spain, 4-5 November 2016.

Qing Wang

1ST PRIZE WINNER (1 OUT OF 155) IN EUROPE OF 1ST CHINA (SHENZHEN) INNOVATION COMPETITION OF INTERNATIONAL TALENTS

Project proposal: «Lighting up the Internet-of-Lights/Things with Li-Fi» Munich, Germany Division, April 2016.

Luis F. Chiroque

(PhD Student, IMDEA Networks & UC3M), Juan Miguel Carrascosa, (PhD Student, UC3M), Costas Iordanou, (PhD Student, Telefonica & UC3M), Dr. Rubén Cuevas (Assistant Professor, UC3M)

I-COM 2016 DATA SCIENCE HACKATHON AWARD - SCIENTIST LEVEL & I-COM AUDIENCE AWARD

Data Science Hackathon contest, celebrated in conjunction with the I-COM Global Summit 2016, 18-21 April 2016, Seville, Spain.

Domenico Giustiniano

MOST ENTERTAINING VIDEO AWARD, AND NOMINATION FOR THE BEST VIDEO AND BEST ROBOT VIDEO

Video: «Finding Linda - A Search and Rescue Mission by SWARMIX, SWARMIX project team» The 10th AAAI Video Competition 2016, 12-17 February 2016, Phoenix, USA.

5.2. Publications

IMDEA Networks presented its scientific work in various formats and venues during 2015. There were **117** publications, out of which **96** were peer reviewed. This is how they are structured:

3 Book Chapters | 34 Journal Articles | 6 Magazine Articles | 53 Conference or Workshop Papers | 21 Invited Papers, Keynotes, Invited Talks, Tutorials, Lectures, Demos, etc.
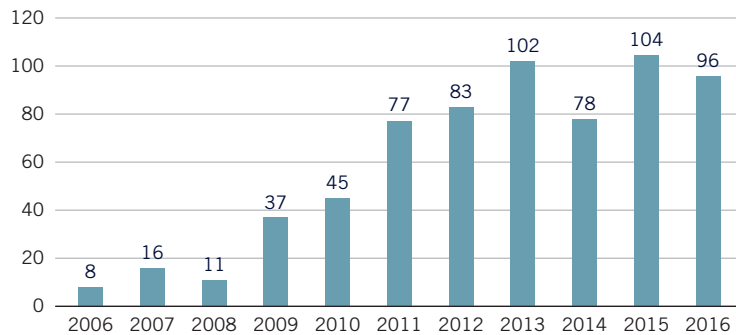
As well as the previous there were:

10 PhD Theses | 6 Masters Theses | 1 Technical Report

According to **Google Scholar**, IMDEA Networks' researchers have received around **53.322 citations in total** along their research career, which corresponds to an **aggregated H-index of 103**.
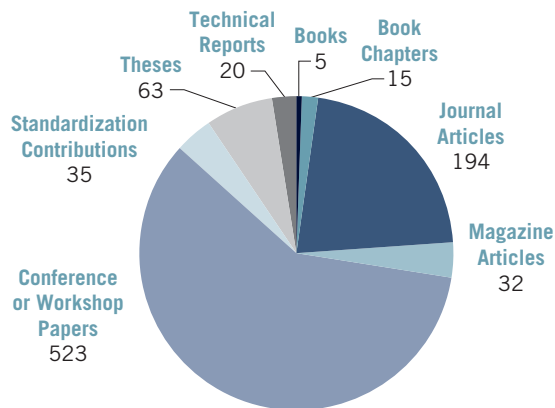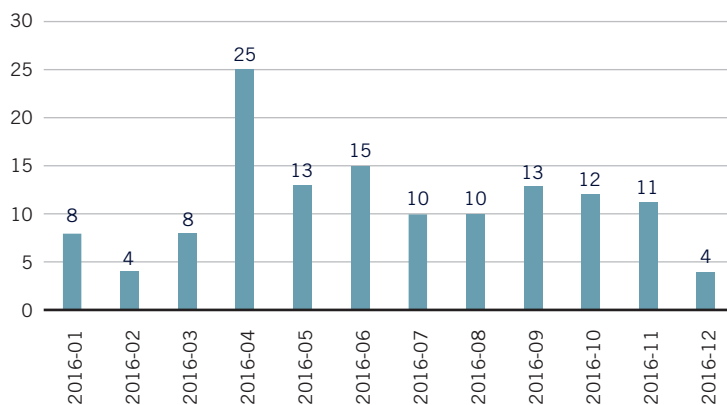
publications

2006-2016

number of publications (peer-reviewed)

Year	Value
2006	8
2007	16
2008	11
2009	37
2010	45
2011	77
2012	83
2013	102
2014	78
2015	104
2016	96

publications by type

Technical Reports 20

Books 5

Book Chapters 15

Theses 63

Standardization Contributions 35

Journal Articles 194

Magazine Articles 32

Conference or Workshop Papers 523

2016

total number of publications per month

Total = 134

publications by type (peer reviewed)

Book Chapters 3

Journal Articles 34

Conference or Workshop Papers 53

Magazine Articles 6

Total = 96
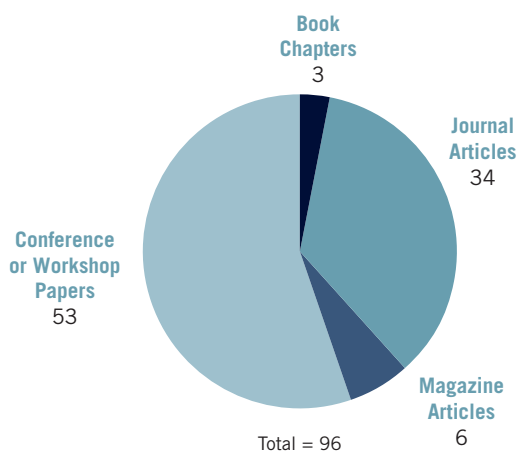
Publications 2016

Books Chapters [3]

1. Patrick Eugster, William Culhane, Chamikara Jayalath, Kirill Kogan, Julian Stephen (June 2016) (Ed.) San Murugesan, Irena Bojanova
Cloud Federation and Geo-Distribution
In: Encyclopedia of Cloud Computing. John Wiley & Sons Ltd., 178-190. ISBN ISBN-13: 978-1118821978; ISBN-10: 1118821971

2. Sergey Nikolenko, Kirill Kogan (April 2016) (Ed.) Kao Ming-Yang Kao
Single and Multiple Buffer Processing
In: Encyclopedia of Algorithms. Springer Science+Business Media New York, 1-9. ISBN 978-3-642-27848-8

3. Marco Ajmone Marsan, Stefano Ceri, Roberto Verganti, Roberto Zanino (January 2016) (Ed.) Banny Banerjee, Stefano Ceri
Alta Scuola Politecnica: Innovation, Multi-disciplinarity and Passion
In: Creating Innovation Leaders. Springer International Publishing, 215-225. ISBN 978-3-319-20519-9

Journal Articles [34]

1. Jordi Arjona Aroca, Antonio Fernández Anta (December 2016)
Empirical Comparison of Power-efficient Virtual Machine Assignment Algorithms
Computer Communications, 96. pp. 86-98. ISSN 0140-3664

2. Jorge Ortin, Pablo Serrano, Carlos Donato (December 2016)
Optimal configuration of a Resource-on-Demand 802.11 WLAN with Non-Zero Start-Up Times
Computer Communications, 96. pp. 99-108. ISSN 0140-3664

3. Pedro J. Muñoz-Merino, José A. Ruipérez-Valiente, Carlos Delgado Kloos, Maria A Auger, Susana Briz, Vanesa de Castro, Silvia N. Santalla (November 2016)
Flipping the classroom to improve learning with MOOCs technology
Computer Applications in Engineering Education, 25 (1). pp. 15-25. ISSN 1099-0542

4. Jorge Ortin, Carlos Donato, Pablo Serrano, Albert Banchs (November 2016)
Resource-on-Demand Schemes in 802.11 WLANs with Non-Zero Start-Up Times
IEEE Journal on Selected Areas in Communications, 34 (12). pp. 1-1. ISSN 0733-8716

5. Arash Asadi, Vincenzo Mancuso (October 2016)
Network-assisted Outband D2D-clustering in 5G Cellular Networks: Theory and Practice
IEEE Transactions on Mobile Computing, PP (99). ISSN 1536-1233

6. Kirill Kogan, Alejandro López-Ortiz, Sergey Nikolenko, Gabriel Scalosub, Michael Segal (October 2016)
Large Profits or Fast Gains: A Dilemma in Maximizing Throughput with Applications to Network Processors
Journal of Network and Computer Applications, 74. pp. 31-43. ISSN 1084-8045

7. Henry S. Dol, Paolo Casari, Timo van der Zwan, Roald Otnes (September 2016)
Software-Defined Underwater Acoustic Modems: Historical Review and the NILUS Approach
IEEE Journal of Oceanic Engineering, pp. 1-16. ISSN 0364-9059

8. **Heinz Droste, Peter Rost, Mark Doll, Ignacio Berberana, Christian Mannweiler, Marcus Breitbach, Albert Banchs, Miguel A. Puente (September 2016)**

An adaptive 5G multiservice and multitenant radio access network architecture

Transactions on Emerging Telecommunications Technologies (Special Issue: 5GPPP Feature Issue), 27 (9). pp. 1262-1270. ISSN 2161-3915

9. **Mehrdad Shariat, David Gutierrez-Estevez, Arnesh Vijay, Krystian Safjan, Patrik Rugeland, Icaro da Silva, Javier Lorca, Joerg Widmer, Maria Fresia, Yilin Li, Isabelle Siaud (September 2016)**

5G radio access above 6 GHz

Transactions on Emerging Telecommunications Technologies (Special Issue: 5GPPP Feature Issue), 27 (9). pp. 1160-1167. ISSN 2161-3915

10. **Patrick Eugster, Kirill Kogan, Sergey Nikolenko, Alexander V. Sirotkin (August 2016)**

Heterogeneous Packet Processing in Shared Memory Buffers

Journal of Parallel and Distributed Computing, 99. pp. 1-13. ISSN 0743-7315

11. **Agustín Santos, Antonio Fernández Anta, José A. Cuesta, Luis López Fernández (August 2016)**

Fair Linking Mechanisms for Resource Allocation with Correlated Player Types

Computing, 98 (8). pp. 777-801. ISSN 0010-485X

12. **Vincenzo Sciancalepore, Vincenzo Mancuso, Albert Banchs, Shmuel Zaks, Antonio Capone (August 2016)**

Enhanced Content Update Dissemination through D2D in 5G Cellular Networks

IEEE Transactions on Wireless Communications, 15 (11). ISSN 1536-1276

13. **Víctor M. López Millán, Vicent Cholvi, Antonio Fernández Anta, Luis López Fernández (July 2016)**

Resource location based on precomputed partial random walks in dynamic networks

Computer Networks, 103. pp. 165-180. ISSN 1389-1286

14. **José A. Ruipérez-Valiente, Pedro J. Muñoz-Merino, Carlos Delgado Kloos, Katja Niemann, Maren Scheffel, Martin Wolpers (July 2016)**

Analyzing the Impact of Using Optional Activities in Self-Regulated Learning

IEEE Transactions on Learning Technologies, 9 (3). pp. 1-14. ISSN 1939-1382

15. **Christina Vlachou, Albert Banchs, Pablo Salvador, Julien Herzen, Patrick Thiran (July 2016)**

Analysis and Enhancement of CSMA/CA with Deferral in Power-Line Communications

IEEE Journal on Selected Areas in Communications, 34 (7). pp. 1978-1991. ISSN 7338716

16. **Roee Diamant, Paolo Casari, Filippo Campagnaro, Michele Zorzi (June 2016)**

A Handshake-based Protocol Exploiting the Near-Far Effect in Underwater Acoustic Networks

IEEE Wireless Communications Letters, 5 (3). pp. 308-311. ISSN 2162-2337

17. **Foivos Michelinakis, Nicola Bui, Guido Fioravantti, Joerg Widmer, Fabian Kaup, David Hausheer (June 2016)**

Lightweight Capacity Measurements For Mobile Networks

Computer Communications, 84. pp. 73-83. ISSN 0140-3664

18. **Evgenia Christoforou, Antonio Fernández Anta, Agustín Santos (May 2016)**

A Mechanism for Fair Distribution of Resources without Payments

PLOS ONE, 11 (5). pp. 1-20. ISSN 1932-6203

19. **Antonio Fernández Anta, Chryssis Georgiou, Dariusz R. Kowalski, Joerg Widmer, Elli Zavou (April 2016)**

Measuring the Impact of Adversarial Errors on Packet Scheduling Strategies

Journal of Scheduling, 19 (2). pp. 135-152. ISSN 1094-6136

20. **Antonio Fernández Anta, Vincent Gramoli, Ernesto Jiménez, Anne-Marie Kermarrec, Michel Raynal (April 2016)**

Distributed Slicing in Dynamic Systems

IEEE Transactions on Parallel and Distributed Systems, 27 (4). pp. 1030-1043. ISSN 1045-9219

21. **Kirill Kogan, Sergey Nikolenko, Ori Rottenstreich, William Culhane, Patrick Eugster (April 2016)**

Exploiting Order Independence for Scalable and Expressive Packet Classification

IEEE/ACM Transactions on Networking, 24 (2). pp. 1251-1264. ISSN 1063-6692

22. **Kshitiz Verma, Gianluca Rizzo, Antonio Fernández Anta, Rubén Cuevas, Arturo Azcorra, Shmuel Zaks, Alberto García-Martínez (April 2016)**

Energy-optimal collaborative file distribution in wired networks

Peer-to-Peer Networking and Applications, pp. 1-20. ISSN 1936-6442

23. **Marco Gramaglia, Oscar Trullols-Cruces, Diala Naboulsi, Marco Fiore, María Calderón (March 2016)**

Mobility and connectivity in highway vehicular networks: A case study in Madrid

Computer Communications, 78. pp. 28-44. ISSN 1403664

24. **Fabian Kaup, Foivos Michelinakis, Nicola Bui, Joerg Widmer, Katarzyna Wac, David Hausheer (March 2016)**

Assessing the Implications of Cellular Network Performance on Mobile Content Access

IEEE Transactions on Network and Service Management, 13 (2). pp. 168-180. ISSN 1932-4537

25. **Qing Wang, Domenico Giustiniano (March 2016)**

Intra-Frame Bidirectional Transmission in Networks of Visible LEDs

IEEE/ACM Transactions on Networking, 24 (6). pp. 1-13. ISSN 1063-6692

26. **Biyu Zhou, Fa Zhang, Lin Wang, Chenying Hou, Antonio Fernández Anta, Athanasios V. Vasilakos, Youshi Wang, Jie Wu, Zhiyong Liu (March 2016)**

HDEER: A Distributed Routing Scheme for Energy-Efficient Networking

IEEE Journal on Selected Areas in Communications, 34 (5). pp. 1713 -1727. ISSN 0733-8716

27. **Albert Banchs, Jorge Ortin, Andres Garcia-Saavedra, Douglas J. Leith, Pablo Serrano (February 2016)**

Thwarting Selfish Behavior in 802.11 WLANs

IEEE/ACM Transactions on Networking, 24 (1). pp. 492-505. ISSN 1063-6692

28. **Juan Camilo Cardona, Stefano Vissicchio, Paolo Lucente, Pierre Francois (February 2016)**

"I Can't Get No Satisfaction": Helping Autonomous Systems Identify Their Unsatisfied Inter-domain Interests

IEEE Transactions on Network and Service Management , 13 (1). pp. 43-57. ISSN 1932-4537

29. **Jordi Arjona Aroca, Antonio Fernández Anta, Miguel A. Mosteiro, Christopher Thraves, Lin Wang (January 2016)**

Power-efficient Assignment of Virtual Machines to Physical Machines

Future Generation Computer Systems, 54. pp. 82-94. ISSN 0167-739X

30. **Stefano Avallone, Albert Banchs (January 2016)**

A Channel Assignment and Routing Algorithm for Energy Harvesting Multi-Radio Wireless Mesh Networks

IEEE Journal on Selected Areas in Communications, 34 (5). pp. 1463 -1476. ISSN 0733-8716

31. George Koutitas, George Iosifidis, Bart Lannoo, Mathieu Tahon, Sofie Verbrugge, Pavlos Ziridis, Lukasz Budzisz, Michela Meo, Marco Ajmone Marsan, Leandros Tassiulas (January 2016)

Greening the Airwaves With Collaborating Mobile Network Operators

IEEE Transactions on Wireless Communication, 15 (1). pp. 794-806. ISSN 1536-1276

32. Shou-pon Lin, Nicholas F. Maxemchuk (January 2016)

The Fail-Safe Operation of Collaborative Driving Systems

Journal of Intelligent Transportation Systems: Technology, Planning, and Operations (Special Issue: Cyber Transportation Systems and Connected Vehicle Research), 20 (1). pp. 88-101. ISSN 1547-2450

33. Carla Panarello, Alfio Lombardo, Giovanni Schembra, Michela Meo, Marco Mellia, Marco Ajmone Marsan (January 2016)

Network Interface Power Management and TCP Congestion Control: a Troubled Marriage

Australian Journal of Electrical and Electronics Engineering, 13 (2016). pp. 1-10. ISSN 1448-837X

34. Vincenzo Sciancalepore, Domenico Giustiniano, Albert Banchs, Andreea Hossmann-Picu (January 2016)

Offloading Cellular Traffic Through Opportunistic Communications: Analysis and Optimization

IEEE Journal on Selected Areas in Communications, 34 (1). pp. 122-137. ISSN 0733-8716

Magazine Articles [6]

1. Patrick Eugster, Chamikara Jayalath, Kirill Kogan, Julian Stephen (October 2016)

Big Data Analytics beyond the Datacenter

IEEE Computer Magazine, pp. 1-8.

2. Hamed Haddadi, Rishab Nithyanand, Sheharbano Khattak, Mobin Javed, Narseo Vallina-Rodriguez, Marjan Falahrastegar, Julia E. Powles, Emiliano De Cristofaro, Steven J. Murdoch (October 2016)

The Adblocking Tug-of-War

The USENIX Magazine, 41 (4). pp. 41-43.

3. Qing Yang, Kejie Lu, Vincenzo Mancuso, Chan-Hyun Youn (August 2016)

Device-to-device communications with social awareness [Guest Editorial]

IEEE Wireless Communications Magazine, 23 (4). pp. 10-11. ISSN 1536-1284

4. Gek Hong Sim, Adrian Loch, Arash Asadi, Vincenzo Mancuso, Joerg Widmer (June 2016)

5G Millimeter-Wave and D2D Symbiosis: 60 GHz for Proximity-based Services

IEEE Wireless Communications Magazine, ISSN 1536-1284

5. Peter Rost, Albert Banchs, Ignacio Berberana, Markus Breitbach, Mark Doll, Heinz Droste, Christian Mannweiler, Miguel A. Puente, Konstantinos Samdanis, Bessem Sayadi (May 2016)

Mobile network architecture evolution toward 5G

IEEE Communications Magazine, 54 (5). pp. 84-91. ISSN 0163-6804

6. Antonio De la Oliva, José Alberto Hernández, David Larrabeiti, Arturo Azcorra (February 2016)

An overview of the CPRI specification and its application to C-RAN-based LTE scenarios

IEEE Communications Magazine, 54 (2). pp. 152-159. ISSN 0163-6804

Conference or Workshop Papers [53]

1. Antonio Fernández Anta, Theophanis Hadjistasi, Nicolas Nicolaou (December 2016)
Computationally Light "Multi-Speed" Atomic Memory (Paper)
In: The 20th International Conference on Principles of Distributed Systems (OPODIS 2016), 13-16 December 2016, Madrid, Spain

2. Qing Wang, Marco Zuniga, Domenico Giustiniano (December 2016)
Passive Communication with Ambient Light (Paper)
In: The 12th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2016), 12-15 December 2016, Irvine, California, USA

3. Patricia Callejo, Rubén Cuevas, Ángel Cuevas, Mikko Kotila (November 2016)
Independent Auditing of Online Display Advertising Campaigns (Paper)
In: The 15th ACM Workshop on Hot Topics in Networks (HotNets 2016), 9-10 November 2016, Atlanta, Georgia, USA

4. Muhammad Ikram, Narseo Vallina-Rodriguez, Suranga Seneviratne, Mohamed Ali Kaafar, Vern Paxson (November 2016)
An Analysis of the Privacy and Security Risks of Android VPN Permission-enabled Apps (Paper)
In: The 16th ACM Internet Measurement Conference 2016 (ACM IMC 2016), 14-16 November 2016, Santa Monica, CA, USA

5. Kirill Kogan, Sergey Nikolenko, Patrick Eugster, Alexander Shalimov, Ori Rottenstreich (November 2016)
FIB Efficiency in Distributed Platforms (Paper)
In: The 24th IEEE International Conference on Network Protocols (ICNP 2016), 8-11 November 2016, Singapore

6. Philipp Richter, Florian Wohlfart, Narseo Vallina-Rodriguez, Mark Allman, Randy Bush, Anja Feldmann, Christian Kreibich, Nicholas Weaver, Vern Paxson (November 2016)
A Multi-perspective Analysis of Carrier-Grade NAT Deployment (Paper)
In: The 16th ACM Internet Measurement Conference 2016 (ACM IMC 2016), 14-16 November 2016, Santa Monica, CA, USA

7. Iñaki Ucar, Carlos Donato, Pablo Serrano, Andres Garcia-Saavedra, Arturo Azcorra, Albert Banchs (November 2016)
Revisiting 802.11 Rate Adaptation from Energy Consumption's Perspective (Paper)
In: The 19th ACM International Conference on Modeling Analysis and Simulation of Wireless and Mobile Systems (ACM MSWIN 2016), 13-17 November 2016, Malta, Malta

8. Narseo Vallina-Rodriguez, Srikanth Sundaresan, Abbas Razaghpanah, Rishab Nithyanand, Mark Allman, Christian Kreibich, Phillipa Gill (November 2016)
Tracking the Trackers: Towards Understanding the Mobile Advertising and Tracking Ecosystem (Paper)
In: Workshop on Data and Algorithmic Transparency (DAT 2016), in conjunction with the Data Transparency Lab Conference and the FATML 2016 Workshop, 19 November 2016, New York, NY, USA

9. Christian Vitale, Vincenzo Mancuso (November 2016)
Energy Efficiency in Mixed Access Networks (Paper)
In: The 19th ACM International Conference on Modeling Analysis and Simulation of Wireless and Mobile Systems (ACM MSWIN 2016), 13-17 November 2016, Malta, Malta

10. **Nicola Bui, Joerg Widmer (October 2016)**

OWL: a Reliable Online Watcher for LTE Control Channel Measurements (Paper)

In: The 6th Workshop on All Things Cellular: Operations Applications and Challenges, The 22nd Annual International Conference on Mobile Computing and Networking (ACM MobiCom 2016), 3-7 October 2016, New York, USA

11. **Evgenia Christoforou, Antonio Fernández Anta, Kishori Konwar, Nicolas Nicolaou (October 2016)**

Evaluating Reliability Techniques in the Master-Worker Paradigm (Paper)

In: The 15th IEEE International Symposium on Network Computing and Applications (NCA 2016), 31 October - 2 November 2016, Boston, Cambridge, Massachusetts, USA

12. **Adrian Loch, Guillermo Bielsa, Joerg Widmer (October 2016)**

Practical Lower Layer 60 GHz Measurements Using Commercial Off-The-Shelf Hardware (Paper)

In: The 10th ACM International Workshop on Wireless Network Testbeds Experimental evaluation & CHaracterization (ACM WiNTECH 2016), The 22nd Annual International Conference on Mobile Computing and Networking (ACM MobiCom 2016), 3-7 October 2016, New York City, NY, USA

13. **Francesca Meneghello, Filippo Campagnaro, Roee Diamant, Paolo Casari, Michele Zorzi (October 2016)**

Design and Evaluation of a Low-Cost Acoustic Chamber for Underwater Networking Experiments (Paper)

In: The 11th ACM International Conference on Underwater Networks & Systems (ACM WUWNet 2016), 24–26 October 2016, Shanghai, China

14. **Nicolas Nicolaou, Antonio Fernández Anta, Chryssis Georgiou (October 2016)**

CoVer-ability: Consistent Versioning in Asynchronous, Fail-Prone, Message-Passing Environments (Paper)

In: The 15th IEEE International Symposium on Network Computing and Applications (NCA 2016), 31 October - 2 November 2016, Boston, Cambridge, Massachusetts, USA

15. **José A. Ruipérez-Valiente, Pedro J. Muñoz-Merino, Carlos Delgado Kloos (October 2016)**

An analysis of the use of badges in an educational experiment (Paper)

In: The 46th Annual Frontiers in Education Conference (FIE 2016), 12-15 October 2016, Erie, PA, USA

16. **M. Isabel Sanchez, Antonio De la Oliva, Vincenzo Mancuso (October 2016)**

Experimental Evaluation of an SDN-based Distributed Mobility Management Solution (Paper)

In: The 11th International Workshop on Mobility in the Evolving Internet Architecture (MobiArch 2016), 3-7 October 2016, New York, NY, USA

17. **Elizaveta Dubrovinskaya, Ivor Nissen, Paolo Casari (September 2016)**

On the Accuracy of Passive Multipath-Aided Underwater Range Estimation (Paper)

In: Underwater Communications and Networking (UComms 2016), 30 August 2016 - 01 September 2016, Lerici, Italy

18. **Antonio Fernández Anta, Chryssis Georgiou, Miguel A. Mosteiro, Daniel Pareja (September 2016)**

Multi-round Master-Worker Computing: a Repeated Game Approach (Paper)

In: The 35th Symposium on Reliable Distributed Systems (SRDS 2016), 26-29 September 2016, Budapest, Hungary

19. **Joan Palacios, Danilo De Donno, Domenico Giustiniano, Joerg Widmer (September 2016)**

Speeding Up mmWave Beam Training through Low-Complexity Hybrid Transceivers (Paper)

In: The 27th Annual IEEE International Symposium on Personal Indoor and Mobile Radio Communications (IEEE PIMRC 2016), 4-7 September 2016, Valencia, Spain

20. **Gianluca Rizzo, Marco Ajmone Marsan (September 2016)**

QoS-Aware CAPEX Minimization in Urban Off-Grid Radio Access Networks (Paper)

In: The IEEE 24th International Symposium on Modelling Analysis and Simulation of Computer and Telecommunication Systems (MASCOTS 2016), 19-21 September 2016, London, UK

21. **Florent Becker, Antonio Fernández Anta, Ivan Rapaport, Eric Rémila (August 2016)**

The effect of range and bandwidth on the round complexity in the congested clique model (Paper)

In: The 22nd International Computing and Combinatorics Conference (COCOON 2016), 2-4 August 2016, Ho Chi Minh City, Vietnam

22. **Filippo Campagnaro, Roberto Francescon, Federico Guerra, Federico Favaro, Paolo Casari, Roee Diamant, Michele Zorzi (August 2016)**

The DESERT Underwater Framework v2: Improved Capabilities and Extension Tools (Paper)

In: The 3rd Underwater Communicatios and Networking Conference (UComms 2016), 30 August 2016 - 01 September 2016, Lerici, Italy

23. **Yonas Mitike Kassa, Jose Gonzalez, Angel Cuevas, Rubén Cuevas, Miriam Marciel, Roberto González (August 2016)**

Your Data in the Eyes of the Beholders: Design of a Unified Data Valuation Portal to Estimate Value of Personal Information from Market Perspective (Paper)

In: The 11th International Conference on Availability, Reliability and Security (ARES 2016), 31 Aug – 2 Sep 2016, Salzburg, Austria

24. **Miriam Marciel, Jose Gonzalez, Yonas Mitike Kassa, Roberto Gonzalez, Mohamed Ahmed (August 2016)**

The Value of Online Users: Empirical Evaluation of the Price of Personalized Ads (Paper)

In: The 11th International Conference on Availability, Reliability and Security (ARES 2016), 31 Aug – 2 Sep 2016, Salzburg, Austria

25. Hany Assasa, Adrian Loch, Joerg Widmer (June 2016)

Packet Mass Transit: Improving Frame Aggregation in 60 GHz Networks (Paper)

In: The 17th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal

26. Hany Assasa, Joerg Widmer (June 2016)

Implementation and Evaluation of a WLAN IEEE 802.11ad Model in ns-3 (Paper)

In: The Workshop on ns-3 (WNS3 2016), 15-16 June 2016, Seattle, WA, USA

27. Vincenzo Mancuso, Arash Asadi, Peter Jacko (June 2016)

Tie-breaking Can Maximize Fairness without Sacrificing Throughput in D2D-assisted Networks (Paper)

In: The 17th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal

28. Alain Olivier, Guillermo Bielsa, Irene Tejado, Michele Zorzi, Joerg Widmer, Paolo Casari (June 2016)

Lightweight Indoor Localization for 60-GHz Millimeter Wave Systems (Paper)

In: IEEE International Conference on Sensing Communication and Networking (SECON 2016), 27-30 June, London, UK

29. Gek Hong Sim, Rui Li, Paul Patras, Cristina Cano, David Malone, Joerg Widmer (June 2016)

Learning from Experience: Efficient Decentralized Scheduling for 60GHz Mesh Networks (Paper)

In: The 17th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal

30. Javier Suárez, Iván Vidal, Jaime José García-Reinoso, Francisco Valera, Arturo Azcorra (June 2016)

Exploring the Use of RPAs as 5G Points of Presence (Paper)

In: The 25th European Conference on Networks and Communications (EuCNC 2016), 27-30 June 2016, Athens, Greece

31. **Angelos Chatzipapas, Vincenzo Mancuso (May 2016)**

Measurement-Based Coalescing Control for 802.3az (Paper)

In: IFIP Networking 2016, 17-19 May 2016, Vienna, Austria

32. **Evgenia Christoforou, Antonio Fernández Anta, Chryssis Georgiou, Miguel A. Mosteiro (May 2016)**

Internet Computing: Using Reputation to Select Workers from a Pool (Paper)

In: The 4th International Conference on NETworked sYStems (NETYS 2016), 18-20 May 2016, Marrakesh, Morocco

33. **Danilo De Donno, Joan Palacios, Domenico Giustiniano, Joerg Widmer (May 2016)**

Hybrid Analog-Digital Beam Training for mmWave Systems with Low-Resolution RF Phase Shifters (Paper)

In: International Workshop on 5G RAN Design, in conjunction with the IEEE International Conference on Communications (ICC 2016), 27 May 2016 , Kuala Lumpur, Malaysia

34. **Aymen Fakhreddine, Domenico Giustiniano, Vincent Lenders (May 2016)**

Evaluation of Self-Positioning Algorithms for Time-of-Flight based Localization (Paper)

In: The 14th International Symposium on Modeling and Optimization in Mobile Ad Hoc and Wireless Networks (WiOpt 2016), 9-13 May 2016, Tempe, Arizona, USA

35. **Marco Gramaglia, Ignacio Digon, Vasilis Friderikos, Dirk von Hugo, Christian Mannweiler, Miguel A. Puente, Konstantinos Samdanis, Bessem Sayadi (May 2016)**

Flexible connectivity and QoE/QoS management for 5G Networks: The 5G NORMA view (Paper)

In: The IEEE International Conference on Communications (ICC 2016) , 23-27 May 2016, Kuala Lumpur, Malaysia

36. **Giuseppe Leonardi, Michela Meo, Marco Ajmone Marsan (May 2016)**

Markovian models of solar power supply for a LTE macro BS (Paper)

In: The IEEE International Conference on Communications (ICC 2016) , 23-27 May 2016, Kuala Lumpur, Malaysia

37. **Adrian Loch, Irene Tejado, Joerg Widmer (May 2016)**

Potholes Ahead: Impact of Transient Link Blockage on Beam Steering in Practical mm-Wave Systems (Paper)

In: European Wireless Conference 2016 (EW 2016), 18-20 May, Oulu, Finland

38. **Bessem Sayadi, Marco Gramaglia, Vasilis Friderikos, Dirk von Hugo, Paul Arnold, Marie-Line Alberi-Morel, Miguel A. Puente, Vincenzo Sciancalepore, Ignacio Digon, Marcos Rates Crippa (May 2016)**

SDN for 5G Mobile Networks: NORMA Perspective (Paper)

In: The 10th Competition Law and Economics European Network (CLEEN) Workshop, 24-25 May 2016, Max Planck Institute for Research on Collective Goods, Bonn, Germany

39. **Arash Asadi, Vincenzo Mancuso, Rohit Gupta (April 2016)**

An SDR-based Experimental Study of Outband D2D Communications (Paper)

In: The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, USA

40. **Filippo Campagnaro, Federico Guerra, Paolo Casari, Roee Diamant, Michele Zorzi (April 2016)**

Implementation of a Multi-modal Acoustic-Optic Underwater Network Protocol Stack (Paper)

In: MTS/IEEE OCEANS 2016, 10-13 April 2016, Shanghai, China

41. Pavel Chuprikov, Sergey Nikolenko, Kirill Kogan (April 2016)

On Demand Elastic Capacity Planning for Service Auto-Scaling (Paper)

In: The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, USA

42. Roee Diamant, Paolo Casari, Michele Zorzi (April 2016)

A TDMA-based MAC Protocol Exploiting the Near-Far Effect in Underwater Acoustic Networks (Paper)

In: MTS/IEEE OCEANS 2016, 10-13 April 2016, Shanghai, China

43. Roderick Fanou, Gareth Tyson, Pierre Francois, Arjuna Sathiaseelan (April 2016)

Pushing the Frontier: Exploring the African Web Ecosystem (Paper)

In: The 25th International World Wide Web Conference (WWW 2016), 11-15 April 2016, Montreal, Canada

44. Adrian Loch, Gek Hong Sim (April 2016)

Millimeter-Wave Blind Spots: Mitigating Deafness Collisions Using Frame Aggregation (Paper)

In: Millimeter-wave Networking Workshop 2016, The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, USA

45. Miriam Marciel, Rubén Cuevas, Albert Banchs, Roberto González, Stefano Traverso, Mohamed Ahmed, Arturo Azcorra (April 2016)

Understanding the Detection of View Fraud in Video Content Portals (Paper)

In: The 25th International Conference on World Wide Web (WWW 2016), 11-15 April 2016, Montreal, Canada

46. Sergey Nikolenko, Kirill Kogan, Gábor Rétvári, Erika R. Bérczi-Kovács, Alexander Shalimov (April 2016)

How to Represent IPv6 Forwarding Tables on IPv4 or MPLS Dataplanes (Paper)

In: The 19th IEEE Global Internet Symposium (IEEE GI 2016), The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016 , San Francisco, CA, USA

47. Emmanuel S. Peters, Nicholas F. Maxemchuk (April 2016)

Privacy in the Cloud: Anonymous Tax Preparation (Paper)

In: The 2nd IEEE International Conference on Big Data Security on Cloud (BigDataSecurity 2016), IEEE International Conference on High Performance and Smart Computing (HPSC 2016), IEEE International Conference on Intelligent Data and Security (IDS 2016), 8-10 April 2016, New York City, NY, USA

48. José A. Ruipérez-Valiente, Giora Alexandron, Zhongzhou Chen, David E. Pritchard (April 2016)

Using Multiple Accounts for Harvesting Solutions in MOOCs (Paper)

In: The 3rd ACM Conference on Learning @ Scale (L@S 2016), 25-26 April 2016, Edinburgh, Scotland, UK

49. José A. Ruipérez-Valiente, Pedro J. Muñoz-Merino, Carlos Delgado Kloos (April 2016)

Analyzing students' intentionality towards badges within a case study using Khan academy (Paper)

In: The 6th International Conference on Learning Analytics & Knowledge (LAK 2016), 25-29 April 2016, Edinburgh, Scotland, UK

50. Ali Safari Khatouni, Marco Ajmone Marsan, Marco Mellia (April 2016)

Video upload from public transport vehicles using multihomed systems (Paper)

In: Computer Communications Workshops (INFOCOM WKSHPS), in conjunction with the 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, USA

51. Miurel Tercero, Peter von Wrycza, Aditya Amah, Joerg Widmer, Maria Fresia, Valerio Frascolla, Javier Lorca, Tommy Svensson, Marie-Hélène Hamon, Sandrine Destouet Roblot, Arnesh Vijay, Michael Peter, Victoria Sgardoni, Mythri Hunukumbure, Jian Luo, Nikola Vucic (April 2016)

5G systems: The mmMAGIC project perspective on Use cases and Challenges between 6-100 GHz (Paper)

In: Workshop on Millimeter Wave-Based Integrated Mobile Communications for 5G Networks (mmW5G-Workshop), The IEEE Wireless Communications and Networking Conference (IEEE WCNC 2016), 3-6 April 2016, Doha, Qatar

52. Kirill Kogan, Danushka Menikkumbura, Gustavo Petri, YoungTae Noh, Sergey Nikolenko, Patrick Eugster (March 2016)

BASEL (Buffer mAnagement SpEcification Language) (Paper)

In: The 12th ACM/IEEE Symposium on Architectures for Networking and Communications Systems (ANCS 2016), The 13th USENIX Symposium on Networked Systems Design and Implementation (NSDI 2016), 17-18 March 2016, Santa Clara, CA, USA

53. Milad Heydariaan, Shengrong Yin, Omprakash Gnawali, Daniele Puccinelli, Domenico Giustiniano (February 2016)

Embedded Visible Light Communication: Link Measurements and Interpretation (Paper)

In: MadCom: New Wireless Communication Paradigms for the Internet of Things, International Conference on Embedded Wireless Systems and Networks (EWSN 2016), 15-17 February 2016, TU Graz, Austria

PhD Theses [10]

1. Pradeep Bangera (November 2016)

Competition and Cooperation Between Service Providers in the Internet Economic Ecosystem

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain Supervisor: Dr. Sergey Gorinsky, IMDEA Networks Institute, Madrid, Spain

2. Angelos Chatzipapas (November 2016)

Optimization of Energy Efficiency in Data and Web Hosting Centers

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain Supervisor: Dr. Vincenzo Mancuso, IMDEA Networks Institute, Madrid, Spain

3. Elli Zavou (September 2016)

Online Scheduling in Fault-prone Systems: Performance Optimization and Energy Efficiency

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain Supervisor: Dr. Antonio Fernández Anta, IMDEA Networks Institute, Madrid, Spain

4. Syed Hasan (June 2016)

The Role of Topology and Contracts in Internet Content Delivery

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain Supervisor: Dr. Sergey Gorinsky, IMDEA Networks Institute, Madrid, Spain

5. Juan Camilo Cardona (May 2016)

Inter-domain traffic management in an evolving Internet peering ecosystem

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain Supervisor: Dr. Pierre Francois, Cisco Systems

6. Qing Wang (May 2016)

Visbile Light and Device-to-Device Communications: System Analysis and Implementation

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain Supervisor: Dr. Domenico Giustiniano, IMDEA Networks Institute, Madrid, Spain

7. Pablo Salvador (April 2016)

Efficient voice and video traffic delivery in IEEE 802.11 WLANs: design, implementation and experimental evaluation

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Dr. Pablo Serrano, Universidad Carlos III de Madrid, Spain

8. Arash Asadi (March 2016)

Opportunistic Device-To-Device Communication In Cellular Networks: From Theory To Practice

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Dr. Vincenzo Mancuso, IMDEA Networks Institute, Madrid, Spain

9. M. Isabel Sanchez (March 2016)

Analysis, Design and Experimental Evaluation of Connectivity Management in Heterogeneous Wireless Environments

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Dr. Antonio De la Oliva, Universidad Carlos III de Madrid, Spain

10. Gek Hong Sim (March 2016)

Algorithm Design for Scheduling and Medium Access Control in Heterogeneous Mobile Networks

Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Dr. Joerg Widmer, IMDEA Networks Institute, Madrid, Spain

Masters Theses [6]

1. Patricia Callejo (September 2016)

Auditing Methodology to Assess the Quality of Online Display Advertising Campaigns

Masters thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Dr. Rubén Cuevas, Universidad Carlos III de Madrid, Spain

2. Nuria Molner (September 2016)

Optimization of an integrated fronthaul/backhaul network for hard real-time traffic

Masters thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisors: Dr. Arturo Azcorra, IMDEA Networks Institute, Madrid, Spain / Universidad Carlos III de Madrid, Spain. Dr. Antonio De la Oliva, Universidad Carlos III de Madrid, Spain

3. Guillermo Bielsa (July 2016)

Analysis of off-the-shelf Millimeter Wave Systems with Phased Antenna Arrays

Masters thesis, Department of Signal Theory and Communications, Universidad Carlos III de Madrid, Spain
Supervisor: Dr. Joerg Widmer, IMDEA Networks Institute, Madrid, Spain

4. Joan Palacios (July 2016)

Hybrid Analog-Digital mmWave Systems wi tBhe Laomw T-Rraeisnoilnugt ifoonr RF Phase Shifters

Masters thesis, Department of Signal Theory and Communications, Universidad Carlos III de Madrid, Spain
Supervisor: Dr. Joerg Widmer, IMDEA Networks Institute, Madrid, Spain

5. Antonio Pastor Valles (September 2016)

An entropy-based methodology for detecting Online Advertising Fraud at scale

Masters thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisors: Dr. Arturo Azcorra, IMDEA Networks Institute, Madrid, Spain / Universidad Carlos III de Madrid, Spain. Dr. Rubén Cuevas, Universidad Carlos III de Madrid, Spain

6. Maurizio Rea (July 2016)

Filtering Noisy 802.11 Time-of-Flight Ranging Measurements from Commoditized WiFi Radios

Masters thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisors: Dr. Arturo Azcorra, IMDEA Networks Institute, Madrid, Spain / Universidad Carlos III de Madrid, Spain. Dr. Domenico Giustiniano, IMDEA Networks Institute, Spain

5.3. Scientific service

IMDEA Networks conducts its scientific activities with the final objective of ensuring the widest possible dissemination of the results of the work carried out by the Institute, both within the scientific community and towards the general public. Our scientific service includes participation by our researchers at different levels of involvement in leading conferences and journals in the field, R&D committees, standardization bodies, awards, publications, projects or sponsorships.

Marco AJMONE MARSAN

Professional posts & activities
- Vice-Director: "Alta Scuola Politecnica", Technical universities of Milan and Turin (Italy)
- Coordinator: PhD program in Electronic Engineering, Politecnico di Torino,Italy
- Member: IEEE EPPI (European Public Policy Initiative) ICT Working Group
- Scientific Committee Member: FBK (Fondazione Bruno Kessler - Trento), Italy

Journal editorial boards
- Editorial Board member: Computer Networks Journal (Elsevier)
- Editorial Board member: Performance Evaluation Journal (Elsevier)
- Editorial Board member: The ACM Transactions on Modeling and Performance Evaluation of Computing Systems Journal (ACM ToMPECS)

Technical Program Committee (TPC) memberships
- The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA
- The 25th IEEE International Conference on Network Protocols (ICNP 2017), 10-13 October 2017, Toronto, Canada

Arturo AZCORRA

Professional posts & activities

- Steering Board Vice-Chairman: 5TONIC Laboratory, October 2015 – present
- Chairman: Expert Advisory Group of the NetWorld2020 European Technology Platform (ETP), May 2015 – present
- Partnership Board member and member of «Vision Group»: 5G Infrastructure Association, August 2014 – present
- Steering Board member: NetWorld2020 European Technology Platform (ETP) (formerly Net!Works & ISI ETPs), October 2013 – February 2017
- Member: Advanced 5G Network Infrastructure Association, December 2013 – present
- Member: Board of Mentors of the entrepreneurial association "The Heroes Club", May 2013 – present
- Advisory Board member: Future Internet PPP, European Commission, February 2012 – December 2017
- Member of the Board of Directors: PhD School, University Carlos III of Madrid, December 2013 – present
- Member of the Executive Committee: Doctorate School of University Carlos III of Madrid, December 2015 – present
- Member of the European Scientific Mission to Korea for international collaboration on 5G Research, 10–14 October 2016
- Member of the European Scientific Mission to Brazil for international collaboration on 5G Research, 18–23 September 2016
- Member of ACM-SIGCOMM, 2007 – present

TPC memberships

- The 37th IEEE International Conference on Computer Communications (IEEE INFOCOM 2018), 15–19 April 2018, Honolulu, Hawaii, USA
- The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1–4 May 2017, Atlanta, Georgia, USA
- Workshop «On-the-fly services in on-the-fly mobile infrastructures» (OSOMI 2016), 5 July 2016, in conjunction with the 17th ACM International Symposium on Mobile Ad Hoc Networking and Computing (ACM MobiHoc 2016), 5-8 July 2016, Paderborn, Germany
- The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10–15 April 2016, San Francisco, California, USA

Albert BANCHS

Professional posts & activities

- Steering Board member: the IEEE Online Conference on Green Communications (IEEE OnlineGreenComm), 2014-present
- IEEE Senior Member
- IEEE Distinguished Lecturer. IEEE Communications Society

Journal editorial boards

- Editor: IEEE Transactions on Wireless Communications, 2014 – present
- Editor: IEEE/ACM Transactions on Networking, 2016 – present
- Guest editor, Special issue on «Network Slicing in 5G systems», IEEE Communications Magazine

Organization committees

- TPC Co-Chair: International Workshop on Cloud Technologies and Energy Efficiency in Mobile Communication Networks (CLEEN 2016), May 2016, Grenoble, France
- General Co-Chair: The 3rd International Workshop on 5G Architecture (5GArch 2016), in conjunction with the IEEE International Conference on Communications (ICC 2016), 23-27 May 2016, Kuala Lumpur, Malaysia

TPC memberships

- The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, CA, USA
- The 17th IEEE International Symposium on a World of Wireless Mobile and Multimedia Networks (IEEE WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal
- The 84th IEEE Vehicular Technology Conference (VTC Fall 2016), 18-21 September 2016, Montreal, Canada
- The 27th Annual IEEE International Symposium on Personal Indoor and Mobile Radio Communications (IEEE PIMRC 2016), 4-7 September 2016, Valencia, Spain
- The 13th IEEE International Conference on Sensing Communication and Networking (SECON 2016), 27-30 June, London, UK
- The 28th International Teletraffic Congres (ITC 28), 12-16 September 2016, Würzburg, Germany
- The 25th European Conference on Networks and Communications (EuCNC 2016), 27-30 June 2016, Athens, Greece

Paolo CASARI

Journal editorial boards

- Named «Excellent Reviewer» by the Editorial Board of the IEEE Journal of Oceanic Engineering
- Reviewer for COST actions, 2017
- Co-Guest Editor: Special Section on «Underwater Wireless Communications and Networking», IEEE Access Journal

Organization committees

- Co-organizer: The 9th IMDEA Networks Annual International Workshop, 7-8 June 2017, Madrid, Spain
- Local arrangements chair: The 15th International Conference on Embedded Wireless Systems and Networks (EWSN 2018), 14-16 February 2018, Madrid, Spain

TPC memberships

- The IEEE International Conference on Communications (ICC 2017), 21-25 May 2017, Paris, France
- M2M Communications and the Internet of Things Workshop (M2M IOT 2017), in conjunction with the IEEE Wireless Communications and Networking Conference (IEEE WCNC 2017), 19-22 March 2017, San Francisco, CA, USA
- The 2017 IEEE 86th Vehicular Technology Conference (VTC2017-Fall), 24-27 September 2017, Toronto, Canada
- The IEEE Global Communications Conference Exhibition & Industry Forum (IEEE GLOBECOM 2017), 4-8 December 2017, Singapore

Danilo DE DONNO

Journal editorial boards

- Associate Editor: International Journal on Distributed Sensor Networks

Other activities

- Within the framework of the mmMAGIC project co-funded by the European Commission's 5G PPP program, he holds the leadership of Task 4.3 "Efficient Access Schemes" in Work Package 4 (WP4) "Radio Interface Definitions and Functions"

Antonio FERNÁNDEZ ANTA

Professional posts & activities

- Evaluator: national call for research projects, Spanish Ministry of Economy and Competitiveness (MINECO) (Retos y Excelencia 2015)
- Evaluator: project proposals for the Spanish National Evaluation and Foresight Agency (ANEP – Agencia Nacional de Evaluación y Prospectiva)
- Evaluator: Chilean National Fund for Scientific and Technological Development (FONDECYT - Fondo Nacional de Desarrollo Científico y Tecnológico)
- Evaluator: project proposals for the BBVA Foundation, July 2016
- Book proposal evaluator: Wiley publishing company, 2016
- Member of the Board of Directors of the Spanish Association for the Study of Complex Socio-technological Systems (COMSOTEC - Asociación para el estudio de Sistemas Complejos Sociotecnológicos), February 2015 - present
- "Vocal Primero" (Main Chairperson) of the Spanish Association on Parallel and Distributed Computing (SCCD - Sociedad de Computación Concurrente y Distribuida) (June 2015 – present), responsible for the organization of the annual event «Jornadas de Concurrencia y Sistemas Distribuidos»
- Signature of MoU together with Business Integration Partners (BIP), March 2016, Madrid, Spain

Journal editorial boards

- Editor: The Computer Journal (Oxford Journals), July 2015 - present

Organization committees

- Member of the Executive Committee of the Spanish Cibersecurity Research National Conferences (JNIC - Jornadas Nacionales de Investigación en Ciberseguridad)
- «Experiments & Applications» Track Chair: of The 12th International Symposium on Algorithms and Experiments for Wireless Sensor Networks (ALGOSENSORS 2016), 25-26 August 2016, Aarhus, Denmark
- «Distributed Algorithms & Theory» Track Chair: The 36th IEEE International Conference on Distributed Computing Systems (ICDCS 2016), June 2016, Nara, Japan
- Organization Committee Member: The 20th International Conference on Principles of Distributed Systems (OPODIS 2016), 13-16 December 2016, Madrid, Spain

TPC Memberships

- The 28th ACM Symposium on Parallelism in Algorithms and Architectures (SPAA 2016), 24-26 July 2017, Washington D.C., USA
- The 35th Symposium on Reliable Distributed Systems (SRDS 2016), 26-29 September 2016, Budapest, Hungary
- The 5th International Conference on Smart Cities and Green ICT Systems (SMART-GREENS 2016), 23-25 April 2016, Rome, Italy
- The 2nd IEEE Workshop on Pervasive Energy Services 2016 (PerEnergy 2016), 14 March 2016, Sydney, Australia

- The 13th annual conference on Theory and Applications of Models of Computation (TAMC 2016), 20-22 April, Bern, Switzerland
- The 11th International Conference on Availability, Reliability and Security (ARES 2016), 31 August – 2 September 2016, Salzburg, Austria
- XXIV Jornadas de Concurrencia y Sistemas Distribuidos (JCSD 2016),15 -17 June 2016, Granada, Spain

Claudio FIANDRINO

TPC Memberships

- The IEEE International Conference on Communications (ICC 2017), 21-25 May 2017, Paris, France
- The 12th ACM International Symposim on QoS and Security for Wireless and Mobile Networks (Q2SWinet 2016), 13-17 November 2016, Malta
- The 1st IEEE International Conference on Emerging Technologies and Innovative Business Practices for the Transformation of Societies (EmergiTech 2016), 1-6 August 2016, Mauritius
- The International Workshop on Green ICT and Smart Networking (GISN 2016), 4 November 2016, in conjunction with the International Conference on Network and Service Management (CNSM 2016), 31 October – 4 November 2016, Montreal, Quebec, Canada

Domenico GIUSTINIANO

Organization committees

- General co-chair: The 15th International Conference on Embedded Wireless Systems and Networks (EWSN 2018), 14-16 February 2018, Madrid, Spain
- Co-chair of Demo Session: The 23rd Annual International Conference on Mobile Computing and Networking (ACM MobiCom 2017), 26-20 October 2017, Snowbird, Utah, USA
- Chair: The International Workshop on New Wireless Communication Paradigms for the Internet of Things (MadCom 2017 Workshop), in conjunction with the 14th International Conference on Embedded Wireless Systems and Networks (EWSN 2017), 20-22 February 2017, Uppsala, Sweden

TPC Memberships

- The 13th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea
- Poster and Demo Session: The Annual Conference of the ACM Special Interest Group on Data Communication (SIGCOMM) on the applications, technologies, architectures, and protocols for computer communication (ACM SIGCOMM 2016)
- The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, Georgia, USA

- The 3rd ACM Workshop on Visible Light Communication Systems (VLCS 2016), in conjunction with the 22nd Annual International Conference on Mobile Computing and Networking (ACM MobiCom 2016), 3-7 October 2016, New York, USA
- The 11th Workshop on Challenged Networks (CHANTS 2016), in conjunction with ACM MobiCom 2016
- The 10th ACM International Workshop on Wireless Network Testbeds, Experimental Evaluation and Characterization (WiNTECH 2016), in conjunction with ACM MobiCom 2016
- The 15th IFIP Networking 2016 Conference (NETWORKING 2016), 17-19 May 2016, Vienna, Austria
- The IEEE/IFIP Wireless Days Conference 2016, 23-25 March 2016, Toulouse, France
- MadCom 2016 Workshop, in conjunction with the 13th International Conference on Embedded Wireless Systems and Networks (EWSN 2016), 15-17 February 2016, Graz, Austria

Sergey GORINSKY

Professional posts & activities
- Co-coordinator: IMDEA Networks-UC3M research seminar series

Organization committees
- General Co-Chair: The 31st Annual Conference of the ACM Special Interest Group on Data Communication (SIGCOMM) on the applications technologies architectures and protocols for computer communication (ACM SIGCOMM 2018), 20-24 August 2018, Budapest, Hungary
- General Co-Chair: The 9th International Conference on COMmunication Systems and NETworkS (COMSNETS 2017), 4-8 January 2017, Bangalore, India
- TPC Co-Chair: The 25th IEEE International Conference on Network Protocols (ICNP 2017), 10-13 October 2017, Toronto, Canada
- Publication Chair: The 30th Annual Conference of the ACM Special Interest Group on Data Communication (SIGCOMM) on the applications technologies architectures and protocols for computer communication (ACM SIGCOMM 2017), 21-25 August 2017, Los Angeles, USA
- Steering Committee Member: COMSNETS Association, a steering committee for COMSNETS conferences
- TPC Track Co-Chair: The 26th International Conference on Computer Communication and Networks (ICCCN 2017), 31 July - 3 August 2017, Vancouver, Canada

TPC Memberships
- Distinguished Member: IEEE INFOCOM 2016, 10-15 April 2016, San Francisco, USA & IEEE INFOCOM 2017, 1-4 May 2017, Atlanta, USA
- The 13th ACM International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea

- The 29th Annual Conference of the ACM Special Interest Group on Data Communication (SIGCOMM) on the applications technologies architectures and protocols for computer communication (ACM SIGCOMM 2016), 22-26 August 2016, Florianópolis, Brazil
- The 5th International Conference on Cloud Engineering (IC2E 2017), 4-7 April 2017, Vancouver, Canada
- The 18th International Conference on Passive and Active Measurement (PAM 2017), 30-31 March 2017, Sidney, Australia
- The 12th ACM International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2016), 12-15 December 2016, Irvine, USA
- The 24th IEEE International Conference on Network Protocols (ICNP 2016), 8-11 November 2016, Singapore
- The 12th Asian Internet Engineering Conference (AINTEC 2016), 30 November - 2 December 2016, Bangkok, Thailand
- IFIP Networking 2016, 17-19 May 2016, Vienna, Austria
- The 28th International Teletraffic Congress (ITC 28), 12-16 September 2016, Würzburg, Germany

Marco GRAMAGLIA

TPC Memberships
- The 6th IEEE Online Conference on Green Communications (OnlineGreenComm 2016), 14-17 November 2016

Kirill KOGAN

TPC Memberships
- The 25th annual edition of the IEEE International Conference on Network Protocols (IEEE ICNP 2017), 10-13 October 2017, Toronto, Canada
- The 25th IEEE Annual Symposium on High-Performance Interconnects (HOTI 2017), 28-30 August 2017, Santa Clara, California, USA
- The 18th IEEE International Conference on High Performance Switching and Routing (HPSR 2017), 18-21 June 2017, Campinas, Brazil
- The 9th International Conference on COMmunication Systems and NETworkS (COMSNETS 2017), 4-8 January 2017, Bangalore, India
- The 8th IEEE International Conference and Workshops on Cloud Computing Technology and Science (CloudCom 2016) 12-15 December 2016, Luxembourg
- The 24th International Symposium on High Performance Interconnects (HotI 2016), 24-26, August 2016, Santa Clara, CA, USA
- The IEEE 17th International Conference on High Performance Switching and Routing (HPSR 2016), 14-17 July 2016, Yokohama, Japan
- The 36th IEEE International Conference on Distributed Computing Systems (ICDCS 2016), 27-30 June 2016, Nara, Japan

- The 2nd IEEE Conference on Network Softwarization (NetSoft 2016), 6-10 June 2016, Seoul, South Korea
- The 9th ACM International Systems and Storage Conference (SYSTOR 2016), 6-8 June 2016, Haifa, Israel
- The 19th IEEE Global Internet Symposium (GI 2016), 11 April 2016, in conjunction with IEEE INFOCOM 2016, 10-15 April 2016, San Francisco, CA, USA
- The 1st International Workshop on Software-Driven Flexible and Agile Networking (SWFAN 2016), 11 April 2016, in conjunction with IEEE INFOCOM 2016, 10-15 April 2016, San Francisco, CA, USA
- The 8th International Conference on COMmunication Systems and NETworkS (COM-SNETS 2016), 5-9 January 2016, Bangalore, India

Adrian LOCH

Organization committees
- EDAS Chair: Millimeter-wave Networking Workshop (mmNet2016), 11 April 2016, in conjunction with IEEE INFOCOM 2016, 10-15 April 2016, San Francisco, USA

Vincenzo MANCUSO

Professional posts & activities
- PhD opponent for doctoral thesis defense: "Small world for dynamic wireless cyber-physical systems", by Juhani Latvakoski, 1 December 2016, University of Oulu, Finland
- PhD defense committee member: "Online Scheduling in Fault-prone Systems: Performance Optimization and Energy Efficiency", by Elli Zavou, 30 September 2016, University Carlos III of Madrid, Spain
- Evaluation Board Member: EU project MONROE Open Call 2

Journal editorial boards
- Editor: IEEE Wireless Communications – Special Issue on «Device-to-Device (D2D) Communications with Social Awareness», 2016
- Editor: Special issue on «D2D-based offloading techniques of Elsevier Physical Communication», 2016

Organization committees
- Demos/Posters Chair: The 16th IFIP Networking 2017 Conference (NETWORKING 2017), Stockholm, Sweden, 12-15 June 2017, Stockholm, Sweden
- Publicity Chair: The 5th International Workshop on Cloud Technologies and Energy Efficiency in Mobile Communication Networks (CLEEN 2017), 22 June 2017, Turin, Italy

TPC Memberships

- IEEE/IFIP Workshop on Mobile Network Measurements (MNM 2017), 20 June 2017, in conjunction with the 1st Network Traffic Measurement and Analysis Conference (TMA 2017), 21-23 June 2017, Dublin, Ireland
- The 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (IEEE WoWMoM 2017), 12-15 June 2017, Macau, China
- The 16th IFIP Networking 2017 Conference (NETWORKING 2017), Stockholm, Sweden, 12-15 June 2017, Stockholm, Sweden
- The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1–4 May 2017, Atlanta, Georgia, USA
- The 2017 IEEE Conference on Standards for Communications and Networking (IEEE CSCN 2017), 23 April 2017, Helsinki, Finland
- The 28th International Teletraffic Congress (ITC 2016), 12-16 September 2016, Würzburg, Germany
- The 12th International Symposium on Algorithms and Experiments for Wireless Sensor Networks, (ALGOSENSORS 2016), 25-26 August 2016, Aarhus, Denmark
- The 5th International Conference on Smart Cities and Green ICT Systems (SMART-GREENS 2016), 23–25 April 2016, Roma, Italy
- The 1st International INFOCOM Workshop on Software-Driven Flexible and Agile Networking (SWFAN 2016), in conjunction with IEEE INFOCOM 2016, 10-15 April, San Francisco, CA, USA
- The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, California, USA

Narseo VALLINA-RODRIGUEZ

Organization committees

- Co-organizer: The 9th IMDEA Networks Annual International Workshop, 7-8 June 2017, Madrid, Spain

TPC Memberships

- The 17th International Conference on Passive and Active Network Measurement Conference (PAM 2016), 31 March – 1 April 2016, Heraklion, Crete, Greece
- CoNEXT Student Workshop, 12 December 2016, in conjunction with the 12th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2016), 12-15 December 2016, Irvine, California, USA

Christian VITALE

TPC Memberships

- The 2nd International Workshop on Edge Computing (EdgeCom 2017), 8 January 2017, in conjunction with the 14th Annual IEEE Consumer Communications & Networking Conference (CCNC 2017), 8-11 January 2017, Las Vegas, USA

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Joerg WIDMER

Professional posts & activities
- Member: awards committee of the «IEEE ComSoc Best Young Professionals Awards»
- Reviewer: «German Research Foundation» (DFG- Deutsche Forschungsgemeinschaft) project proposals
- External Reviewer: «ERC Consolidator» grant proposals

Journal editorial boards
- Associate Editor: «IEEE Transactions on Communications», 2010 – present

Organization committees
- Co-Chair: Wireless Communications Symposium (ICNC WC Symposium 2018)
- Demo Chair: The 17th International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal
- Co-Organizer: International Workshop on 5G RAN Design, in conjunction with the IEEE International Conference on Communications (ICC 2016), 27 May 2016, Kuala Lumpur, Malaysia
- Co-Chair: Millimeter-wave Networking Workshop (mmNet2016), 11 April 2016, in conjunction with IEEE INFOCOM 2016, 10-15 April 2016, San Francisco, USA

TPC Memberships
- The 5th International Workshop on Emerging Technologies for 5G Wireless Cellular Networks, in conjunction with the 59th IEEE Global Communications Conference Exhibition & Industry Forum (IEEE GLOBECOM 2016), 4-8 December 2016, Washington, D.C., USA
- The 41st IEEE Conference on Local Computer Networks (LCN 2016), 7-10 November 2016, Dubai, UAE
- The 3rd IEEE Cooperative Wireless Networks Workshop (CoCoNet 2016), 17 October 2016, New York, USA
- The 5th Workshop on All Things Cellular: Operations, Applications and Challenges (All Things Cellular), in conjunction with the 22nd Annual International Conference on Mobile Computing and Networking (ACM MobiCom 2016), 3-7 October 2016, New York, USA
- The 17th International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal
- The 2nd International Workshop on 5G RAN Design, in conjunction with the IEEE International Conference on Communications (ICC 2016), 23-27 May 2016, Kuala Lumpur, Malaysia
- IFIP Networking 2016, 17-19 May 2016, Vienna, Austria
- The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, USA
- The 12th Annual Conference on Wireless On-demand Network Systems and Services (WONS 2016), 20-22 January 2016, Cortina d'Ampezzo, Italy

Other activities
- Formal research collaboration of the Wireless Networking Group led by Dr. Widmer, with the research institute IMEC, Belgium

5.4. Invited Papers, Keynotes, Invited Talks, Tutorials, Lectures, Demos, etc.

Amongst the activities of scientific dissemination undertaken by our researchers are presentations, such as keynotes, invited papers, keynotes, tutorials, lectures, demos, panels, etc., at academic conferences, universities and labs worldwide. Our researchers delivered a total of **21** of these presentations during 2016.

1. Narseo Vallina-Rodriguez (November 2016)
Empirical Analysis of Mobile Systems: Illuminating the Dark Side (Invited Talk)
In: The 2nd Spring School on Networks (SSN 2016), 21-22 November 2016, Universidad de Chile, Santiago, Chile

2. Ozgu Alay, Andra Lutu, Rafael García, Miguel Peón-Quirós, Vincenzo Mancuso, Thomas Hirsch, Tobias Dely, Jonas Werme, Kristian Eversen, Audun Hansen, Stefan Alfredsson, Jonas Karlsson, Anna Brunstrom, Ali Safari Khatouni, Marco Mellia, Marco Ajmone Marsan, Roberto Monno, Hakon Lonsethagen (October 2016)
Demo: MONROE, a distributed platform to measure and assess mobile broadband networks (Demo)
In: The 10th ACM International Workshop on Wireless Network Testbeds Experimental evaluation & CHaracterization (ACM WiNTECH 2016), The 22nd Annual International Conference on Mobile Computing and Networking (ACM Mobi-Com 2016), 3-7 October 2016, New York City, NY, USA

3. Joerg Widmer (September 2016)
Challenges and Solutions for Millimeter-Wave Wireless Networks (Invited Talk)
In: Technische Universität Darmstadt, 6 September 2016, Darmstadt, Germany

4. Joerg Widmer (September 2016)
Challenges and Solutions for Millimeter-Wave Wireless Networks (Tutorial)
In: 5G Wireless Summer School, 21-28 September 2016, Dresden, Germany

5. Roderick Fanou, Victor Sanchez Agüero, Francisco Valera, Michuki Mwangi, Jane Coffin (August 2016)
African Route Collectors Data Analyzer: a compass to support peering growth in the region (Invited Talk)
In: The 7th African Peering and Interconnection Forum (AfPIF 2016), 30 August - 1 September 2016, Dar es Salaam, Tanzania

6. Roderick Fanou, Gareth Tyson, Pierre Francois, Arjuna Sathiaseelan (August 2016)
Pushing the Frontier: Exploring the African Web Ecosystem (Invited Talk)
In: The 7th African Peering and Interconnection Forum (AfPIF 2016), 30 August - 1 September 2016, Dar es Salaam, Tanzania

7. Sergey Gorinsky (July 2016)
Transit, CDN, IXP, and Other Beasts of the Internet Ecosystem (Invited Talk)
In: Applied Research Center for Computer Networks (ARCCN), 26 July 2016, Moscow, Russia
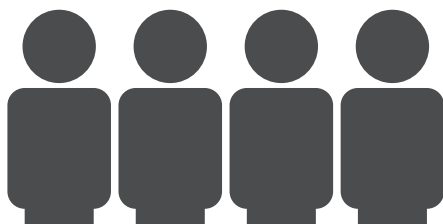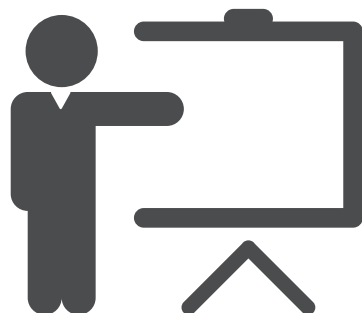
8. Joerg Widmer (July 2016)

Frontiers in wireless communications (Invited Talk)

In: BMW Summer School 2016, 18-23 July 2016, Tegernsee, Germany

9. Theophanis Hadjistasi, Nicolas Nicolaou, Alexander A. Schwarzmann (July 2016)

Brief Announcement: Oh-RAM! One and a Half Round Read/Write Atomic Memory (Other)

In: ACM Symposium on Principles of Distributed Computing (PODC 2016), 25-29 July 2016, Chicago, Illinois, USA

10. Matthias Schulz, Adrian Loch, Matthias Hollick (July 2016)

Demonstrating Practical Known-Plaintext Attacks against Physical Layer Security in Wireless MIMO Systems (Demo)

In: The 9th ACM Conference on Security and Privacy in Wireless and Mobile Networks (ACM WiSec 2016), 18-20 July 2016, Darmstadt, Germany

11. Ozgu Alay, Andra Lutu, Rafael García, Miguel Peón-Quirós, Vincenzo Mancuso, Thomas Hirsch, Tobial Dely, Jonas Werme, Kristian Eversen, Audun Hansen, Stefan Alfredsson, Jonas Karlsson, Anna Brunstrom, Ali Safari Khatouni, Marco Mellia, Marco Ajmone Marsan, Roberto Monno, Hakon Lonsethagen (June 2016)

Measuring and Assessing Mobile Broadband Networks with MONROE (Demo)

In: The 17th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal

12. Luis F. Chiroque, Rubén Cuevas, Juan Miguel Carrascosa Amigo, Costas Iordanou (June 2016)

Winning the I-COM Datascience Hackathon 2016 (Lecture)

In: The 2nd Annual Workshop on Complex Socio-technical Systems, 8-10 June 2016, València, Spain

13. Joerg Widmer (June 2016)

Challenges and Solutions for Millimeter-Wave Wireless Networks (Keynote)

In: The 17th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal

14. Joerg Widmer (June 2016)

Panel: Challenges of mobile content and interpersonal communications in high demand scenario (Other)

In: The 17th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2016), 21-24 June 2016, Coimbra, Portugal

15. Antonio Fernández Anta (May 2016)

Saving Energy by Powering Down Links (Keynote)

In: The 7th International Conference on Ambient Systems Networks and Technologies (ANT 2016), The 6th International Conference on Sustainable Energy Information Technology (SEIT 2016), 23-26 May 2016, Madrid, Spain

16. Roderick Fanou, Gareth Tyson, Pierre Francois, Arjuna Sathiaseelan (April 2016)

Pushing the Frontier: Exploring the African Web Ecosystem (Presented by Gareth Tyson) (Invited Talk)

In: The 25th International World Wide Web Conference (WWW 2016), 11-15 April 2016, Montreal, Canada

17. Kirill Kogan (April 2016)

Adopting Software-Defined Networking: Challenges and Recent Developments (Invited Talk)

In: CRC MAKI – Scientific Workshop 2016 Robust Communication in Software-Defined and Mobile Networks, 8 April 2016, Darmstadt, Germany

18. Héctor J. Pijeira Díaz, Javier Santofimia Ruiz, José A. Ruipérez-Valiente, Pedro J. Muñoz-Merino, Carlos Delgado Kloos (April 2016)

A Demonstration of ANALYSE: A Learning Analytics Tool for Open edX (Demo)

In: The 3rd Annual ACM Conference on Learning @ Scale (L@S 2016), 25-26 April 2016, Edinburgh, Scotland, UK

19. Maurizio Rea, Héctor Cordobés de la Calle, Domenico Giustiniano, Vincent Lenders (April 2016)

Robust WiFi Time-of-Flight Positioning System (Demo)

In: The 15th ACM/IEEE International Conference on Information Processing in Sensor Networks - Microsoft Indoor Localization Competition (ACM/IEEE IPSN 2016), 11-14 April 2016, Vienna, Austria

20. Qing Wang, Danilo De Donno, Domenico Giustiniano (April 2016)

Demonstration Abstract: Research Platform for Visible Light Communication and Sensing Systems (Demo)

In: The 15th International Conference on Information Processing in Sensor Networks (IPSN 2016), 11-14 April 2016, Vienna, Austria

21. Ignacio Castro, Sergey Gorinsky (January 2016)

Estimating the Real with the Virtual: How does the Accuracy Relate to the Internet Penetration? (Invited Paper)

In: The 8th International Conference on COMmunication Systems and NETworkS (COMSNETS 2016), 5-9 January 2016, Bangalore, India

5.5. Major events

XVI Science Week – Madrid 2016: Radical business innovation with machine learning and intelligent optimization

16 November 2016 | Madrid, Spain

Speaker: Prof. Dr. Roberto Battiti, Full Professor of Computer Science, Università degli Studi di Trento, Italy; IMDEA Networks Institute and Chair of Excellence University Carlos III of Madrid - Banco Santander

Organization: IMDEA Networks Institute; XV Semana de la Ciencia - 2015 - mi+d

In this event the speaker presented the concept of «Learning and Intelligent Optimization (LION)», which he described as the combination of machine learning from data and optimization to solve challenging and dynamic problems, previously thought to require intelligent human intervention and creativity.

Businesses can be run more and more by defining objectives, measuring and collecting data, using data to build models, using models to connect new data directly to decisions and actions, with very limited human intervention. With support of the right software, a huge power is directly in the hands of businesses in a self-service and automated manner. The talk highlighted the scientific principles and mentioned some notable examples of this radical transformation which can produce wealth for everybody provided that the risk of higher unemployment rate is properly addressed.

Workshop on OpenDayLight and NFV/SDN Orchestration

19 October 2016 | Madrid, Spain

Organization: 5TONIC, University Carlos III of Madrid, IMDEA Networks Institute

5TONIC, together with IMDEA Networks, OpenDayLight, University Carlos III of Madrid (UC3M) and Telefonica organized this workshop, which was held at UC3M and sponsored by the Linux Foundation. The UC3M Telematics PhD program recognized this workshop as 'Specific training'.

5TONIC @ South Summit 2016

5 – 7 October 2016 | | Madrid, Spain

Organization: 5TONIC, Telefónica, IMDEA Networks Institute

The open research and innovation laboratory 5TONIC participated in the South Summit 2016 event. South Summit is the leading startup conference in Southern Europe. A platform created with the aim to bring together startups, international investors and leading corporations in the search for innovation by means of collaboration.

5TONIC was represented on a stand where information about lab activities and proposals was distributed to event participants. Also, 5TONIC members, including IMDEA Networks, took part on the program of presentations that closed South Summit on October 7th. The presentation, which was part of the panel «Connectivity and 5G: Fueling the Digital Revolution», focused on the lab's vision of the 5G revolution.

European Researchers' Night of Madrid 2016

30 September 2016 | Madrid, Spain

5G on stage: this technology will change your life (and you don't know it yet)

Speakers: Arturo Azcorra & Albert Banchs, Director & Deputy Director, IMDEA Networks Institute; Full Professors, University Carlos III of Madrid; Carlos Jesús Bernardos Cano, Pablo Serrano & Francisco Valera, Associate Professors, University Carlos III of Madrid.

Organization: University Carlos III of Madrid, in collaboration with IMDEA Networks Institute.

Informative show that combined dance, music, theater and audiovisual aspects to explain how 5G technology will influence our lives and everydayness in the coming years. Hyper-connectivity, the Internet of Things, drones… how does technology affect the way we live and relate to the environment and those around us?

Sporty Science or Sports full of Science

Speakers: Researchers representing each of the IMDEA research institutes on Water, Food, Energy, Materials, Nanoscience, Networks and Software. Domenico Giustiniano represented IMDEA Networks.

Organization: This event is co-organized by all institutes part of the IMDEA initiative.

In today's professional sports, what is science and what is effort? Is the athlete born or made? And what about the scientist? IMDEA researchers met to discuss the relationship between science and sports, two worlds with as many differences as commonalities, worlds in which effort, the need for improvement and teamwork are essential.

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5G Communications Day:
Challenges and Opportunities in Key Sectors –
Sectors of Application, Technologies and R&D&I

29 September 2016 | Madrid, Spain

Speakers: Representatives from the Spanish Secretary of State for Telecommunications and the Information Society (SETSI) and other national governing bodies, 5TONIC, CDTI, European Commission and ICT companies

Organization: 5TONIC, AMETIC, IMDEA Networks Institute

Top-level speakers presented at this event the future of 5G communications technology, as well as the challenges and opportunities that 5G will represent for multiple relevant sectors of economic activity. Large multinational companies are already positioning themselves to mitigate threats and seize opportunities originated by 5G in the medium term.
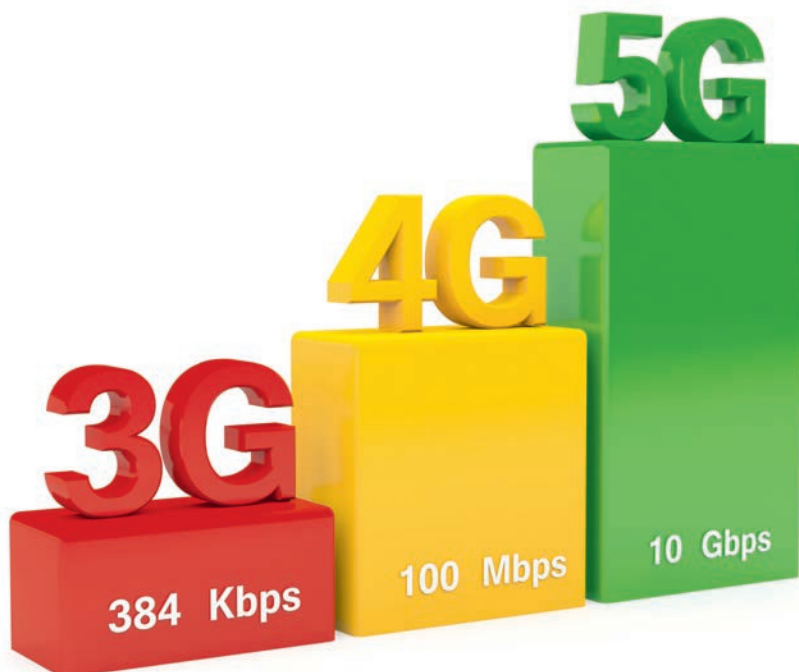
8th IMDEA Networks Annual International Workshop

9 June 2016 | Madrid, Spain

Speakers: Members of IMDEA Networks' Scientific Council and IMDEA Networks faculty

Organization: Joerg Widmer, Research Director at IMDEA Networks, was the local organizer

IMDEA Networks Institute annually holds a by-invitation-only thematic workshop in Madrid. The workshop accompanies a meeting of our Scientific Council comprised of prominent researchers. In addition to talks by Scientific Council members, the workshop includes invited talks by external experts in the research theme of the workshop. The goal of the 2016 event was to foster discussion and present disruptive visions on a critical aspect of future wireless networks.

The workshop program aimed at presenting recent research results from participants, debate on and identify priorities and challenges in the research agenda, as well as exploring new paths towards making future networks a true commodity for the needs of society.

5.6. Workshops, seminars & lectures

Weekly seminars alternated invited talks with presentations by internal researchers. These events were organized together with University Carlos III of Madrid and University of Alcalá. The topics ranged from scientific presentations to technology-transfer oriented talks. All events were held in Madrid. Out of the **40 total number of events** in which the Institute participated during 2016, **25** were conducted by invited speakers. We list those here:
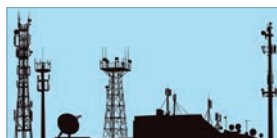
Smart Antenna Systems and Reconfigurable Radios based on Functional Materials
Holger Maune, Head of the Tunable Microwave Devices Group at Institute for Microwave Engineering and Photonics, Technische Universität Darmstadt, Germany
14 December 2016

Feature selection for smarter data analysis
Andrea Mariello, PhD Student, ICT International Doctoral School, University of Trento, Italy
12 December 2016

Interference-aware Flexible TDD Design for Massive MIMO 5G Systems
David M. Gutierrez Estevez, Senior 5G Researcher, Samsung Electronics R&D Institute, UK
24 November 2016

Bayesian jamming games and queues
Leonardo Badia, Associate Professor, University of Padova, Italy
7 November 2016
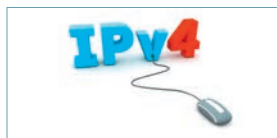
IPv4 Address Space Exhaustion: Where Are We Now?
Philipp Richter, PhD student, INET group, Technische Universität Berlin, Germany
27 October 2016

Distributed and Energy Efficient Routing for Large Scale Networks
Prof. Zhiyong Liu, Ph.D., Professor, The Institute of Computing Technology, Chinese Academy of Sciences, Beijing, China
13 July 2016

DataBeers NOTRE

Members of the NOTRE, the Network for sOcial compuTing REsearch project

29 June 2016

Network Geometry: Theory and Applications

Dr. Fragkiskos Papadopoulos, Department of Electrical Engineering, Computer Engineering and Informatics, Cyprus University of Technology, Cyprus

29 June 2016

Keynote: Internet of Vehicles - From Intelligent Grid to Autonomous Cars and Vehicular Clouds

Mario Gerla, University of California, Los Angeles, USA

9 June 2016

On the Past, Presence and Future of "Big (Internet) Data"

Dr. Walter Willinger, Chief Scientist at NIKSUN Inc., Princeton, New Jersey, USA

1 June 2016

Recent Research Insights from MIT Sloan's Center for Information Systems Research (MIT CISR): Expanding the Reach of Digital Innovation

Nils Olaya Fonstad, Research Scientist, Europe and LATAM, MIT Center for Information Systems Research (MIT CISR)

4 May 2016

A Look at Basics of Distributed Computing

Prof. Dr. Michel Raynal, Professor of Informatics, University of Rennes, France

19 April 2016

This is Why Adtech Can't Have Nice Things

Mikko Kotila, Internet Researcher, Technology Innovator and Principal at botlab.io

11 April 2016

Challenges and Approaches to Mobility in Wireless Sensor Networks

Prof. Dr. Fernando Boavida, Full Professor, Faculty of Science and Technology, University of Coimbra, Portugal

6 April 2016

Low Delay Random Linear Coding and Scheduling Over Multiple Interfaces
Andrés García Saavedra, Research Scientist at NEC Laboratories Europe, Heidelberg, Germany
31 March 2016

Design and Implementation of Secure Distributed Systems and Networks
Andrei Gurtov, Principal Scientist at the Helsinki Institute for Information Technology (HIIT) and Adjunct Professor at Aalto University, University of Helsinki and University of Oulu
25 February 2016
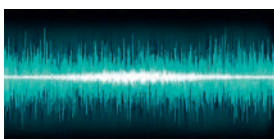
The ICSI Haystack: A Tool to Illuminate the Dark Side of the Mobile Ecosystem
Narseo Vallina-Rodriguez, Research Scientist in the Networking and Security team at the International Computer Science Institute (ICSI), Berkeley
23 February 2016

Smart Indoor Visible Light Communications
Yeon-Ho Chung, Professor at the Department of Information and Communications Engineering, Pukyong National University (PKNU), Busan, Republic of Korea
18 February 2016

I Always Feel Like Somebody's Watching Me. Measuring Online Behavioral Advertising
Rubén Cuevas Rumin, Assistant Professor, Department of Telematics Engineering, University Carlos III of Madrid, Spain
17 February 2016

Optimization of mobile crowd-sensing and recommender system platforms
Iordanis Koutsopoulos, Associate Professor at the Department of Informatics, Athens University of Economics and Business (AUEB)
8 February 2016
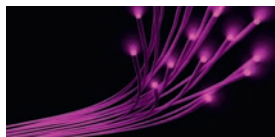
Understanding Capacity Scaling through Dense Deployments in Future Radio Access Networks

David López-Pérez, Senior Research Scientist at Bell Labs Alcatel-Lucent (ALU), Dublin, UK
5 February 2016
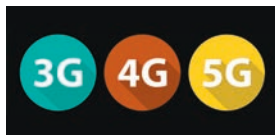
Mobile edge-Networking Solutions and Data Offloading Mechanisms for 5G Systems

Georgios Iosifidis, Post-doctoral Research Associate at the Department of Electrical Engineering and the Institute for Network Science (YINS), Yale University
4 February 2016

Topology and connectivity in large-scale networks

Matthias Wildemeersch, Postdoctoral Research Scholar at the International Institute for Applied Systems Analysis, Laxenburg, Austria
1 February 2016

Distributed power and rate control in wireless networks

Themistoklis Charalambous, Post-Doctoral Researcher at the Communication Group of the Department of Signals and Systems, Chalmers University of Technology, Gothenburg, Sweden
25 January 2016

Human behavior: the interaction governing complex socio-technological systems

Anxo Sánchez, Founder of GISC (Grupo Interdisciplinar de Sistemas Complejos), Professor at the University Carlos III of Madrid, Department of Mathematics & Institute UC3M-BS of Financial Big Data
13 January 2016

5.7. Local Scientific Partnership

IMDEA Networks Institute has established a strong scientific partnership with one of the local universities in the Madrid region, namely the **University of Alcalá** *(Universidad de Alcalá - UAH)*. This partnership involves stable research collaboration in joint activities and projects as well as an institutional collaboration in the form of UAH's participation on the Institute's Board of Trustees.

Among other activities, the cooperation between IMDEA Networks and UAH involves their joint participation in projects of a regional scope, such as **MEDIANET**, completed in 2014, and **TIGRE5-CM**, ongoing until 2018. The TIGRE5-CM project focuses on integrated technologies for management and operation of 5G networks. In addition to IMDEA Networks and UAH, the third project partner is University Carlos III of Madrid. Elisa Rojas from UAH also participated as a Post-Doc Researcher in **NetIDE**, a research project concluded in December 2016 and carried out by IMDEA Networks with a clear focus on an integrated development environment for portable network applications. Deepening this spirit of collaborative work, one of our PhD graduates, Andra Lutu, undertook a 6 month research fellowship at UAH.

In addition to projects, UAH and IMDEA Networks are also conducting several research activities in partnership. One of these focuses on link-level technologies, based on the design of novel architectures that implement advance link layer functions, such as combined transparent bridges and fast path Ethernet switches, among other developments. As a result of this common undertaking, several **results** have been produced, which are co-authored by IMDEA Networks and University of Alcalá researchers. Among others, a **joint patent** was granted in February 2016 *(see section 6.1)*, which presents procedures to establish and repair paths at the transport and network levels.

Other shared research work focuses on the design of incentive mechanisms for peer-to-peer networks, which has resulted in several high quality **publications**.

Besides the above activities, IMDEA Networks and UAH are also taking advantage of the physical proximity between the two institutions to share many of their daily labors, such as the **biweekly scientific seminars** organized by IMDEA Networks, University of Alcalá and University Carlos III of Madrid. Other shared **research work** focuses on 5G networks. In this area, the TIGRE-CM project mentioned above is being performed by the two institutions, and has produced substantial results in terms of publications and other outcomes during 2016.

impact and technology transfer

6
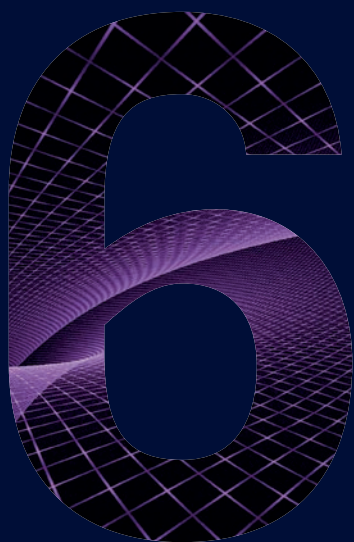
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6.1. Patents

Patents are important steps in the process of transferring technology to marketplace. Patent creation has strong implications for the Institute: patents are incentives for their creators, as they imply recognition for their creativity and material reward when these inventions are marketable. These incentives encourage innovation, the guarantee to the continuous improvement in the quality of research and, ultimately, of human life. It is IMDEA Networks Institute's policy to share a very high percentage of financial proceeds with inventors (our researchers) as reward for their excellence and hard work.

The following are examples of our patenting activities during 2015. This is not an exhaustive list of all IMDEA Networks' patents, as we are unable to disclose some due to confidentiality agreements with the funding companies.

Spanish Patent Granted (February 2016)

Title: *Procedimientos de establecimiento y reparacion de caminos capa de transporte y puente de red-transporte (PROCEDURES FOR THE ESTABLISHMENT AND REPAIR OF TRANSPORT LAYER AND NETWORK-TRANSPORT BRIDGE PATHS)*

Inventors: Arturo AZCORRA, Guillermo IBÁÑEZ FERNÁNDEZ, Elisa ROJAS SÁNCHEZ, Isaías MARTÍNEZ YELMO
Joint patent between IMDEA Networks and University of Alcalá (Spain)

Overview:

The present invention describes mechanisms that, in a network of transparent bridges, both seek and establish a specific path for each new TCP connection established between two terminals. The new path is established by the border bridge connected to the source terminal when receiving a TCP segment type SYN to establish a connection, encapsulating the said segment within a special path request packet that is resent by all network links and is responded to in unicast mode by the border bridge of the destination terminal

through an acceptance package in which the SYN + ACK response segment of terminal S is encapsulated, the said packet confirming both the TCP connection as well as the chosen path between A and S. The path is automatically cleared after a certain period of time without the use of the connection or through exchanges of FIN segments in both directions of the connection.

Publication no. ES2540595 A1 (10.07.2015) | Also published as no. ES2540595 B2 (02.02.2016) | Request no. P201301133 (10.12.2013)

6.2. Technology transfer

We direct our work towards strengthening collaboration ties with industry, particularly through joint participation in projects and technology transfer. We aim to develop technologies that have genuine socio-economic impact; that is to say, projects that deliver value and that can be transferred to industry and, ultimately, to society. In order to ensure that our focus remains on addressing real-world problems and that our development activities result in generating value, we continue to build on our strong links with the business community both in the Madrid region of Spain and in the rest of the World.

Our technology transfer strategy is aimed to ensure that the Institute's research activities remain relevant, that its innovations are diffused and their full value to society realized through various transfer processes such as licensing and the sale of patents, creation and support of spin-off companies in the region that seek to commercialize products exploiting innovations developed within the Institute.

We carry out several forms of collaboration, including direct contracts with industry, as well as participation in joint projects financed by public entities. The **projects listed in section 4** include both types of partnerships with specific listings of those enterprises and organizations currently working with us.

Joint, funded research projects enable us to establish solid ties to business. We are engaged in various research projects with private sector collaborators:

SPECTRUMCOP - IMDEA - Technologies for Collaborative Detection of Spectrum Anomalies

Funded by: Contract with the industry
Duration: March 2016 to February 2017
Project partners: Science and Technology, IMDEA Networks Institute

The SPECTRUMCOP-IMDEA project has the overarching goal of providing the turnkey technologies to bring a concrete application to the **Electrosense network**. In the context of this project, we aim to pervasively **monitor the spectrum** such that the backend will swiftly detect any anomaly and misuse in the spectrum usage. SPECTRUMCOP-IMDEA will study the necessary theoretical and practical concepts, and propose solutions that will be analysed in testbeds managed by IMDEA as well as in the overall Electrosense network.

Improving Routing in Service Provider Networks

Funded by: Cisco Systems
Duration: November 2012 to September 2016
Project partners: Cisco Systems, IMDEA Networks Institute

Following the requirements from Service Provider Network operators and data center network operators, research and development in the field of networking aims at **providing network architectures that allow for a flexible, scalable, and manageable definition of transit paths across a network**. Dr. Pierre Francois, Research Assistant Professor at IMDEA Networks Institute, will collaborate with Cisco Systems to carry out research in this direction, by researching on the protocol suite supporting the Segment Routing technology, a new network architecture defined to meet these emerging requirements.

Pierre Francois will contribute to the research, prototyping, and standardization of techniques aimed at providing resilient services in a Segment Routing network.

Potential benefits of this research:
- Protocols allowing Internet Service Provider networks to define flexible transit paths across their network.
- Support of services with tight SLA over IP infrastructures
- Resiliency of SDN networks.

Potential applications:
- Management tools allowing to better operate cloud networks Internal Transit Cost reduction for network operators

TALENTUM - Fundación SEPI - Telefónica Scholarship Program: Talentum Startups 2016

Project website: https://talentum.telefonica.com/
Funded by: Fundación SEPI (Sociedad Estatal de Participaciones Industriales) - Telefónica España
Duration: February 2016 to July 2016
Project partners: Telefónica S.A.; IMDEA Networks Institute

Telefónica Talentum Startups is a comprehensive program intended to find and attract talent within Spain. It is a **funded scholarship plan** that seeks **to promote innovative young talent**, providing the tools and support needed to encourage them to participate in the creation of a new European digital world. Through practical training, this scholarship program offers **university students with entrepreneurial skills** the opportunity to experience at close-hand the realities of professional life, thus encouraging their early integration into the labor market. Internship students at IMDEA Networks will receive **tutored practical training** at the same time as performing tasks to **support advanced research projects** in the field of information and communications technology (ICT).

MATISSE - Pervasive Mobile Location and Spectrum Sensing Systems

Research contract

Funded by: Contract with the industry
Duration: April 2015 to March 2016
Project partners: Science and Technology, IMDEA Networks Institute

The spectrum data usage and the user location knowledge are essential information to build any communication protocol and service. MATISSE has two-fold objectives: (i) solve the poor knowledge of the electro-magnetic spectrum usage by introducing cyber-physical nodes that will be capable of monitoring the spectrum at very large scale and (ii) devise and build a pervasive localization system that can make possible to pin-point the position of a mobile device regardless of the environmental conditions. For the first objective, we aim to build a customized embedded device for monitoring the spectrum, and introduce novel signal processing and decoding mechanisms for fusing the data of multiple nodes. For the second objective, we will design and build a mobile device-centric system that uses opportunistic timing signals for positioning and tracking and address the research and practical challenges to solve the limitations of timing protocols.

Other forms of collaboration with the private sector are:

Telefónica - IMDEA Networks Joint Research Unit in 5G technologies

IMDEA Networks and Telefónica Research and Development continue collaborating on their Joint Research Unit (JRU), which was created in May 2014. The JRU is also known under the name 'Telefónica - IMDEA Networks Joint Research Unit in 5G technologies'. The **development of 5G** has already become a landmark in the global competition for technological leadership. Over a period of seven years up to 2020, this private-public alliance will share a wealth of know-how and in-house capabilities to tackle the challenge of creating a blueprint for the new technology and the standards that are to define **future ICT networks.**

Located at IMDEA Networks' headquarters in Madrid, the aim of the **JRU Telefónica I+D - IMDEA Networks** is to establish a strategic partnership that provides an operational framework for close interaction in a varied set of scientific activities. In particular, the JRU brings together a team comprising highly specialized multidisciplinary profiles ready to work collaboratively on externally-funded R&D projects. One of the main areas in which this collaboration is reflected is the program **'Advanced 5G Network Infrastructure for Future Internet PPP'**, sponsored by the EU Commission within the Horizon 2020 program.

The private-public alliance shares a wealth of know-how and in-house capabilities to tackle the challenge of creating a blueprint for the new technology and the standards that are to define future ICT networks. **Work led by experienced researchers** Diego R. López and Pedro Aranda Gutiérrez, from Telefónica I+D and Arturo Azcorra, Joerg Widmer and Albert Banchs, from IMDEA Networks, focuses on **key 5G enablers** such as flexible functional split, joint handover optimization, 60GHz wireless networks, network function operating systems, secure virtual computing and green networking.

5TONIC - An Open Research and Innovation Laboratory focusing on 5G technologies

5TONIC is an open research and innovation laboratory focusing on 5G technologies that was **founded by Telefonica and IMDEA Networks Institute** in 2015. The **first laboratory of 5G excellence in Spain** also counts with **Ericsson Spain**, **INTEL**, **Commscope**, **University Carlos III of Madrid**, **Cohere Technologies** and **Artesyn Embedded Technologies** amongst its members.

The objective of 5TONIC is to create a global open environment where members from industry and academia work together in specific **research and innovation projects related to 5G technologies** with a view to boost technology and business innovative ventures. The laboratory promotes joint project development and entrepreneurial ventures, discussion fora, events and conference sites, all in an international environment oriented to achieve the highest technological impact in the area of 5G.

5G networks are considered **the gateway to the age of "intelligent everything"** that awaits us. The development of 5G has thus become a landmark in the global competition for technological leadership.

5TONIC will serve to show the capabilities and interoperation of pre-commercial 5G equipment, services and applications by leading global companies in the 5G arena. Apart from the initial members, 5TONIC welcomes new members to join and gain from the benefits of an advanced research and innovation laboratory, oriented to research, debate, field-testing and demonstration of all technologies and equipment to support 5G communications, services and applications.

The main **5TONIC Research & Innovation Laboratory** site is located at IMDEA Networks. The Institute is one of the main leaders at European level in the field of 5G networks. Among 5G research projects carried out by the Madrid Institute are the ongoing **SEARCHLIGHT**, **TIGRE-CM, Cloud4BigData, mmMAGIC** and **Flex5Gware** projects.

6.2.1. Industry partners

Our technology transfer activities have led to **a significantly increased portfolio of companies we collaborate with**. During 2016 they were the following:

Studio Professionale Associato a Baker & McKenzie	Celerway Communications AS	certSIGN S.A.	Cisco Systems
Ericsson	De Productizers B.V.	Fujitsu Technology Solutions (FTS)	Exus Software Ltd.
Huawei Technologies Dusseldorf GmbH (HWDU)	INTEL Corporation Intel Mobile Communications France	Internet Advertising Bureau (IAB) Europe	Keysight Technologies Denmark Aps
NEC Europe Ltd.	Netvision Telecom	Nextworks Engineering Forward	Nokia Bell Labs Deutschland AG
Nokia Solutions and Networks Sp. z o.o. (Poland) Nokia Solutions and Networks Oy (Finland)	Orange	Qamcom Research and Technology AB	

Rohde & Schwarz GmbH
& Co. KG

Samsung Electronics Ltd.
(UK)

Sequans Communications

Technicolor R&D

Tecnologías, Servicios
Telemáticos y Sistemas S.A.

Telcaria

Telecom Italia S.p.a.

Telefónica S.A.

Telefónica I+D

Telenor ASA

Thales

Upcom BvBa

Virtual I Tech Inc
(South Korea)

Verizon Nederland B.V.

Teknologian Tutkimuskeskus
VTT

Wedia Ltd.

WINGS ICT Solutions

We continue to build firm relationships and sound collaborative arrangements with these
companies and other key players in the field, including various regional, national and
international bodies.

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iMdea networks

6.3. Other collaborations

IMDEA Networks Institute collaborates with the Madrid-region network of Scientific Parks and Clusters (Madrid Network) that brings together industry and research institutes in the region. We are members of the ICT Audiovisual Cluster (Cluster Audiovisual) and of the ICT Security and Trust Cluster (Cluster de Seguridad y Confianza). We also collaborate with RedIRIS, the Spanish National Research and Education Network, and with REDIMadrid, the Research Network of Madrid.

ICT Audiovisual Cluster

ICT Security and Trust Cluster *(Cluster de Seguridad y Confianza)*

RedIRIS

REDIMadrid

In 2016, Madri+d and the IMDEA initiative continued collaborating through the **Oficina de Proyectos Europeos Madri+d – IMDEA (Madri+d – IMDEA European Projects Bureau)**. The bureau provides a networked structure to support the participation of its members in European programs. It is made up of the seven IMDEA institutes and the Madrimasd Knowledge Foundation in a coordination role. This collaboration contributes to ensure that the IMDEA institutes achieve their goal of **creating a solid base for the generation of knowledge within the Community of Madrid** maintaining a critical presence in each of their scientific fields within the wider international context.

personnel
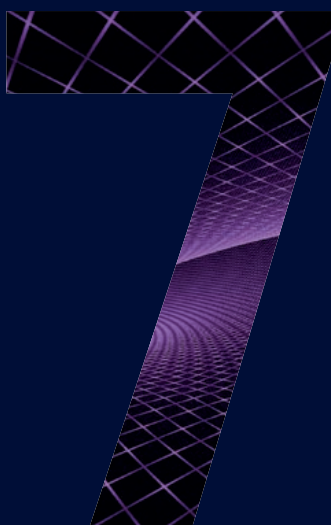
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director

The Director is the CEO of the Institute. He is appointed by the Board of Trustees amongst scientists with a well-established international reputation in computer networking. The Director fosters and supervises the activities of IMDEA Networks Institute, and establishes the distribution and application of the available funds in accordance with the Institute's strategic goals and within the limits established by the Board of Trustees. The Director reports regularly to the Board. He is aided by the Scientific Council in determining the scientific research strategy and associated policies. The Director is also assisted by the Deputy Director, the Research Director and the General Manager.

Dr. Arturo AZCORRA
Director

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
PhD: Polytechnic University of Madrid. Spain
Research: 5G Networks and Services; Network Virtualization and Softwarization; Drone Communications; On-line Social Networks Data Analytics; Mammal Brain Cartography and Topology
Contact: arturo.azcorra@imdea.org
Personal Site: http://people.networks.imdea.org/~arturo_azcorra/

Short Bio:
Arturo Azcorra holds a double appointment as Full Professor at the University Carlos III of Madrid (UC3M) in the Telematics Engineering Department and Director of IMDEA Networks, where he conducts his research activities. He returned to his post as Director of IMDEA Networks in June 2012, after a period from May 2010 to February 2012 during which he held the position of Director General at the Centre for the Development of Industrial Technology (CDTI), the Spanish agency to fund advanced industrial research. He previously held the position of Director General for Technology Transfer and Corporate Development at the then Spanish Ministry of Science and Innovation. Currently he is also Chairman of the Expert Advisory Group of the Net-World2020 European Technology Platform (ETP), Vice chairman of the 5TONIC Lab, and Partnership Board member as well as member of the Vision Group within the 5G Infrastructure Association.

He graduated from Loy Norrix High School (Michigan, USA) in 1980. In 1986, he received his MSc degree in Telecommunications Engineering from the Polytechnic University of Madrid, with the "Sobresaliente" (Outstanding) grade, and was sub-sequently awarded the Price Waterhouse Prize for Best Student. He then obtained his PhD from the same university in 1989. His PhD received the National Award for Best Thesis, jointly granted by the professional Association of Telecommunication Engineers (COIT-AEIT) and the National Association of Electronic Industries (then ANIEL, today AMETIC). In 1993 he obtained an MBA from the *Instituto de Empresa* (one of the World's most prestigious business schools), graduating first in his class.

He was an Associate Professor at the Polytechnic University of Madrid from 1987 to 1998. In 2000 he was appointed Deputy Vice-Provost for Academic Infrastructures at the UC3M. He worked in this role until 2007, teaching and also developing the application of Information Technologies to research. He previously worked at ICSI-University of California at Berkeley as a Visiting Researcher in 1999, and late in 2002, at the Massachusetts Institute of Technology.

Arturo Azcorra is an IEEE Senior Member and an ACM SIGCOMM Member. He has participated in and directed 55 European research and technological development projects, including ESPRIT, RACE, ACTS, IST and ICT programs. He previously held the position of Coordinator of the international Networks-of-Excellence (NoE) E-NEXT (Emerging Networking Experiments and Technologies) and CONTENT (Excellence in Content Distribution Network Research), part of the European Commission's VII Framework Program. Currently, he is coordinating the European 5G-Crosshaul project, which is part of the Horizon 2020 framework project for research and innovation.

He has also performed direct consulting and engineering work for institutions, such as the European Space Agency, MFS-Worldcom, Madrid Regional Government, RENFE, REPSOL and the Spanish Ministry of Science and Technology. Arturo Azcorra is the founder of the ACM CoNEXT conference series, of which he was the first General Chair. He is a member of the Standing Committee of the IEEE INFOCOM Conference since 2005, and has chaired prestigious international conferences such as IEEE INFOCOM, ACM CoNEXT and PROMS-IDMS. His publications in national and international magazines, books and conferences number over 170 titles.

deputy director

The Deputy Director provides assistance to the Director in the fostering and supervision of the scientific activities of the Institute and of its administrative management.

Dr. Albert BANCHS
Deputy Director

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
PhD: Telematics Engineering. Polytechnic University of Catalonia. Barcelona. Spain
Research: Wireless Networks; 5G Networks; Performance Evaluation
Contact: albert.banchs@imdea.org
Personal Site: http://people.networks.imdea.org/~albert_banchs/

Short Bio:
Dr. Albert Banchs received his Telecommunications Engineering degree from UPC BarcelonaTech, Spain, in 1997, and the PhD degree from the same university in 2002. He was a visitor researcher at ICSI, Berkeley, CA, in 1997, worked for Telefonica I+D, Spain, in 1998, and for the Network Laboratories of NEC Europe Ltd., Germany, from 1998 to 2003. Since 2003, he is with University Carlos III of Madrid. Since 2009, he also has a double affiliation as Deputy Director of the IMDEA Networks research institute (he was acting director from 2009 to 2012). He was Academic Guest at ETHZ in 2012, and Visiting Professor at EPFL in 2013 and 2015.

Dr. Banchs authors more than 100 conference and journal papers, including publications at top conferences such as IEEE INFOCOM, ACM CoNEXT, ACM IMC, WWW and IEEE ICNP, and at top journals such as IEEE/ACM ToN, IEEE JSAC, IEEE TMC, IEEE TWC and IEEE TVT. Prof. Banchs is editor for IEEE/ACM Transactions on Networking and IEEE Transactions on Wireless Communications, and has been area editor for the Green Networking and Communication Series of IEEE JSAC (2015-2016), Computer Communications (2010-2014) and IEEE Communications Letters (associate editor in 2005-2010 and senior editor in 2010-2012). He has been guest editor for a number of journals (IEEE Communications Magazine, Computer Networks, Computer Communications, Pervasive Mobile Computing and IEEE Wireless Commnications) and has served in many TPCs (including IEEE INFOCOM, IEEE GLOBECOM, IEEE ICC, IEEE WoW-MoM, IEEE PIMRC, IEEE WCNC, IEEE VTC, ITC and ACM WiN-TECH). He has been general chair of IEEE Online GreenComm 2013 and ACM WiNTECH 2013, and TPC co-chair of IEEEE WoWMoM 2012, European Wireless 2010 and IEEE HotMESH 2010.

Prof. Albert Banchs has been a key contributor to many EU projects. He was activity leader in the Daidalos I project (2003-2006), deputy WP leader in Daidalos II (2006-2008), the coordinator of the projects CARMEN (2008-2010) and iJON (2012-2015), and principal investigator for the projects FLAVIA (2010-2013), MEDIEVAL (2010-2013), eCOUSIN (2012-2015) and CROWD (2013-2015). Currently, his main effort is on the 5GNORMA project (2015-2017). Dr. Banchs has also been the principal investigator of several industry contracts, is the inventor of 5 granted patents and authors a number of standardization proposals at the IETF and the IEEE.

Dr. Banchs has received a number of awards, including the national prize to the best PhD thesis on broadband networks, the runner-up award to the best collaborative project in the region of Madrid and the 2013 Excellence Award to Young UC3M Research Staff. He has supervised 4 PhD theses, three of them recipient of the Outstanding PhD award of University Carlos III of Madrid. His papers have received a number of awards, including the Best Paper Runner-up Award at ICNP 2014 and the AT4Wireless award at the JITEL 2007, in addition to the SATIN award of the CONTENT Network of Excellence for his paper at IEEE INFOCOM 2009. The MEDIEVAL project was short-listed as one of the three finalists for the Future Internet award 2012. Prof. Banchs is a Senior Member of IEEE and an IEEE Distinguished Lecturer. His research interests include the resource allocation, design of novel algorithms and performance evaluation of wired and wireless networks.

research professors

Research Professors are our most published and cited researchers. They are recognized and respected leaders in their field of research. They have already made a difference. Their expertise and research interests have a significant impact on the Institute's scientific output and on the careers of their charges.

Dr. Joerg WIDMER
Research Professor (tenured) & Research Director

PhD: Computer Science. University of Mannheim. Germany
Previous Position: Manager. Docomo Euro-Labs. Munich. Germany
Research: Computer Networks; in particular Wireless Networking; Extremely High Frequency Communication (60GHz); Network Coding; Mobile Network Architectures; Transport Protocols
Contact: joerg.widmer@imdea.org
Personal Site: http://people.networks.imdea.org/~joerg_widmer/

Short Bio:
Joerg Widmer is Research Professor at IMDEA Networks Institute in Madrid, Spain. His research focuses primarily on wireless networks, ranging from extremely high frequency millimeter-wave communication and MAC layer design to mobile network architectures. From 2005 to 2010, he was manager of the Ubiquitous Networking Research Group at DOCOMO Euro-Labs in Munich, Germany, leading several projects in the area of mobile and cellular networks. Before, he worked as post-doctoral researcher at EPFL, Switzerland on ultra-wide band communication and network coding. He was a visiting researcher at the International Computer Science Institute in Berkeley, CA, USA and University College London, UK. Joerg Widmer authored more than 150 conference and journal papers and three IETF RFCs, holds 13 patents, serves on the editorial board of IEEE Transactions on Communications, and regularly participates in program committees of several major conferences. He was awarded an ERC consolidator grant, the Friedrich Wilhelm Bessel Research Award of the Alexander von Humboldt Foundation, as well as a Spanish Ramon y Cajal grant. He is senior member of IEEE and ACM.

Dr. Marco AJMONE MARSAN
Research Professor

Affiliation: IMDEA Networks Institute and Politecnico di Torino. Italy
PhD: Telecommunication Networks. Budapest University of Technology and Economics (honoris causa). Hungary
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Contact: marco.ajmone@imdea.org
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Short Bio:
Marco Ajmone Marsan was born in Turin, Italy, on May 25, 1951. He obtained his Laurea degree in Electronic Engineering in October 1974 from the Politecnico di Torino, and a Master of Science in Electrical Engineering (MSEE) from the University of California, Los Angeles (UCLA) in 1978. From 1974 to 1987 he was teaching and doing research at the Electronics and Telecommunications Department of the Politecnico di Torino, first as an Assistant and then an Associate Professor. In 1987 he became a Full Professor in the field of Computer Science at the Department of Information Sciences of the University of Milan.

Since 1990 he is a Full Professor in the field of Telecommunications at the Electronics and Telecommunications Department of the Politecnico di Torino.

Marco Ajmone Marsan started his research activity in 1974. He has been working initially in the field of digital transmission, but later moved to networking and distributed systems. He published over 300 papers in the most important international journals and conferences in his fields. He is coauthor of the books Performance Models of Multiprocessor Systems (MIT Press, 1987), and Modelling with Generalized Stochastic Petri Nets (John Wiley, 1995).
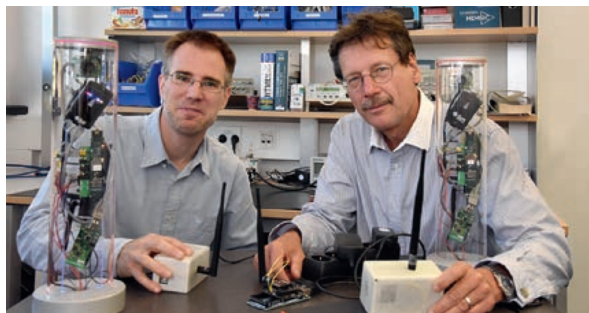
Marco Ajmone Marsan is the founder of the Telecommunication Networks Group at the Electronics and Telecommunications Department of the Politecnico di Torino. As the leader of this research group, he coordinated many research projects funded by national and international agencies (CNR, MIUR, European Commission, European Space Agency, etc.) and by telecommunication companies (Telecom Italia, Fastweb, Cisco Systems, Narus, etc.). He was the coordinator of the Network of Excellence TREND, funded by the EC within the 7th Framework Programme.

The publications of Marco Ajmone Marsan received almost 13,000 citations, with two works having obtained more than 1,600 citations each, and 23 additional works having received more than 100 citations. He is among the "ISI highly cited researchers" in Computer Science. His h-index is equal to 47 in Google Scholar.

Marco Ajmone Marsan spent two research periods at the Computer Science Department of the University of California, Los Angeles, and one at the University of Christchurch (New Zealand) funded by the Erskine Foundation. He is currently a part time Research Professor at the IMDEA Networks Institute in Spain.

He was a member of the editorial board of the journal "ACM/IEEE Transactions on Networking", for which he also chaired the Steering Committee. He is a member of the editorial board of the journals "Computer Networks" and "Performance Evaluation" of Elsevier, and of the ACM Transactions on Modeling and Performance Evaluation of Computer Systems. He was technical program chair or general chair of many international conferences. He was general chair of INFOCOM 2013. He was a member of many PhD Committees in several foreign universities.

Marco Ajmone Marsan is a Life Fellow of the IEEE, and a member of the Academia Europaea and of the Academy of Sciences of Torino. He received the Bonavera prize from the Academy of Sciences of Torino in 1980, the best paper award at the 1982 International Conference on Distributed Computing Systems, Fort Lauderdale, USA, the best paper award at the 23rd International Teletraffic Congress (ITC 23), San Francisco, 2011, the 1982 Informatics Award by Sperry and CILEA. He was awarded a honorary degree in Telecommunication Networks from the Budapest University of Technology and Economics in 2002. He was named Commendatore dell'Ordine al Merito della Repubblica Italiana by the President of Italy in 2006.

Marco Ajmone Marsan was Vice-Rector for Research, Innovation and Technology Transfer of the Politecnico di Torino from 2002 to 2009. From 2013 to 2016 he was the Director of the Alta Scuola Politecnica (ASP), the Honors Program of the two Polytecnical Universities of Torino and Milano. Since 2014 he is the Coordinator of the PhD Program in Electrical, Electronic and Communications Engineering at the Politecnico di Torino. From 2002 to 2009 he was the Director of the Istituto di Elettronica e Ingegneria dell'Informazione e delle Telecomunicazioni of the Italian National Research Council (CNR). In the same period, he was also coordinating the activities of the ICT Department of CNR.

He was the President of the Italian Association of Telecommunication Professors (Gruppo Telecomunicazioni e Tecnologie dell'Informazione - GTTI). He was the Italian Delegate at the ICT Committee and at the IDEAS Committee of the 7th Framework Programme (FP7) of the European Commission. He was the president of the Engineering Panel (GEV09) for the first evaluation of research in Italy, performed by ANVUR. He evaluates research projects for many international funding agencies (in Australia, Austria, Belgium, Cyprus, Finland, France, Ireland, Israel, The Netherlands, Qatar, Romania, Russia, Sweden, USA).

He was a member of the Scientific Committee of CSELT, of CSITE-CNR, of the Centro Supercalcolo del Piemonte, of the Centro per il Sistema Informativo (CSI) del Piemonte, of the Centro Interuniversitario sulle Comunicazioni di Torino, of Intecs SpA, a member of the Directive Committee of the Consorzio Nazionale Interuniversitario sulle Telecomunicazioni (CNIT), NARUS Fellow, member of the Italian Consiglio Superiore delle Comunicazioni, member of the Scientific Committee of the FUB (Fondazione Ugo Bordoni). He is currently a member of the Scientific Committee of the Fondazione Bruno Kessler.

Dr. Antonio FERNÁNDEZ ANTA
Research Professor

PhD: Computer Science. University of Southwestern Louisiana (now University of Louisiana at Lafayette). USA

Previous Position: Full Professor. Universidad Rey Juan Carlos. Madrid. Spain

Research: Parallel and Distributed Processing; Algorithms; Social Computing; Social Networks Analysis; Communications and Networks; Big Data; Machine Learning; Discrete and Applied Mathematics

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Personal Site: http://people.networks.imdea.org/~antonio_fernandez/

Short Bio:

Antonio Fernández Anta is a Research Professor at IMDEA Networks Institute. Previously he was a Full Professor at the Universidad Rey Juan Carlos (URJC) in Madrid, where he has been on the Faculty since 1998. He was before on the Faculty of the Universidad Politécnica de Madrid, where he received an award for his research productivity. He was a postdoc at MIT from 1995 to 1997. He has more than 20 years of research experience, with a steady productivity of more than 5 papers per year on average. He has published in top conferences and journals like INFOCOM, STOC, FOCS, PODC, DISC, Journal of the ACM, SIAM Journal on Computing, or IEEE Transactions on Computers. He was Chair of the Steering Committee of DISC and has served as chair and member in the TPC of numerous conferences and workshops. He is a senior member of the IEEE since 2002 and of the ACM since 2007. Antonio Fernández Anta received his M.Sc. and Ph.D. degrees in Computer Science from the University of Louisiana in 1992 and 1994, respectively. He completed his undergraduate studies (Licenciado and Diplomado en Informática) at the Universidad Politécnica de Madrid, Spain, in 1988 and 1991 respectively, having received awards at the university and national level for his academic performance.

research associate professors

Research Associate Professors are typically researchers with several years' experience who assume a position of responsibility in leading the day-to-day activities of our research teams.

Dr. Domenico GIUSTINIANO
Research Associate Professor

PhD: Telecommunication Engineering. University of Rome "Tor Vergata". Italy
Previous Position: Senior Researcher & Lecturer. Communication Systems Group (CSG). Swiss Federal Institute of Technology Zurich (ETH Zurich). Switzerland
Research: Next Generation Wireless Networks; Visible Light Communication Systems; Mobile Indoor Localization Systems; Distributed Spectrum Monitoring Systems; mmWave Communication Systems
Contact: domenico.giustiniano@imdea.org
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Short Bio:
Dr. Domenico Giustiniano is Research Associate Professor at IMDEA Networks Institute and leader of the Pervasive Wireless Systems group. Before joining IMDEA, he was a Senior Researcher and Lecturer at ETH Zurich. He also worked as Post-Doctoral Researcher at Disney Research Zurich and at Telefonica Research Barcelona. He holds a PhD in Telecommunication Engineering from the University of Rome Tor Vergata (2008). Dr. Giustiniano devotes most of his current research to emerging areas in wireless networking and pervasive wireless systems.

Dr. Giustiniano has large experience in leading and participating in funded research projects such as MATISSE, SPECTRUMCOP (industrial projects), mmMAGIC (EU H2020 PPP), Flex5gware (EU H2020 PPP). The activity of Dr. Giustiniano creates bridges between high scientific work, targeting publications in top venues, and practical work, as demonstrated by his leadership role in initiatives such as the OpenVLC project, an open-source platform for research in visible light communication networks. Dr. Giustiniano is co-founder of the non-profit Electrosense association, a crowd-sourcing initiative to collect and analyse spectrum data. His approach to scientific work oriented to devise solutions to real-world problems based on real-world assumptions is proved by i) five patents and ii) the best project Award (2010) within all the R&D centers of Telefonica Corporation for the innovation and visibility to the company and the clients and iii) two Cyber Awards (2015 and 2016) for outstanding scientific contribution in Cyberspace and Information research program of Armasuisse Science and Technology.

Dr. Giustiniano has supervised one PhD thesis ("sobresaliente" grade of the PhD dissertation and "Outstanding thesis awards 2015/2016" from UC3M) and he is currently supervising four PhD students. The original contributions he has made to his field of research are exemplified by publications in top conference venues such as ACM MobiCom, ACM CoNEXT (6), IEEE INFOCOM (2), ACM/IEEE IPSN (2), and in journals such as IEEE Journal on Selected Areas in Communications, IEEE/ACM Transactions on Networking (2) and IEEE Transactions on Wireless Communications. He has received the best paper award at IFIP Wireless Days 2013, best student paper award at IEEE PIRMC 2016 and best paper award runner-up at ACM CoNEXT 2016. He has been general co-chair of IFIP/IEEE SustainIT 2015, and regularly serves as TPC member in top conferences such as ACM Conext 2017 and IEEE INFOCOM 2014-2017.

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iMdea networks

Dr. Sergey GORINSKY
Research Associate Professor

PhD: Computer Sciences. University of Texas at Austin. USA
Previous Position: Assistant Professor. Washington University in St. Louis. USA
Research: Computer Networking; Distributed Systems; Network Economics
Contact: sergey.gorisnky@imdea.org
Personal Site: http://people.networks.imdea.org/~sergey_gorinsky/

Short Bio:
Sergey Gorinsky is a tenured Research Associate Professor at IMDEA Networks Institute, Madrid, Spain, where he leads the NetEcon (Network Economics) research group. Dr. Gorinsky received his Ph.D. and M.S. degrees from the University of Texas at Austin, USA in 2003 and 1999 respectively and Engineer degree from Moscow Institute of Electronic Technology, Zelenograd, Russia in 1994. From 2003 to 2009, he served on the tenure-track faculty at Washington University in St. Louis, USA. The areas of his primary research interests are computer networking, distributed systems, and network economics. His research contribu-

tions include multicast congestion control resilient to receiver misbehavior, analysis of binary adjustment algorithms, efficient fair transfer of bulk data, network service differentiation based on performance incentives, and economic perspectives on Internet interconnections and routing. His work appeared at top conferences and journals such as ACM SIGCOMM, ACM CoNEXT, IEEE INFOCOM, IEEE/ACM Transactions on Networking, and IEEE Journal on Selected Areas in Communications. Sergey Gorinsky delivered keynote addresses at NPSec 2013 and RAIT 2012. He has served on the TPCs (technical program committees) of SIGCOMM (2012, 2016), CoNEXT (2015-2017), INFOCOM (2006-2017; Distinguished Member: 2015-2017), ICNP (2008, 2010-2017; area chair: 2013, 2016; TPC co-chair: 2017), and other networking conferences. Prof. Gorinsky co-chaired the TPCs of ICNP 2017, COMSNETS 2013, NetSciCom 2014, E6 2012, HSN 2008, FIAP 2008 and served as a TPC vice-chair for ICCCN 2009. He is a member of the COMSNETS Association, a steering committee for COMSNETS conferences. Sergey Gorinsky has also served as a general co-chair for WoWMoM 2013, COMSNETS 2017, and SIGCOMM 2018.

Dr. José Félix KUKIELKA
Research Associate Professor

PhD: High Frequency Integrated Circuits. University of California at Berkeley. USA
Previous Position: Visiting Professor. University Carlos III of Madrid. Spain
Research: Wideband Access to Private Networks; Quality of Service in Wireless networks; Service-aware Wireless Routing; Wireless Protocol Optimization for High-throughput Data and Voice
Contact: josefelix.kukielka@imdea.org
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Short Bio:
José Félix Kukielka is Research Associate Professor at IMDEA Networks. From 2003 until 2007, he worked at the UC3M as Ramón y Cajal Researcher. He obtained his undergraduate degree at the Universidad Nacional Autónoma de México (Federal District, Mexico) in 1972, and went on to complete a M.Sc. and a Ph.D., both at the University of California, Berkeley (Berkeley, USA).

He has been the Technical Director of REDIMadrid from 2007 until 2009. REDIMadrid was created in collaboration with the UC3M in 2003. It is a regional research network for education and research institutions based in the Madrid Region. The program contributes to the consolidation of a dedicated, high-performance telecommunications infrastructure for its scientific community. Such infrastructure eases and promotes collaborative work, the establishment of eminent working groups and participation in national and international networks.

José Félix Kukielka has 23 years of industrial experience in designing, manufacturing and marketing communications products and Radio Frequency for the semi-conductor and telecommunications industries. Throughout his career, he has worked in both academia and industry, working for Grupo AIA (Spain), Alcatel España, Philips Consumer Communications (Le Mans, France), Alcatel Telecom (Spain) and Avantek, Inc. (California, USA).

He was elected Associate Member of the Technical Team for Alcatel-Lucent Technical Academy (ALTA). He is the creator of the "Kukielka Configuration"", a topology for microwave monolithic integrated circuit amplifiers with multiple feedback loops that is characterized by an excellent gain-bandwidth product, implemented successfully in several semiconductor technologies.

Dr. Vincenzo MANCUSO
Research Associate Professor

PhD: Electronic Engineering. Computer Science and Telecommunication Engineering. University of Palermo. Italy

Previous Position: Post-Doc Researcher. INRIA Sophia Antipolis. France

Research: Opportunistic Mobile Networks; IoT; MEC; 5G

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Personal Site: http://people.networks.imdea.org/~vincenzo_mancuso/

Short Bio:

Dr. Vincenzo Mancuso (Male, H-index: 19, 1713 citations. Last 5 years: H-index: 18, 1557 citations) is Research Associate Professor since January 2016, with a contract co-financed by the Spanish Ministry of Economy and Competitiveness under the Ramon y Cajal Grant. Previously, he has been Research Assistant Professor at IMDEA Network between 2010 and 2015, after having built his research experience by working with University of Palermo (Italy), from which he received a Ph.D. in Electronic, Computer Science and Telecommunications in 2005, Rice University (Houston, TX, USA), and INRIA Sophia Antipolis (France).

His research activities focus on analysis, design, and experimental evaluation of protocols and architectures for opportunistic mobile networks, including IoT and integration with distributed computing solutions.

He has authored more than 80 conference and journal papers, among which 7 CORE A* papers, 11 CORE A papers and 15 JCR Q1 articles.

He has been involved in 24 national and international projects, including ICT CROWD (as project technical manager and IMDEA's PI), H2020 FIRE+ MONROE (as technical manager), H2020 Flex5GWare (as IMDEA PI), H2020 RECAP, ICT FLAVIA, IST FIFTH, IST SatNEx, CELTIC IMAGES, HyperAdapt, Tigre5-CM, MEDI-ANET and E2NET.

Vincenzo has participated in more than 60 technical committees of conferences and journals, and has served in the organization of various scientific events. He is guest Editor of JSAC and has organized special issues for Elsevier PHYCOM and IEEE Wireless Communications Magazine.

In addition to the above-mentioned Ramon y Cajal grant, Vincenzo has been the recipient of a Marie Curie AMAROUT fellowship for three consecutive years (2010-2012), has received a "sexenio equivalente" in 2012 in Spain, and the accreditation to teach at universities in France (for Computer Science disciplines) and Italy (for Telecommunications). Moreover, he has received the best paper award at IEEE GreenCom 2015, the Honorable mention for a work presented at COMSNETS 2015, and his paper at Wireless Days 2013 was runner-up for the best paper award.

research assistant professors

Research Assistant Professors at IMDEA Networks Institute are bright researchers at the beginning of their research career, who want to establish a strong research group based on their research vision. They lead their own team of Pre-doc and Post-doc researchers and collaborate with top Research Associate Professors. Research Assistant Professors are not required to teach, so they can focus full-time on research if they so wish.

Dr. Paolo CASARI
Research Assistant Professor

PhD: Information Engineering. University of Padova. Italy
Previous Position: Senior Postdoctoral Researcher. University of Padova. Italy
Research: Underwater Communications; Network Protocol Design; Field Experiments; Localization; Passive Sensing; Cloud and Edge Computing
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Short Bio:
Paolo Casari received the PhD in Information Engineering in 2008 from the University of Padova, Italy. After being on leave at the Massachusetts Institute of Technology in 2007, his research progressively focused on underwater communications and networks. He collaborated to several funded projects including CLAM (FP7), RACUN (EDA), and several US ARO, ONR and NSF initiatives. He was Technical Manager of the NAUTILUS and WISE-WAI projects. In 2015, he joined IMDEA Networks, where he leads the Ubiquitous Wireless Networks group. He is currently the Scientific Manager of the H2020 project RECAP. He served in the organizing committee of several conferences and has been guest editor of a special issue of the Hindawi Journal of Electrical and Computer Engineering on "Underwater Communications and Networking." His research interests include underwater communications and networks, cloud computing, as well as passive sensing and localization in wireless networks.

IMDEA Networks faculty researchers

Dr. Kirill KOGAN
Research Assistant Professor

PhD: Communication Systems Engineering. Ben-Gurion University of the Negev. Israel
Previous Position: Postdoctoral Fellow. Purdue University. West Lafayette. Indiana. USA Research: Admission Control and Buffer Management; Packet Classification; Software-Defined Networking; Network Functions Virtualization
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Short Bio:
Kirill Kogan is a Research Assistant Professor at IMDEA Networks Institute in Madrid, Spain. His current research interests are in design, analysis, and implementation of networked systems, broadly defined (in particular network processors, switch fabrics, packet classification, network management, service architecture, cloud computing). During 2000-2012 he worked as a Technical Leader at Cisco Systems. During his work he gained enough theoretical and practical experience that he formalized in Ph.D at Ben-Gurion University (Israel) (2008-2012). During 2012-14 he was a Postdoctoral Fellow at the University of Waterloo (Canada) and later at the Purdue University (USA).

Dr. Narseo VALLINA-RODRÍGUEZ
Research Assistant Professor

PhD: Computer Science. University of Cambridge. Cambridge. UK
Previous Position: Research Staff. International Computer Science Institute (ICSI). Berkeley. CA. USA
Research: Network and Traffic Measurements; Mobile Privacy and Security; IoT
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Short Bio:
Narseo Vallina-Rodriguez is an Assistant Research Professor at IMDEA Networks and a research scientist at the Networking and Security team at the International Computer Science Institute (ICSI) in Berkeley. Narseo received his Ph.D. from the University of Cambridge in 2013. His research has been awarded with a Qualcomm Innovation Fellowship in 2012, the best short paper award at ACM CoNEXT'14, the best paper award at ACM HotMiddlebox'15 and a Data Transparency Lab grant in 2016 for characterizing mobile tracking services with the Lumen Privacy Monitor. The research presented was funded by the National Science Foundation and the Data Transparency Lab.

post-doc researchers

Post-doctoral Researchers at IMDEA Networks Institute are early-stage, post-doctorate researchers who are looking to establish their research career, working with top research professors and a team of young, pre-doctorate researchers.

Dr. Danilo DE DONNO
Post-Doc Researcher

PhD: Information Engineering. University of Salento. Lecce. Italy
Previous Position: Postdoctoral Fellow. Electromagnetic Lab. Innovation Engineering Department. University of Salento. Lecce. Italy
Research: Millimeter-Wave Networks; 802.11ad Wireless LANs
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Short Bio:
Danilo De Donno joined the Pervasive Wireless Systems Group and the Wireless Networking Group at IMDEA Networks Institute in July 2015 as a Post-Doc Researcher. As his main research area, he is investigating the feasibility of multiple-access and initial-access schemes at mm-wave frequencies for 5G applications. In the framework of the mmMAGIC project co-funded by the European Commission's 5G PPP program, he holds the leadership of Task 4.3 "Efficient Access Schemes" in Work Package 4 (WP4) "Radio Interface Definitions and Functions", focusing his research on the development of efficient schemes for beam training and tracking using hybrid analog-digital beamforming.

Prior to joining the IMDEA Networks Institute, Danilo De Donno earned his Bachelor's Degree in Telecommunications Engineering from the Politecnico di Milano, Italy, in 2005 after discussing a thesis titled "60-GHz Indoor Radio Propagation: Analysis by Ray-Tracing Simulations". In 2008, he obtained the Master's Degree in Telecommunications Engineering from the Politecnico di Milano with a thesis titled "Optimization of Gateway Positions in Wireless Sensor Networks: Models and Algorithms". In 2012, he completed his Ph.D. in Information Engineering at the Innovation Engineering Department of the University of Salento, Lecce, Italy after discussing a dissertation on "EM Enabling Technologies for Smart Wireless Systems: SDR, RFID, and GPU computing". From July 2011 to December 2011, he was a Short-Term Scholar at the School of Electrical and Computer Engineering of the Georgia Institute of Technology (Atlanta, GA, USA) and, from June 2012 to June 2015, he was a Postdoctoral Fellow with the Electromagnetic Lab Lecce (EML2) of the University of Salento.

Dr. Claudio FIANDRINO
Post-Doc Researcher

BSc: Telematics Engineering. Politecnico di Torino. Turin. Italy
MSc: Computer and Communication Networks Engineering. Politecnico di Torino. Turin. Italy
PhD: Computer Science. University of Luxembourg. Luxembourg
Previous Position: PhD Student. University of Luxembourg. Luxembourg
Research: Cloud RAN; mm-Wave Communications; Mobile Crowdsensing
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Short Bio:
I joined the Wireless Networking Group led by Dr. Joerg Widmer in December 2016. My primary research interests include mobile cloud/fog computing, mobile crowdsensing and data center communication systems.

Dr. Marco GRAMAGLIA
Post-Doc Researcher

PhD: Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Previous Position: Research Fellow. IEIIT-CNR (Institute of Electronics, Computer and Telecommunication Engineering - National Research Council of Italy). Turin. Italy
Research: Vehicular Networks; Wireless Networks; 5G Networks; Mobile Networks; Big Data
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Personal website: http://people.networks.imdea.org/~marco_gramaglia/

Short Bio:
I am a Post-Doc researcher at Institute IMDEA Networks and an Honorary Professor at Universidad Carlos III de Madrid, Department of Telematics Engineering.

I'm currently working under the supervision of Albert Banchs on the 5G NORMA H2020 project.

My research interests include Vehicular Networks, Wireless Networks, 5G Networks, Mobile Networks, and Big Data.

Dr. Adrian LOCH
Post-Doc Researcher

PhD: Computer Science. Technische Universität Darmstadt. Darmstadt. Germany
Previous Position: Research associate. Secure Mobile Networking Lab. Technische Universität Darmstadt. Darmstadt. Germany
Research: Wireless Networking; Millimeter-Wave Communications; Cross-Layer Optimization; Software-Defined Radio; IEEE 802.11ad
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Short Bio:
Adrian Loch is a post-doc researcher at IMDEA Networks in Madrid, Spain. He graduated in Electrical Engineering from Universidad Politécnica de Madrid and Technische Universität Darmstadt in 2011 after completing an international double degree program. After that, he obtained a PhD in Computer Science from Technische Universität Darmstadt in March 2015. During his PhD, he was a research associate at the Secure Mobile Networking Lab. His main areas of interest lie in cooperative communications for both wireless access and wireless multihop networks, including routing issues as well as practical validation on wireless testbeds. Currently, he focuses on millimeter-wave communications and, in particular, wireless LANs such as in the 802.11ad standard.

Dr. Nicolas NICOLAOU
Post-Doc Researcher (Marie Curie Fellow)

PhD: Computer Science and Engineering. University of Connecticut. Storrs. USA
Previous Position: Visiting Lecturer. University of Cyprus. Nicosia. Cyprus
Research: Parallel Algorithms; Wireless and Sensor Networks; Security Evaluation and Analysis of Voting Technologies; Distributed Storage Systems; Fault Tolerant Computing; Distributed Algorithms
Contact: nicolas.nicolaou@imdea.org
Personal website: http://people.networks.imdea.org/~nicolas_nicolaou

Short Bio:
Dr. Nicolas Nicolaou is a Marie Curie Fellow at IMDEA Networks Research Institute since December 2014. He obtained a Ph.D. in 2011 and an M.S. in 2006 from the Department of Computer Science and Engineering at the University of Connecticut (UCONN), and a B.Sc. in Computer Science from the University of Cyprus (UCY) in 2003. Previously he hold the position of Visiting Lecturer at UCY (2011 -2013) and he served as a Special Scientist at the Cyprus University of Technology (2013-2014). Before that he worked as a Research Assistant in the Dependable Distributed Systems Lab at UCONN, and as a Senior Research Assistant in the VoTeR Lab at the same university.

His main research interests focus on the analysis, design and implementation of practical and robust distributed and parallel algorithms, design and implementation of algorithms for consistent distributed storage systems, ad-hoc mobile and sensor networks and evaluation and exploitation of voting technologies. His research was published in top conferences like PODC, DISC, SPAA, and journals like JPDC, IEEE Transactions on Information Forensics and Security in the fields of distributed computing, networks and security. For his work he received funding from the Cyprus Research Promotion Foundation (2010-2011) and secured an Intra-European Marie-Curie Fellowship (2014-2016).

Dr. Agustín SANTOS
Post-Doc Researcher

PhD: Computer Science. University Rey Juan Carlos. Madrid. Madrid. Spain

Previous Position: Entrepreneur & Lecturer. University Rey Juan Carlos. Madrid. Spain

Research: Distributed Systems; Simulation; Game theory; Big Data and Data Analysis; Natural Language Processing

Contact: agustin.santos@imdea.org

In 2016 Agustín Santos Méndez was a Visiting Scholar at the Harvard School of Engineering and Applied Sciences - Economics & Computer Science Research Group, and an Adjunct Assistant Professor at University Rey Juan Carlos in Computer Science and Engineering. Since 2013 he also collaborated with IMDEA Networks Institute working on projects related to social networks, machine learning, recommendation engines and distributed resource allocation.

His early career included more than twenty years as CEO and co-founder of several start-up companies. He also has a strong background in the development of multinational projects in many different areas (compilers, distributed systems, simulation, system integration, etc).

He obtained his PhD in Computer Science from the Universidad Rey Juan Carlos in 2013. His research interests are diverse covering areas such as game theory, design of mechanisms for resource allocation (fair allocation) and distributed systems. His main research interest is on decentralized resource allocation problems as they arise in large distributed computational systems.

A map of the world displaying the international academic background of IMDEA Networks personnel

visiting professors

Visiting Professors share our research interests and spend their sabbatical with us for either one or two terms. They usually have several years' post-doctoral research experience and are interested in extending their horizons with a temporary assignment in a new environment.

Dr. Roberto BATTITI
Visiting Professor

Affiliation: IMDEA Networks Institute and Chair of Excellence University Carlos III of Madrid - Banco Santander
University of origin: Università degli Studi di Trento. Italy
PhD: Neural Networks and Parallel Computing. California Institute of Technology (Caltech). USA
Research: Machine learning and Intelligent Optimization (LION) for improving quality of service in telematics applications: Machine Learning; Intelligent Optimization; Meta-Heuristics; Marketing/Sales; Collaborative Recommendations; Network-related Graph Algorithms; Dynamic Network Management; Startups and Innovation
Contact: roberto.battiti@imdea.org
Personal Site: http://lion.disi.unitn.it/~battiti/
Joining & leaving dates: September 2016 to February 2017

Short Bio:
I was born in Trento (a small Italian-German town with an intriguing history, barycenter of Europe in the Alps) and received the Laurea in Theoretical Physics from the University of Trento in 1985. Then I moved to the USA, where I received the Ph. D. degree from the California Institute of Technology (Caltech) in 1990. As full professor of Computer Science I organize research initiatives in the area of reactive search optimization (RSO) and learning and intelligent optimization (LION) heuristics. My passion is to use data to build flexible models and extract actionable knowledge (machine learning), to exploit knowledge to automate the discovery of improving solutions (intelligent optimization), to connect insight to decisions and actions ("prescriptive analytics").

I am the director of the LION lab: machine Learning and Intelligent OptimizatioN for prescriptive analytics, recent co-author of THE LION WAY, Machine Learning plus Intelligent Optimization, with a rich experience in startup activities.

I am a Fellow of the IEEE (class of 2009).

Short Bio:

Sungoh Kwon (S'05/M'08) received his B.S. and M.S. degrees in electrical engineering from KAIST, Daejeon, Korea, and the Ph.D. degree in electrical and computer engineering from Purdue University, West Lafayette, IN, in 1994, 1996, and 2007, respectively. From 1996 to 2001, he was a research staff member with Shinsegi Telecomm Inc., Seoul, Korea. From 2007 to 2010, he developed LTE schedulers as a principal engineer in Samsung Electronics Company, Ltd., Korea. He has joined to University of Ulsan as an assistant professor since 2010. His research interests are in wireless communication networks.

Dr. Sungoh KWON
Visiting Professor

University of origin: University of Ulsan. Ulsan. South Korea
PhD: Routing for Multi-hop Wireless Networks. Purdue University. Indiana. USA
Research: Scheduling Algorithms; Routing Algorithms; Cross-layer Optimization; Energy-efficient Algorithms; Multi-hop Wireless Networks; Small-cell Networks; Heterogeneous Wireless Networks; Vehicular Networks; Indoor Positioning Systems; Geometric Probability
Contact: sungoh@ulsan.ac.kr
Joining & leaving dates: October to December 2016

Dr. Fernando BOAVIDA
Visiting Professor

University of origin: University of Coimbra. Coimbra. Portugal
PhD: Informatics. University of Coimbra. Coimbra. Portugal
Research: Wireless Sensor Networks; Mobility; Quality of Service; Computer Networks
Contact: fernando.boavida@imdea.org
Personal Site: https://apps.uc.pt/mypage/faculty/uc24338/en
Joining & leaving dates: September 2015 to July 2016

Short Bio:

Fernando Boavida received his PhD in Informatics Engineering in 1990, and he currently is Full Professor at the Department of Informatics Engineering (DEI) of the Faculty of Sciences and Technology of the University of Coimbra. He was the founder of the Laboratory of Communi-cations and Telematics (LCT) of DEI, the Strategic Director for Communications and Informa-tion Technology of the University of Coimbra from October 2003 to December 2015, the Director of the Department of Informatics Engineering from February 2004 to January 2008, and the Director of the Centre for Informatics and Systems of the University of Coimbra (http://cisuc.uc.pt) from October 2013 to September 2015.

His main research interests are wireless sensor networks, mobility, quality of service, and computer networks in general. He is author/co-author of more than 170 international publications (books, book chapters, refereed journals and conference proceedings) and 50 national publications. He was the chairman of the Program Committee of QofIS'2001, IDMS-PROMS'2002, NETWORKING 2006, WWIC 2007, FMN 2008, EWSN 2010, FMN 2012, IWQoS 2012, ACM SIGCOMM FhMN 2013, Mobiquitous 2015, and WoWMoM 2016 international conferences/workshops. He has been involved in numerous program committees of major international conferences, including INFOCOM 2006 and 2007. He participated in many European projects, such as E-NEXT (FP6 Network of Excellence on Emerging Networking Experiments and Technologies) EuQoS (End-to-end Quality of Service support over heterogeneous networks, IST-FP6-2004-004503), WEIRD (WiMAX Extension to Isolated Research Data networks, IST FP6 Integrated Project 034622), OpenNet (Open Interconnect for the Internet Community, IST-FP6 Specific Support Action 035185), CONTENT (Content Networks and Services for Home Users, IST-FP6-0384239), GINSENG (Performance Control in Wireless Sensor Networks", ICT-FP7-224282) and MICIE (Tool for systemic risk analysis and secure mediation of data ex-changed across linked CI information infrastructures", ICT-FP7-225353).

He is a senior member of the IEEE and a licensed Professional Engineer. He is a member of the Editorial Advisory Board of the Computer Communications journal.

Dr. Antonio CARZANIGA
Visiting Professor

University of origin: Università della Svizzera Italiana (USI). Lugano. Switzerland
PhD: Computer Science. Electronics and Information Department. Politecnico di Milano. Italy
Research: Future Internet Architecture; Information Centric Networking; Content-Based Routing; Publish/Subscribe Systems; Software Engineering; Software Reliability; Software Fault Tolerance
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Personal Site: http://www.inf.usi.ch/carzaniga/
Joining & leaving dates: October 2015 to January 2016

Short Bio:
Antonio Carzaniga is a Professor at the Faculty of Informatics of Università della Svizzera italiana (USI) (Switzerland) which he joined as an Assistant Professor when the Faculty was founded in 2004. From 2001 to 2007 he was an Assistant Research Professor in the Department of Computer Science at the University of Colorado at Boulder. He received the Laurea degree in Electronic Engineering and the PhD degree in Computer Science from Politecnico di Milano, Italy, in 1994 and 1999, respectively. Dr. Carzaniga serves as an Associate Editor of ACM Transactions on Software Engineering and Methodology. He also co-chaired a number of international conference committees, including the Technical Program Committee of the 2nd ACM Conference on Information-Centric Networking (ICN 2015), and repeatedly served on the program committees of various international conferences, including the major conferences in software engineering and middleware.

Antonio Carzaniga has conducted research and published papers in the areas of mobile code, distributed configuration management, testing and validation of distributed systems, distributed publish/subscribe middleware, and advanced networking architectures. Antonio's work has been quite influential in some areas. Most notably, his 2001 paper on the Siena distributed publish/subscribe system, published in ACM Transactions on Computer Systems, is highly cited and one of the five most cited articles of all times of that prestigious journal. Also, Antonio received the ICSE Most Influential Paper Award of ACM SIGSOFT and IEEE TCSE in 2007 for the ICSE'97 paper "Designing Distributed Applications with Mobile Code Paradigms".

Currently, Antonio Carzaniga's primary research interests are in the areas of future internet architectures, and in particular, information centric networking (ICN) which is a natural continuation of his long-standing and highly cited research in distributed publish/subscribe systems and content-based communication. His goal is to architect a more functional and expressive network, one that does more for applications than connecting end-points, but also more than incorporating parts of the Web at the network level. Specifically, Antonio Carzaniga is working on an ICN architecture that, unlike in the mainstream ICN, combines "push" and "pull" information flows, supports expressive descriptors as well as very efficient locators, features loop-free routing to single or multiple destinations, and does not require per-packet in-network state. Antonio has formulated such a network architecture, and is working on both the algorithmic and systems aspects of routing and forwarding, as well as on many other ideas to make the network scalable, robust, and secure.

emeritus professors

Emeritus Professors are eminent Research Professors who are acclaimed for their many years of service to IMDEA Networks. With their dedication they have brought prominence and international repute to the Institute.
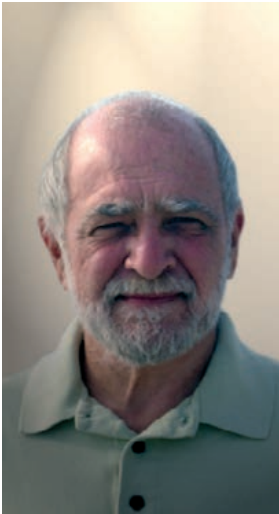
Dr. Nicholas F. MAXEMCHUK
Emeritus Professor

Affiliation: IMDEA Networks Institute and Columbia University in the City of New York. USA
PhD: Systems Engineering. University of Pennsylvania. USA
Research: Random Coding Network Services; Advanced Network Design for QoS Deployment; Traffic Engineering in Wireless Networks
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Personal Site:
http://www.ee.columbia.edu/~nick/

Short Bio:
Nicholas Maxemchuk, a networking pioneer, holds a permanent double appointment as Professor at the world-leading Columbia University of New York City (New York, USA) and Research Professor at IMDEA Networks.

He holds a M.Sc. in Electrical Engineering and a Ph.D. in Systems Engineering, both from the University of Pennsylvania (Philadelphia, USA). Before joining Columbia University and IMDEA Networks, Nick Maxemchuk held the position of Technical Leader at AT&T Research Laboratories (1996 – 2001) and, prior to that, was the Head of Distributed Systems Research Department at AT&T Bell Laboratories (1976 – 1996). From 1968 to 1976 he was a member of the technical staff at the RCA David Sarnoff Research Center in Princeton, New Jersey.

Many of his far-sighted contributions to computer-communications networking have been years ahead of their time and have led to the development of groundbreaking new systems. His invention of Dispersity Routing in the 1970s, for example, has recently been applied to ad hoc networks. In 2006, his achievements in the field were recognized by the world's leading professional association for the advancement of technology, the IEEE, when he was awarded the prestigious 2006 IEEE Koji Kobayashi Computers and Communications Award.

Amongst other awards that he has been given, some of the most noteworthy are the RCA Laboratories Outstanding Achievement Award in 1970, the Bell Laboratories Distinguished Technical Staff Award in 1984, the IEEE's Leonard G. Abraham Prize Paper Award in 1985 and 1987, and the William R. Bennett Prize Paper Award in 1997. He was also made a fellow of the IEEE in 1989, and received the 1996 R&D 100 award for his work on document marking.

As well as owning 30 patents and publishing three books, Nicholas Maxemchuk has co-authored over 100 publications. His strong reputation as an eminent scientist has earned him many editorial and advisory positions with organizations including the IEEE, ACM, NSF Expert Group and the United Nations. He has published three award winning papers and had two of his publications voted into the Communication Society 50th Anniversary Issue. He is a member of the Board of Governors of the Armstrong Foundation and also works as a Consultant on Data Networks in Transportation Networks for The National Academies/Transportation Research Board.

pre-doc researchers

Our Pre-Doc Researchers are young, aspiring researchers who occupy a salaried position in our research team whilst undertaking their Ph.D. at a leading Madrid University for up to five years. Most of our Pre-Doc Researchers enter the Ph.D. program at University Carlos III of Madrid (UC3M). IMDEA Networks Institute has a far-reaching collaboration agreement with UC3M which includes the provision of a Postgraduate program for our early-stage researchers. In the future we may have similar arrangements with other Madrid Universities.
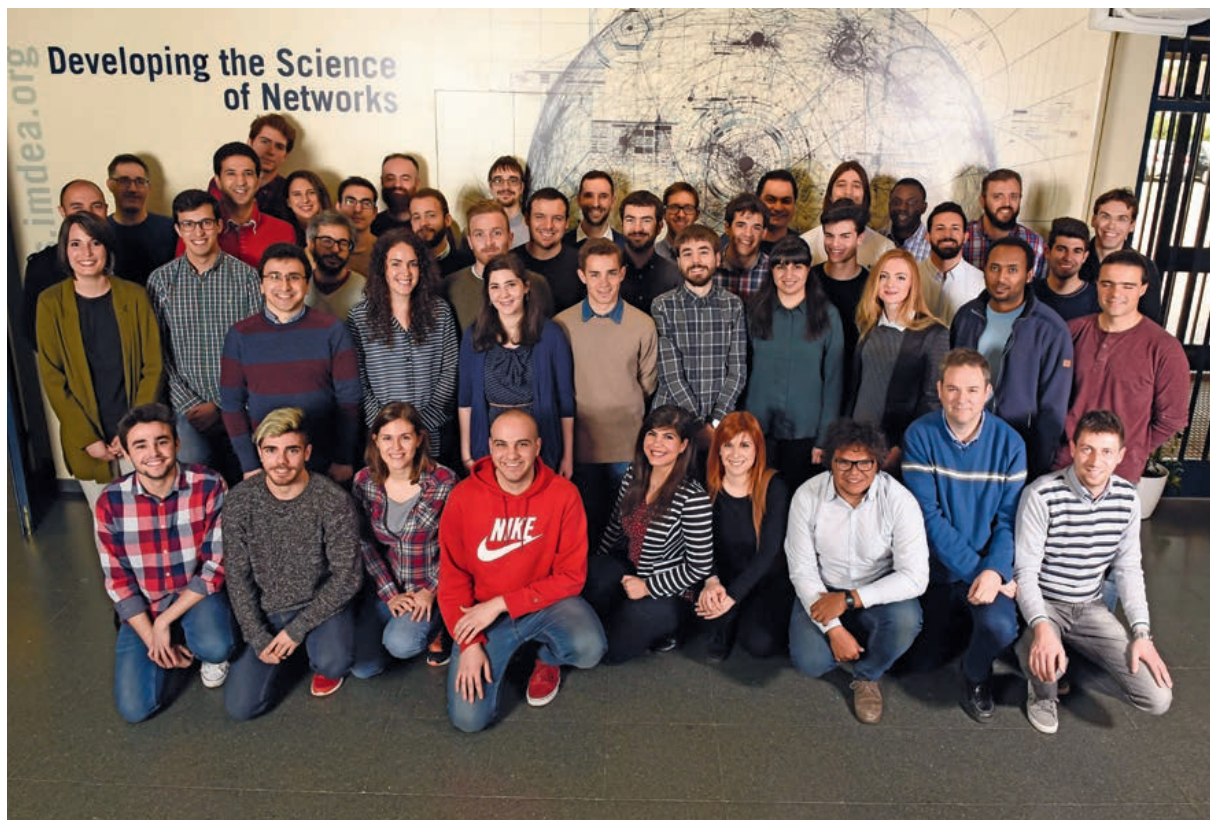
IMDEA Networks research team of postdocs, pre-doctoral researchers, engineers and internship students

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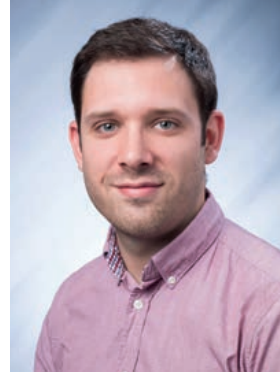
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Research: IP Mobility; Wireless Networks; Dense Heterogeneous Networking; SDN; Vehicular Networks; Mobile Broadband Networks; Connectivity management
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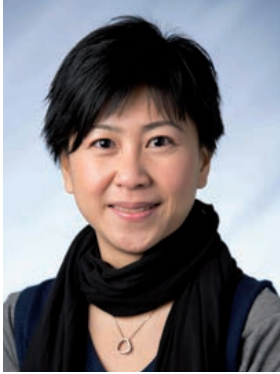
Gek Hong SIM
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Previous Position: Technical Trainer. Huawei Technologies Co. Ltd. Malaysia
Research: 60 GHz millimeter wave, scheduling, multicast scheduling
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external PhD students

Our External PhD Students are young, aspiring researchers who are supervised or co-supervised by a member of the IMDEA Networks' research team. Most of the External PhD Students to IMDEA Networks are undertaking the Ph.D. program at University Carlos III of Madrid.

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research engineering and support

Research Engineering and Support employees at IMDEA Networks Institute are responsible for the design, installation and maintenance of the IT infrastructure, either at the level of the entire Institute, or working closely with researchers and their groups. Typical roles include systems administration and software engineering. These positions are similar to their industry equivalents, but enable our employees to work on cutting-edge research problems and technology in a stimulating environment.

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internship students

IMDEA Networks offers a Research Internship program. Eligible candidates are students who are currently undertaking a B.Sc., M.Sc. or equivalent in Computer Science, Electrical Engineering, Computer Engineering, Telecommunications, Telematics or a related field, and who wish to enhance their research potential developing the Science of Networks. Interns work closely with members of our research team, which allows them to acquire on-the-job training and gain valuable experience in computer networking science and technology.

The minimum expected internship duration is usually 3 months, but longer stays are accommodated depending on individual circumstances. Successful interns also receive special consideration for future positions on our Pre-doc Researchers team. Several of the interns listed here have benefited from the Telefonica Scholarship Program: Talentum Startups 2016 (see p. 95).

Manuel CASARIEGO
Supervisor: Carlos Bernardos
Research: 5GEx; SDN; NFV; Network Simulation
Internship sponsored by Telefonica Talentum program

Paolo CASTAGNO
Supervisor: Vincenzo Mancuso
Research: D2D Communications; Game Theory

Vincenzo COMITE
Supervisor: Vincenzo Mancuso
Research: Broadband Networks; Network Analysis and Management; Data Mining

Carlos CUADRADO
Supervisor: Joerg Widmer
Research: Wireless Networks; IEEE 802.11ad; LTE; Network Simulation

Alba DE JUANAS SANZ
Supervisor: Joerg Widmer
Research: Wireless Networks; IEEE 802.11ad; 60GHz

Gonzalo FAJARDO
Supervisor: Arturo Azcorra
Research: SDN; NFV; Virtualization; Network Simulation

José Manuel GRAN JOSA
Supervisor: Arturo Azcorra
Research: SDN; Mobile Networks; Virtualization; 5G

Irene HERNÁNDEZ
Supervisor: Jose Félix Kukielka
Research: Wideband Access to Private Networks; Quality of Service in Wireless Networks; Service-aware Wireless Routing and Wireless Protocol Optimization for High-throughput Data and Voice

Boram JIN
Supervisor: Joerg Widmer
Research: 5G; LTE; mmWave; Mathematical Analysis for Network Performance

Norbert LUDANT
Supervisor: Joerg Widmer
Research: Wireless Communications; LTE; 5G; Massive MIMO; mmWave

Adrian MARTINEZ
Supervisor: Albert Banchs
Research: Multipath-tcp protocol, mptcp proxy
Internship sponsored by Telefonica Talentum program

Rubén MARTÍN VÁZQUEZ
Supervisor: Jose Félix Kukielka
Research: Wideband Access to Private Networks; Quality of Service in Wireless Networks; Service-aware Wireless Routing and Wireless Protocol Optimization for High-throughput Data and Voice

Magnus OFFERMANNS
Supervisors: Joerg Widmer, Adrian Loch
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María PERAL
Supervisor: Joerg Widmer
Research: Wireless Networks; 60 GHz; 802.11ad; Robotics

Juan POBLETE
Supervisor: Jose Félix Kukielka
Research: Wideband Access to Private Networks; Quality of Service in Wireless Networks; Service-aware Wireless Routing and Wireless Protocol Optimization for High-throughput Data and Voice

Víctor Manuel RAMÍREZ
Supervisor: Jose Félix Kukielka
Research: Wideband Access to Private Networks; Quality of Service in Wireless Networks; Service-aware Wireless Routing and Wireless Protocol Optimization for High-throughput Data and Voice

Alejandro RANCHAL PEDROSA
Supervisor: Joerg Widmer
Research: Wireless Networks; 60 GHz; 802.11ad

Swetank Kumar SAHA
Supervisor: Joerg Widmer
Research: Wireless Networks; Millimeter-wave networking; 60 GHz; 802.11ad

Roberto SANTOS
Supervisor: Joerg Widmer
Research: Wireless Networks; IEEE 802.11ad; 60GHz

María SCALABRÍN
Supervisor: Joerg Widmer
Research: Wireless Networking; Machine Learning; Hidden Markov Models; Pattern Matching

Bana SHEHADEH ALREFAEE
Supervisor: Joerg Widmer
Research: Wireless Networks; 60 GHz Communication; IEEE 802.11ad; Wireless Testbed Experiments and Performance Evaluation

iMdea **networks**

networked
systems&algorithms

Research Director
· Dr. Arturo Azcorra

Researchers
· Dr. Sergey Gorinsky
· Dr. José F. Kukielka
· Dr. Kirill Kogan

Pre-Doc Researchers
· Patricia Callejo
· Juan Camilo Cardona
· Pavel Chuprikov
· Roderick Fanou
· Vadim Kirilin
· Yonas Mitike Kassa
· Nuria Molner Siurana
· José Antonio Ruipérez
· Pablo Salvador
· María Isabel Sánchez
· Sergio N. Tamurejo Moreno

wireless
networking

Research Director
· Dr. Joerg Widmer

Researchers
· Dr. Nicholas Maxemchuk
  (Emeritus Research Professor)
· Dr. Domenico Giustiniano
· Dr. Paolo Casari

Pre-Doc & Post-Doc Researchers
· Dr. Danilo De Donno
· Dr. Claudio Fiandrino
· Dr. Adrian Loch
· Elnaz Alizadeh Jarchlo
· Hany Assasa
· Guillermo Bielsa
· Nicola Bui
· Pablo Caballero
· Roberto Calvo Palomino
· Carlos Donato
· Elizaveta Dubrovinskaya
· Aymen Fakhreddine
· Ander Galisteo
· Pablo Jiménez Mateo
· Foivos Michelinakis
· Joan Palacios Beltrán
· Maurizio Rea
· Gek Hong Sim
· Qing Wang

network
measurements&analytics

Research Director
· Dr. Albert Banchs

Researchers
· Dr. Marco Ajmone-Marsan
· Dr. Antonio Fernández-Anta
· Dr. Vincenzo Mancuso
· Dr. Narseo Vallina-Rodríguez

Pre-Doc & Post-Doc Researchers
· Dr. Marco Gramaglia
· Dr. Nicolas Nicolaou
· Dr. Miguel Peón-Quirós
· Amr AbdelKhalek Abdelnabi
· Edgar Arribas
· Arash Asadi
· Dario Bega
· Angelos Chatzipapas
· Luis. F. Chiroque
· Evgenia Christoforou
· Ginés García Avilés
· Jorge Martín Pérez
· Noelia Pérez Palma
· Christian Vitale
· Elli Zavou

Our current team

administrative unit

The Institute is managed by the Director – Dr. Arturo Azcorra and the Deputy Director – Dr. Albert Banchs.

They are supported by a small administration team who are dedicated to the efficient and effective achievement of the Institute's goals and to providing the levels of support required by its team of international researchers.

Rebeca DE MIGUEL
Operations Manager

Qualifications: Licenciatura en Ciencias de la Comunicación (Periodismo) (5-year degree in Communication Sciences (Journalism)). University of the Basque Country - UPV/EHU. Spain; BA (1st Class Hons) in History and Theory of Art & Film Studies. University of Kent at Canterbury. UK
Contact: rebeca.demiguel@imdea.org

Brian DUNNE
Human Resources Manager

Qualifications: BBS in Business Studies and French. Trinity College Dublin. Ireland
Contact: brian.dunne@imdea.org

Ana GONZÁLEZ
Projects & Funding Manager

Qualifications: BA (Hons) "Modern European Studies". University of West London. UK; Postgraduate Diploma in "European Studies". University of West London. UK
Contact: ana.gonzalez@imdea.org

Admin and research support team

alumni network

The Institute's Alumni Network is built upon graduate Pre-Doc Researchers who have obtained their Ph.D. and have left the team to further their research career in other organizations. Networking is about making contacts and building relationships. The alumni frame provides its members a supportive community of graduates who have shared experiences, values and goals that will last a lifetime. It also provides a venue through which former Pre-Doc Researchers can maintain a long-term collaborative relationship with the Institute. Alumni are IMDEA Networks' ambassadors worldwide, creating awareness and opening up new communication channels with the global scientific community.

The members of the alumni network appear listed here following the most recent graduation date up to the end of 2016.

Dr. Angelos CHATZIPAPAS

Current Position: Innovation Architect. Lloyds Banking Group. London. United Kingdom
Ph.D. Thesis: *Optimization of Energy Efficiency in Data and Web Hosting Centers* (November 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Vincenzo MANCUSO

Dr. Elli ZAVOU

Current Position: Postdoc. Inria Grenoble - Rhône-Alpes & INSA Lyon. Lyon. France
Ph.D. Thesis: *Online Scheduling in Fault-prone Systems: Performance Optimization and Energy Efficiency* (September 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
**Ph.D. Supervisor:** Dr. Antonio FERNÁNDEZ ANTA

Dr. Syed Anwar UL HASAN

Ph.D. Thesis: *The Role of Topology and Contracts in Internet Content Delivery* (June 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Sergey GORINSKY
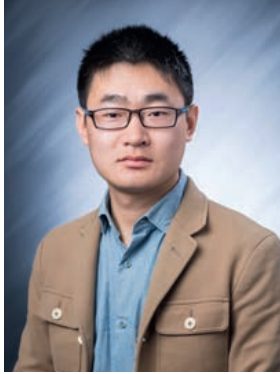
Dr. Qing WANG

Current Position: Postdoc Researcher. Delft University of Technology (TU Delft). Delft. The Netherlands
Ph.D. Thesis: *Visible Light and Device-to-Device Communications: System Analysis and Implementation* (May 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Domenico GIUSTINIANO

Dr. Pablo SALVADOR

Current Position: Technology Innovation Engineer. Fon Technology. Madrid. Spain
Ph.D. Thesis: *Efficient voice and video traffic delivery in IEEE 802.11 WLANs: design, implementation and experimental evaluation* (April 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Pablo SERRANO YÁÑEZ-MINGOT

Dr. Gek Hong SIM

Current Position: Post-doc Researcher. TU Darmstadt. Germany
Ph.D. Thesis: *Algorithm Design for Scheduling and Medium Access Control in Heterogeneous Mobile Networks* (March 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Joerg WIDMER

Dr. Juan Camilo CARDONA

Current Position: Software Engineer. Cisco Systems. Barcelona. Spain
Ph.D. Thesis: *Inter-domain traffic management in an evolving Internet peering ecosystem* (May 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Pierre FRANCOIS

Dr. M. Isabel SANCHEZ

Current Position: Postdoctoral Fellow. Simula Research Laboratory. Oslo. Norway
Ph.D. Thesis: *Analysis, Design and Experimental Evaluation of Connectivity Management in Heterogeneous Wireless Environments* (March 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Antonio DE LA OLIVA

Dr. Arash ASADI

Current Position: Post-doc Researcher. TU Darmstadt. Germany
Ph.D. Thesis: *Opportunistic Device-To-Device Communication In Cellular Networks: From Theory To Practice* (March 2016)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Vincenzo MANCUSO
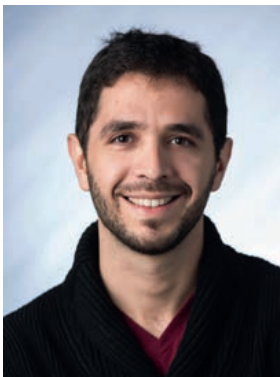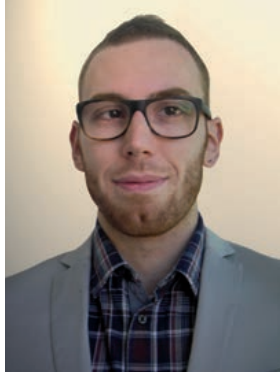
Dr. Vincenzo SCIANCALEPORE

Current Position: Research Scientist. NEC Deutschland GmbH. Germany
Ph.D. Thesis: *Enhancement in Spectrum Management Techniques for Heterogeneous 5G Future Networks* (November 2015)
**University:** University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Albert Banchs

Dr. Ignacio CASTRO

Current Position: Post-doctoral Research Assistant. Queen Mary University of London. UK
Ph.D. Thesis: *Economics of Internet Interdomain Interconnections* (July 2015)
University: Open University of Catalonia (UOC). Barcelona. Spain
Doctoral Program: Information and Knowledge Society
Ph.D. Supervisor: Dr. Sergey GORINSKY

Dr. Jordi ARJONA AROCA

Current Position: Postdoctoral Researcher. Cloud Computing Group. Bell Labs. Dublin. Ireland
Ph.D. Thesis: *Structural Issues and Energy Efficiency in Data Centers* (February 2015)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Antonio FERNÁNDEZ ANTA

Dr. Thomas NITSCHE

Current Position: Wissenschaftlicher Mitarbeiter/Research Fellow. Fraunhofer Institute for Embedded Systems and Communication Technologies ESK. Munich. Germany
Ph.D. Thesis: *Enhancing Wireless local area Networks by leveraging Diverse Frequency Resources* (September 2015)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Joerg Widmer
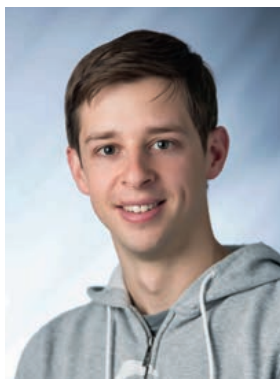
Dr. Fabio GIUST

Current Position: Research scientist. NEC Laboratories Europe. Heidelberg. Germany
Ph.D. Thesis: *Distributed Mobility Management for a Flat Architecture in 5G Mobile Networks: Solutions, Analysis and Experimental Validation* (March 2015)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Carlos Jesús BERNARDOS CANO

Dr. Andra LUTU

Current Position: Postdoctoral Fellow. Simula School of Research and Innovation (SSRI). Simula Research Laboratory. Fornebu. Norway
Ph.D. Thesis: *A system for the detection of Limited Visibility in BGP* (November 2014)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Marcelo BAGNULO

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Dr. Agustín SANTOS

Current Position: Post-Doc Researcher. IMDEA Networks Institute. Madrid. Spain
Ph.D. Thesis: *Quid Pro Quo: Mecanismos para la asignación de tareas en entornos distribuidos* (June 2013)
University: Rey Juan Carlos University. Madrid. Spain
Doctoral Program: Department of Telematic Systems and Computation (GSYC)
Ph.D. Supervisors: Dr. Antonio Fernández Anta & Dr. Luis López Fernández

Dr. Marco GRAMAGLIA

Current Position: Post-Doc Researcher. IMDEA Networks Insitute. Madrid. Spain
Ph.D. Thesis: *VANET-Based optimization of infotainment and traffic efficiency vehicular services* (September 2012)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisors: Dr. María CALDERÓN PASTOR & Dr. Carlos Jesús BERNARDOS CANO
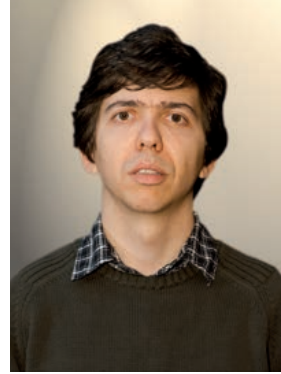
Dr. Paul PATRAS

Current Position: Chancellor's Fellow / Lecturer in the School of Informatics at the University of Edinburgh. Scotland
Ph.D. Thesis: *Control-Theoretic Adaptive Mechanisms for Performance Optimization of IEEE 802.11 WLANs: Design, Implementation and Experimental Evaluation* (March 2011)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Albert BANCHS

Dr. Alex BIKFALVI

Dr. Michal KRYCZKA

Current Position: TGP Systems Integration Analyst. Accenture. Warsaw. Poland
Ph.D. Thesis: *Experimental analysis of the socio-economic phenomena in the BitTorrent ecosystem* (February 2013)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisors: Dr. Arturo AZCORRA and Dr. Rubén CUEVAS

Current Position: Software Engineer. Midokura. Barcelona. Spain; Part-time Lecturer. Network Technologies and Strategies Research Group. Pompeu Fabra University. Barcelona. Spain
Ph.D. Thesis: *Peer-to-Peer Television for the IP Multimedia Subsystem* (July 2012)
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Supervisor: Dr. Jaime GARCÍA-REINOSO

headquarters and research laboratories infrastructure

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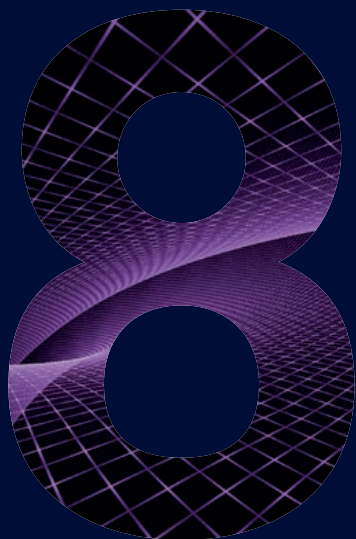
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8.1. Headquarters

IMDEA Networks includes in its goals the provision of the highest international level of research and technology development capabilities geared to the advancement of future Internet technologies. Our headquarters aim to fulfill the functional requirements of a leading- edge research center and to attract researchers from around the World. The main objective of our office and lab space is to provide a high quality working environment for researchers. We are continuously refurbishing our site at Avenida del Mar Mediterraneo in Leganes (Madrid) in order to furnish it with renovated and extended facilities. The new spaces are conceived primarily with researchers' needs and preferences in mind, including spacious premises with state-of-the-art facilities and equipment, labs adapted to the needs of our lines of research, with excellent communications and ICT infrastructure, and specific research equipment.

The area of the building already remodeled amount to 1488 m^2.

In 2016 we continued to improve the building. We finalized the plans for a new refurbishing. Included in the plans are:

- a new office area in the first floor,
- a new central location for the floor network infrastructure communication racks,
- added laboratories on the ground floor,
- increased meeting spaces on the second floor,
- an eating area.

At our scientific laboratories we aim to transform our research results into high value added products and services. They allow us to perform:

- The measurements and prototypes of the devices, protocols and algorithms developed by our researchers.

- Simulations of highly complex baseband and medium access control systems, as well as sophisticated radio subsystems.

- Radio parameter measurements involved in mobile and fixed communications and evaluation of effects on the radio spectrum of the new protocols and algorithms designed in the Institute.

- The development and deployment of reliable, high-performance networked systems, of software defined networking, and of novel architectures and protocols for behavioral networking and for network economics.

8.2. Research laboratories

In order to support cutting-edge research, IMDEA Networks invests in the latest, state-of-the- art laboratory test equipment, endowing the Institute with the capacity of transforming research into high added value products and services.

The laboratories are used for:

- Constructing prototypes and measuring the devices, protocols and algorithms developed by the researchers.

- Simulating complex base-band and medium access systems, as well as sophisticated radio subsystems.

- Measuring radio parameters involved in mobile, fixed and satellite communications, designing and characterizing radiating elements, and measuring the effects on the radio electric spectrum of new protocols and algorithms designed by the Institute.

Examples of the laboratories capabilities include:

- Visible light communication system testbed OpenVLC platform

- Vubiq mm-Wave Frontends

- National Instruments PXIE-1082
- Software radio prototyping stations

- 2,4 GHz oscilloscope with wideband waveform analysis software

- V-Band converter boards
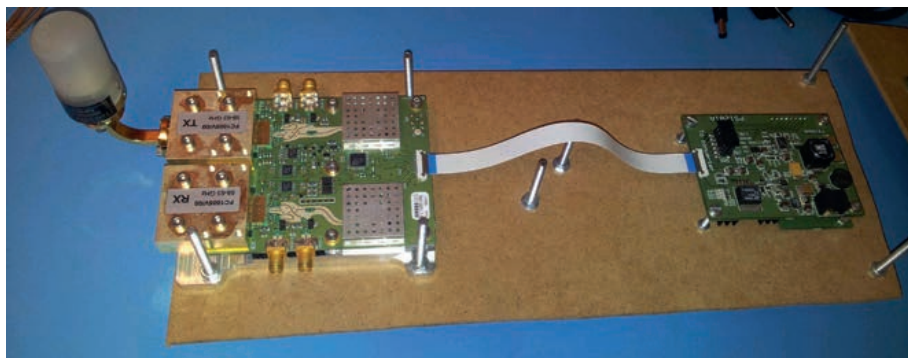
- 3D printer
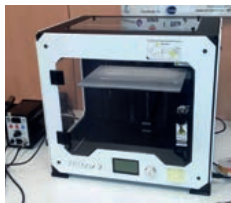
- 60GHz 802.11ad routers

The 5TONIC Laboratory

At the end of 2016 we started the construction of the 5TONIC Laboratory. Initially, it will contain **12 equipment racks and associated tools**. The lab aims to provide **infrastructure** to support a wide range of systems, functionality, services and applications allowing the **deployment, analysis, testing, trial and demonstration of choice technologies currently considered the driving forces of 5G development**. With the 2020 horizon in sight, the **private-public** 5TONIC initiative aims to tackle the challenge of creating a blueprint for the new technologies and standards that are to define future ICT networks, the backbone of the "networked society".

In late February 2017, 5TONIC became **one of the Mobile IoT Open Labs recognized by GSMA**. To assist with the deployment of the 3GPP standardized Mobile IoT technologies (NB-IoT, LTE-M, and EC-GSM), the GSMA's **Connected Living programme** launched the «Mobile IoT Open Lab Map», a unique resource which provides information on the operators, equipment manufacturers and associated technologies that are being developed in any particular region. Over 70 global mobile operators back this initiative, which is also supported by more than **150 hardware and software providers** participating in the **GSMA MIoT Innovator community**. There is a total of 15 **GSMA Mobile IoT Open Labs** in the world, 9 of them in Europe, and 5TONIC is one of them.
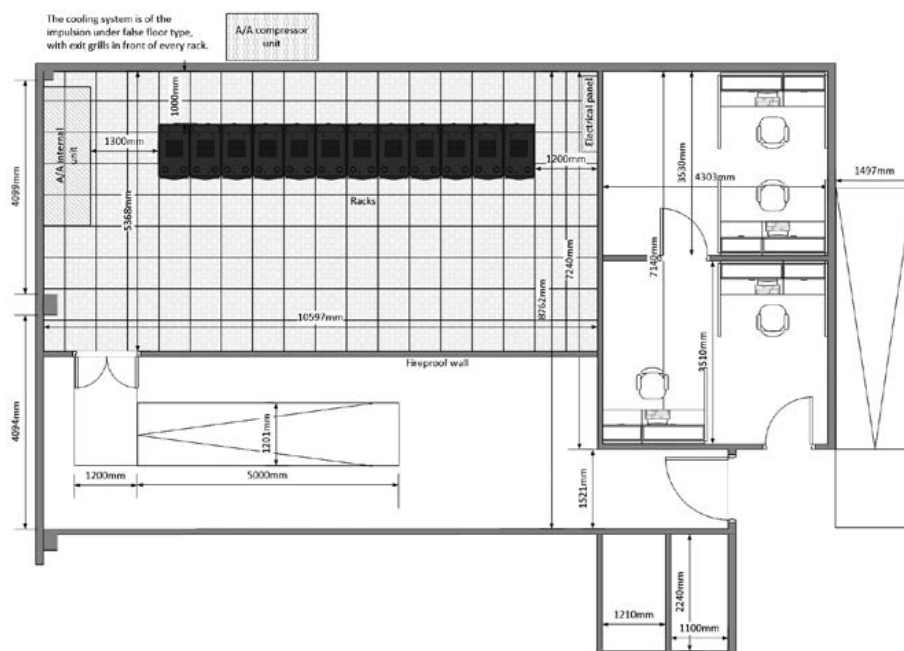
A floor plan of the 5TONIC lab

5TONIC supports a wide range of systems, functionality, services and applications, including user terminals and outdoors equipment, as well as edge and cloud based back-office functionality. This is a non-exhaustive list of **equipment** available in the two main research areas of the Laboratory:

- **5G Virtual Software Network Area**
  - 3 high-profile servers to deploy Virtual Network Functions (VNFs)
  - 4 servers to deploy the Management and Orchestration (MANO) functionalities for Network Functions Virtualization (NFV)
  - 30 mini-PC computers to test NFV components
  - 50 single-board computers to test and deploy OpenFlow switches
  - 30 laptops for programmers to connect to the previous equipment
  - 5 Micro Air Vehicles (MAVs) to deploy 5G points of presence

- **5G Wireless Systems Area**
  - 2 LTE-A base stations
  - 1 vEPC
  - 2 eNodeB with 8 FPGA cards
  - 4 radio frequency transceivers
  - 1 real-time controller

5TONIC hosted **ETSI's 1st Network Functions Virtualization (NFV) Interoperability event**, called **NFV Plugtests™**, from January 23 to February 3, 2017, with outstanding results.

35 commercial and open source implementations were tested for interoperability, including 15 virtual network functions, 9 management and orchestration solutions and 11 NFV platforms. More than 160 engineers were involved in the preparation of the Plugtests, 80 of them on-site, coming from a diverse community of NFV implementers, including vendors and key Open Source projects such as ETSI OSM, Open Baton, OPEN-O and OPNFV.

organization

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9.1. Legal status

IMDEA Networks Institute was legally constituted under Spanish law at the end of 2006 as a public, not-for-profit Foundation. It is governed by a Board of Trustees, consisting of representatives from the various stakeholders in the Institute.

The full, registered name of the Institute is 'Fundación IMDEA Networks'. The Institute is registered in the Register of Foundations of the Autonomous Region of Madrid (*Registro de Fundaciones de la Comunidad de Madrid*), personal sheet number 476.

Our Spanish tax identification number (CIF) is G-84912708.

IMDEA Networks Institute's registered address is:
Avenida del Mar Mediterraneo, 22
28918 Leganes, Madrid
Spain

9.2. Governing bodies & organizational structure

9.2.1. Organizational structure
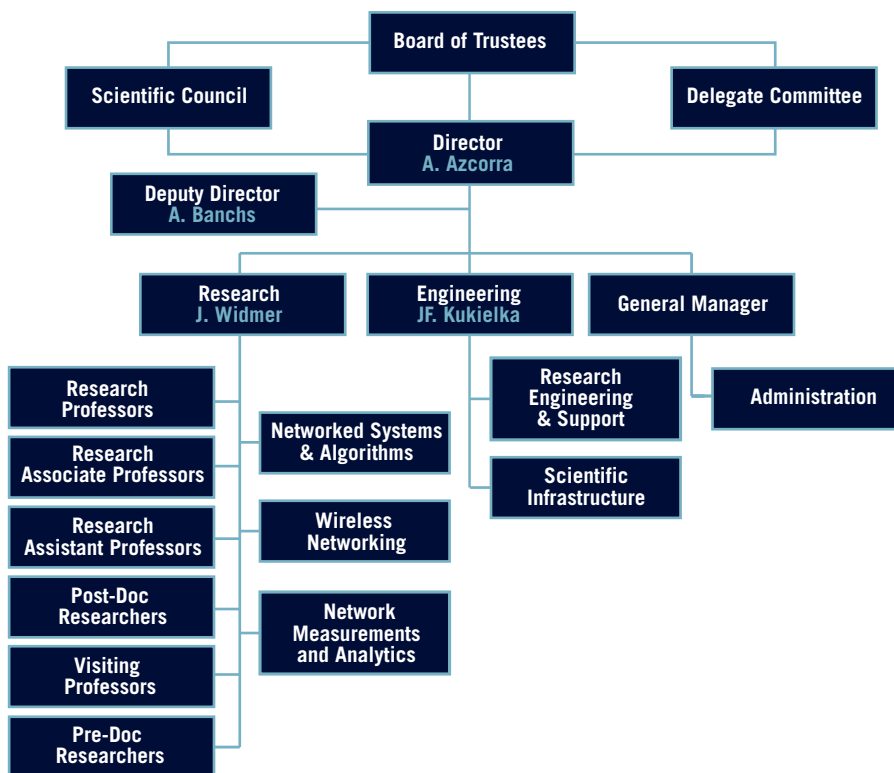
9.2.2. Board of Trustees

The Board of Trustees of IMDEA Networks Institute is its highest organ of governance, representation and administration. In accordance with the Institute's statutes, the Board of Trustees is composed of Ex Officio Members representing the Regional Government of Madrid and Elective Members who are recognized leaders in the scientific matters of the Institute. The Director and General Manager of the Institute also participate in the Board of Trustees.

President: Prof. Dr. Ralf Steinmetz   **Vice-President: Excmo. Sr. D. Rafael van Grieken Salvador**

9.2.3. Scientific Council

The Scientific Council is a very important organ of IMDEA Networks, advising us on all aspects of the Institute's scientific activities. Among many other things, the Council proposes the incorporation and renewal of Scientific Expert members of the Board of Trustees; reviews and approves scientific appointments, and generally provides support to the Director – Dr. Arturo Azcorra and the Deputy Director – Dr. Albert Banchs – in determining scientific research strategy and policies.

The Institute's Scientific Council is composed of internationally-prestigious researchers in the field of Telematics and Internet technologies. IMDEA Networks is greatly strengthened by the participation of these eminent scientists. The current members are:

Dr. Gonzalo CAMARILLO
Standardization Director.
Ericsson. Finland

PhD: Aalto University. Helsinki. Finland
Research: Signaling; Multimedia Applications; Transport Protocols; Network Security; Networking Architectures

Prof. Dr. Jon CROWCROFT
Marconi Professor of Communication Systems. University of Cambridge. Cambridge. UK

PhD: Computer Science. University College London (UCL). England. UK
**Research:** Opportunistic Communications; Privacy in the Cloud; Carbon Neutral Networking

Prof. Dr. Gustavo DE VECIANA
Cullen Trust Professor of Electrical and Computer Engineering. University of Texas at Austin. USA

PhD: Electrical Engineering. University of California at Berkeley. USA
Research: Analysis and Design of Wireless and Wireline Telecommunication Networks; Architectures and Protocols to Support Sensing and Pervasive Computing; Applied Probability, Queuing and Information Theory
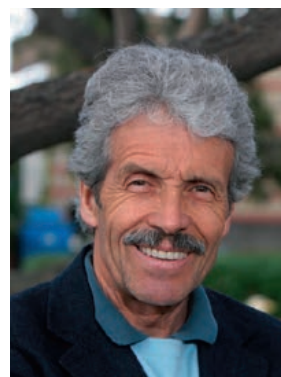
Prof. Dr. Mario GERLA
Professor. Computer Science Department. University of California (UCLA). Los Angeles. USA

PhD: Engineering. University of California. USA
Research: Design and performance evaluation of Ad Hoc wireless networks; Routing; multicast and congestion management in tactical networks; Vehicular ad hoc networks; Wireless security and privacy; Cognitive radios and dynamic spectrum sharing; Urban vehicular traffic management for congestion and pollution mitigation; Mobile health and wireless patient monitoring; Underwater sensor networks

Prof. Dr. Edward KNIGHTLY

Professor of Electrical and Computer Engineering. Rice University. Houston. Texas. USA

PhD: University of California at Berkeley. Berkeley. USA
Research: Wireless Networks and Protocols; Wireless Access for Developing Regions; Dynamic Spectrum Access Networks

Dr. Huw OLIVER

Former Technical Director. European Research Consortium. Hewlett-Packard Laboratories. Bristol. UK

PhD: University College Aberystwyth. Aberystwyth. UK
Research: Computer & Network Security; Wireless OSS; Wireline Core and Access Networks

Prof. Dr. Ioannis STAVRAKAKIS

Full Professor & Head. Department of Informatics and Telecommunications. National and Kapodistrian University of Athens. Athens. Greece

PhD: Electrical Engineering. University of Virginia. Charlottesville. USA
Research: Analysis and Design aspects of Networking Technologies ranging from Link to Application Layers: Social, Mobile, Ad Hoc, Autonomic, Information-Centric, Delay-tolerant and Future Internet Networking; Network Resource Allocation Algorithms & Protocols, Traffic Management & Performance Evaluation; Content Dissemination, Placement & (Cooperative) Replication in Unstructured P2P and Social Networks; (Human-Driven) Decision Making in Competitive Environments
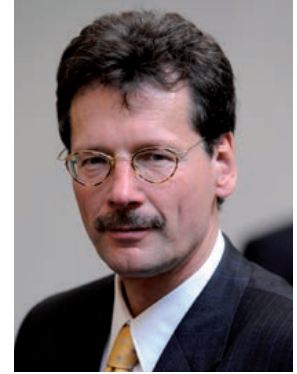
Prof. Dr. Ralf STEINMETZ

President of Board of Trustees. IMDEA Networks Institute; Full Professor & Managing Director. Multimedia Communications Lab (KOM). Technische Universität Darmstadt. Darmstadt. Germany

PhD: Electrical Engineering. Technische Universität Darmstadt. Darmstadt. Germany
Research: Scalable Quality of Service; Content Distribution Networks; Context Aware Communications; Adaptive Mobile Networking; Knowledge Media; Serious Games

Prof. Dr. Jim KUROSE

Assistant Director. Directorate for Computer & Information Science & Engineering (CISE). National Science Foundation (NSF). USA

PhD: Columbia University of New York City. Nueva York. USA
Research: Network Protocols and Architecture; Network Measurement; Sensor Networks; Multimedia Communication; Modeling and Performance Evaluation

Dr. Pablo RODRIGUEZ RODRIGUEZ

CEO. Telefonica Innovation. Alpha. Spain

PhD: École Polytechnique Fédérale de Lausanne (EPFL). Lausanne. Switzerland
Research: Networking; Distributed Systems; Information Theory; Wireless and Mobile; Network Economics; Social Networks