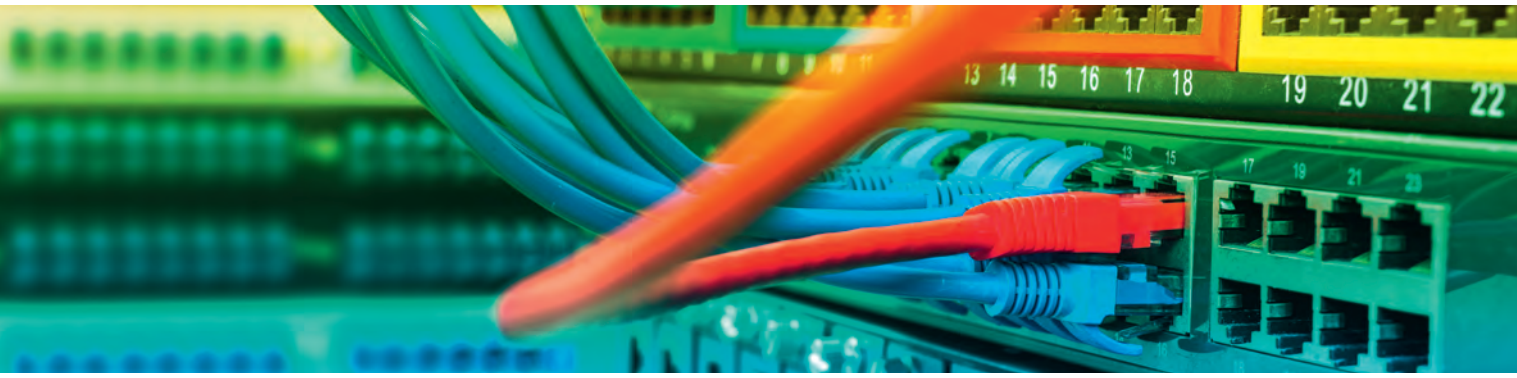
imdea **networks** institute



developing the
science of networks

institute
IMdea
networks

annual report 2017

www.networks.imdea.org

foreword

Arturo Azcorra
Director of the IMDEA Networks Institute
May 2018

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IMDEA Networks Institute is a top worldwide research institute in the Science of Networks. In 2017, 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 of knowledge that has a profound impact on people's lives and is continuously transforming society and economy. Our lives are increasingly entangled with ubiquitous communication technologies and the limitless digital information they provide access to. The ways we relate to each other, work, travel, shop, or entertain ourselves are increasingly driven by new, compelling mobile services. Most such services heavily rely on the collection and analysis of personal data. These data are often generated and provided willingly by the users themselves. Tweeting about an event, browsing the World Wide Web, calling with a mobile phone, using a car navigation system, using a health and fitness app or paying with a credit card are examples of situations creating trails of individual "digital breadcrumbs". Location-based service providers, web tracking platforms, mobile network opera-

tors, automotive manufacturers, or banking information systems can then gather substantial amounts of such data originating from millions of customers, at unprecedented accuracy level and at very low cost, and develop their services on the basis of that treasure-trove of information.

While personal data-driven technologies provide undeniable benefits to individuals and society, the collection and manipulation of personal data has reached a point where it raises alarming privacy issues. Not only the experts but also legislators, regulators and indeed the population at large, are becoming increasingly aware of the risks involved, due to cases of violations and leaks that keep hitting the headlines. Examples abound, from iPhones storing and uploading device location data to Apple without users' knowledge to the popular Angry Birds mobile game being exploited by NSA and GCHQ to gather users' private and sensitive information such as age, gender and location. If privacy risks connected to personal data collection and analysis are not addressed in a way that is fully convincing, there exists a clear risk that users will grow distrustful and curb the huge (and still to be fully explored) potential of personal-data driven services. Ultimately, such a situation will prevent the development of many services with a potential for high societal impact and dramatically hinder a worldwide market valued at billions of euros. The General Data Protection Regulation (GDPR) coming into effect in Europe on May 25th is a positive and much needed step that aims to provide to individuals clear and transparent information and most importantly control over how and what data is collected, used or even exported by the various services and browsers they use.

At IMDEA Networks we believe that having mechanisms and solutions that preserve the privacy of the users while providing them with a transparent view of how their data is used and protected is an essential component for the successful deployment of future networks. We pursue the vision of a world where pervasive mobile services are inalienable life enhancers, but users are fully guaranteed that the privacy of the personal data they share on digital platforms is preserved.

To realize our vision, one of the institute's research lines focuses on the understanding of privacy in the Internet and on the design of novel paradigms and solutions to achieve greater security and transparency. Our findings and proposals have not only strongly impacted the research community, where we are taking a leading role worldwide, but have also caught the attention of a much wider audience, showing the growing social concern around this type of issues. For instance, our analysis of the privacy risks of children-oriented Android apps has revealed many developers potentially violating the U.S. federal laws aiming to protect minors' privacy, received a lot of attention from the general public, appearing in major international newspapers (such as the Washington Post and The Guardian), TV channels (such as NBC News) as well as in national media (including TVE, El País, La Vanguardia and La Razón, among many others). This type of outcome, which involves findings that bring high benefits to society, produces results of very high economic impact and at the same time achieves the highest quality and excellence from a scientific standpoint, exemplifies the goals of the IMDEA Networks' initiative.

In addition to the above, 2017 has also been a great success on 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. Building on its achievements over the years the Institute has become 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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A research team of technical leaders

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. At the same time, our scientists also possess an extensive industry background. Most of them have been employed at leading industry research laboratories, and have been granted many 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 PhD theses at IMDEA Networks. In 2017 the Institute graduated 5 new PhD Students: Dr. Roderick Fanou, Dr. Christian Vitale, Dr. José A. Ruipérez-Valiente, Dr. Evgenia Christoforou and D. Nicola Bui. Among those, it is worth highlighting the PhD thesis of José A. Ruipérez-Valiente, which received the Outstanding Young Researcher in Computer Science award from the SCIE and the BBVA Foundation on the basis of his contributions to artificial intelligence in online learning. This adds to a long list of our pre-doctoral researchers to have received important distinctions and been awarded highly selective scholarships.

In 2017, the Institute has continued to reinforce its research team. This year our team experienced a substantial increase in the number of pre-doc and post-doc researchers as well as engineers hired for (and funded by) the various projects and contracts in which the Institute is involved. As in previous years, our calls have been extremely competitive. For instance, we received 149 applications from 42 countries for our pre-doc researcher positions, out of which 8 excellent candidates were selected.

In 2017 we have also benefited from and appreciated the incorporation of several pre-eminent scientists of international stature as Visiting Professors. Dr. Ioannis Stavrakakis was awarded a Chair of Excellence by the Department of Education and Research of the Community of Madrid and joined us in March 2017 for a long stay. Dr. Sungoh Kwon and Dr. John Heidemann also served as Visiting Professors in 2017.

The many important awards and prizes received by our researchers for their research work and achievements testify to their international reputation. In 2017, our Research Professor Dr. Joerg Widmer was awarded The Friedrich Wilhelm Bessel-Research Prize that is given in Germany through the Alexander von Humboldt Foundation to internationally renowned scientists from abroad. Dr. Joerg Widmer was one of 20 scientists to be awarded this prize for outstanding research work. Furthermore, the Research Professor

Dr. Marco Ajmone was made an IEEE Life Member. This special honor is reserved for individuals who have distinguished themselves through their professional achievements in technology and who have had a significant impact on the growth and development of the IEEE.

The excellence of our scientific results

The efforts made by our team to produce outstanding scientific work led to a large number of scientific publications in 2017, in addition to various distinctions in the form of awards, prizes and funding which vouch for the high quality of our scientific results.

Publications of our researchers won the Best Paper Award at the 14th IEEE Workshop on Positioning, Navigation and Communications (WPNC 2017) in Bremen, Germany, and the Best Student Paper Award at the 29th International Teletraffic Congress (ITC 29) in Genoa, Italy. Three of our papers at IEEE INFOCOM 2017 were rewarded with Best In-Session Presentation awards.

It is particularly worth highlighting the impact that IMDEA Networks had this year at INFOCOM, the best conference in our area according to Google Scholar. While IMDEA Networks has published consistently in this conference over the last years, this year was particularly successful with 10 papers authored by our researchers presented in the main conference. 7 researchers served on the conference's Technical Program Committee (3 of which were granted the Distinguished TPC Member Award) and IMDEA Networks' director Arturo Azcorra participated on one of the two panels organized. This makes IMDEA Networks the 5th institution worldwide with most papers included in the program and the 1st one in Europe, which is an extraordinary achievement.

Another important recognition received this year was the 2017 IRTF Applied Networking Research Prize, awarded to an international research team that includes Narseo Vallina-Rodriquez for the paper "A Multi-perspective Analysis of Carrier-Grade NAT Deployment," published at the ACM Internet Measurement Conference 2016. This award is particularly gratifying as it recognizes not only scientific excellence but also its value as applied research. Notably this is the second time an IMDEA Networks researcher received this prize.

In January 2017, IEEE COMSOC published a list of Best Reading Topics on Device-to-Device Communications. The list covers works published over the last 10 years, with 58 papers in total. We were honored to have four publications included in the list. This recognition shows the impact that our research work is having on the scientific community, in this particular case on the area of device-to-device communications.

Contributing to a knowledge-based economy

The ultimate goal of IMDEA Networks is to produce high quality research results that contribute to a knowledge-based economy. Our strategy to transfer scientific and technological developments to industry over the last year has led to various new collaborations in addition to strengthening the existing partnerships with some of our key industrial collaborators. Our success has been recognized by the Spanish business magazine, Actualidad Económica, which annually rewards innovation and business originality with its awards for the one hundred best ideas of the year. In the thirty-eighth edition of these awards, in the category of "Industrial Innovation", the magazine highlighted the work of IMDEA Networks, Telefónica and Ericsson in the development of the 5TONIC innovation laboratory in 5G technologies.

Our researchers are currently contributing to 18 ongoing research projects that have attracted funding from various sources: eight European projects, four financed by the regional government of Madrid, one supported by the National Science Foundation (NSF) of China, another by NATO and one with Huawei Technologies. Five of these projects were launched in 2018. Two of these projects focus on topics of great socio-economic impact: SMOOTH, a European project, looks at GDPR compliance, and MyBubble, a project in collaboration with the MIT-MediaLab and UC3M, explores the online advertising ecosystem. We also initiated research work funded by the Cisco University Research Program Fund (an advised fund of the Silicon Valley Community Foundation) and Armasuisse – Science and Technology

The last year saw IMDEA Networks continuing to focus many of its resources on the development of 5G technologies and on the 5TONIC initiative, in particular. Several years ago we made a strategic decision to place 5G center-stage in our scientific mission. IMDEA Networks founded the 5TONIC innovation lab in collaboration with Telefonica in 2014 as a Spanish public-private initiative and a global leader in the development of 5G technology, services and pilot studies. In 2017, the initiative incorporated InterDigital, Inc. and ASTI as members, joining the existing group of 5G technological leaders, such as Ericsson, Intel, University Carlos III of Madrid, CommScope, Artesyn, and Cohere. The lab's ongoing activities are in the fields of e-Health and emergency services; AGVs (Automatic Guided Vehicles); industry 4.0; drones for agriculture; fair tourism (IFEMA / FITUR), and the entertainment industry (4K videos for television), among others. During the year the lab's importance in Spain's drive for a leadership position in the evolving 5G landscape as well as in the 4th Industrial Revolution promised by the Internet of Things, was recognized with the official visit of Mr. José María Lasalle, Secretary of State for the Information Society and the Digital Agenda.

Enhancing our facilities and laboratories

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 2017, the equipment hosted by these laboratories has continued to expand with the most advanced networking devices.

At the same time, our research facilities have been extended with the refurbishment of a further 400m2 of our building, giving us a total of over 2200m2 of usable space. This space accommodates office facilities for our entire workforce and eight laboratories at the disposal of the research team. Of course, we also provide a home for the 5TONIC 5G innovation lab.

Communicating our results

In addition to producing results of the highest technical quality and applying them to improve the life of the citizens, it is also very important for the Institute that these positive contributions to society are conveyed to the general public, to prospective PhD students, who might come to join the ranks of our research team one day, to scientists, academics and specialists from other areas; all in all, to decision-makers, stakeholders, and collaborators, so that they can appreciate the benefits of having such a research institute located in Madrid and speaking to the whole world.

Over the last years we have been consistently appearing in national and international media with a large outreach, and this year has been no exception. To achieve this, we actively disseminate our scientific results in a bilingual format (English and Spanish) at national and international levels, in direct contact with the media, through specialized platforms for the dissemination of scientific results, through social media and the organization of specialized events as well as those oriented to explain science to the general public. IMDEA Networks also places at the disposal of the scientific community an open document repository of its scientific production.

In 2017 our press releases achieved significant impact on influential specialized and non-specialised, national and international media (also with remarkable echo in the Latin American world). The Verge, The Conversation, Arstechnica, GlobeNewswire, The Economic Times, Telecompaper, Sputnik News, Mobile Europe, EFE, ABC, El País, La Razón, Expansión, El Periódico, Agencia SINC, La Vanguardia, TVE or Radio Internacional de España, are some amongst many examples. Most interest has been garnered by the study on the dubious practices of smartphone apps that share without consent users' data with third-party services. The activities of 5TONIC, in particular the inauguration of IFEMA-5TONIC, the first 5G prototype R&D lab for the tourism and trade fair sector, was also covered by over 40 major media outlets and enjoyed the special attention of King

Felipe VI and Queen Letizia of Spain at the world's largest International Tourism Fair, FITUR 2018. Some examples of the success of our communications strategy include the media interest and awareness raised by our cutting-edge work on millimeter-wave technologies in connection with 5G, on underwater acoustic localization of marine mammals and vehicles, on the project to build an autonomous platform for securing marine infrastructures from external threats, on next-generation cloud service provisioning for the Internet of Everything, and on how Facebook's gender divide reflects real inequality.

Looking ahead to 2018

We can look forward to 2018 and beyond with confidence. We have a team of exceptional scientists from around the world working with us here in Madrid to help us achieve our mission. Our researchers are recognized for the quality of their work with awards and citations for a growing body of important, published work. The Regional Government of Madrid continues to demonstrate its long-term and far-sighted vision of creating scientific centers of excellence in the region with its financial support for our project. Our industrial and academic partners, themselves global leaders in their field and sectors such as Telefonica and Ericsson, show their faith in what we are doing with their on-going collaboration. We are working with them on projects that are helping to shape the future of how people and devices connect with each other. We have every reason to believe that the coming year will be our best yet.

The problems for which we are seeking solutions are among the most fundamental that society is addressing today. Our work addresses the issues of data security and privacy. The current media frenzy around Facebook, Cambridge Analytica and the use of personal data is bringing home to everyone how relevant this subject is to us all. The challenges of delivering healthcare to an ageing population; the question of how to provide an infrastructure that can allow citizens to move freely and safely around our cities; how to join up islands of automation in factories, offices and the home. These are some of the issues in which our partners and we are engaged. We believe our work is highly relevant to society, both today and in the coming years. Ultimately, it is this relevance as well as our effectiveness in helping to shape scientific and technological solutions to society's problems that will ensure our future growth and success.

Building on our great results of 2017, we look forward to many more exciting discoveries and collaborations in the year ahead.

about us

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2.1. Profile

IMDEA Networks Institute is a research organization on computer and communication networks whose multinational team is engaged in cutting-edge fundamental science and technology. As an English-speaking institute located in Madrid, Spain, IMDEA Networks offers a unique opportunity for pioneering scientists to develop their ideas. IMDEA Networks has established itself internationally at the forefront in the **development of future network principles and technologies**. Our **team** of highly-reputed researchers is designing and creating today the networks of tomorrow.

Some keywords that define us: *5G, Big Data, blockchains and distributed ledgers, cloud computing, content-delivery networks, data analytics, energy-efficient networks, fog and edge computing, indoor positioning, Internet of Things (IoT), machine learning, millimeter-wave communication, mobile computing, network economics, network measurements, network security, networked systems, network protocols and algorithms, network virtualization (software defined networks – SDN and network function virtualization – NFV), privacy, social networks, underwater networks, vehicular networks, wireless networks and more…*

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 Vision

IMDEA Networks focuses on an area that has a profound impact on people's lives. Over the last decades, the Internet, smartphones, Wi-Fi and social networks transformed society and the economy. Indeed, the **widespread access to networks** has dramatically changed the way manufacturers produce and supply their goods, how public administrations operate, how professionals work and in general how individuals and society are shaped. **The Internet socio-economic phenomenon** continues to transform our lives at an amazing pace, and will continue to do so in the future with the deployment of new communication technologies and paradigms.

2.4. Our Mission

Our mission is to create value by **leading research in protocol, algorithm and systems developments** that enable the **Digital Knowledge Society.** 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 optimal working conditions and the most attractive and best-equipped environment in which researchers can focus on this process of innovation and scientific advance.

2.5. 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 when they are in the service of shared goals

- 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

2.6. 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.

wireless networking

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 also 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. 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.

4.1.1 European

ERC Grants

Awardee

- Dr. Joerg WIDMER, Research Professor (tenured) & Research Director **(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)

"MARIE CURIE" AMAROUT II Europe Programme

Awardees

- Dr. Paolo CASARI, Research Assistant Professor
- Dr. Kirill KOGAN, Research Assistant Professor

Funded by

European Union. Marie Curie Action (PEOPLE COFUND)

4.1.2 National

Ramón y Cajal Grants

(Programa Ramón y Cajal)

Awardees

- Dr. Joerg WIDMER, Research Professor (tenured) & Research Director
- Dr. Vincenzo MANCUSO, Research Associate Professor

Funded by

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

Juan de la Cierva Incorporation Grants 2015

Awardee

- Dr. Kirill KOGAN, Research Assistant Professor

Funded by

Spanish Ministry of Economy, Industry and Competitiveness (MINECO), National Programme for the Promotion of Talent and Its Employability, part of the National Plan for Scientific and Technical Research and Innovation 2013-2016

Grants for training university teachers – FPU

(Ayudas para la Formación del Profesorado Universitario)

Awardees

- Edgar ARRIBAS, PhD Student
- Dr. Evgenia CHRISTOFOROU, PhD Student (2014-2017)

Funded by

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

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)

Awardee

- 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

4.1.3 Regional

Attraction of research talent – Chairs of Excellence Programme

(Ayudas destinadas a la atracción y retención de talento investigador en centros I+D de la Comunidad de Madrid)

Awardee

- Dr. Ioannis STAVRAKAKIS, Visiting Professor

Funded by

Department of Education and Research , Regional Government of Madrid (Consejería de Educación e Investigación de la Comunidad de Madrid)

Youth Employment Initiative (YEI)

(Ayudas para la realización de contratos de ayudantes de investigación y técnicos de laboratorio a través del Programa Operativo de Empleo Juvenil)

Awardee

- Víctor SÁNCHEZ AGÜERO, PhD Student

Supervisor

- Dr. Jose Félix KUKIELKA, Research Associate Professor

Funded by

European Social Fund (Youth Employment Initiative), Department of Education and Research, Regional Government of Madrid (Consejería de Educación e Investigación de la Comunidad de Madrid)

Industrial PhDs 2017

Grants aimed to the execution of Industrial PhDs within the Autonomous Region of Madrid (2017)

Awardees

- Scientist in charge: Dr. José Félix KUKIELKA, Research Associate Professor, IMDEA Networks Institute
- Industry partner: Telcaria Ideas S.L.
- Industrial PhD student: Jose María ROLDÁN GIL

Funded by
Department of Education and Research, Regional Government of Madrid (Consejería de Educación e Investigación de la Comunidad de Madrid)

4.1.4 Other

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

Awardee
- Ander GALISTEO, PhD Student

Funded by
Fundación "la Caixa" (Fundación Caja de Ahorros y Pensiones de Barcelona)

MIT-SPAIN – "la Caixa" Foundation SEED FUND

Awardees
- Dr. Antonio FERNÁNDEZ ANTA, Research Professor, IMDEA Networks Institute
- Dr. Iyad RAHWAN, Associate Professor of Media Arts & Sciences, MIT Media Lab

Funded by
MISTI Global Seed Funds

Project Title
MyBubble: Influence of Algorithms in Users Filter Bubbles

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 probabilities 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), Huazhong University of Science and Technology (China), University of California, Riverside (USA)

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

SYMBIOSIS

A Holistic Opto-Acoustic System for Monitoring Marine Biodiversities

Funded by: European Union. H2020-BLUE GROWTH 2017
Duration: November 2017 to October 2020
Project partners: University of Haifa (Israel), IMDEA Networks Institute, EvoLogics GmbH (Germany), Wireless and More s.r.l. (Italy)

The SYMBIOSIS project is an innovation action funded in the scope of Horizon 2020's BlueGrowth program, **EU's long term strategy to support sustainable growth in the marine and maritime sectors as a whole.**

SYMBIOSIS will provide a **mature, cost effective autonomous opto-acoustic prototype for the characterization, classification, and biomass evaluation of six target species of pelagic fish** that are important to the fishery industry, and that reflect on the health of the environment.

The processing will be made in a real-time fashion on site, and the results will be sent to a shore station. The system will be completely autonomous and will withstand a three-month deployment without recharging. SYMBIOSIS will also demonstrate the capabilities of the system and its readiness to a TRL6 (Technology Readiness Level) stage over three sea and ocean mooring sites.

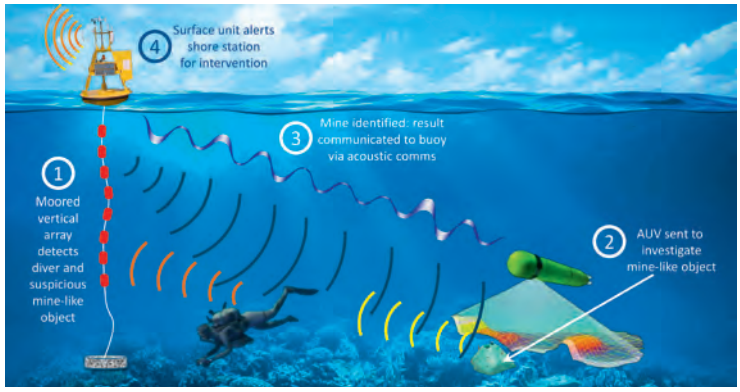
SYMBIOSIS is devised as a blend of acoustic and optical components. The **acoustic unit** will include an active underwater acoustic array of 2X3 elements, to detect, classify, evaluate the biomass, and localize the predefined pelagic fish up to 500 m. The **optical component** will encompass a fixed frame of six underwater optical cameras, and will perform machine learning-based classification and biomass evaluation in the near field of 2-3 attenuation lengths in low light conditions. To conserve power, the optical unit will be triggered upon detection from the acoustic unit, and will use the results from the acoustic localization. The system will be modular, both in term of performance and in terms of composition, and will adapt to different scenarios and cost requirements.

MYP-ThreatDetect

Autonomous Platform for Securing Marine Infrastructures
IMDEA Networks Institute is the Project Coordinator

Funded by: NATO. Science for Peace and Security Programme (SPS)
Duration: May 2017 to May 2020
Project partners: University of Haifa (Israel), IMDEA Networks Institute, University of British Columbia (Canada)

With the increase of marine activity, protecting marine infrastructures from terrorist threats has become a main concern. We propose **to develop and demonstrate a novel prototype for reliable, real-time detection of diver and mines.** Our system combines acoustic remote detection with verification using pattern recognition on underwater imagery. First, we analyse the acoustic reflections to localize a target that fits the pattern of a diver or a submerged mine. Then, in case the release or presence of a mine is suspected, a vehicle is dispatched to first inspect the target through its optical and sonar systems, and then to send the processed information back through underwater acoustic communication.



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 provisioned close to the users that actually need them by self-configurable cloud computing systems.

SEARCHLIGHT

A new communication paradigm for future very high speed

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.**

NOTRE

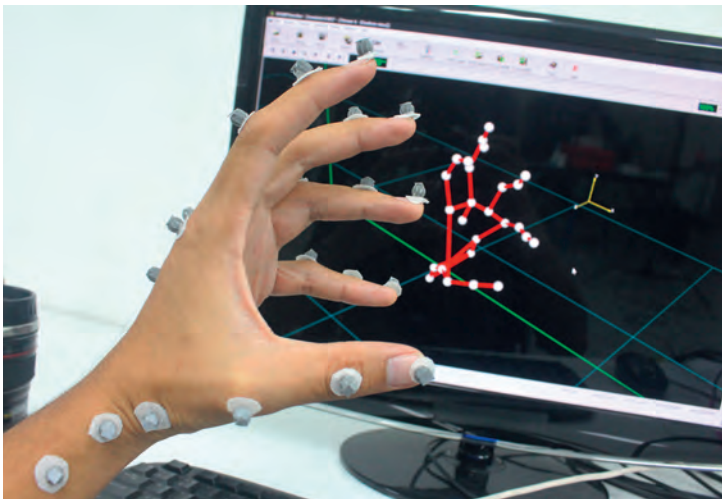
Network for sOcial compuTing REsearch

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, Foundation for Research and Technology – Hellas, IMDEA Networks Institute, Université de Genève (UNIGE), Heinrich-Heine-Universität Düsseldorf

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 network

BRADE-CM

BRAin inspired Data Engineering

Project website: http://www.brade-cm.es/
Funded by: Department of Education and Research 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.

Cloud4BigData

Efficient Cloud and BigData Infrastructure

Project website: http://lsd1.ls.fi.upm.es/cloud4bigdata/
Funded by: Department of Education and Research 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.**

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 and Research 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 firstly, the design of an SDN network controller, including its interfaces, for 5G networks; second, the design of mechanisms for the monitoring, supervision, and protection of the control network; third, the development of mechanisms to optimize network resource efficiency, based on traffic measurement and predictions of traffic demand; fourth, 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; finally, 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.

LF assists HF in beam tracking and mobility

LF assists HF in beam tracking and mobility

Funded by: Huawei Technologies (China)
Duration: July 2017 to August 2018
Project partners: IMDEA Networks Institute, Huawei Technologies (China)

In this collaboration between Huawei Technologies and IMDEA Networks, the project partners explore the potential of using low frequency bands to infer the channel characteristics of high frequency millimeter-wave bands. The inferred channel characteristics can support the network in terms of beam tracking, angle of arrival estimation, and location information. This results in improved performance in the millimeter-wave band since these techniques reduce the control overhead required to operate the network. The project also includes an experimental evaluation to verify that the developed mechanisms and algorithms work not only in theory but also in practical real-world wireless networking environments.

TEAM

Technologies for information and communications, 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, 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, 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,** "Technologies for Information and Communication, Europe – East Asia Mobilites (TEAM)", coordinated

by Université Pierre et Marie Curie (France), is to **promote institutional cooperation and mobility activities between European and East Asian Higher Education Institutions** (HEIs). This 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.

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 July 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+ has been introduced to build upon the previous FIRE initiative. MONROE is a FIRE+ project.*

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: Consorzio Nazionale Interuniversitario per le Telecommunicazioni, Studio Professionale Associato a Baker & McKenzie, IMDEA Networks Institute, University of Piraeus Research Center, Telefónica I+D, Verizon Nederland B.V., certSIGN S.A., Wedia Limited, Exus Software Ltd., Upcom BvBa, De Productizers B.V., Cyprus University of Technology, Universidad Carlos III de Madrid

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 users 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.

Location-aware MAC scheduling in Mobile and Dense Networks

Project website: http://www.wishful-project.eu/
Funded by: European Union. H2020 Future Internet Fire - Wishful 4-th Open Call for Experiments
Duration: July 2017 to December 2017

This project investigates novel MAC scheduling strategies that take advantage of the knowledge of real-time position estimates and other context information in challenging indoor environments, with a mix of static and mobile devices and in presence of dense networks.

The use of the Wishful software platform, hardware radio and testbeds as well as of the positioning system of the Pervasive Group led by Dr. Giustiniano ('Indoor Location Technology Has Become Simpler') will enable the early experimental investigation of network applications based on real-time location data using commodity WiFi radios.

TYPES

Towards transparencY and Privacy in the onlinE advertising business

Project website: http://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 Limited, 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, 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: http://5g-ppp.eu/flex5gware/
Funded by: European Union. ICT Programme H2020
Duration: July 2015 to June 2017
Project partners: INTEL Mobile Communications GmbH, Nokia Bell Labs Deutschland AG, Commissariat à l'Energie Atomique et aux Energies Alternatives, Consorzio Nazionale Interuniversitario per le Telecommunicazioni, Fundació Centre Tecnològic 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, Lund University, 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 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.

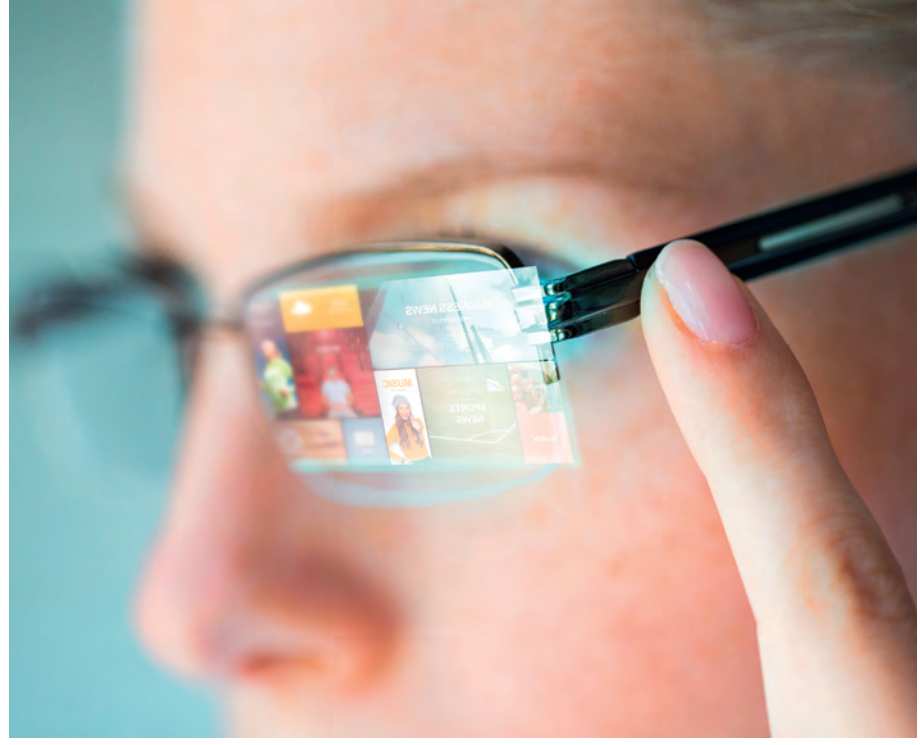
Flex5Gware will evaluate and demonstrate the developed 5G technologies, in terms of proofs-of-concept, which will be showcased in a demonstration event where all the partners in the consortium will participate. The Flex5Gware consortium includes large industry leaders from infrastructure providers (ALUD, 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

Millimetre-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 (UK) Ltd., Ericsson AB, 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

Funded by: Spanish Ministry of Economy and Competitiveness (Ministerio de Economía y Competitividad), State Program for Research, Development and Innovation Aimed at Society´s Challenges (Programa Estatal de Investigación, Desarrollo e Innovación Orientada a los Retos de la Sociedad), Call 2014 – R+D+i Projects, within the 2013-2016 Nationwide Plan for Scientific and Technical Research and Innovation (Proyectos de I+D+i, en el marco del Plan Estatal de Investigación Científica y Técnica y de Innovación 2013-2016)
Duration: January 2015 to June 2017

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.

4.2.2 Projects commencing in 2018

SMOOTH

GDPR Compliance Cloud Platform for Micro Enterprises

Funded by: European Union. H2020 Cibersecurity PPP
Duration: May 2018 to October 2020
Project partners: Eurecat – Technology Centre of Catalonia; Agencia de Protección de Datos; Katholieke Universiteit Leuven; Naver France; NEC Laboratories Europe; Universidad Carlos III de Madrid; IMDEA Networks Institute; Asociación Española de Normalización y Certificación – AENOR; Fundingbox Accelerator Sp z o.o; European Small Business Alliance Of Small and Medium Independent Enterprises – ESBA; Datu Valsts Inspekcija (Data State Inspectorate); Lstech Espana SL

According to the last official available 2015 data, almost 93% of all enterprises in Europe in the non-financial business sector have less than 10 employees. These micro enterprises (MEnts) are responsible for 30% and 21% of the overall employment and value added in the EU, respectively. However, when it refers to the imminent General Data Protection Regulation (GDPR)'s application, MEnts are the most vulnerable due to their lack of expertise and resources to invest in their adoption. It is urgent to develop solutions that assist MEnts in smoothly adopting the GDPR, safeguarding the interests of the EU citizens on data privacy and security, avoiding the negative socioeconomic

consequences entailed to breaches for MEnts, and, by extension, benefitting the European society. SMOOTH project addresses this challenge from two complementary focuses:

1) Creating awareness on the importance of being compliant with the GDPR, as many MEnts ignore their obligations in this respect, involving as partners Data Protection Authorities and associations representing EU MEnts. For the same purpose, SMOOTH will deliver a practical GDPR interactive handbook (website and mobile app) tailored specifically to MEnts.

2) Assisting MEnts to effectively adopt and comply with the GDPR. The SMOOTH cloud platform will use machine learning, text and data mining, and advance online auditing methods to automatically create a bespoke GDPR compliance report for the most critical aspects to MEnts. Likewise, SMOOTH will provide useful materials for solving those identified aspects of the GDPR that are not properly covered.

All this will positively contribute to citizens' rights, while avoiding potential fines for the MEnts that may account for as much as 4% of the annual income, according to the GDPR. SMOOTH is born from technology partners and data protection authorities and will be designed and validated by actual MEnts with the aim of becoming the reference tool platform for them to adopt the GDPR.

Software and Virtualization Techniques for the Improvement of Performance and Scalability in the Integration of SDN and Network Services based on the Cloud in 5G Technologies

Funded by: Grants aimed to the execution of Industrial PhDs within the Autonomous Region of Madrid (2017). Department of Education and Innovation. Regional Government of Madrid
Duration: February 2018 to February 2021
Project partners: IMDEA Networks Institute, Telcaria Idea S.L.

Today's **networks** have been provisioned statically because of historical reasons, however current and future traffic trends require a dynamic way of providing processing inside the network that can span from mobiles, access networks, core networks and clouds.

In this project new incremental dynamic mechanisms are proposed in order to allow that processing be deployed whenever and wherever it is needed. The ideas presented here aims to achieve the following key characteristics that together will help enable **dynamic**

processing in **5G** networks. Firstly, **location-independence,** so that the processing can be placed in a number of different places and networks along the end-to-end path, as deemed optimal by the beneficiary of that processing. Secondly, **time-independence,** whereby processing can be deployed or moved near instantaneously, without end-users noticing or traffic being affected. Thirdly, **scale independence** to achieve seamless scaling by decoupling network services from their scaling. Fourthly, **hardware independence,** such that the processing can run efficiently irrespective of the different kinds of underlying, possibly heterogeneous, both commodity and proprietary hardware.

The key is to allow software basic blocks to run and migrate seamlessly in a multitude of locations in the network, with minimum disruption to traffic. However, it is possible that the network will also have a number of "static" basic blocks that cannot be moved and include switching infrastructure, Radio Access Networks, and heterogeneous commodity and proprietary hardware deployment. In such cases, it would be preferable to move higher-level programs than relying on the statically deployed functionality, thus making an efficient use of heterogeneous hardware to achieve high performance.

MyBubble

MyBubble: Influence of Algorithms in Users' Filter Bubbles

Funded by: MISTI Global Seed Funds | MIT-SPAIN - "la Caixa" Foundation SEED FUND
Duration: January 2018 to August 2019
Projects partners: Massachusetts Institute of Technology - MIT Media Lab, Universidad Carlos III de Madrid, IMDEA Networks Institute

Online services have the capacity of learning the preferences and interests of individual customers based on their online activity. Using this knowledge, the online services can be personalized. This personalization filter is referred to as the filter bubble, and it is built from the actions of the user by algorithms run by the services. However, the **algorithms used by the online services are not public and carefully kept private,** whilst the filter bubble of users strongly influences the information they access, which has a big impact in society. Therefore, properly understanding the algorithms for filter bubbles is an important and open question.

The goal of MyBubble is modeling the influence of algorithms in the users' filter bubble in the online advertising ecosystem. To this end, a methodology developed by researchers of the MyBubble team will be leveraged. This methodology allows creating "personas", "bots" that visit carefully selected websites, referred to as "training websites" that assign them a specific behavior. Once the persona profile has been created, the researchers will make the persona visit "training" and "control" websites. "Control websites" are

those from where the ads shown to the created persona will be collected. The persona will keep visiting the training websites so that it retains its behavior during the whole execution of the experiment.

The experiments to be run with this methodology will allow the unveiling of existing algorithmic biases, how the personalization modifies the behavior of the online advertising algorithms under different personas, and how the algorithms change the filter bubble when the persona changes its behavior.

scientific activities

annual report 2017

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

Elizaveta Dubrovinskaya, Roee Diamant, **Paolo Casari**

BEST PAPER AWARD

Anchorless Underwater Acoustic Localization **(October 2017)**

In: IEEE 14th Workshop on Positioning, Navigation and Communications (WPNC 2017), 25-26 October 2017, Bremen, Germany

Gaetano Manzo, **Marco Ajmone Marsan,** Gianluca Rizzo

BEST STUDENT PAPER AWARD

Performance Modeling of Vehicular Floating Content in Urban Settings **(September 2017)**

In: The 29th International Teletraffic Congress (ITC 29), 4-8 September 2017, Genoa, Italy

Vincenzo Sciancalepore, Konstantinos Samdanis, Xavier Costa-Perez, Dario Bega, Marco Gramaglia, Albert Banchs

BEST-IN-SESSION PRESENTATION AWARD

Mobile Traffic Forecasting for Maximizing 5G Network resource Utilization **(May 2017)**

In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA

Dario Bega, Marco Gramaglia, Albert Banchs, Vincenzo Sciancalepore, Konstantinos Samdanis, Xavier Costa-Perez

BEST-IN-SESSION PRESENTATION AWARD

Optimising 5G Infrastructure Markets: The Business of Network Slicing **(May 2017)**

In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA

Marco Gramaglia, Marco Fiore, Alberto Tarable, Albert Banchs

BEST-IN-SESSION PRESENTATION AWARD

Preserving Mobile Subscriber Privacy in Open Datasets of Spatiotemporal Trajectories **(May 2017)**

In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA

BEST READING TOPICS ON DEVICE-TO-DEVICE COMMUNICATIONS

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

awards

and the quality of research carried out in IMDEA Networks in recent years is the inclusion of the following articles published by our scientists:

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

- **Arash Asadi, Vincenzo Mancuso,** Rohit Gupta
  An SDR-based Experimental Study of Outband D2D Communications **(April 2016)**
  In: The 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016), 10-15 April 2016, San Francisco, USA

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

- Qing Yang, Kejie Lu, **Vincenzo Mancuso,** Chan-Hyun Youn
  Device-to-device communications with social awareness [Guest Editorial] **(August 2016)**
  IEEE Wireless Communications Magazine, 23 (4) pp. 10-11. ISSN 1536-1284

5.1.2. Researcher Awards

Joerg Widmer (July 2017)

MERCATOR FELLOWSHIP - TECHNISCHE UNIVERSITÄT DARMSTADT, GERMANY

Funding awarded by the German Research Foundation (Deutsche Forschungsgemeinschaft - DFG), Bonn, Germany

Evgenia Christoforou (May 2017)

OUTSTANDING DOCTORAL THESIS AWARD UNIVERSITY CARLOS III OF MADRID – ACADEMIC YEAR 2016/2017 I PH.D. PROGRAM IN MATHEMATICAL ENGINEERING

Premio extraordinario de doctorado Universidad Carlos III de Madrid – Convocatoria 2016/2017 I Programa de Doctorado en Ingeniería Matemática

Achieving Reliability and Fairness in Online Task Computing Environments

Phd thesis defended on May 2017. Department of Mathematics, Universidad Carlos III de Madrid, Spain

Supervisors: Antonio Fernández Anta, IMDEA Networks Institute, Madrid, Spain
Angel Sánchez, Departamento de Matemáticas, Universidad Carlos III de Madrid, Spain

Albert Banchs (May 2017)

2017 EXCELLENCE PRIZE – UNIVERSIDAD CARLOS III DE MADRID (9TH EDITION). MODALITY: YOUNG RESEARCH STAFF

"Premio de excelencia 2017 – Universidad Carlos III de Madrid (9ª edición), modalidad: Joven personal investigador".

Prize awarded by the Social Council of University Carlos III of Madrid. The prize is sponsored by the said Council and Banco Santander. 16 May 2017

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

5.2. Publications

IMDEA Networks presented its scientific work in various formats and venues during 2017. There were **158** publications, out of which **124** were peer reviewed. This is how they are structured:

2 Books | 37 Journal Articles | 5 Magazine Articles | 69 Conference and Workshop Papers | 11 Conference and Workshop Posters & Demos | 25 Invited Papers, Keynotes, Invited Talks, Tutorials, Lectures, etc.

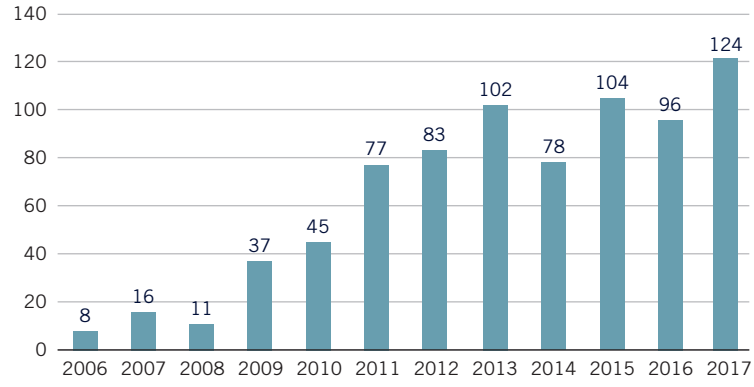
As well as the previous there were:

5 PhD Theses | 4 Masters Theses

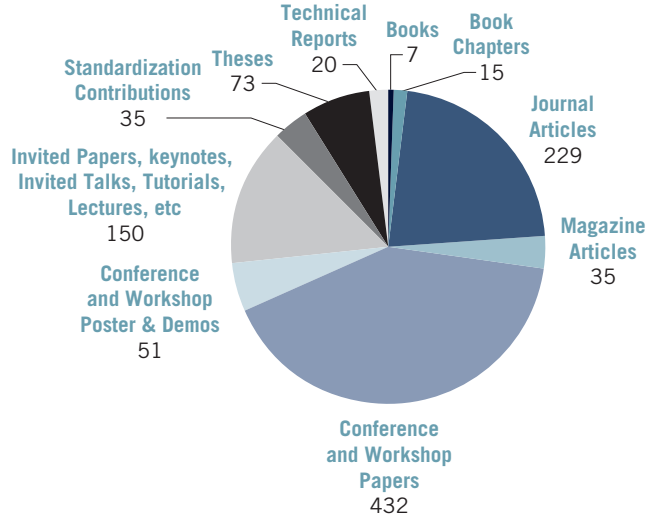
According to **Google Scholar,** IMDEA Networks' researchers have received around **61604 citations in total** along their research career, which corresponds to an **aggregated H-index of 108.**

publications 2006-2017

number of publications (peer-reviewed)

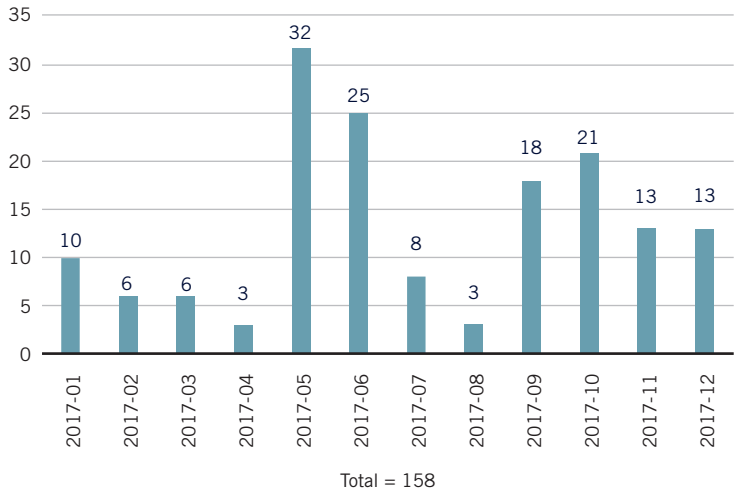


all publications by type



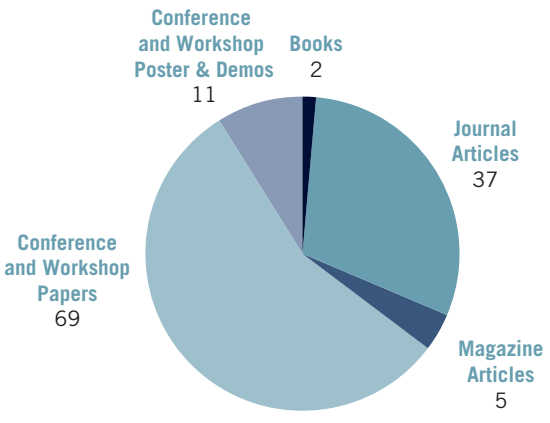
2017

total number of publications per month



Total = 158

publications by type (peer reviewed)



Total = 124

Publications 2017

Books [2]

1. **(Ed.) Antonio Fernández Anta, Tomasz Jurdzinski, Miguel A. Mosteiro, Yanyong Zhang (December 2017)**
Algorithms for Sensor Systems - 13th International Symposium on Algorithms and Experiments for Wireless Sensor Networks, ALGOSENSORS 2017, Vienna, Austria, September 7-8, 2017, Revised Selected Papers
Springer International Publishing. ISBN 978-3-319-72750-9.

2. **(Ed.) Marek Chrobak, Antonio Fernández Anta, Leszek Gasieniec, Ralf Klasing (January 2017)**
Algorithms for Sensor Systems - 12th International Symposium on Algorithms and Experiments for Wireless Sensor Networks, ALGOSENSORS 2016, Aarhus, Denmark, August 25-26, 2016, Revised Selected Papers
Springer International Publishing. ISBN 978-3-319-53057-4.

Journal Articles [37]

1. **Giovanni Toso, Riccardo Masiero, Paolo Casari, Maksym Komar, Oleksiy Kebkal, Michele Zorzi (December 2017)**
Revisiting Source Routing for Underwater Networking: The SUN Protocol
IEEE Access. 6. pp. 1525-1541. IEEE. ISSN 2169-3536.

2. **Kirill Kogan, Sergey Nikolenko, Patrick Eugster, Alexander Shalimov, Ori Rottenstreich (December 2017)**
Efficient FIB Representations on Distributed Platforms
IEEE/ACM Transactions on Networking. 25 (6). pp. 3309-3322. Co-sponsored by the IEEE Communications Society, the IEEE Computer Society, and the ACM with its Special Interest Group on Data Communications (SIGCOMM). ISSN 1063-6692.

3. **Roee Diamant, Filippo Campagnaro, Michele de Filippo de Grazia, Paolo Casari, Alberto Testolin, Violeta Sanjuan Calzado, Michele Zorzi (December 2017)**
On the Relationship between the Underwater Acoustic and Optical Channels
IEEE Transactions on Wireless Communications. 16 (12). pp. 8037-8051. IEEE. ISSN 1536-1276.

4. **José A. Ruipérez-Valiente, Pedro J. Muñoz-Merino, José A. Gascón-Pinedo, Carlos Delgado Kloos (December 2017)**
Scaling to Massiveness With ANALYSE: A Learning Analytics Tool for Open edX
IEEE Transactions on Human-Machine Systems. 47 (6). pp. 909-914. IEEE. ISSN 2168-2291.

5. **Roderick Fanou, Francisco Valera, Pierre Francois, Amogh Dhamdhere (November 2017)**
Reshaping the African Internet: From Scattered Islands to a Connected Continent
Computer Communications. 113. pp. 25-42. Elsevier. ISSN 0140-3664.

6. **Maryam Pouryazdan, Claudio Fiandrino, Burak Kantarci, Tolga Soyata, Dzmitry Kliazovich, Pascal Bouvry (November 2017)**
Intelligent Gaming for Mobile Crowd-Sensing Participants to Acquire Trustworthy Big Data in the Internet of Things
IEEE Access. 5. pp. 22209-22223. IEEE. ISSN 2169-3536.

7. **Iria Manuela Estévez-Ayres, Jesús Arias-Fisteus, Lucía Uguina, Carlos Alario-Hoyos, Carlos Delgado Kloos (November 2017)**
Uncovering Flipped-classroom Problems at an Engineering Course on Systems Architecture through Data-driven Learning Design
International Journal of Engineering Education. TEMPUS Publications. ISSN ISSN: 0949-149X.

8. **Arash Asadi, Vincenzo Mancuso, Rohit Gupta (October 2017)**
DORE: An Experimental Framework to Enable Outband D2D Relay in Cellular Networks
IEEE/ACM Transactions on Networking. 25 (5). pp. 2930-2943. Co-sponsored by the IEEE Communications Society, the IEEE Computer Society, and the ACM with its Special Interest Group on Data Communications (SIGCOMM). ISSN 1063-6692.

9. **Pablo Caballero, Albert Banchs, Gustavo de Veciana, Xavier Costa-Perez (October 2017)**
Multi-Tenant Radio Access Network Slicing: Statistical Multiplexing of Spatial Loads
IEEE/ACM Transactions on Networking. 25 (5). pp. 3044-3058. Co-sponsored by the IEEE Communications Society, the IEEE Computer Society, and the ACM with its Special Interest Group on Data Communications (SIGCOMM). ISSN 1063-6692.

10. **Claudio Fiandrino, Fazel Anjomshoa, Burak Kantarci, Dzmitry Kliazovich, Pascal Bouvry, Jeanna Matthews (October 2017)**
Sociability-Driven Framework for Data Acquisition in Mobile Crowdsensing over Fog Computing Platforms for Smart Cities
IEEE Transactions on Sustainable Computing. 2 (4). pp. 345-358. IEEE. ISSN 2377-3790.

11. **Arturo Azcorra, Iñaki Ucar, Francesco Gringoli, Albert Banchs, Pablo Serrano (September 2017)**
µNap: Practical micro-sleeps for 802.11 WLANs
Computer Communications. 110. pp. 175-186. Elsevier. ISSN 0140-3664.

12. **Antonio Fernández Anta, Chryssis Georgiou, Dariusz R. Kowalski, Elli Zavou (September 2017)**
Adaptive Packet Scheduling over a Wireless Channel under Constrained Jamming
Theoretical Computer Science. 692 (5). pp. 72-89. Elsevier. ISSN 0304-3975.

13. **José A. Ruipérez-Valiente, Pedro J. Muñoz-Merino, Carlos Delgado Kloos (September 2017)**
Detecting and Clustering Students by their Gamification Behavior with Badges: A Case Study in Engineering Education
International Journal of Engineering Education. 33 (2-B). pp. 816-830. TEMPUS Publications. ISSN ISSN: 0949-149X.

14. **Kirill Kogan, Alejandro López-Ortiz, Sergey Nikolenko, Alexander V. Sirotkin (September 2017)**
The Impact of Processing Order on Performance: a Taxonomy of Semi-FIFO Policies
Journal of Computer and System Sciences. 88. pp. 220-235. Elsevier. ISSN 0022-0000.

15. **Maurizio Rea, Aymen Fakhreddine, Domenico Giustiniano, Vincent Lenders (August 2017)**
Filtering Noisy 802.11 Time-of-Flight Ranging Measurements From Commoditized WiFi Radios
IEEE/ACM Transactions on Networking. 25 (4). pp. 2514-2527. Co-sponsored by the IEEE Communications Society, the IEEE Computer Society, and the ACM with its Special Interest Group on Data Communications (SIGCOMM). ISSN 1063-6692.

16. **Dario Bega, Marco Gramaglia, Carlos Jesús Bernardos, Albert Banchs, Xavier Costa-Perez (August 2017)**
Toward the network of the future: From enabling technologies to 5G concepts
Transactions on Emerging Telecommunications Technologies. 28 (8). pp. 1-13. John Wiley & Sons, Ltd. ISSN 2161-3915.

17. **Iñaki Ucar, Carlos Donato, Pablo Serrano, Andres Garcia-Saavedra, Arturo Azcorra, Albert Banchs (July 2017)**
On the energy efficiency of rate and transmission power control in 802.11
Computer Communications. Elsevier. ISSN 0140-3664.

18. **Waqas bin Abbas, Paolo Casari, Michele Zorzi (July 2017)**
Controlled Flooding of Fountain Codes
IEEE Transactions on Wireless Communications. 16 (7). pp. 4698-4710. IEEE. ISSN 1536-1276.

19. **Kshitiz Verma, Gianluca Rizzo, Antonio Fernández Anta, Rubén Cuevas, Arturo Azcorra, Shmuel Zaks, Alberto García-Martínez (July 2017)**
Energy-optimal collaborative file distribution in wired networks
Peer-to-Peer Networking and Applications. 10 (4). pp. 925-944. Springer US. ISSN 1936-6442.

20. **Henry S. Dol, Paolo Casari, Timo van der Zwan, Roald Otnes (July 2017)**
Software-Defined Underwater Acoustic Modems: Historical Review and the NILUS Approach
IEEE Journal of Oceanic Engineering. 42 (3). pp. 722-737. IEEE. ISSN 0364-9059.

21. **Pietro Ruiu, Claudio Fiandrino, Paolo Giaccone, Andrea Bianco, Dzmitry Kliazovich, Pascal Bouvry (June 2017)**
On the Energy-Proportionality of Data Center Networks
IEEE Transactions on Sustainable Computing. 2 (2). pp. 197-210. IEEE. ISSN 2377-3790.

22. **Danilo De Donno, Joan Palacios, Joerg Widmer (June 2017)**
Millimeter-Wave Beam Training Acceleration through Low-Complexity Hybrid Transceivers
IEEE Transactions on Wireless Communications. 16 (6). pp. 3646-3660. IEEE. ISSN 1536-1276.

23. **Ignacio Berberana (June 2017)**
PoC of SCMA-Based Uplink Grant-Free Transmission in UCNC for 5G
Journal on Selected Areas in Communications. 35 (6). pp. 1353-1361. IEEE. ISSN 0733-8716.

24. **Giora Alexandron, José A. Ruipérez-Valiente, Zhongzhou Chen, Pedro J. Muñoz-Merino, David E. Pritchard (May 2017)**
Copying@Scale: Using Harvesting Accounts for Collecting Correct Answers in a MOOC
Computers & Education. 108. pp. 96-114. Elsevier. ISSN 0360-1315.

25. **Nicola Bui, Matteo Cesana, S. Amir Hosseini, Qi Liao, Ilaria Malanchini, Joerg Widmer (April 2017)**
A Survey of Anticipatory Mobile Networking: Context-Based Classification, Prediction Methodologies, and Optimization Techniques
IEEE Communications Surveys & Tutorials. 19 (3). pp. 1790-1821. IEEE Communications Society. ISSN 1553-877X.

26. **Pedro J. Muñoz-Merino, Eva Méndez Rodríguez, Carlos Delgado Kloos, José A. Ruipérez-Valiente (April 2017)**
Design, Implementation and Evaluation of SPOCs at the Universidad Carlos III de Madrid
Journal of Universal Computer Science. 23 (2). pp. 167-186. Springer Verlag. ISSN 0948-695X.

27. **Roderick Fanou, Pierre Francois, Emile Aben, Michuki Mwangi, Nishal Goburdhan, Francisco Valera (March 2017)**
Four Years Tracking Unrevealed Topological Changes in the African Interdomain
Computer Communications. 106C. pp. 117-135. Elsevier. ISSN 0140-3664.

28. **Gek Hong Sim, Joerg Widmer (March 2017)**
Finite Horizon Opportunistic Multicast Beamforming
IEEE Transactions on Wireless Communications. 16 (3). pp. 1452-1465. IEEE. ISSN 1536-1276.

29. **Andrea Capponi, Claudio Fiandrino, Dzmitry Kliazovich, Pascal Bouvry, Stefano Giordano (March 2017)**
A Cost-Effective Distributed Framework for Data Collection in Cloud-based Mobile Crowd Sensing Architectures
IEEE Transactions on Sustainable Computing. 2 (1). pp. 3-16. IEEE. ISSN 2377-3790.

30. **Roee Diamant, Paolo Casari, Filippo Campagnaro, Michele Zorzi (March 2017)**
Leveraging the Near-Far Effect for Improved Spatial-Reuse Scheduling in Underwater Acoustic Networks
IEEE Transactions on Wireless Communications. 16 (3). pp. 1480-1493. IEEE. ISSN 1536-1276.

31. **Mahdi Asadpour, Karin Anna Hummel, Domenico Giustiniano, Stefan Draskovic (March 2017)**
Route or Carry: Motion-driven Packet Forwarding in Micro Aerial Vehicle Networks
IEEE Transactions on Mobile Computing. 16 (3). pp. 843-856. IEEE Communications Society. ISSN 1536-1233.

32. **Claudio Fiandrino, Andrea Capponi, Giuseppe Cacciatore, Dzmitry Kliazovich, Ulrich Sorger, Pascal Bouvry, Burak Kantarci, Fabrizio Granelli, Stefano Giordano (February 2017)**
CrowdSenSim: a Simulation Platform for Mobile Crowdsensing in Realistic Urban Environments
IEEE Access. 5. pp. 3490-3503. IEEE. ISSN 2169-3536.

33. **Christina Vlachou, Albert Banchs, Julien Herzen, Patrick Thiran (February 2017)**
How CSMA/CA With Deferral Affects Performance and Dynamics in Power-Line Communications
IEEE/ACM Transactions on Networking. 25 (1). pp. 250-263. Co-sponsored by the IEEE Communications Society, the IEEE Computer Society, and the ACM with its Special Interest Group on Data Communications (SIGCOMM). ISSN 1063-6692.

34. **Alberto Tarable, Alessandro Nordio, Emilio Leonardi, Marco Ajmone Marsan (February 2017)**
The Importance of Worker Reputation Information in Microtask-Based Crowd Work Systems
IEEE Transactions on Parallel and Distributed Systems. 28 (2). pp. 558-571. IEEE Computer Society. ISSN 1045-9219.

35. **Yi Zhang, Michela Meo, Raffaella Gerboni, Marco Ajmone Marsan (January 2017)**
Minimum cost solar power systems for LTE macro base stations
Computer Networks. 112. pp. 12-23. Elseiver. ISSN 1389-1286.

36. **José A. Ruipérez-Valiente, Pedro J. Muñoz-Merino, Héctor J. Pijeira Díaz, Javier Santofimia Ruiz, Carlos Delgado Kloos (January 2017)**
Evaluation of a Learning Analytics Application for Open edX Platform
Computer Science & Information Systems. 14 (1). pp. 51-73. ComSIS Consortium. ISSN 1820-0214.

37. **Joan Palacios, Danilo De Donno, Joerg Widmer (January 2017)**
Lightweight and Effective Sector Beam Pattern Synthesis with Uniform Linear Antenna Arrays
IEEE Antennas and Wireless Propagation Letters. 16. pp. 605-608. IEEE. ISSN 1536-1225.

Magazine Articles [5]

1. **Gek Hong Sim, Adrian Loch, Arash Asadi, Vincenzo Mancuso, Joerg Widmer (August 2017)**
5G Millimeter-Wave and D2D Symbiosis: 60 GHz for Proximity-based Services
IEEE Wireless Communications Magazine. 24 (4). pp. 140-145. IEEE Communications Society. ISSN 1536-1284.

2. **Patrick Eugster, Chamikara Jayalath, Kirill Kogan, Julian Stephen (June 2017)**
Big Data Analytics beyond the Single Datacenter
IEEE Computer Magazine. 50 (6). pp. 60-68. IEEE. ISSN 0018-9162.

3. **Narseo Vallina-Rodriguez, Srikanth Sundaresan (May 2017)**
7 in 10 smartphone apps share your data with third-party services
The Conversation. The Conversation Trust.

4. **Konstantinos Samdanis, Steven Wright, Albert Banchs, Antonio Capone, Mehmet Ulema, Kazuaki Obana (May 2017)**
5G Network Slicing: Part 1 – Concepts, Principales, and Architectures [Guest Editorial]
IEEE Communications Magazine. 55 (5). pp. 70-71. IEEE Communications Society. ISSN 0163-6804.

5. **Peter Rost, Christian Mannweiler, Diomidis Michalopoulos, Cinzia Sartori, Vincenzo Sciancalepore, Nishanth Sastry, Oliver Holland, Shreya Tayade, Bin Han, Dario Bega, Danish Aziz, Hajo Bakker (May 2017)**
Network Slicing to Enable Scalability and Flexibility in 5G Mobile Networks
IEEE Communications Magazine. 55 (5). pp. 72-79. IEEE Communications Society. ISSN 0163-6804.

Conference or Workshop Papers [69]

1. **Daniel Steinmetzer, Daniel Wegemer , Matthias Schulz, Joerg Widmer, Matthias Hollick (December 2017)**
Compressive Millimeter-Wave Sector Selection in Off-the-Shelf IEEE 802.11ad Devices
In: The 13th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea.

2. **Mario Almeida, Alessandro Finamore, Diego Perino, Narseo Vallina-Rodriguez, Matteo Varvello (December 2017)**
Dissecting DNS Stakeholders in Mobile Networks
In: The 13th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea.

3. **Ander Galisteo, Qing Wang, Aniruddha Deshpande, Marco Zuniga, Domenico Giustiniano (December 2017)**
Follow that Light: Leveraging LEDs for Relative Two-Dimensional Localization
In: The 13th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea.

4. **Abbas Razaghpanah, Arian Akhavan Niaki, Narseo Vallina-Rodriguez, Srikanth Sundaresan, Johanna Amann, Phillipa Gill (December 2017)**
Studying TLS Usage in Android Apps
In: The 13th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea.

5. **Adrian Loch, Hany Assasa, Joan Palacios, Joerg Widmer, Hans Suys, Björn Debaillie (December 2017)**
Zero Overhead Device Tracking in 60 GHz Wireless Networks using Multi-Lobe Beam Patterns
In: The 13th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea.

6. **Cristina Márquez, Marco Gramaglia, Marco Fiore, Albert Banchs, Cezary Ziemlicki, Zbigniew Smoreda (December 2017)**
Not All Apps Are Created Equal: Analysis of Spatiotemporal Heterogeneity in Nationwide Mobile Service Usage
In: The 13th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea.

7. **Patricia Callejo, Conor Kelton, Narseo Vallina-Rodriguez, Rubén Cuevas, Oliver Gasser, Christian Kreibich, Florian Wohlfart, Ángel Cuevas (November 2017)**
Opportunities and Challenges of Ad-based Measurements from the Edge of the Network
In: The 16th ACM Workshop on Hot Topics in Networks (HotNets 2017), 30 November - 1 December 2017, Palo Alto, California, USA.

8. **Filippo Campagnaro, Roberto Francescon, Oleksiy Kebkal, Paolo Casari, Konstantin Kebkal, Michele Zorzi (November 2017)**
Full Reconfiguration of Underwater Acoustic Networks through Low-Level Physical Layer Access
In: The 12th ACM International Conference on Underwater Networks & Systems (ACM WUWNet 2017), 6-8 November 2017, Halifax, Nova Scotia, Canada.

9. **Filippo Campagnaro, Roberto Francescon, Paolo Casari, Roee Diamant, Michele Zorzi (November 2017)**
Multimodal Underwater Networks: Recent Advances and a Look Ahead
In: The 12th ACM International Conference on Underwater Networks & Systems (ACM WUWNet 2017), 6-8 November 2017, Halifax, Nova Scotia, Canada.

10. **Antonio Fernández Anta, Chryssis Georgiou, Nicolas Nicolaou (November 2017)**
Formalizing Distributed Ledger Objects
In: The 1st Workshop on Storage, Control, Networking in Dynamic Systems (SCNDS 2017), in conjunction with the 19th International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS 2017), 5 November 2017 , Boston, MA, USA.

11. **Roderick Fanou, Francisco Valera, Amogh Dhamdhere (November 2017)**
Investigating the Causes of Congestion on the African IXP Substrate
In: The 17th ACM Internet Measurement Conference (IMC 2017), 1-3 November 2017, London, UK.

12. **Elizaveta Dubrovinskaya, Roee Diamant, Paolo Casari (October 2017)**
Anchorless Underwater Acoustic Localization
In: IEEE 14th Workshop on Positioning, Navigation and Communications (WPNC 2017), 25-26 October 2017, Bremen, Germany.

13. **Roberto Calvo-Palomino, Fabio Ricciato, Domenico Giustiniano, Vincent Lenders (October 2017)**
LTESS-track: A Precise and Fast Frequency Offset Estimation for low-cost SDR Platforms
In: The 11th ACM Workshop on Wireless Network Testbeds, Experimental evaluation & CHaracterization (ACM WiNTECH 2017), 16-20 October 2017, Snowbird, Utah, USA.

14. **Ozgu Alay, Andra Lutu, Miguel Peón-Quirós, Vincenzo Mancuso, Thomas Hirsch, Kristian Evensen, Audun Hansen, Stefan Alfredsson, Jonas Karlsson, Anna Brunstrom, Ali Safari Khatouni, Marco Mellia, Marco Ajmone Marsan (October 2017)**
Experience: An Open Platform for Experimentation with Commercial Mobile Broadband Networks
In: The 23rd Annual International Conference on Mobile Computing and Networking (MobiCom 2017), 16-20 October 2017, Snowbird, Utah, USA.

15. **Daniel Steinmetzer, Adrian Loch, Amanda García-García, Joerg Widmer, Matthias Hollick (October 2017)**
Mitigating Lateral Interference: Adaptive Beam Switching for Robust Millimeter-Wave Networks
In: The 1st ACM Workshop on Millimeter-Wave Networks and Sensing Systems (mmNets 2017), 16 October 2017, Snowbird, Utah, USA.

16. **Domenico Giustiniano (October 2017)**
Position: Health Effects in LED-based Communication Systems and Possible Mitigations
In: The 4th ACM Workshop on Visible Light Communication Systems (VLCS 2017), 16 October 2017, Snowbird, UT, USA.

17. **Miguel Peón-Quirós, Vincenzo Mancuso, Vincenzo Comite, Andra Lutu, Ozgu Alay, Stefan Alfredsson, Jonas Karlsson, Anna Brunstrom, Marco Mellia, Ali Safari Khatouni, Thomas Hirsch (October 2017)**
Results from Running an Experiment as a Service Platform for Mobile Networks
In: The 11th ACM Workshop on Wireless Network Testbeds, Experimental evaluation & CHaracterization (ACM WiNTECH 2017), 16-20 October 2017, Snowbird, Utah, USA.

18. **Kirill Kogan, Danushka Menikkumbura, Gustavo Petri, Yangtae Noh, Sergey Nikolenko, Alexander V. Sirotkin, Patrick Eugster (October 2017)**
A Programmable Buffer Management Platform
In: The 25th IEEE International Conference on Network Protocols (IEEE ICNP 2017), 10-13 October 2017, Toronto, Canada.

19. **Pavel Chuprikov, Kirill Kogan, Sergey Nikolenko (October 2017)**
General Ternary Bit Strings on Commodity Longest-Prefix-Match Infrastructures
In: The 25th IEEE International Conference on Network Protocols (IEEE ICNP 2017), 10-13 October 2017, Toronto, Canada.

20. **Hoang DuyTrinh, Nicola Bui, Joerg Widmer, Lorenza Giupponi, Paolo Dini (October 2017)**
Analysis and Modeling of Mobile Traffic Using Real Traces
In: The 28th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (IEEE PIMRC 2017), 8-13 October 2017, Montreal, QC, Canada.

21. **Norbert Ludant, Nicola Bui, Ana García Armada, Joerg Widmer (October 2017)**
Data-Driven Performance Evaluation of Carrier Aggregation in LTE-Advanced
In: The 28th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (IEEE PIMRC 2017), 8-13 October 2017, Montreal, QC, Canada.

22. **Diomidis S. Michalopoulos, Mark Doll, Vincenzo Sciancalepore, Dario Bega, Peter Schneider, Peter Rost (October 2017)**
Network Slicing via Function Decomposition and Flexible Network Design
In: The 28th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (IEEE PIMRC 2017), 8-13 October 2017, Montreal, QC, Canada.

23. **Sungoh Kwon, Joerg Widmer (October 2017)**
Relay Selection for mmWave Communications
In: The 28th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (IEEE PIMRC 2017), 8-13 October 2017, Montreal, QC, Canada.

24. **Amr AbdelKhalek Abdelnabi, Fawaz Fawaz S. Al-Qahtani, Redha Redha M. Radaydeh, Mohamed Mohammed Shaqfeh, Raed Raed F. Manna (September 2017)**
Performance of Overlaid MIMO Cellular Networks with TAS/MRC Under Hybrid-Access Small Cells and Poisson Field Interference
In: The 2017 IEEE 86th Vehicular Technology (VTC2017-Fall), 24-27 September 2017, Toronto, Canada.

25. **Roberto Calvo-Palomino, Domenico Giustiniano, Vincent Lenders (September 2017)**
Measuring Spectrum Similarity in Distributed Radio Monitoring Systems
In: Tyrrhenian International Workshop on Digital Communications (TIWDC 2017), 18-20 September 2017, Mondello (Palermo), Italy.

26. **Nicola Bui, Joerg Widmer (September 2017)**
Data-driven Evaluation of Anticipatory Networking in LTE Networks
In: The 29th International Teletraffic Congress (ITC 29), 4-8 September 2017, Genoa, Italy.

27. **Gaetano Manzo, Marco Ajmone Marsan, Gianluca Rizzo (September 2017)**
Performance Modeling of Vehicular Floating Content in Urban Settings
In: The 29th International Teletraffic Congress (ITC 29), 4-8 September 2017, Genoa, Italy.

28. **Ali Safari Khatouni, Marco Mellia, Marco Ajmone Marsan, Stefan Alfredsson, Jonas Karlsson, Anna Brunstrom, Ozgu Alay, Andra Lutu, Cise Midoglu, Vincenzo Mancuso (September 2017)**
Speedtest-like Measurements in 3G/4G Networks: the MONROE Experience
In: The 29th International Teletraffic Congress (ITC 29), 4-8 September 2017, Genoa, Italy.

29. **Roee Diamant, Filippo Campagnaro, Michele de Filippo de Grazia, Alberto Testolin, Violeta Sanjuan Calzado, Michele Zorzi, Paolo Casari (September 2017)**
Exploring the statistical relation between the underwater acoustic and optical channels
In: Underwater Acoustics Conference & Exhibition (UACE), 3-8 September 2017, Skiathos, Greece.

30. **Emmanuel S. Peters, Nicholas F. Maxemchuk (July 2017)**
A Privacy-Preserving Distributed Medical Insurance Claim Clearinghouse & EHR Application
In: The 2nd IEEE/ACM International Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE 2017), 17-19 July 2017, Philadelphia, PA, USA.

31. **Pradeep Bangera, Syed Hasan, Sergey Gorinsky (July 2017)**
An Advertising Revenue Model for Access ISPs
In: The 22nd IEEE Symposium on Computers and Communications (ISCC 2017), 3-6 July 2017, Heraklion, Crete, Greece.

32. **Nikolaos Bartzoudis, Oriel Font-Bach, Marco Miozzo, Carlos Donato, Pavel Harbanau, Manuel Requena-Esteso, David López Bueno, Iñaki Ucar, Arturo Azcorra, Pablo Serrano, Josep Mangues-Bafalluy, Miquel Payaró (June 2017)**
Energy footprint reduction in 5G reconfigurable hotspots via function partitioning and bandwidth adaptation
In: The 5th International Workshop on Cloud Technologies and Energy Efficiency in Mobile Communication Networks (CLEEN 2017), 22 June 2017, Turin, Italy.

33. **Nuria Molner, Sergio González, Thomas Deiss, Antonio De la Oliva (June 2017)**
The 5G-Crosshaul Packet Forwarding Element pipeline: measurements and analysis
In: The 5th International Workshop on Cloud Technologies and Energy Efficiency in Mobile Communication Networks (CLEEN 2017), 22 June 2017, Turin, Italy.

34. **Pradeep Bangera, Sergey Gorinsky (June 2017)**
Ads versus Regular Contents: Dissecting the Web Hosting Ecosystem
In: The 16th IFIP Networking 2017 Conference (NETWORKING 2017), 12-16 June 2017, Stockholm, Sweden.

35. **Hany Assasa, Joerg Widmer (June 2017)**
Extending the IEEE 802.11ad Model: Scheduled Access, Spatial Reuse, Clustering, and Relaying
In: The Workshop on ns-3 (WNS3), 13-14 June 2017, Porto, Portugal.

36. **Guillermo Bielsa, Adrian Loch, Joerg Widmer (June 2017)**
60 GHz Range Boost: Exploiting Frequency Selectivity in Millimeter-Wave Networks
In: The 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2017), 12-15 June 2017, Macau, China.

37. **Swetank Kumar Saha, Tariq Siddiqui, Dimitrios Koutsonikolas, Adrian Loch, Joerg Widmer, Ramalingam Sridhar (June 2017)**
A Detailed Look into Power Consumption of Commodity 60 GHz Devices
In: The 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2017), 12-15 June 2017, Macau, China.

38. **Ali Safari Khatouni, Marco Ajmone Marsan, Marco Mellia, Reza Rejaie (June 2017)**
Adaptive Schedulers for Deadline-Constrained Content Upload from Mobile Multihomed Vehicles
In: The 23rd IEEE International Symposium on Local and Metropolitan Area Networks (LANMAN 2017), 12-14 June 2017, Osaka, Japan.

39. **Nicola Bui, Foivos Michelinakis, Joerg Widmer (June 2017)**
Fine-grained LTE Radio Link Estimation for Mobile Phones
In: The 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2017), 12-15 June 2017, Macau, China.

40. **Filippo Campagnaro, Matteo Calore, Paolo Casari, Violeta Sanjuan Calzado, Giacomo Cupertino, Claudio Moriconi, Michele Zorzi (June 2017)**
Measurement-based Simulation of Underwater Optical Networks
In: MTS/IEEE OCEANS 2017, 12-19 June 2017, Aberdeen, Scotland, UK.

41. **Maria Scalabrin, Michele Rossi, Guillermo Bielsa, Adrian Loch, Joerg Widmer (June 2017)**
Millimetric Diagnosis: Machine Learning Based Network Analysis for mm-Wave Communication
In: The 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2017), 12-15 June 2017, Macau, China.

42. **Edgar Arribas, Vincenzo Mancuso (June 2017)**
Multi-Path D2D Leads to Satisfaction
In: The 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2017), 12-15 June 2017, Macau, China.

43. **A. Sgambelluri, F. Tusa, M. Gharbaoui, E. Maini, L. Toka, Jorge Martin Perez, F. Paolucci, B. Martini, W. Y. Poe, J. Melian Hernandes, A. Muhammed, A. Ramos, O. G. De Dios, B. Sonkoly, P. Monti, I. Vaishnavi, Carlos Jesús Bernardos, R. Szabo (June 2017)**
Orchestration of Network Services Across Multiple Operators: The 5G Exchange Prototype
In: The 26th European Conference on Networks and Communications (EuCNC 2017), 12-15 June 2017, Oulu, Finland.

44. **Per-Olov Östberg, James Byrne, Paolo Casari, Philip Eardley, Antonio Fernández Anta, Johan Forsman, John Kennedy, Thang Le Duc, Manuel Noya Mariño, Loomba Radhika, Miguel Ángel López Peña, José López Veiga, Theo Lynn, Vincenzo Mancuso, Sergej Svorobej, Anders Torneus, Stefan Wesner, Peter Willis, Jörg Domaschka (June 2017)**
Reliable Capacity Provisioning for Distributed Cloud/Edge/Fog Computing Applications
In: The 26th European Conference on Networks and Communications (EuCNC 2017), 12-15 June 2017, Oulu, Finland.

45. **Paolo Castagno, Vincenzo Mancuso, Matteo Sereno, Marco Ajmone Marsan (June 2017)**
Why Your Smartphone Doesn't Work in Very Crowded Environments
In: The 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2017), 12-15 June 2017, Macau, China.

46. **Vasileios Dragonas, Konstantinos Oikonomou, Ioannis Stavrakakis (May 2017)**
A Topology-Independent TDMA MAC Policy for Safety Applications in Vehicular Networks
In: The 1st International Balkan Conference on Communications and Networking (BalkanCom 2017), 30 May - 2 June 2017, Tirana, Albania.

47. **Tobias Rueckelt, Ioannis Stavrakakis, Tobias Meuser, Doreen Böhnstedt, Ralf Steinmetz (May 2017)**
Data Transmission Plan Adaptation for Connected Vehicles
In: The 1st International Balkan Conference on Communications and Networking (BalkanCom 2017), 30 May - 2 June 2017, Tirana, Albania.

48. **Georgios Tsoumanis, Konstantinos Oikonomou, Sonia Aïssa, Ioannis Stavrakakis (May 2017)**
Recharging Vehicle Distance Minimization in Wireless Sensor Networks
In: The 1st International Balkan Conference on Communications and Networking (BalkanCom 2017), 30 May - 2 June 2017, Tirana, Albania.

49. **Irwin Reyes, Primal Wiesekera, Abbas Razaghpanah, Joel Reardon, Narseo Vallina-Rodriguez, Serge Egelman, Christian Kreibich (May 2017)**
"Is Our Children's Apps Learning?" Automatically Detecting COPPA Violations
In: Workshop on Technology and Consumer Protection (ConPro 2017), in conjunction with the 38th IEEE Symposium on Security and Privacy (IEEE S&P 2017) , 25 May 2017, San Jose, CA, USA.

50. **Zarrar Yousaf Faqir, Marco Gramaglia, Vasilis Friderikos, Borislava Gajic, Dirk von Hugo, Bessem Sayadi, Vincenzo Sciancalepore, Marcos Rates Crippa (May 2017)**
Network Slicing with Flexible Mobility and QoS/QoE Support for 5G Networks
In: 5GArch 2017: 4th International Workshop on 5G Architecture, in conjunction with the IEEE International Conference on Communications (ICC 2017), 25 May 2017, Paris, France.

51. **José A. Ruipérez-Valiente, Ruth Cobos, Pedro J. Muñoz-Merino, Álvaro Andújar, Carlos Delgado Kloos (May 2017)**
Early Prediction and Variable Importance of Certificate Accomplishment in a MOOC
In: European Conference on Massive Open Online Courses (EMOOCs 2017), 22-26 May 2017, Madrid, Spain.

52. **Giuseppe Cacciatore, Claudio Fiandrino, Dzmitry Kliazovich, Fabrizio Granelli, Pascal Bouvry (May 2017)**
Cost Analysis of Smart Lighting Solutions for Smart Cities
In: The IEEE International Conference on Communications (ICC 2017), 21-25 May 2017, Paris, France.

53. **Miltiades C. Filippou, Danilo De Donno, Camila Priale, Joan Palacios, Domenico Giustiniano, Joerg Widmer (May 2017)**
Throughput vs. Latency: QoS-centric Resource Allocation for Multi-User Millimeter Wave Systems
In: The IEEE International Conference on Communications (ICC 2017), 21-25 May 2017, Paris, France.

54. **Jiaxiao Zheng, Pablo Caballero, Gustavo de Veciana, Seung Jun Baek, Albert Banchs (May 2017)**
Statistical Multiplexing and Traffic Shaping Games for Network Slicing
In: The 15th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2017) , 15-19 May 2017, Paris, France.

55. **Thomas Bonald, James Roberts, Christian Vitale (May 2017)**
Convergence to multi-resource fairness under end-to-end window control
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

56. **Roberto Calvo-Palomino, Domenico Giustiniano, Vincent Lenders, Aymen Fakhreddine (May 2017)**
Crowdsourcing Spectrum Data Decoding
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

57. **Andrea Capponi, Claudio Fiandrino, Dzmitry Kliazovich, Pascal Bouvry, Stefano Giordano (May 2017)**
Energy Efficient Data Collection in Opportunistic Mobile Crowdsensing Architectures for Smart Cities
In: The 3rd IEEE INFOCOM Workshop on Smart Cities and Urban Computing, in conjunction with the 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1 May 2017, Atlanta, GA, USA.

58. **Joan Palacios, Paolo Casari, Joerg Widmer (May 2017)**
JADE: Zero-Knowledge Device Localization and Environment Mapping for Millimeter Wave Systems
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

59. **Vincenzo Sciancalepore, Konstantinos Samdanis, Xavier Costa-Perez, Dario Bega, Marco Gramaglia, Albert Banchs (May 2017)**
Mobile Traffic Forecasting for Maximizing 5G Network resource Utilization
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

60. **Sergey Nikolenko, Kirill Kogan, Antonio Fernández Anta (May 2017)**
Network Simplification Preserving Bandwidth and Routing Capabilities
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

61. **Pablo Caballero, Albert Banchs, Gustavo de Veciana, Xavier Costa-Perez (May 2017)**
Network Slicing Games: Enabling Customization in Multi-Tenant Mobile Networks
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

62. **Dario Bega, Marco Gramaglia, Albert Banchs, Vincenzo Sciancalepore, Konstantinos Samdanis, Xavier Costa-Perez (May 2017)**
Optimising 5G Infrastructure Markets: The Business of Network Slicing
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

63. **Marco Gramaglia, Marco Fiore, Alberto Tarable, Albert Banchs (May 2017)**
Preserving Mobile Subscriber Privacy in Open Datasets of Spatiotemporal Trajectories
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

64. **Roee Diamant, Paolo Casari, Filippo Campagnaro, Michele Zorzi (May 2017)**
Routing in Multi-Modal Underwater Networks: a Throughput-optimal Approach
In: The 1st IEEE Workshop on Wireless Communications and Networking in Extreme Environments Workshop (WCNEE 2017), in conjunction with the 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1 May 2017, Atlanta, GA, USA.

65. **Alex Davydow, Pavel Chuprikov, Sergey Nikolenko, Kirill Kogan (May 2017)**
Throughput Optimization with Latency Constraints
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

66. **Joan Palacios, Danilo De Donno, Joerg Widmer (May 2017)**
Tracking mm-Wave Channel Dynamics: Fast Beam Training Strategies under Mobility
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

67. **José A. Ruipérez-Valiente, Srecko Joksimović, Vitomir Kovanović, Dragan Gašević, Pedro J. Muñoz-Merino, Carlos Delgado Kloos (April 2017)**
A Data-driven Method for the Detection of Close Submitters in Online Learning Environments
In: The 26th International World Wide Web Conference (WWW 2017), 3-7 April 2017, Perth, Western Australia.

68. **Gek Hong Sim, Arash Asadi, Adrian Loch, Matthias Hollick, Joerg Widmer (January 2017)**
Opp-Relay: Managing Directionality and Mobility Issues of Millimeter-Wave via D2D Communication
In: The 9th International Conference on COMmunication Systems and NETworkS (COMSNETS 2017), 4-8 January 2017, Bangalore, India.

69. **Adrian Loch, Arash Asadi, Gek Hong Sim, Joerg Widmer, Matthias Hollick (January 2017)**
mm-Wave on Wheels: Practical 60 GHz Vehicular Communication Without Beam Training
In: The 9th International Conference on COMmunication Systems and NETworkS (COMSNETS 2017), 4-8 January 2017, Bangalore, India.

Conference and Workshop Posters & Demos [11]

1. **Alessandro Finamore, James Newman, Diego Perino, Norrathep Rattanavipanon, Claudio Soriente, Narseo Vallina-Rodriguez (November 2017)**
Characterising users experience and critical path in mobile applications (Poster, peer-reviewed)
In: The 17th ACM Internet Measurements Conference (IMC 2017), 1-3 November 2017, London, UK.

2. **Foivos Michelinakis, Hossein Doroud, Abbas Razaghpanah, Andra Lutu, Narseo Vallina-Rodriguez, Phillipa Gill, Joerg Widmer (November 2017)**
Content Distribution Networks in the mobile age (Poster, peer-reviewed)
In: The 17th ACM Internet Measurements Conference (IMC 2017), 1-3 November 2017, London, UK.

3. **Swetank Kumar Saha, Roshan Shyamsunder, Naveen Muralidhar Prakash, Hany Assasa, Adrian Loch, Dimitrios Koutsonikolas, Joerg Widmer (October 2017)**
Poster: Can MPTCP Improve Performance for Dual-Band 60 GHz/5 GHz Clients? (Poster, peer-reviewed)
In: The 23rd Annual International Conference on Mobile Computing and Networking (MobiCom 2017), 16-20 October 2017, Snowbird, Utah, USA.

4. **Ander Galisteo, Hongjia Wu, Qing Wang, Diego Juara, Marco Zuniga, Domenico Giustiniano (October 2017)**
Demo: OpenVLC1.2 for Increased Data Rate with Embedded Systems (Demo, peer-reviewed)
In: The 4th ACM Workshop on Visible Light Communication Systems (VLCS 2017),, 16 October 2017, Snowbird, UT, USA.

5. **Maurizio Rea, Héctor Cordobés de la Calle, Domenico Giustiniano, Domenico Garlisi, Pierluigi Gallo, Spilios Giannoulis, Ingrid Moerman (October 2017)**
Poster: Integration of WiFi ToF Positioning System in the Open, Flexible and Adaptive WiSHFUL Architecture(Poster, peer-reviewed)
In: The 11th ACM Workshop on Wireless Network Testbeds, Experimental evaluation & CHaracterization (ACM WiNTECH 2017), 16-20 October 2017, Snowbird, Utah, USA.

6. **Pavel Chuprikov, Alex Davydow, Kirill Kogan, Sergey Nikolenko, Alexander V. Sirotkin (October 2017)**
Planning in Compute-Aggregate Problems as Optimization Problems on Graphs (Poster, peer-reviewed)
In: The 25th IEEE International Conference on Network Protocols (IEEE ICNP 2017), 10-13 October 2017, Toronto, Canada.

7. **Andrés Abeliuk, Antonio Fernández Anta, Nick Obradovich, Iyad Rahwan (July 2017)**
Modeling the Evolution of Political Ideologies (Poster, peer-reviewed)
In: The 3rd Annual International Conference on Computational Social Science (IC2S2 2017), 10-13 July 2017, Cologne, Germany.

8. **Thomas Deiss, Jorge Baranda, Luca Cominardi, Luis Miguel Contreras Murillo, Jessé Gomes, Sergio González, Paola Iovanna, Josep Mangues-Bafalluy, Nuria Molner, José Núñez-Martínez, Antonio De la Oliva, Stefano Stracca (June 2017)**
Dataplane Measurements on a Fronthaul (FH) and Backhaul (BH) integrated network (Poster)
In: The 5th International Workshop on Cloud Technologies and Energy Efficiency in Mobile Communication Networks (CLEEN 2017), 22 June 2017, Turin, Italy.

9. **Adrian Loch, Guillermo Bielsa, Roberto Santos, Joerg Widmer (June 2017)**
mm-View: Obtaining Real-Time Lower Layer Information of Commercial Off-The-Shelf 60 GHz Hardware (Demo, peer-reviewed)
In: The 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM 2017), 12-15 June 2017, Macau, China.

10. **Bertold Van den Bergh, Domenico Giustiniano, Héctor Cordobés de la Calle, Markus Fuchs, Roberto Calvo-Palomino, Sofie Pollin, Sreeraj Rajendran, Vincent Lenders (March 2017)**
Electrosense: Crowdsourcing Spectrum Monitoring (Demo, peer-reviewed)
In: The 13th IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN 2017), 6-9 March 2017, Baltimore, MD, USA.

11. **Narseo Vallina-Rodriguez, Christian Kreibich, Mark Allman, Vern Paxson (January 2017)**
Lumen: Fine-Grained Visibility and Control of Mobile Traffic in User-Space (Poster)
In: The 3rd Biennal NSF Secure and Trustworthy Cyberspace Principal Investigators Meeting (SaTC PI Meeting 2017), 9-11 January 2017, Washington, D.C., USA.

PhD Theses [5]

1. **Roderick Fanou (December 2017)**
Methods for revealing and reshaping the African Internet ecosystem as a case study for developing regions: From isolated networks to a connected continent
Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisors: · Francisco Valera, Universidad Carlos III de Madrid, Spain. · Pierre Francois

2. **Christian Vitale (June 2017)**
Analytical Characterization of In-band and Out-band D2D Communications for Network Access
Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Vincenzo Mancuso, IMDEA Networks Institute, Madrid, Spain

3. **José A. Ruipérez-Valiente (May 2017)**
Analyzing the Behavior of Students Regarding Learning Activities, Badges, and Academic Dishonesty in MOOC Environments
Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Pedro J. Muñoz-Merino, Universidad Carlos III de Madrid, Spain

4. **Evgenia Christoforou (May 2017)**
Achieving Reliability and Fairness in Online Task Computing Environments
Phd thesis, Department of Mathematics, Universidad Carlos III de Madrid, Spain
Supervisors: Antonio Fernández Anta, IMDEA Networks Institute, Madrid, Spain. · Angel Sánchez, Departamento de Matemáticas, Universidad Carlos III de Madrid, Spain

5. **Nicola Bui (May 2017)**
Prediction-based Techniques for the Optimization of Mobile Networks
Phd thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Joerg Widmer, IMDEA Networks Institute, Madrid, Spain

Masters Theses [4]

1. **Ginés García (September 2017)**
SEMPER: A Stateless Traffic Engineering Solution based on MP-TCP for WAN networks
Masters thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Pablo Serrano, Universidad Carlos III de Madrid, Spain

2. **Jorge Martin Perez (September 2017)**
Multi-domain VNF mapping algorithms
Masters thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Carlos Jesús Bernardos, Universidad Carlos III de Madrid, Spain

3. **Pablo Jimenez Mateo (September 2017)**
Analysis of TCP Performance in 5G mm-wave Mobile Networks
Masters thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisor: Albert Banchs, IMDEA Networks Institute, Madrid, Spain / Universidad Carlos III de Madrid, Spain

4. **Noelia Pérez (September 2017)**
On the persistence of wireless advertising without infrastructure support
Masters thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain
Supervisors: Vincenzo Mancuso, IMDEA Networks Institute, Madrid, Spain. Marco Ajmone Marsan, IMDEA Networks Institute, Madrid, Spain / Politecnico di Torino, Italy

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

- International Workshop on Application of green techniques to emerging communication and computing paradigms (GCC), in conjunction with IEEE International Conference on Communications (ICC 2017), 21 May 2017, Paris, France
- 25th IEEE International Conference on Network Protocols (ICNP 2017), 10-13 October 2017, Toronto, Canada
- 27th International Telecommunication Networks and Applications Conference (ITNAC 2017), 22-24 November 2017, Melbourne, Australia
- 4th NAFOSTED Conference on Information and Computer Science (NICS 2017), 24-25 November 2017, Hanoi, Vietnam
- 9th ITU Kaleidoscope 2017 - Challenges for a data-driven society, 27-29 November 2017, Nanjing, China
- Green Communications Systems and Networks Symposium(GCSN), in conjunction with the IEEE Global Communications Conference Exhibition & Industry Forum (GLOBECOM 2017), 4-8 December 2017, Singapore
- 7th International Conference on Computing, Networking and Communications (ICNC 2018 GCNC): Green Computing, Networking, and Communications, 5-8 March 2018, Maui, Hawaii, USA

- 37th IEEE International Conference on Computer Communications (IEEE INFOCOM 2018), 15-19 April 2018, Honolulu, Hawaii, USA
- IEEE ICC 2018 Green Communications Systems and Networks Symposium (GCSN), in conjunction with the IEEE International Conference on Communications (IEEE ICC 2018), 20-24 May 2018, Kansas City, MO, USA
- IEEE ICC 2018 Wireless Communications Symposium (WCS), in conjunction with the IEEE International Conference on Communications (IEEE ICC 2018), 20-24 May 2018, Kansas City, MO, USA
- 7th IEEE International Conference on Communications and Electronics (IEEE ICCE 2018), 18-20 July 2018, Hue City, Vietnam
- IEEE 88th Vehicular Technology Conference – Track 6: Green Communications and Networks (VTC2018-Fall), 27-30 August 2018, Chicago, USA
- 9th Symposium on Green Networking and Computing (SGNC 2018), in conjunction with the 26th International Conference on Software, Telecommunications, and Computer Networks (SoftCOM 2018), 13-15 September 2018, Split – Supetar, Croatia
- 26th IEEE International Conference on Network Protocols (ICNP 2018), 24-27 September 2018, Cambridge, UK
- 28th International Telecommunication Networks and Applications Conference (ITNAC 2018), 21-23 November 2018, Sydney, Australia
- 10th ITU Kaleidoscope 2018 - Machine learning for a 5G future, 26-28 November 2018, Santa Fe, Argentina
- Green Communications Systems and Networks Symposium (GCSN), in conjunction with IEEE Global Communications Conference Exhibition & Industry Forum (GLOBECOM 2018), 9-3 December 2018, Abu Dhabi, UAE

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: Doctorate School, University Carlos III of Madrid, December 2013 – present
- Member of the Executive Committee: Doctorate School, University Carlos III of Madrid, December 2015 – present
- Member of ACM-SIGCOMM, 2007 – present
- Member of scientific mission to Taiwan organized by the European Commission to discuss mutual collaboration on 5G research, 9-14 January 2018

TPC memberships

- 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, Georgia, USA
- 37th IEEE International Conference on Computer Communications (IEEE INFOCOM 2018), 15-19 April 2018, Honolulu, Hawaii, USA

Albert BANCHS

Professional posts & activities

- IEEE Senior Member
- Distinguished Member of the INFOCOM Technical Program Committee, 2017
- IEEE Distinguished Lecturer, IEEE Communications Society
- Deputy Director: Department of Telematics Engineering, University Carlos III of Madrid, 2017 – present

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

- Track Chair: IEEE Wireless Communications and Networking Conference (IEEE WCNC 2017), 19-22 March 2017, San Francisco, CA, US
- Area Chair: 30th International Teletraffic Congress – Teletraffic in a Smart World (ITC 2018), 3-7 September 2018, Vienna, Austria

TPC memberships

- 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA
- IEEE INFOCOM 2017 Workshop on 5G New Radio (NR) Technologies 2017, in conjunction with IEEE INFOCOM 2017, 1 May 2017, Atlanta, GA, USA
- IEEE International Conference on Communications (ICC 2017), 21-25 May 2017, Paris, France
- 18th IEEE International Symposium on a World of Wireless Mobile and Multimedia Networks (IEEE WoWMoM 2017), 12-15 June 2017, Macao, China
- The 26th European Conference on Networks and Communications (EuCNC 2017), 12-15 June 2017, Oulu, Finland

Paolo CASARI

Journal editorial boards

- Reviewer: «Proyectos de Investigación Científica y Tecnológica (PICT)» granted by the «Agencia Nacional de Promoción Científica y Tecnológica de Argentina»
- Reviewer: EU H2020 COST actions, 2017 Fall session
- 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

- 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 IEEE International Conference on Communications (ICC 2017), 21-25 May 2017, Paris, France
- IEEE 86th Vehicular Technology Conference (VTC2017-Fall), 24-27 September 2017, Toronto, Canada
- IEEE Global Communications Conference Exhibition & Industry Forum (GLOBECOM 2017), 4-8 December 2017, Singapore

- 37th IEEE International Conference on Computer Communications (IEEE INFOCOM 2018), 15-19 April 2018, Honolulu, Hawaii, USA
- 2nd IEEE International Workshop on Wireless Communications and Networking in Extreme Environments (IEEE WCNEE 2018), in conjunction with IEEE INFOCOM 2018, 16 April 2018, Honolulu, Hawaii, USA
- IEEE International Workshop of the Technical Committee on Communications Quality and Reliability (CQR), 14-17 May 2018, Austin, Texas
- IEEE 87th Vehicular Technology Conference (VTC2018-Spring), 3-6 June 2018, Porto, Portugal
- EuCNC 2018 - Wireless, Optical and Satellite Networks (WOS) track, in conjunction with the 27th European Conference on Networks and Communications (EuCNC 2018), 18-21 June 2018, Ljubljana, Slovenia
- EuCNC 2018 Workshop «Fog, Edge and Cloud: Current Challenges and Opportunities», in conjunction with EuCNC 2018, 18 June 2018, Ljubljana, Slovenia
- 17th Annual Mediterranean Ad Hoc Networking Workshop (Med-Hoc-Net 2018), 20-22 June 2018, Capri, Italy

Danilo DE DONNO

Journal editorial boards

- Associate Editor: International Journal on Distributed Sensor Networks

Other activities

- mmMAGIC project co-funded by the European Commission's 5G PPP program, 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: project proposals for the Spanish National Evaluation and Foresight Agency (ANEP – Agencia Nacional de Evaluación y Prospectiva)
- Vocal 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 – April 2017
- «VocalPrimero» (MainChairperson) of the Spanish Association on Parallel and Distributed Computing (SCCD - Sociedad de Computación Concurrente y Distribuida) (June 2015 – June 2017), responsible for the organization of the annual event «Jornadas de Concurrencia y Sistemas Distribuidos»
- Reviewer: PhD Thesis of Antonella Del Pozo, Universitá di Roma "Sapienza" (Roma, Italy) and Université Pierre et Marie Curie (Paris, France), January 2017
- PhD Program Steering Committee member, Escuela Técnica Superior de Ingenieros Informáticos, Universidad Politécnica de Madrid (Spain)

Journal editorial boards

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

Organization committees

- TPC Co-Chair: the 13th International Symposium on Algorithms and Experiments for Wireless Sensor Networks (ALGOSENSORS 2017), 4-8 September 2017, Vienna, Austria

TPC Memberships

- III Jornadas Nacionales de Investigación en Ciberseguridad (JNIC 2017), 31 May – 2 June 2017
- 24th International Colloquium on Structural Information and Communication Complexity (SIROCCO 2017), 19-22 June 2017, Porquerolles, France
- 11th ACM International Conference on Distributed and Event-based Systems (DEBS 2017), 19-23 June 2017, Barcelona, Spain
- 44th International Colloquium on Automata, Languages, and Programming (ICALP 2017), 10-14 July 2017, Warsaw, Poland
- 36th Annual ACM Symposium on Principles of Distributed Computing (ACM PODC 2017) 25-27 July 2017, Washington, DC, USA
- 26th International Conference on Computer Communication and Networks (ICCCN 2017), 31 July – 31 August 2017, Vancouver, BC, Canada
- 1st Workshop on Storage, Control, Networking in Dynamic Systems (SCNDS 2017), in conjunction with the 19th International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS 2017), 5 November 2017, Boston, MA, USA

Claudio FIANDRINO

TPC Memberships

- IEEE International Conference on Communications (ICC 2017), 21-25 May 2017, Paris, France
- IEEE Global Communications Conference Exhibition & Industry Forum (GLOBECOM 2017), 4-8 December 2017, Singapore
- IEEE International Conference on Cloud Computing Technology and Science (CloudCom 2017), 11-14 December 2017, Hong Kong
- IEEE International Conference on Computing, Networking and Communications (ICNC 2018), 5-8 March 2018, Maui, Hawaii, USA
- IEEE International Conference on Communications (ICC 2018), 20-24 May 2018, Kansas City, MO, USA
- 1st IEEE 5G World Forum (5GWF 2018), 9-11 July 2018, Santa Clara, California, USA
- IEEE 87th Vehicular Technology Conference (VTC2018-Spring), 3-6 June 2018, Porto, Portugal

Domenico GIUSTINIANO

Professional posts & activities

- Reviewer of proposals submitted to Non-profit Institution «Serrapilheira», Brazil, November 2017
- PhD Defense Committee of Shuai Li, University of Eindhoven and Philips Research (Eindhoven, The Netherlands), May 2017
- PhD Defense Committee of Ambuj Varshney, University of Uppsala (Uppsala, Sweden), May 2018

Organization committees

- 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
- 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
- General Co-Chair: the 15th International Conference on Embedded Wireless Systems and Networks (EWSN 2018), 14-16 February 2018, Madrid, Spain

TPC Memberships

- 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, Georgia, USA

- 4th ACM Workshop on Visible Light Communication Systems (VLCS 2016), in conjunction with the 23rd Annual International Conference on Mobile Computing and Networking (ACM MobiCom 2017), 16-20 October 2017, Snowbird, Utah, USA
- 11th ACM International Workshop on Wireless Network Testbeds, Experimental Evaluation and Characterization (WiNTECH 2017), in conjunction with ACM MobiCom 2017, 16-20 October 2017, Snowbird, Utah, USA.
- 13th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea
- 37th IEEE International Conference on Computer Communications (IEEE INFOCOM 2018), 15-19 April 2018, Honolulu, HI, USA
- IEEE INFOCOM 2018 Workshop on Computer and Networking Experimental Research using Testbeds (CNERT 2018), in conjunction with IEEE INFOCOM 2018, 15-19 April 2018, Honolulu, HI, USA
- 15th Annual IEEE International Conference on Sensing, Communication and Networking (SECON 2018), 11-13 June 2018, Hong Kong, Hong Kong SAR

Sergey GORINSKY

Professional posts & activities

- Member of the COMSNETS Association, the steering committee of COMSNETS conferences
- Horizon 2020 Project Evaluator for the European Commission
- ITRA-Mobile Project Evaluator for the Information Technology Research Academy, India
- Horizon 2020 Proposal Evaluator for the European Commission
- Proposal Evaluator for the COST Association
- Proposal Evaluator for EDGE MSCA COFUND Postdoctoral Fellowships
- ISF Proposal Evaluator for the Israel Science Foundation
- NKFIH Proposal Evaluator for the National Research, Development, and Innovation Office of Hungary
- FWO Proposal Evaluator for the Research Foundation Flanders
- Nominator for the IEEE INFOCOM 2017 Achievement Award
- Nominator for the ACM SIGCOMM 2018 Lifetime Contribution Award

Journal editorial boards

- Reviewer: IEEE/ACM Transactions on Networking
- Reviewer: IEEE Journal on Selected Areas in Communications

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
- TPC Track Co-Chair: the 26th International Conference on Computer Communication and Networks (ICCCN 2017), 31 July - 3 August 2017, Vancouver, Canada
- Session Chair: the 16th IFIP Networking 2017 Conference (NETWORKING 2017), 12-15 June 2017, Stockholm, Sweden
- Session Chair: the 22nd IEEE Symposium on Computers and Communications (ISCC 2017), 3-6 July 2017, Heraklion, Crete, Greece
- Best Paper Award Committee Member: the 13th ACM International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea
- Area Chair: IEEE International Conference on Computer Communications (INFOCOM 2019), 29 April - 2 May 2019, Paris, France

TPC Memberships

- 18th International Conference on Passive and Active Measurement (PAM 2017), 30-31 March 2017, Sidney, Australia
- 5th International Conference on Cloud Engineering (IC2E 2017), 4-7 April 2017, Vancouver, Canada
- Distinguished Member: 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, Georgia, USA
- 13th ACM International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2017), 12-15 December 2017, Seoul, South Korea
- 37th IEEE International Conference on Computer Communications (INFOCOM 2018), 15-19 April 2018, Honolulu, HI, USA

Kirill KOGAN

Professional posts & activities

- Referee: Israel Science Foundation (ISF)

Organization committees

- Publicity Co-Chair: the 24th Annual International Conference on Mobile Computing and Networking (MOBICOM 2018), 29 October – 2 November 2018, New Delhi, India

TPC Memberships

- 9th International Conference on COMmunication Systems and NETworkS (COMSNETS 2017), 4-8 January 2017, Bangalore, India
- 18th IEEE International Conference on High Performance Switching and Routing (HPSR 2017), 18-21 June 2017, Campinas, Brazil
- 3rd IEEE Conference on Network Softwarization (NetSoft 2017), 3-7 July 2017, Bologna, Italy
- 26th International Conference on Computer Communications and Networks (ICCCN 2017), 31 July – 3 August 2017, Vancouver, Canada
- 25th IEEE Annual Symposium on High-Performance Interconnects (HOTI 2017), 28-30 August 2017, Santa Clara, California, USA
- 25th IEEE International Conference on Network Protocols (IEEE ICNP 2017), 10-13 October 2017, Toronto, Canada
- 9th IEEE International Conference and Workshops on Cloud Computing Technology and Science (CloudCom 2017) 11-14 December 2017, Hong Kong, China

Adrian LOCH

TPC Memberships

- 1st IEEE Workshop on Millimeter-Wave Networked Systems (mmSys), in conjunction with the 37th IEEE International Conference on Computer Communications (INFOCOM 2018), 15-19 April 2018, Honolulu, HI, USA
- 19th International Symposium on a World of Wireless Mobile and Multimedia Networks (WOWMOM 2018), 12-15 June 2018, Chania, Greece
- 27th International Conference on Computer Communications and Networks (ICCCN 2018), July 30 – August 2, 2018, Hangzhou, China

Vincenzo MANCUSO

Professional posts & activities

- PhD Pre-Defense & Defense Committees of Patricia Arroba, Universidad Politécnica de Madrid

- Director of master theses degrees of Noelia Pérez and Mohamed Moulay, Universidad Carlos III de Madrid
- Director of PhD Thesis degree of Christian Vitale, IMDEA Networks Institute & Universidad Carlos III de Madrid

Journal editorial boards

- Editorial Board member: IEEE Journal on Selected Areas in Communications (IEEE JSAC-SI-CACHING'18, JSAC Special issue on Caching for Communication Systems and Networks)
- Editorial Board member: IEEE Transactions on Green Communications and Networking

Organization committees

- Demos/Posters Chair: the 16th IFIP Networking 2017 Conference (NETWORKING 2017), 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
- Organizer of a special session on Large Scale Measurements / MONROE at the 24th European Wireless Conference (EW 2018), 2-4 May 2018, Catania, Italy

TPC Memberships

- 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, Georgia, USA
- 18th International Symposium on a World of Wireless Mobile and Multimedia Networks (IEEE WoWMoM 2017), 12-15 June 2017, Macau, China
- 16th IFIP Networking 2017 Conference (NETWORKING 2017), 12-15 June 2017, Stockholm, Sweden
- IEEE/IFIP Workshop on Mobile Network Measurements (MNM 2017), in conjunction with the 1st Network Traffic Measurement and Analysis Conference (TMA 2017), 20 June 2017, Dublin, Ireland
- 3rd IEEE Conference on Standards for Communications and Networking (IEEE CSCN 2017), 18-21 September 2017, Helsinki, Finland
- 3rd Workshop on Edge Computing, in conjunction with the 14th Annual IEEE Consumer Communications & Networking Conference (CCNC 2018) and with the International Consumer Electronics Show (CES 2018), 12-15 January 2018, Las Vegas, USA
- 37th IEEE International Conference on Computer Communications (IEEE INFOCOM 2018), 15-19 April 2018, Honolulu, Hawaii, USA
- 24th European Wireless Conference (EW 2018), 2-4 May 2018, Catania, Italy
- The 2018 International Workshop on Resource Allocation, Cooperation and Competition in Wireless Networks (RAWNET 2018), in conjunction with the 16th International

Symposium on Modeling and Optimization in Mobile, Adhoc, Wireless Networks (WiOpt 2018), 11 May 2018, Shanghai, China
- 17th IFIP Networking 2018 (NETWORKING 2018), 14-16 May 2018, Zurich, Switzerland
- 6th International Workshop on Cloud Technologies and Energy Efficiency in Mobile Communication Networks (CLEEN 2018), in conjunction with IEEE VTC2018-spring, 3 June 2018, Porto, Portugal
- 19th International Symposium on a World of Wireless Mobile and Multimedia Networks (IEEE WOWMOM 2018), 12-15 June 2018, Chania, Greece
- 2nd Workshop on Mobile Network Measurement (MNM 2018), in conjunction with the Network Traffic Measurement and Analysis Conference (TMA 2018), 26-29 June 2018, Vienna, Austria
- 30th International Teletraffic Congress – Teletraffic in a Smart World (ITC 2018), 3-7 September 2018, Vienna, Austria

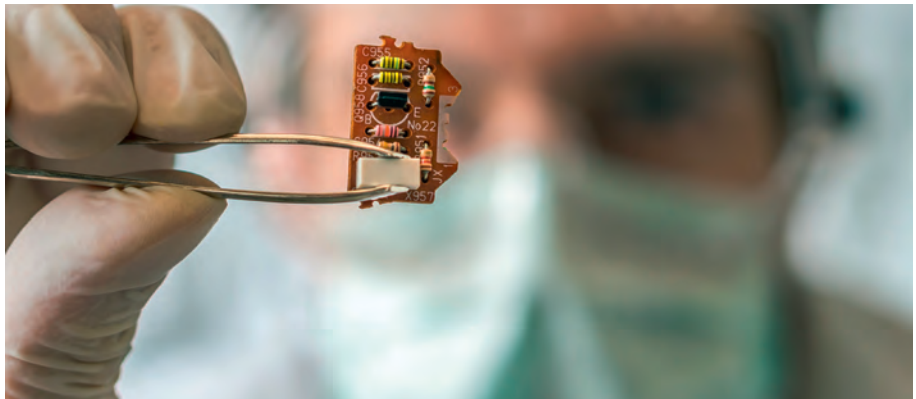
Narseo VALLINA-RODRIGUEZ

Organization committees

- Co-organizer: the 9th IMDEA Networks Annual International Workshop, 7-8 June 2017, Madrid, Spain
- Workshop Co-Chair: the 14th International Conference on emerging Networking EXperiments and Technologies (CoNEXT 2018), 4-7 December, 2018, Heraklion, Crete, Greece

TPC Memberships

- IEEE/IFIP TMA Conference Passive and Active Measurements (PAM 2017), 30-31 March 2017, Sydney, Australia
- 4th IEEE/ACM International Conference on Mobile Sofware Engineering and Systems - New Ideas Track (MOBILESoft 2017), in conjunction with the 39th International Conference on Software Engineering (ISCE 2017), 22-23 May 2017, Buenos Aires, Argentina
- Workshop on Big Data Analytics and Machine Learning for Data Communications Networks (BIG-DAMA 2017), in conjunction with ACM SIGCOMM 2017, 21-25 August 2017, Los Angeles, CA, USA



- Spring School on Networks (SSN 2017), in conjunction with (IEEE Chilecon 2017), 19-20 October 2017, Pucón, Chile
- ACM Workshop on Internet of Things (IoT) Security and Privacy (S&P), in conjunction with the 24th ACM Conference on Computer and Communications Security (SIGSAC CCS 2017), 30 October – 3 November 2017, Dallas, Texas, USA
- 13th ACM International Conference on emerging Networking EXperiments and Technologies (CoNEXT 2017), 12-15 December 2017, Seoul, Incheon, South Korea
- 1st Conference on Fairness, Accountability, and Transparency (FAT 2018), 23-24 February, 2018, New York City, NY, USA
- 19th International Conference on HotMobile Passive and Active Measurements Conference (PAM 2018), 26-27 March 2018, Berlin, Germany
- 10th International Workshop on Hot Topics in Pervasive Mobile and Online Social Networking (HotPOST 2018), in conjunction with the 37th IEEE International Conference on Computer Communications (IEEE INFOCOM 2018), 15-19 April 2018, Honolulu, Hawaii, USA
- 11th Network Traffic Measurement and Analysis Conference (TMA 2018), 26-29 June 2018, Vienna, Austria
- 18th Privacy Enhancing Technologies Symposium (PETS 2018), 24-27 July 2018, Barcelona, Spain
- ACM Workshop on Internet of Things (IoT) Security and Privacy (S&P), in conjunction with ACM SIGCOMM 2018, 20-24 August 2018, Budapest, Hungary
- 18th ACM Internet Measurements Conference (IMC 2018), 31 October 31 – 2 November 2018, Boston, MA, USA
- 14th ACM International Conference on emerging Networking EXperiments and Technologies (CoNEXT 2018), 4-7 December 2018, Heraklion, Crete, Greece

Christian VITALE

TPC Memberships

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

Joerg WIDMER

Professional posts & activities

- Evaluator: «MAKI – Multi Mechanism Adaption for the Future Internet» project
- External Reviewer: DFG (Deutsche Forschungsgemeinschaft) Collaborative Research Centre 1053 on Multi Mechanism Adaption for the Future Internet
- External Reviewer: «ERC Consolidator» grant proposals
- Distinguished member: IEEE International Conference on Computer Communications (INFOCOM 2018)

Journal editorial boards

- Associate Editor: IEEE Transactions on Mobile Computing
- Editor: Computer Networks Journal (Elsevier)

Organization committees

- Co-Chair: 4th International Workshop on 5G/5G+ Communications in Higher Frequency Bands (5GCHFB), in conjunction with the IEEE Global Communications Conference Exhibition & Industry Forum (GLOBECOM 2017), 4 December 2017, Singapore

- Co-Chair: Wireless Communications Symposium (ICNC WC Symposium 2018), 5-8 March 2018, Maui, Hawaii, USA

TPC Memberships

- 13th Annual Conference on Wireless On-demand Network Systems and Services (WONS 2016), 21-24 February 2017, Jackson Hole, Wyoming, USA
- IEEE Wireless Communications and Networking Conference (WCNC 2017), 19-22 March 2017, San Francisco, CA, USA
- 36th IEEE International Conference on Computer Communications (INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA
- 1st IEEE International Workshop on Small Cell Networking for 5G (SCN 2017), 12 June 2017, Macau, China
- 18th IEEE International Symposium on a World of Wireless Mobile and Multimedia Networks (IEEE WoWMoM 2017), 12-15 June 2017, Macao, China
- 16th IFIP Networking 2017, 12-15 June 2017, Stockholm, Sweden
- 19th International Symposium on a World of Wireless Mobile and Multimedia Networks (IEEE WOWMOM 2018), 12-15 June 2018, Chania, Greece
- Workshop on ns-3 (WNS3), 13-14 June 2017, Porto, Portugal
- 42nd IEEE Conference on Local Computer Networks (LCN 2016), 9-12 October 2017, Singapore
- 11th ACM International Workshop on Wireless Network Testbeds, Experimental Evaluation and Characterization (WiNTECH 2017), in conjunction with the 23rd Annual International Conference on Mobile Computing and Networking (MobiCom 2017), 16-20 October 2017, Snowbird, Utah, USA

- 1st ACM Workshop on Millimeter Wave Networks and Sensing Systems (mmNets) 2017, in conjunction with the 23rd Annual International Conference on Mobile Computing and Networking (ACM MobiCom 2017), 16 October 2017, Snowbird, Utah, USA
- 4th International Workshop on 5G/5G+ Communications in Higher Frequency Bands (5GCHFB), in conjunction with the IEEE Global Communications Conference Exhibition & Industry Forum (GLOBECOM 2017), 4 December 2017, Singapore
- 6th International Workshop on Emerging Technologies for 5G and Beyond Wireless and Mobile Networks (ET5GB), in conjunction with the IEEE Global Communications Conference Exhibition & Industry Forum (GLOBECOM 2017), 8 December 2017, Singapore
- 14th Wireless On-Demand Network Systems and Services (WONS 2018), 6-8 February 2018, Isola 2000, France
- 17th IFIP Networking 2018 (NETWORKING 2018), 14-16 May 2018, Zurich, Switzerland
- 38th IEEE International Conference on Distributed Computing Systems (ICDCS 2018), 2-5 July 2018, Vienna, Austria
- 24th Annual International Conference on Mobile Computing and Networking (MobiCom 2018), 29 October – 2 November 2018, New Delhi, India

5.4. Invited Papers, Keynotes, Invited Talks, Tutorials, Lectures, 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 25 of these presentations during 2017.

1. **Kirill Kogan (December 2017)**
Adopting Software-Defined Networking: Challenges and Recent Developments **(Invited talk)**
In: Machine Learning and Analysis of Algorithms at St. Petersburg (Huawei), 18-20 Dec 2017, POMI Russian Academy of Science at St. Petersburg, Russia.

2. **Joerg Widmer (November 2017)**
Millimeter Wave Networking Challenges **(Invited talk)**
In: Impromptu Workshop on Next-Generation Wireless, 10 November 2017, Northeastern University, Boston, Massachusetts, USA.

3. **Joerg Widmer (November 2017)**
Millimeter Wave Networking Challenges **(Invited talk)**
In: Massachusetts Institute of Technology, 9 November 2017, Boston, Massachusetts, USA.

4. **Ioannis Stavrakakis (November 2017)**
Accessing Resources in (city-wide) Networked Environments: Issues and alternatives **(Invited talk)**
In: XVII Science Week Madrid 2017, 6 November 2017, Madrid, Spain.

5. **Joerg Widmer (October 2017)**
Novel Radio Solutions **(Other)**
In: Panel: Visions for Future Communications Summit, 23 October 2017, ISCTE - University Institute of Lisbon, Lisbon, Portugal.

6. **Antonio Fernández Anta (October 2017)**
Opportunistic Information Dissemination in Mobile Ad-hoc Networks **(Invited talk)**
In: The 2nd Workshop on Computing in Dynamic Networks (formerly Workshop on Dynamic Graphs in Distributed Computing), in conjunction with The 31st International Symposium on DIStributed Computing (DISC 2017), 20 October 2017, Vienna, Austria.

7. **Narseo Vallina-Rodriguez (September 2017)**
Dissecting the Mobile Ecosystem with the Lumen Privacy Monitor **(Invited talk)**
In: The 4th Mobile Networking, Analytics and Edge Computing Workshop 2017, 28 September 2017, Technische Universitat, Munich, Germany.

8. **Albert Banchs (September 2017)**
Network slicing: Enabling Customization in 5G Mobile Networks Abstract **(Keynote)**
In: XIII Jornadas de Ingeniería Telemática (JITEL 2017), 27-29 Septiembre 2017, Valencia, Spain.

9. **Paolo Casari (September 2017)**
Underwater communications and networks: evolution and recent results **(Keynote)**
In: The 2nd Global Conference on Wireless and Optical Communications (GC-WOC 2017), 18-20 September 2017, Málaga, Spain.

10. **Joerg Widmer (September 2017)**
Millimeter-wave networking tutorial **(Tutorial)**
In: The 17th IEEE International Conference on Ubiquitous Wireless Broadband (ICUWB 2017), 12-15 September 2017, Salamanca, Spain.

11. **Arturo Azcorra (July 2017)**
Challenges in EU-China 5G Trials **(Invited talk)**
In: EU-China workshop on 5G developments and collaboration opportunities, 12 July 2017, European Commission, Brussels, Belgium.

12. **Ioannis Stavrakakis (June 2017)**
Human-driven Decision-making in Accessing Distributed Resources **(Invited talk)**
In: Distinguished Lecture Series, The Collaborative Research Centre (CRC) 1053 "MAKI – Multi-Mechanisms Adaptation for the Future Internet", Technische Universität Darmstadt, 29 June 2017, Darmstadt, Germany.

13. **Joerg Widmer (June 2017)**
Millimeter Wave Networking Challenges **(Invited talk)**
In: Net Futures 2017, EU-US session on Next Generation Internet, 28 June 2017, Brussels, Belgium.

14. **Narseo Vallina-Rodriguez (June 2017)**
Crowdsourcing Network and Traffic Measurements to Illuminate the Mobile Ecosystem **(Keynote)**
In: Network Traffic Measurement and Analysis Conference (TMA 2017), 21-23 June 2017, Maynooth, Dublin, Ireland.

15. **Antonio Fernández Anta (June 2017)**
Adaptive Scheduling over a Wireless Channel under Constrained Jamming **(Invited talk)**
In: Seminar at Notheastern University, 21 June 21 2017, College of Computer and Information Science, Northeastern University, Boston, USA.

16. **Arturo Azcorra (May 2017)**
5TONIC: A Co-creation Laboratory on 5G **(Invited talk)**
In: INTEL's Network Builders Summit – IIR's 5th Annual Network Virtualization Forum Europe 2017 (Network Virtualization Europe 2017), 29-31 May 2017, Madrid, Spain.

17. **Arturo Azcorra (May 2017)**
Boosting 5G Research through Industry-Academic Partnerships **(Invited talk)**
In: MIT Media Lab, 8 May 2017, Massachusetts Institute of Technology, Cambridge, MA, USA.

18. **Joerg Widmer (May 2017)**
Efficient Networking in Millimeter Wave Bands **(Invited talk)**
In: RWTH Aachen, 5 May 2017, Aachen, Germany.

19. **Arturo Azcorra, Nada Golmie, Haris Gaćanin, Jeff Foerster, Paul Challoner (May 2017)**
Panel: Innovation through Joint Industry-Academic Partnerships **(Other)**
In: The 36th IEEE International Conference on Computer Communications (IEEE INFOCOM 2017), 1-4 May 2017, Atlanta, GA, USA.

20. **Arturo Azcorra (February 2017)**
Panel: Crosshaul (Xhaul) – The fusion of Fronthaul and Backhaul in 5G! **(Other)**
In: Mobile World Congress 2017 (MWC 2017), 27 February - 2 March 2017, Barcelona, Spain.

21. **Salah El Ayoubi, Jean Sébastien Bedo, Miltiades C. Filippou, Anastasius Gavras, Domenico Giustiniano, Paola Iovanna, Antonio Manzalini, Olav Queseth, Theodoros Rokkas, Mike Surridge, Terje Tjelta (February 2017)**
5G innovations for new business opportunities **(Other)**
In: Mobile World Congress 2017 (MWC 2017), 27 February - 2 March 2017, Barcelona, Spain.

22. **Antonio Fernández Anta (February 2017)**
Adaptive Scheduling over a Wireless Channel under Jamming **(Invited talk)**
In: Seindenberg School Seminars, 21 February 2017, Pace University, New York, USA.

23. **Joerg Widmer (January 2017)**
Scaling Future Wireless Networks **(Lecture)**
In: Alexander von Humboldt lecture, 19 January 2017, Darmstadt, Germany.

24. **Narseo Vallina-Rodriguez (January 2017)**
Illuminating the Third Party Mobile Ecosystem with the Lumen Privacy Monitor **(Invited talk)**
In: FTC PrivacyCon 2017, 12 January 2017, Washington, D.C., USA.

25. **Arturo Azcorra (January 2017)**
Enabling 5G through Enhanced and Converged RAN Virtualization at the Edge **(Invited talk)**
In: 5G Mobile Edge and Fog Computing, 11 January 2017, National Chiao Tung University, Hsinchu, Taiwan.

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

7 November 2017 | Madrid, Spain

Speaker: Prof. Dr. Arturo Azcorra, Director, IMDEA Networks Institute; Professor, Universidad Carlos III de Madrid, Spain

Organization: Universidad Carlos III de Madrid; XVII Semana de la Ciencia – 2017 – mi+d

This educational show, entitled **"5G on stage: this technology will change your life (and you don't know it yet)",** combined dance, music, theater and audiovisual elements to explain how 5G technology will influence our lives and everydayness in the years to come. Hyperconnectivity, the Internet of Things, drones ... how does technology affect the way we live and relate to the environment and those around us? We were presented with an example: that of a couple in 2017, when falling in love; and in 2027, about to have a child, when 5G technology is fully implemented.

Accessing Resources in (city-wide) Networked Environments: Issues and alternatives

6 November 2017 | Madrid, Spain

semana de la ciencia mi+d

Speakers: Prof. Dr. Ioannis Stavrakakis, Full Professor, Department of Informatics and Telecommunications, National and Kapodistrian University of Athens (Greece); Visiting Professor IMDEA Networks; Chair of Excellence Comunidad de Madrid (Spain)

Organization: IMDEA Networks Institute; XVII Semana de la Ciencia – 2017 – mi+d

Access to a common (communication) resource has been one of the fundamental problems in the various networking technologies that have emerged over the last half a century. Among those, the problem of accessing a common resource by distributed, non-communicating users (i.e., through an uncoordinated approach) has been a central one and has received wide attention since the appearance of the ALOHA approach. The lack of coordination brings some advantages or keeps complexity low, but it also incurs some cost in terms of resource capacity waste and reduced throughput. Recent advances in Information and Communication Technologies (ICT) have enabled the generation and dissemination of vast amounts of information that enhance awareness about the environment and its resources. While such resource awareness brings benefits, it also intensifies competition and results in potentially significant congestion penalties for the distributed users attempting to access such resources in uncoordinated fashion.

After a brief review of the classical problem of accessing a common channel by distributed non-communicating users, the problem of accessing city-wide, distributed resources by non-communicating users was presented through the case of the search for a (public) parking spot. The role of some information that can be available to the competing users was discussed and optimal or “stable” solutions to this competition were presented. In

the sequel it was discussed how ICT technologies can provide for some coordination in accessing such resources and also discuss significant side issues that emerge. Finally, a distributed, resource auctioning approach was briefly presented as a means of bringing some coordination in the resource accessing problem and shifting the competition to the price arena.

IMDEA-CSI: Crime scene investigation at The European Researchers' Night in Madrid 2017

29 September 2017 | Madrid, Spain

Speakers: Researchers from the IMDEA Institutes; Dr. Narseo Vallina-Rodriguez represented IMDEA Networks

Organization: IMDEA Institutes

Researchers from the IMDEA Water, Food, Energy, Materials, Nanoscience, Networks and Software Institutes gathered at the auditorium of the Residencia de Estudiantes de Madrid to show us the important role that scientific development plays in police work. The researchers attempted to unravel a crime scene with the tools offered by their different areas of expertise. For example, it was shown that analyzing DNA samples may serve to identify a killer but also to find out if we have a genetic propensity to develop certain diseases. We also learnt that studying materials and simulating their behavior allows us to manufacture safer and lighter things, to produce energy more efficiently and also to check whether the vase or a tiny piece of material (which we are unable to identify with

the naked eye) found beside a victim, may or may not have been the homicidal weapon or a part of it. Or to take another example, we saw that it is essential to have experts analyze data down to the last bit of memory of a computer or a mobile phone of a victim or his/her murderer, as this information may render essential clues to solve a crime.

SoftAir: A Software-Defined Networking Architecture for 5G Wireless Systems

19 July 2017 | Madrid, Spain

Speakers: Prof. Dr. Ian F. Akyildiz, Broadband Wireless Networking Lab, School of Electrical and Computer Engineering Georgia Institute of Technology, Atlanta, GA, USA

Organization: 5TONIC

SoftAir is a new wireless software-defined architecture with network function virtualization (NFV) solutions for 5G wireless systems. The concept of SDN has been proposed to efficiently create centralized network abstraction with the provisioning of programmability over the entire network. Moreover, the complementary concept of NFV has been further proposed to effectively separate the abstraction of functionalities from the hardware, such as decoupling the data forwarding plane from the control plane. These two concepts bring the SoftAir architecture that provides cellular networks with the needed flexibility to evolve and adapt according to the ever-changing network context. Three network management tools are built upon SoftAir. First, an in-band control traffic balancing for a centralized controller is proposed to find the optimal control traffic forwarding paths for each switch/BS in such a way the average control traffic delay in the entire network is minimized. Second, a traffic-driven optimal network planning is developed for multi-controller placement that jointly optimizes controller placement and control traffic forwarding paths so that the required controllers and the control traffic delay are minimized simultaneously. Third, two delay-based hypervisors (schdulers) are proposed to achieve high system performance with hybrid light-tailed and heavy-tailed traffic flows. Also dynamic BS formation are presented to solve NLOS problem in 5G millimeter-wave systems. Moreover, a software-defined massive MIMO scheme is developed via 5G spectral-efficient controller.

9th IMDEA Networks Annual International Workshop: Enabling future internet applications

7-8 June 2017 | Madrid, Spain

Speakers: Members of IMDEA Networks' Scientific Council, invited speakers and IMDEA Networks' researchers

Organization: IMDEA Networks Institute

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 2017 event was to foster discussion about **future internet applications with particular focus on networking, privacy and security challenges.**

It is expected that by 2020 there will be over 50 billion devices connected to the Internet with powerful sensing and computing capabilities attached to them. This will enable the visions of the Internet of Things (IoT) and smart environments in which people, things, devices and actuators will constantly interact with each other, blurring the differences between the cyber and the physical worlds. However, there is no clear picture yet about what the future Internet will look like. Current stakeholders (including ISPs, CDNs and cloud providers) as well as new players will have to adapt to new applications and networking paradigms. This will require them to anticipate and face a wide range of unknown challenges, stemming from the need to efficiently interconnect heterogeneous devices while guaranteeing service, security and users' privacy.

The 9th IMDEA workshop brought together industry players, practitioners and academic researchers to share experiences, discuss technological trends, present recent advances and confront the societal, economic, technological and security challenges to be addressed in order to make the future Internet a reality.

1st ETSI NFV PLUGTESTS

23 January 2017 – 3 February | Madrid, Spain

Participant companies: A10 Networks, ADVA Optical Networking, Anritsu A/S, Canonical USA Inc., Cisco Systems, EANTC, Ericsson, F5 Networks, Fortinet, Fraunhofer FOKUS, Hewlett-Packard Enterprise, Huawei, Intel, Italtel, Ixia, Keynetic Technologies, Lenovo, Mahindra Comviva, Netrounds, Openet, Palo Alto Networks, Radware, Red Hat, RIFT.io, Sandvine, Sonus Networks, Spirent, Telefónica, Universidad del País Vasco (UPV/EHU), VMware y Wind River.

Organization: ETSI Centre for Testing and Interoperability; 5TONIC; IMDEA Networks Institute; Telefónica

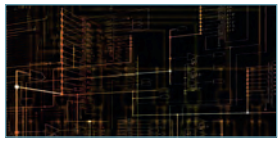
The 5TONIC Laboratory, which is headquartered at IMDEA Networks Institute, in Madrid (Spain), hosted two weeks of intense and rewarding plugtest sessions on the interoperability of the **Network Functions Virtualization (NFV) standard.** The event was organized by ETSI, the European Telecommunications Standards Institute, and counted with the technical backing of Telefónica.

The **1st ETSI NFV Interoperability event** was a challenging enterprise in terms of the maturity of the technology used and of the complexity of the pre-testing phase (with 29 remote labs connected) and of the two week intense testing phase. **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.

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 **38** total number of events in which the Institute participated during 2017, **19** were conducted by invited speakers. We list those here:

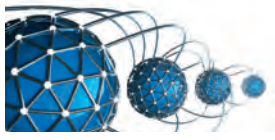
Dissecting the Security and Privacy of Wireless Protocols in Aviation
Martin Strohmeier, Post-doctoral Researcher in Systems Security, Department of Computer Science, University of Oxford, UK
12 December 2017



Network optimization in the era of virtualization
Georgios Paschos, Principal Researcher, Huawei Technologies, Paris, France
1 December 2017

Not All Apps Are Created Equal: Analysis of Spatiotemporal Heterogeneity in Nationwide Mobile Service Usage
Cristina Márquez, PhD Student, NETCOM Research Group, University Carlos III of Madrid, Spain
29 November 2017

Joint design of wireless network architectures and economic models
Beatriz Lorenzo, Postdoc Researcher, Atlantic Research Center for Information and Communication Technologies (AtlantTIC), University of Vigo, Spain
17 November 2017



Two Approaches for the Performance Evaluation of Queueing Systems: Pricing and Scaling
Josu Doncel Vicente, Assistant Professor, Department of Applied Mathematics and Statistics, Faculty of Science and Technology, University of the Basque Country (UPV/EHU), Spain
27 September 2017

OTFS: A New Generation of Modulation Addressing the Challenges of 5G
Christian Ibars Casas, Principal Engineer, Cohere Technologies, Santa Clara, CA, USA
24 July 2017

Towards a Future Multi-Service Mobile Network Architecture

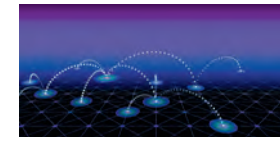
Mahesh Marina, Reader, School of Informatics, University of Edinburgh, Scotland

27 June 2017

Recent advances on hybrid Open-Flow/All-Path switches and Path Discovery protocols (AOSS, TCP-Path, Multiple Disjoint Paths)

Joaquin Alvarez-Horcajo, Diego Lopez-Pajares, and Isaias Martinez-Yelmo with an introduction by Guillermo Ibañez, researchers from the GIST Netserv Group of Telematic Engineering at University of Alcalá, Madrid (Spain)

21 June 2017



Internet Reliability, from Addresses to Outages

John Heidemann, Senior Project Leader, University of Southern California/Information Sciences Institute (USC/ISI); Research Professor in Computer Science, USC, USA

14 June 2017

Time-Critical Social Mobilization: from the DARPA Red Balloon Challenge to the Nightmare Machine

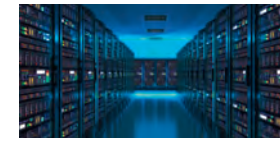
Manuel Cebrian, Principal Research Scientist, Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia

31 May 2017

Big Crisis Data - an exciting frontier for applied computing

Carlos Castillo, Director of Research for Data Science, Eurecat - Technology Centre of Catalonia, Spain

30 May 2017



Network Cloudification: SDN-NFV and 5G-MEC with Edge and Fog Computing

Ying-Dar Lin, IEEE Fellow, IEEE Distinguished Lecturer, ONF Research Associate; Editor-in-Chief, IEEE Communications Surveys and Tutorials; Distinguished Professor of National Chiao Tung University, Hsinchu, Taiwan

26 May 2017

Robustness and Privacy in Mobile and Wireless Systems

Guevara Noubir, Professor, College of Computer and Information Science, Northeastern University, USA

11 May 2017

Three open problems in Network Caching: cost reduction, video delivery and encrypted content

Andrea Araldo, Postdoctoral Researcher, Massachusetts Institute of Technology (MIT), USA

3 May 2017

Privacy in personal trajectories: problems and solutions

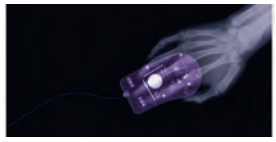
Marco Gramaglia, Post-doc Researcher, University Carlos III of Madrid, Spain

19 April 2017

OpenBox: A Software-Defined Framework for Developing, Deploying, and Managing Network Functions

David Hay, Associate Professor, Rachel and Selim Benin School of Computer Science and Engineering, Hebrew University, Jerusalem, Israel

30 March 2017



The good, the bad and the bait: Detecting and characterizing clickbait videos on YouTube

Savvas Zannettou, PhD student, Cyprus University of Technology, Cyprus / Research Intern, Telefonica I+D, Spain

8 March 2017

Telefonica shares with 5TONIC its vision on industry trends and sector outlook

Carlos Gavilanes, Strategy Director, Telefonica Corp.

6 February 2017

Innovating in a start-up and in a multinational corporation in Spain

Pablo Molinero, Technical Manager in the Global Customer Unit for the Telefonica Group, Ericsson

18 January 2017

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 TIGRE5-CM project mentioned above is being performed by the two institutions, and has produced substantial results in terms of publications and other outcomes during 2017.

impact and technology transfer

annual report 2017

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 2017. 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.

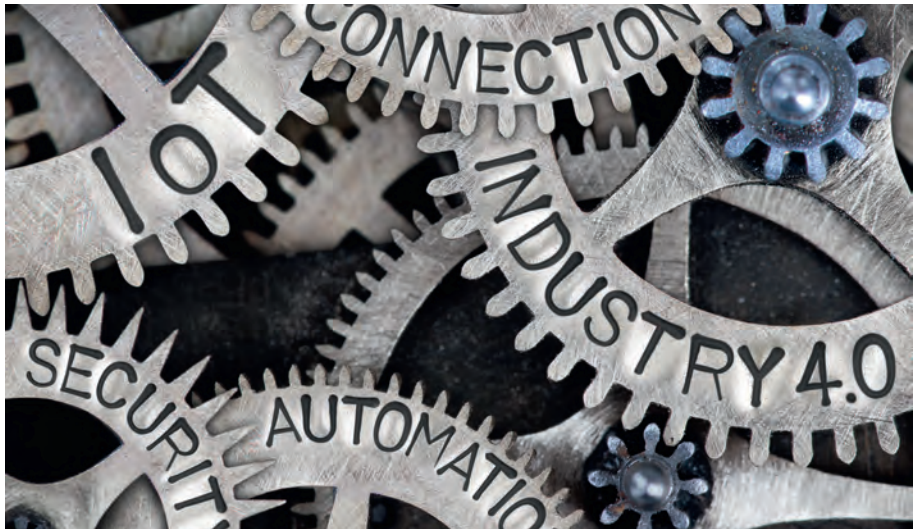
Spanish Patent Application (March 2018)

Title: *Método para determinar información de tipo geométrico en dispositivos de redes en la banda de ondas milimétricas [METHOD FOR DETERMINING GEOMETRIC INFORMATION OF MMWAVE NETWORK DEVICES]*

Inventors: Guillermo BIELSA LÓPEZ, Joan PALACIOS BELTRAN, Paolo CASARI, Joerg WIDMER, Adrian LOCH NAVARRO

Rights: IMDEA Networks Institute

Overview: A method for determining geometric information of mmWave network devices comprising collecting measures, by at least one of the devices, of signal strength and SNR of a transmission received from another device of the mmWave network; estimating angle information of the received signals to generate a set of informed particles comprising initial values of state of each informed particle and input in a modified particle filter; the modified particle filter evolving the sets of informed particles and past particles to obtain



a set of evolved particles which, in turn, is evolved to obtain a set of posterior particles delivered by the modified particle filter. Finally, the modified particle filter delivers as output final values of geometric information of the at least one device extracted from the delivered set of posterior particles.

Application number (OEPM): P201830297 (27.03.2018)

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:

6.2.1. Ongoing projects

LF assists HF in beam tracking and mobility

Funded by: Huawei Technologies (China)
Duration: July 2017 to August 2018
Project Partners: Huawei Technologies (China), IMDEA Networks Institute

In this collaboration between Huawei Technologies and IMDEA Networks, the project partners explore the potential of using low frequency bands to infer the channel characteristics of high frequency millimeter-wave bands. The inferred channel characteristics can support the network in terms of beam tracking, angle of arrival estimation, and location information. This results in improved performance in the millimeter-wave band since these techniques reduce the control overhead required to operate the network. The project also includes an experimental evaluation to verify that the developed mechanisms and algorithms work not only in theory but also in practical real-world wireless networking environments.

SPECTRUMCOP PROGRAM: SPECTRUMCOP II

Technologies for Collaborative Detection of Spectrum Anomalies

Project website: https://www.electrosense.org
Funded by: Contract with the industry
Duration: March 2017 to September 2017
Project partners: Science and Technology, IMDEA Networks Institute

The SPECTRUMCOP II 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 II will study the necessary theoretical and practical concepts, and propose solutions that will be analysed in testbeds managed by IMDEA Networks as well as in the overall Electrosense network.

This project is part of the SPECTRUMCOP PROGRAM which was launched in March 2016 and is still ongoing.

Towards flexible in-network processing of data streams

Funded by: Cisco University Research Program Fund, an advised fund of Silicon Valley Community Foundation
Duration: January 2018 to December 2018

Modern **packet processing engines** (PPEs) are faced with highly heterogeneous workloads driven by high volumes of end users and application types. A primary design challenge in this context consists in selecting and developing PPEs that scale application performance in a robust and cost-effective way providing the desired **flexibility** level and **high performance.** Interrelation among these objectives is non-trivial and definitely involves a certain conflict. In particular, flexibility is a driving objective to introduce new operational behaviors; from the other hand, performance and simplicity are constraining factors that ensure specific requirements. In this project we show that adding flexibility to the scheduling module and enhancing classification capabilities will allow not only consideration of user-defined objectives but also implementations of in-network processing of data streams.

SPECTRUMCOP PROGRAM: MONTEBIANCO

Technologies for Collaborative Detection of Spectrum Anomalies

Project website: https://www.electrosense.org
Funded by: Contract with the industry
Duration: March 2018 to September 2018
Project partners: Science and Technology, IMDEA Networks Institute

The MonteBianco 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. MonteBianco will study the necessary theoretical and practical concepts, and propose solutions that will be analysed in testbeds managed by IMDEA Networks as well as in the overall Electrosense network.

This project is part of the SPECTRUMCOP PROGRAM which was launched in March 2016 and is still ongoing.

6.2.3. Other forms of collaboration with the private sector

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 from Telefónica I+D and 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, Artesyn Embedded Technologies, InterDigital, Altran and RedHat** amongst its members. In 2017 **ASTI Mobile Robotics, IFEMA and Rohde & Schwarz** became 5TONIC collaborators.

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. During 2017 5TONIC scientists actively contributed to the development of 5G in 9 European research projects.

5TONIC Members

Telefónica · institute imdea networks · ERICSSON · intel · COMMSCOPE · uc3m · cohere technologies · ARTESYN EMBEDDED TECHNOLOGIES · INTERDIGITAL · ALTRAN · redhat

5TONIC Collaborators

ASTI MOBILE ROBOTICS Transforming the future together · IFEMA Feria de Madrid · ROHDE&SCHWARZ

6.2.4 Industry partners

Our technology transfer activities have led to a significantly increased portfolio of companies we collaborate with. During 2017 they were the following:

British Telecommunications Public Limited Company (BT)

Celerway Communications AS

certSIGN S.A.

Cisco Systems

De Productizers B.V.

EvoLogics GmbH

Ericsson AB

Exus Software Ltd.

Huawei Technologies (China) Huawei Technologies Dusseldorf GmbH (HWDU)

INTEL Mobile Communications GmbH Intel Research and Development Ireland Limited

Internet Advertising Bureau (IAB) Europe

Keysight Technologies Denmark Aps

Linkno vate Science SL

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

Sistemas Avanzados de Tecnología SA (SATEC)

Studio Professionale Associato a Baker & McKenzie

Technicolor R&D

Tecknologian Tutkimuskes-kus VT

Tecnologías, Servicios Telemáticos y Sistemas S.A.

Telcaria Ideas S.L.

Telecom Italia S.p.a.

Telefónica I+D

Telenor ASA

Tieto Sweden Support Services AB

Upcom BvBa

Verizon Nederland B.V.

Virtual I Tech Inc (South Korea)

Wedia Limited

WINGS ICT Solutions

Wireless and More s.r.l

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.

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 2017, 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

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Short Bio

Prof. Dr. Arturo Azcorra holds a double appointment as Full Professor in the Telematics Engineering Department at the University Carlos III of Madrid (UC3M) (Madrid, Spain) and Director of IMDEA Networks, where he conducts his research activities. Currently he is also Chairman of the Expert Advisory Group of the NetWorld2020 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 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), an agency of the Spanish Ministry of Economy and Competitiveness (MINECO), previously known as the Spanish Ministry of Science and Innovation (Ministerio de Ciencia e Innovación – MICINN). He previously held the position of Director General for Technology Transfer and Corporate Development also at the MICINN.

He graduated from Loy Norrix High School (Michigan, USA) in 1980. In 1986, he received his M.Sc. degree in Telecommunications Engineering from the Universidad Politécnica de Madrid (Polytechnic University of Madrid) (Madrid, Spain), with the "Sobresaliente" (Outstanding) grade, and was subsequently awarded the Price Waterhouse Prize for Best Student. He then obtained his Ph.D. from the same university in 1989. His Ph.D. received the National Award for Best Thesis (Premio Nacional a la Mejor Tesis Doctoral), jointly granted by the Asociación Profesional de Ingenieros de Telecomunicación (Professional Association of Telecommunication Engineers) and the then-named Asociación Nacional de Industrias Electrónicas, ANIEL (The National Association of Electronic Industries) (today ANIEL is known as AMETIC, Asociación de Empresas de Electrónica, Tecnologías de la Información,Telecomunicaciones y Contenidos Digitales). 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 Universidad Politécnica de 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, Berkeley (Berkeley, USA) as a Visiting Professor in 1999, and then, in 2002, at the Massachusetts Institute of Technology (MIT) (Massachusetts, USA).

Arturo Azcorra is an IEEE Senior Member and an ACM SIGCOMM Member. He has participated in and directed 57 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. Most recently, he coordinated the European 5G-CrossHaul project and is now coordinating the 5G-Transformer project, both part of the Horizon 2020 framework 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. He was the General Co-Chair of the ACM CoNEXT 2008 conference, celebrated in Madrid, Spain, co-organized by IMDEA Networks and University Carlos III of Madrid. He has previously worked as a Program Committee Member in many international conferences, including several editions of IEEE PROMS, IDMS,QofIS, CoNEXT and IEEE INFOCOM. He was the General Co-Chair for CoNEXT'05, Steering Committee Member for CoNEXT'06 and CoNEXT'07, and Technical Program Committee Co-Chair for INFOCOM'06. 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

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Short Bio

Prof. Dr. Albert Banchs holds a double appointment as Full Professor in the Telematics Engineering Department at the University Carlos III of Madrid (UC3M) (Madrid, Spain) and Deputy Director of IMDEA Networks, where he conducts his research activities. He is also a Member of the 5TONIC lab.

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 WoWMoM, IEEE PIMRC, IEEE WCNC, IEEE VTC, ITC and ACM WiNTECH). 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), CROWD (2013-2015) and 5GNORMA (2015-2017). Currently, his main effort is on the 5GMoNArch project (2017-2019). 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. Some of the algorithms that he has devised have been incorporated to commercial products.

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 & 2017 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, and his papers have received several awards (the paper at IEEE INFOCOM 2009 received the SATIN award of the CONTENT Network of Excellence, the paper at the JITEL 2007 conference received the AT4Wireless award and the paper at ICNP 2014 received the Best Paper Runner-up Award). The MEDIEVAL project was shortlisted as one of the three finalists for the Future Internet award 2012. Prof. Banchs is a Senior Member of IEEE and was an IEEE Distinguished Lecturer in 2016-2017. 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

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Short Bio

Joerg Widmer is Research Professor as well as Research Director of IMDEA Networks in Madrid, Spain. His research focuses 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, USA, University College London, UK, and TU Darmstadt, Germany. Joerg Widmer authored more than 150 conference and journal papers and three IETF RFCs, and holds 13 patents. He serves or served on the editorial board of IEEE Transactions on Mobile Computing, IEEE Transactions on Communications, Elsevier Computer Networks and the 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, Mercator Fellowship of the German Research Foundation, a Spanish Ramon y Cajal grant, as well as seven best paper awards. He is senior member of IEEE and ACM.

Dr. Marco AJMONE MARSAN

Research Professor

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Short Bio

Marco Ajmone Marsan holds a double appointment as Research Professor at IMDEA Networks (Spain) and Full Professor at the Department of Electronics (Dipartimento di Elettronica) of the Politecnico di Torino (Polytechnic University of Turin) (Italy). He is the founder of the Telecommunication Networks Group, one of the top research groups in networking in Europe, based at the Politecnico di Torino.

From 2003 to 2009 he was Director of the IEIIT-CNR (Institute for Electronics, Information and Telecommunication Engineering of the National Research Council of Italy). From 2005 to 2009 he was Vice-Rector for Research, Innovation and Technology Transfer at Politecnico di Torino.

He earned his graduate degree in Electrical Engineering (Laurea (110/110)), from the Politecnico di Torino in 1974. This was the highest degree in the field obtainable in Italy at the time. He went on to complete his M.Sc. Electrical Engineering at the University of California at Los Angeles (USA) in 1978 and, in 2002, he was awarded an"Honoris Causa" Ph.D. in Telecommunication Networks from the Budapest University of Technology and Economics.

Marco Ajmone Marsan is involved in several national and international scientific groups: He was Chair of the Italian Group of Telecommunication Professors (GTTI); and the Italian Delegate in the ICT Committee of the EC's 7th Framework Programme. He is now the Italian Delegate in the ERC Commitee of the 7th Framework Programme. He is also a Fellow of the IEEE.

He has also been principle investigator for a large number of research contracts with industries, and coordinator of several national and international research projects.

His outstanding contributions to his field were recognized in 2006, when the President of Italy, Carlo Azeglio Ciampi, awarded him the "Commendatore" of the "Ordine al Merito della Repubblica Italiana" (Commander of the Republic of Italy's Order of Merit). In 2003, he was also listed by Thomson-ISI amongst the most highly-cited researchers in Computer Science.

Dr. Antonio FERNÁNDEZ ANTA

Research Professor

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Short Bio

Dr. Antonio Fernández Anta is a Research Professor at IMDEA Networks. Previously he was a Full Professor at the Universidad Rey Juan Carlos (URJC) and was on the Faculty of the Universidad Politécnica de Madrid (UPM), where he received an award for his research productivity. He was a postdoc at MIT from 1995 to 1997. He has more than 25 years of research experience, and more than 200 scientific publications. He was the Chair of the Steering Committee of DISC and has served in the TPC of numerous conferences and workshops. He received his M.Sc. and Ph.D. from the University of SW Louisiana in 1992 and 1994, respectively. He completed his undergraduate studies at the UPM, having received awards at the university and national level for his academic performance. He is a Senior Member of ACM and IEEE.

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

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Short Bio

Dr. Domenico Giustiniano is Research Associate Professor (tenured) at IMDEA Networks Institute, Madrid, Spain, and leader of the Pervasive Wireless Systems group. Before joining IMDEA, he was a Senior Researcher and Lecturer at ETH Zurich. He also worked for a total of four years as Post-Doctoral Researcher in industrial research labs (Disney Research Zurich and Telefonica Research Barcelona). He holds a PhD in Telecommunication Engineering from the University of Rome Tor Vergata, Italy (2008). The original contributions Dr. Giustiniano has made to his field of research are exemplified by publications in top conference venues such as ACM MobiCom, ACM CoNEXT (7), IEEE INFOCOM (2), ACM/IEEE IPSN (4), and in journals such as IEEE Journal on Selected Areas in Communications (2), IEEE/ACM Transactions on Networking (3) 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. Dr. Giustiniano has been general chair of EWSN 2018 and of IFIP/IEEE SustainIT 2015. He regularly serves as TPC member in top conferences such as ACM Conext (2017-2018) and IEEE INFOCOM (2014-2019). Dr. Giustiniano is senior IEEE member and ACM member. Dr. Giustiniano has large experience in coordinating and participating in funded research projects such as MATISSE, SPECTRUMCOP (industrial projects), mmMAGIC (EU H2020 PPP), Flex5gware (EU H2020 PPP). Dr. Giustiniano is leader of the OpenVLC project (openvlc.org), an open-source platform for research in visible light communication networks, and co-founder of the non-profit Electrosense association (electrosense.org), a crowd-sourcing initiative that aims at better understanding the spectrum usage.

Dr. Sergey GORINSKY

Research Associate Professor

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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. Sergey Gorinsky graduated four Ph.D. students. The areas of his primary research interests are computer networking, distributed systems, and network economics. Sergey Gorinsky made research contributions to real-time scheduling, buffer sizing, economics of network interconnection, service differentiation, cache deployment, multicast, congestion control, networking education, routing, and bulk data transfer. His work appeared at top conferences and journals such as SIGCOMM, CoNEXT, INFOCOM, Transactions on Networking, and Journal on Selected Areas in Communications. He served as a TPC chair of ICNP 2017 and other conferences, as well as a TPC member for a much broader conference population including SIGCOMM (2012, 2016), CoNEXT (2015-2017), INFOCOM (2006-2019; distinguished member: 2015-2018; area TPC chair: 2019), ICNP (2008, 2010-2017; area chair: 2013, 2016; TPC chair: 2017). Sergey Gorinsky also contributed to conference organization in many roles, such as a general chair of SIGCOMM 2018.

Dr. José Félix KUKIELKA

Research Associate Professor

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Short Bio

José Félix Kukielka is Senior Researcher at IMDEA Networks and Lecturer at the University Carlos III of Madrid (UC3M) (Madrid, Spain). 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 semiconductor 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 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

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Short Bio

Vincenzo Mancuso is Research Associate Professor at IMDEA Networks Institute, Madrid, Spain, and recipient of a Ramon y Cajal research grant of the Spanish Ministry of Science and Innovation. Previously, he was with INRIA Sophia Antipolis (France), Rice University (Houston, TX, USA) and University of Palermo (Italy), from where he obtained his MSc and his PhD in Electronics, Computer Science and Telecommunications. He has authored more than 90 peer-reviewed publications focusing on Internet QoS and on the analysis, design, and experimental evaluation of opportunistic and adaptive protocols and architectures for wireless networks. He is currently working on analysis and optimization of wireless access networks, on the analysis and design of IoT solutions, and on the measurements and assessment of mobile broadband networks.

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 PhD Students and post-doctoral 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

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Short Bio

Paolo Casari joined IMDEA Networks in 2015, and leads the Ubiquitous Wireless Networks group. He is currently focusing on underwater communications and networking, cloud computing, machine learning, as well as passive sensing and localization in wireless networks. He is Principal Investigator for the NATO project ThreatDetect, Scientific Manager for the H2020 project RECAP, and WP leader for the H2020 project SYMBIOSIS. Paolo served in the organizing committee of several conferences, and was named a distinguished IEEE INFOCOM TPC member twice. He has been guest editor of a special issue of the Hindawi Journal of Electrical and Computer Engineering on "Underwater Communications and Networking," and is currently guest editor of an IEEE Access special issue on the same topic. Previously, he was with the University of Padova, Italy, and with the Massachusetts Institute of Technology. He received his PhD in Information Engineering in 2008, from the University of Padova.

Dr. Kirill KOGAN

Research Assistant Professor

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Short Bio

Dr. Kogan is a Research Assistant Professor at IMDEA Networks Institute. For over decade (2000-2012), he spent at Cisco Systems as a Technical Leader, where he worked on two major platforms C12000 and ASR1000. During his work at Cisco, he formalized his knowledge in Ph.D at Ben-Gurion University, Israel (2008-2012). Later he spent one year as a Postdoctoral Fellow at the University of Waterloo, Canada, where he worked with Srinivasan Keshav in ISS4E group and Alejandro Lopez-Ortiz in Algorithms and Complexity group. Later he worked with Patrick Eugster in DPDS group at the Purdue University, USA.

Dr. Narseo VALLINA-RODRÍGUEZ

Research Assistant Professor

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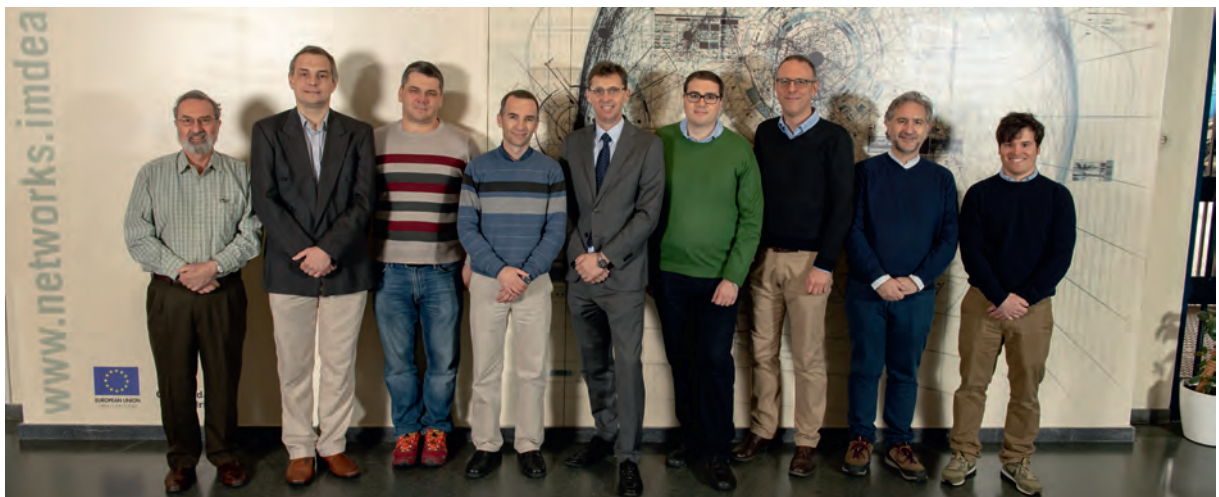
Short Bio

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 degree in Telecommunications Engineering from the University of Oviedo in 2007, which he extended with a 6-month visit at the University of Cambridge to complete his degree dissertation. In 2008, Dr. Vallina-Rodriguez joined Vodafone R&D, returning to the University of Cambridge to complete his Ph.D. program under the supervision of Prof. Jon Crowcroft one year after. In July 2013, Dr. Vallina-Rodriguez joined ICSI in Berkeley (California) as a Post-Doc, becoming a Research Scientist and Principal Investigator one year after. During his doctoral studies Dr. Vallina-Rodriguez also interned in world-class industry research labs, such as Deutsche Telekom Labs in Berlin (Germany) and the scientific group at Telefonica Research (Spain). The outcome of 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 DataTransparencyLabs grant in 2016 for characterizing mobile tracking services with the Lumen Privacy Monitor. Narseo's research has been extensively covered by international media, including Wired, ArsTechnica, NPR, The Verge, ABC Australia, and RTVE (the Spanish public TV) among many others.

IMDEA Networks faculty researchers



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 multipleaccess 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 analogdigital 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 RayTracing 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

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

Claudio is a postdoctoral researcher at IMDEA Networks Institute, Madrid, Spain. He joined the Wireless Networking Group (WNG) in December 2016 after having obtained his Ph.D. degree at the University of Luxembourg in November 2016. He received the Bachelor Degree in Ingegneria Telematica in 2010 and the Master Degree in Computer and Communication Networks Engineering in 2012 both from Politecnico di Torino, Italy. Claudio also holds the 2016 SmartICT Certificate on standardization for business innovation from the joint program of University of Luxembourg and ILNAS, the National Standardization Agency. Claudio's work on indoor localization over fog computing platforms received the Best Paper Award in IEEE CloudNet 2016. Claudio was a Visiting Ph.D. Student for at Clarkson University, NY, USA, where has worked on mobile crowdsensing. He served as Publication and Web Chair at IEEE CloudNet 2014, and as TPC member in several IEEE and ACM conferences and workshops. His primary research interests include transport layer performance in mm-wave networks, mobile crowdsensing and mobile cloud/fog computing.

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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Short Bio

Marco Gramaglia is a post-doc researcher at University Carlos III of Madrid (UC3M). He received an M.Sc (2009) and a Ph.D (2012) in Telematics Engineering from the same university and a M.Sc. degree (2009) in Computer Science engineering from Politecnico di Torino.

Before joining UC3M, he held post-doctoral research positions at Istituto Superiore Mario Boella (Torino, Italy), the Institute of Electronics, Computer, and Telecommunications Engineering (IEIIT) of the National Research Council of Italy (CNR, Torino, Italy) and at the IMDEA Networks institute (Madrid, Spain).

He likes researching on several aspects of mobile networks, ranging from vehicular networking to future 5G Networks. He is also interested in Big Data analytics and end user privacy.

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; cooperative communications
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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. Miguel PEÓN-QUIRÓS

Post-Doc Researcher

PhD: Computer Architecture. Complutense University of Madrid. Madrid. Spain
Previous Position: Research Engineer. IMDEA Networks Institute. Madrid. Spain
Research: Memory optimization; Embedded systems; Energy optimization; Computer architecture
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Short bio

Miguel Peón Quirós received his degree on Computer Engineering (2001) and a PhD on Computer Architecture (2015) from the Complutense University of Madrid. He collaborated as a Marie Curie scholar with IMEC (Belgium) and as a research engineer and postdoctoral researcher with the IMDEA Networks Institute (Madrid, Spain). He has also ample experience in industrial collaborations and has participated in several European Comission founded ERC and H2020 projects. Currently, he is a postdoctoral researcher at the École Polytechnique Fédérale de Lausanne (Switzerland). His research interests include energy optimizations for embedded systems and computer architecture in general.

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
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http://lion.disi.unitn. it/~battiti/
Duration of stay: 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).

Dr. John HEIDEMANN

Visiting Professor

University of origin: Information Sciences Institute. University of Southern California. USA
PhD: Information Sciences Institute. University of Southern California. USA
Research: Network Measurement; Critical Infrastructure; Protocol Design; Naming; Network Security
Duration of stay: June 2017 to July 2017

Short Bio

John Heidemann is a senior project leader at the University of Southern California/Information Sciences Institute (USC/ISI) and a research professor at USC in Computer Science. At ISI he leads the ANT (Analysis of Network Traffic) Lab, studying how to observe and analyze Internet topology and traffic to improve network reliability, security, protocols, and critical services. He is a senior member of ACM and fellow of IEEE.

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
Duration of stay: June to August 2017 and December 2017 to February 2018
Note: Dr. Sungoh Kwon spent a previous period at the Institute as a Visiting Professor from October to December 2016.

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. Ioannis STAVRAKAKIS

Visiting Professor

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid (Chair of Excellence Comunidad de Madrid)
University of origin: 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
Joining Date: March 2017
Contact: ioannis.stavrakakis@imdea.org
Personal Site: http://cgi.di.uoa.gr/~ioannis/

Short Bio

Prof. Ioannis Stavrakakis (IEEE Fellow) is Professor in the Dept. of Informatics and Telecommunications of the National and Kapodistrian University of Athens. He received his Diploma in Electrical Engineering from the Aristotelian University of Thessaloniki and his PhD in the same field from University of Virginia, USA. He served as Assistant Professor in CSEE, University of Vermont (USA), 1988-1994; Associate Professor of Electrical and Computer Engineering, Northeastern University, Boston (USA), 1994-1999; Associate Professor of Informatics and Telecommunications, National and Kapodistrian University of Athens (Greece), 1999-2002; and Professor since 2002. Teaching and research interests are focused on 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 and performance evaluation; content dissemination, placement and (cooperative) replication in unstructured P2P and social networks; (human-driven) decision making in competitive environments. His research has been published in over 220 scientific journals and conference proceedings and was funded by USA-NSF, DARPA, GTE, BBN and Motorola (USA) as well as Greek and European Union (IST, FET, FIRE) funding agencies. He has received 2 Marie-Curie grants for training post and has supervised about 20 Ph.D. graduates. He has served repeatedly in NSF and EU-IST research proposal review panels and involved in the TPC and organization of numerous conferences sponsored by IEEE, ACM, ITC and IFIP societies. He has served as chairman of IFIP WG6.3 and elected officer for IEEE Technical Committee on Computer Communications (TCCC). He has been in the editorial board of Proceedings of IEEE (2015-), Computer Communications (2008-), IEEE/ACM transactions on Networking, ACM /Springer Wireless Networks and Computer Networks journals. He has served as head of the Communications and Signal Processing Division, Director of Graduate Studies, Dept Vice-Chair and Dept Chair.

Note: Ioannis Stavrakakis was a member of the Scientific Council and of the Board of Trustees of IMDEA Networks from 2007 to 2017.

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

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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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 Chief Researcher 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 Society50th 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 PhD Students 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 these 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

Amr AbdelKhalek ABDELNABI

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Electronics and Communication Engineering. Cairo University. Cairo. Egypt
MSc: Wireless Communication. Nile University. Cairo. Egypt
Previous Position: Research Associate. Texas A&M University (TAMUQ). Doha. Qatar
Research: Opportunistic Communication; Stochastic Geometry Application to Wireless networks; Cellular Networks; Wireless PHY and MAC Layers; D2D Communication; Cooperative Communication; Wireless Channel Modeling; Interference Modeling
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Edgar ARRIBAS

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Mathematics. University of Valencia. Valencia. Spain
Previous Position: Research Collaborator and Professor Assistant. Department of Applied Mathematics. University of Valencia. Valencia. Spain
Research: D2D communications; Network Stability; Graph Theory; Analytical Methods Design
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Elnaz ALIZADEH JARCHLO

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Computer Software Engineering. Azad University. Tehran. Iran
MSc: Information Systems. Middle East Technical University (METU). Ankara. Turkey
Previous Position: Researcher in Computer Science. Telecommunications (IBCN). Ghent University. Gent. Belgium
Research: Localization, Mobility and Shape Detection using Visible Light Communications
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Hany ASSASA

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Electronics and Telecommunication Engineering (5-years). Damascus University. Damascus. Syria
MSc: Electronic Engineering. Politecnico di Torino. Torino. Italy; Degree of Master of Science (120 credits), Master's Programme Research on Information and Communications Technologies. KTH Royal Institute of Technology. Stockholm. Sweden
Previous Position: Core Network Packet Switch Engineer. Huawei Technologies Co. Ltd. Damascus. Syria
Research: Millimeter-Wave Networking; WiGig/IEEE 802.11ad; Network Simulation (ns-3); Wireless MAC Layer Design; Wireless Networking; Next Generation Networks Architecture; Software Defined Radio and Networking
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Constantine AYIMBA

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BSc: Electrical and Electronic Engineering. University of Nairobi. Nairobi. Kenya
MSc: Wireless Communications. Lund University. Lund. Sweden
Previous Position: Service Engineer. Ericsson. Nairobi. Kenya
Research: Network Function Virtualization; Cloud Services; Machine Learning
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Guillermo BIELSA

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BSc: Communication System Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Multimedia and Communications. University Carlos III of Madrid. Spain
Previous Position: Internship Student. IMDEA Networks Institute. Madrid. Spain
Research: Wireless Networks; 60 GHz Communication; IEEE 802.11ad; Wireless Testbed Experiments and Performance Evaluation
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Dario BEGA

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BSc: Telecommunication Engineering. University of Pisa. Pisa. Italy
MSc: Telecommunication Engineering. University of Pisa. Pisa. Italy
Previous Position: Security Consultant. Communication Valley Reply. Milan. Italy
Research: 5G Networks; Network Slicing; Multi-tenancy; Reiforcement Learning; Machine Learning; Neural Networks; Network Economycs; Scheduling Algorithm; Wireless Networks
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Alejandro BLANCO

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Telecommunication Technologies Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Double Master's Degree. Telecommunications Engineering & Multimedia and Communications. University Carlos III of Madrid. Madrid. Spain
Previous Position: Junior Consultant. Everis. Madrid. Spain
Research: Mobile Network; LTE; Software Defined Radio (SDR); Measurements; Data Traffic
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Nicola BUI
Pre-Doc Researcher

BSc: Information Engineering. University of Ferrara. Ferrara. Italy
MSc: Telecommunication Engineering. University of Ferrara. Ferrara. Italy; Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Previous Position: CEO. Patavina Technologies. Padova. Italy
Research: Content Distribution Networks; Network Optimization; Internet Of Things
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Roberto CALVO-PALOMINO
Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Computer Science. University Rey Juan Carlos. Madrid. Spain
MSc: Telematics and Computer Science Systems. University Rey Juan Carlos. Madrid. Spain
Previous Position: Researcher at LibreSoft and Robotic group. University Rey Juan Carlos. Madrid. Spain
Research: Collaborative Spectrum Sensing; Collaborative Algorithms; Distributed System; Large Scale Deployments
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Patricia CALLEJO
Pre-Doc Researcher

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BSc: Audiovisual Systems Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Telematics Engineering. University Carlos III of Madrid. Spain
Previous Position: Internship Student. IMDEA Networks Institute. Madrid Spain
Research: Online Advertising; Data Analytics; Machine Learning; Network Measurements; Social Networks
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Evgenia CHRISTOFOROU
Pre-Doc Researcher

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BSc: Computer Science. University of Cyprus. Nicosia. Cyprus
MSc: Computer Science. University of Cyprus. Nicosia. Cyprus
Previous Position: Research Assistant. Department of Computer Science. University of Cyprus. Cyprus
Research: Crowdsourcing & Volunteer Computing; Distributed Computing; Algorithmic & Evolutionary Game Theory; Algorithmic Mechanism Design; Game Theory
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Pavel CHUPRIKOV

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and Steklov Mathematical Institute in Saint Petersburg
BSc: Applied Mathematics and Informatics. ITMO University. St. Petersburg. Russia
MSc: Applied Mathematics and Physics. St. Petersburg Academic University of the Russian Academy of Sciences. St. Petersburg. Russia
Previous Position: Software Developer at JetBrains. St. Petersburg. Russia
Research: Buffer Management; Online Algorithms; Dependent Types; Bioinformatics
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Elizaveta DUBROVINSKAYA

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: BA in Automatics, Telemechanics and Telecommunications (with honors). Saint-Petersburg State Transport University. Sankt Petersburg. Russia.
MSc: Digital Communications. Christian-Albrechts Universität zu Kiel. Kiel. Germany.
Previous Position: Board Member at Teleone OÜ. Tallinn. Estonia.
Research: Underwater Communications; Underwater Localization; Signal Processing
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Vitalii DEMIANIUK

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Applied Mathematics and Computer Science. National Research University of Information-al Technologies, Mechanics and Optics. Saint Petersburg. Russia
MSc: Applied Mathematics and Computer Science. National Research University of Information-al Technologies, Mechanics and Optics. Saint Petersburg. Russia
Previous Position: Algorithms Developer. VeeRoute. Saint Petersburg. Russia
Research: Packet Classification; Software Defined Networks; Network Function Virtualization; Algorithms and Data Structures; Combinatorial Optimization
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Aymen FAKHREDDINE

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Telecommunications Engineering. Institut National des Postes et Télécommunications (INPT). Rabat. Morocco
MSc: Advanced Wireless Communications Systems. École Supérieure d'Électricité - Supélec. Paris. France. Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Previous Position: Intern. Alcatel-Lucent Bell Labs. Paris. France
Research: WLAN Indoor Localization; Tracking Algorithms; GPS; Wireless Communications; Mobile Networks
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Roderick FANOU

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
MSc: Design Engineer in Computer Science, Networks and Telecommunications (majoring in Networks and Telecommunications). Polytechnics of Abomey Calavi (EPAC). University of Abomey Calavi (UAC). Republic of Benin; Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Previous Position: Intern. EUPHORBIA Sarl. Cotonou. Republic of Benin
Research: Impact of Internet eXchange Points (IXPs) in the African Region; Interdomain Routing; Internet Measurement; Content Delivery Networks
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Julien GAMBA

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Computer science. University of Strasbourg. Strasbourg. France
MSc: Computer Networks and Embedded Systems. University of Strasbourg. Strasbourg. France
Previous Position: Internship Student; ICube Laboratory. Strasbourg. France
Research: Network Measurements; Privacy and Security; Interdomain Routing
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Ander GALISTEO

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Telecommunications Systems Engineering. University of Navarra. San Sebastián. Spain
MSc: Telecommunications Engineering. University of Navarra. San Sebastián. Spain; Engineering Technology Network Communication Track. University of Houston. Houston. USA
Previous Position: Teaching Assistant. University of Houston. Houston. USA
Research: VLC; Physical Layer Simulation; VLC localization
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Ginés GARCÍA AVILÉS

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Bachelor in Computer Sciences, University of Murcia (UMU). Murcia. Spain
Previous Position: Internship Student. Engineering Department. IMDEA Networks & University Carlos III of Madrid
Research: Multipath TCP; Transport Protocols; Wireless Networks; 802.11aa; Real-time Multicast; SDN; NFV
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Pablo JIMÉNEZ MATEO

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Degree in Computational Mathematics - Degree in Computer Engineering. Universitat Jaume I. Castellón de la Plana. Spain
MSc: Intelligent Systems. Universitat Jaume I. Castellón de la Plana. Spain
Previous Position: Internship Student. Universitat Jaume I. Castellón de la Plana. Spain
Research: mmWave; Machine Learning; 5G
Contact: pablo.jimenezmateo@imdea.org

Vadim KIRILIN

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Applied Mathematics and Computer Science. Lomonosov Moscow State University. Moscow. Rusia
Previous Position: Software Engineer and Performance Analyst. Softmachines. Moscow. Russia
Research: Inter-domain Routing; Machine Learning Approaches for Caching in CDN
Contact: vadim.kirilin@imdea.org

Yonas Mitike KASSA

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Computer Science. Alemaya University. Dire Dawa. Ethiopia
MSc: Computer and Communication Networks Engineering. Politecnico di Torino. Turin. Italy
Research: Online Social Networks; Online Advertising; Privacy; Large Scale Data Analytics; Machine Learning; Network Measurement; Content Distribution Networks
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Jorge MARTÍN PÉREZ

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Joint Degree in Computer Engineering & Mathematics. Autonomous University of Madrid. Madrid. Spain
Research: VNF Mapping
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Nuria MOLNER

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Mathematics. University of Valencia. Valencia. Spain
MSc: Telematics Engineering. University Carlos III of Madrid. Spain
Previous Position: IRTIC (Institute of Robotics and Information and Comunication Tecnologies). Paterna. Valencia. Spain
Research: Fronthaul/Backhaul Integration and Optimization; NFV Placement Optmization; 5G Networks
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Noelia PÉREZ PALMA

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Bachelor in Computer Sciences, University of Murcia (UMU). Murcia. Spain
Previous Position: Project manager for network creation and optimization projects at Allocation and Supply, Landline Business, Telefónica Spain. Madrid. Spain
Research: Opportunistic Networks; Wireless Networks; D2D Communication
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Joan PALACIOS BELTRAN

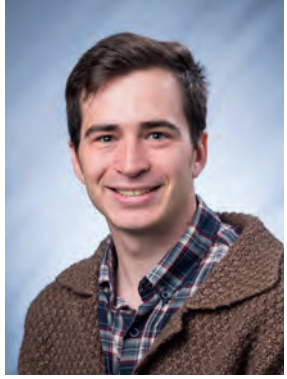
Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Mathematics. University of Valencia. Valencia. Spain
MSc: Multimedia and Communications. University Carlos III of Madrid. Spain
Research: mmWave; Beam-Forming; Channel Estimation; Mobility Models Estimation and Prediction; ADoA Localization
Contact: joan.palacios@imdea.org

Maurizio REA

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Telecommunications Engineering. University of Palermo. Palermo. Italy
MSc: Telecommunications Engineering. University of Palermo. Palermo. Italy
Previous Position: Researcher. ETH Zürich. Switzerland
Research: mmWave Networks; Beam Search Algorithms; Signal Processing
Contact: maurizio.rea@imdea.org



José A. RUIPÉREZ-VALIENTE

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Telecommunications Systems. Catholique University of San Antonio. Murcia. Spain
MSc: Telecommunication Engineering. University Carlos III of Madrid. Spain
Previous Position: Programmer. Accenture Technology Solutions. Spain
Research: Educational Data Mining; Learning Analytics; Information Visualization; Data Science
Contact: joseantonio.ruiperez@imdea.org

Lucía UGUINA

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Telecommunication Technologies Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Computer Science and Mathematics. Universitat Rovira i Vigili / Universitat Oberta de Catalunya. Tarragona. Spain
Previous Position: Junior Assistant. Management Solutions. Madrid. Spain
Research: Learning Analytics; Data Mining; Real-Time Data
Contact: lucia.uguina@imdea.org

Pelayo VALLINA-RODRIGUEZ

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Computer Science. University Carlos III of Madrid. Madrid. Spain
MSc: Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Previous Position: Fellow Student. NETCOM Research Group. University Carlos III of Madrid. Madrid. Spain
Research: Social Computing Systems; Online Advertising; User Privacy
Contact: pelayo.vallina@imdea.org

Víctor SÁNCHEZ AGÜERO

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute y Universidad Carlos III de Madrid. Madrid. España
BSc: Audiovisual Systems Engineering. University Carlos III of Madrid. Madrid. Spain
Previous Position: Internship Student. University Carlos III of Madrid. Madrid. Spain
Research: Internet Measurements; IP Routing; BGP; Data Visualization; Network Architectures; UAV/ Drones
Contact: victor.sanchez@imdea.org

Christian VITALE

Pre-Doc Researcher

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Telecommunication Engineering. University of Pisa. Pisa. Italy
MSc: Telecommunication Engineering. University of Pisa. Pisa. Italy
Previous Position: Student Research Assistant. NEC Europe Ltd. Heidelberg. Germany
Research: 5G Cellular Networks; Performance Evaluation; Green Networking; Queueing Theory
Contact: christian.vitale@imdea.org

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 (UC3M).

Pablo CABALLERO

External PhD Student

Affiliation: University of Texas at Austin. USA
Ph.D. Supervisor(s): Dr. Gustavo DE VECIANA, University of Texas at Austin, USA; Dr. Albert BANCHS, IMDEA Networks Institute & University Carlos III of Madrid, Spain
BSc: Audiovisual Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Previous Position: Internship student. NEC Laboratories Europe. Heidelberg. Germany
Research: Wireless Communications; Network optimization; Cellular Networks;
Contact: pablo.caballero@imdea.org

Luis F. CHIROQUE

External PhD Student

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Telematics Engineering. Polytechnic University of Madrid. Madrid. Spain
MSc: Mathematical Engineering. University Carlos III of Madrid. Spain
Research: Graph Theory; Network Science; Machine Learning; Big Data; Data Mining
Contact: luisfelipe.nunez@imdea.org

Carlos DONATO

External PhD Student

Affiliation: Institute IMDEA Networks and University Carlos III of Madrid
BSc: Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Telematics Engineering. Telematics Engineering Department. University Carlos III of Madrid. Madrid. Spain
Previous Position: Internship student. NEC Laboratories Europe. Heidelberg. Germany
Research: Wireless Communications; Mobile Networks; Computer Networks; Network Programming
Contact: carlos.donato@imdea.org

Foivos MICHELINAKIS

External PhD Student

Affiliation: IMDEA Networks Institute and University Carlos III of Madrid
BSc: Electrical and Computer Engineering (5-years). National Technical University of Athens. Athens. Greece
MSc: Telematics Engineering, Communication Networks and Services. University Carlos III of Madrid. Spain
Previous Position: Analyst-programmer. Hellenic Army. Greece
Research: Mobile Networks; Network Optimization; Content Distribution Networks
Contact: foivos.michelinakis@imdea.org

Antonio PASTOR VALLES

External PhD Student

Affiliation: University Carlos III of Madrid. Spain
Ph.D. Supervisor(s): Dr. Arturo AZCORRA, IMDEA Networks Institute & University Carlos III of Madrid, Spain
MSc: Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Previous Position: Internship Student. Telefonica Talentum Startups scholarship at IMDEA Networks Institute. Madrid. Spain
Research: Complex Networks; Machine Learning; Connectomics; Brain-Machine Interfaces
Contact: antonio.pastor@imdea.org

research engineering and support

The Research Engineering & Support unit at IMDEA Networks is dedicated to supporting the continued growth in our research capacity and maximizing the impact of our research output by providing specific technical and professional expertise and assistance to ongoing research endeavors in a variety of ways. Research Engineering & Support personnel work either at the level of the entire Institute, or closely with researchers and their groups. There are roles with an engineering background that take care of the design, installation and maintenance of the IT infrastructure. Other roles may, for instance, provide administrative or operational support to project or lab management.

Typical jobs include systems administration, research (software and/or hardware) engineering, project or research administrator and laboratory technician. These positions are similar to their industry equivalents. They enable our employees to work on cutting-edge research problems and technology in a stimulating and innovative environment.

Ángel ACOSTA
Systems Administrator

BSc: Computer Engineering. José Antonio Paéz University. Venezuela
MSc: Informatics Engineering. University Carlos III of Madrid. Spain
Previous Position: IT Operations & Support Manager. Next Limit Technologies. Madrid. Spain
Contact: angel.acosta@imdea.org

Ignacio BERBERANA
Senior Research Engineer

MSc: Mining Engineer. School of Mining Engineering. Polytechnic University of Madrid. Madrid. Spain
Previous Position: Innovation Manager - Radio Access Networks. Telefónica Global CTO Team. Spain
Research: 5G; Radio Communications; RAN Virtualization
Contact: ignacio.berberana@imdea.org

Carlos CONTRERAS
Junior Software Developer

BSc: Computer Engineering. Specialization: Information Systems. Universidad Carlos III de Madrid. Madrid. Spain
Previous Position: Internship Student. IMDEA Networks Institute. Madrid. Spain
Contact: carlos.contreras@imdea.org

Héctor CORDOBÉS DE LA CALLE

Research Engineer

MSc: Telecommunications Engineering. University Carlos III of Madrid. Spain, Communications and Multimedia. University Carlos III of Madrid. Spain
Research: NLP; Big Data; Data and Signal Processing
Contact: hector.cordobes@imdea.org

Rafael GARCÍA

Research Engineer

BSc: Computer Science. University of Córdoba. Spain
MSc: Computational Sciences. University of Amsterdam. The Netherlands
Previous Position: R&D Manager. Entropy Computational Services. Madrid. Spain
Research: Big Data; Data Science; Computational Science; Natural Computing
Contact: rafael.garcia@imdea.org

Rosa GÓMEZ

Research Administrator

BSc: Economics. University of Málaga. Málaga. Spain
MSc: Master in Economics of Science and Innovation. Barcelona Graduate School of Economics. Barcelona. Spain; Master in Economics and Finance. Centro de Estudios económicos Financieros (CEF). Madrid. Spain
Previous Position: R&D Project Manager. e-Helth Foundation (FeSalud). Spain
Contact: rosa.gomez@imdea.org

Dr. Amanda GARCÍA-GARCÍA

Research Engineer

BSc: Telecommunications Engineering. Polytechnic University of Madrid. Madrid. Spain
MSc: Communications Technologies and Systems. Polytechnic University of Madrid. Madrid. Spain
PhD: Communications Technologies and Systems. Polytechnic University of Madrid. Madrid. Spain
Previous Position: Researcher assistant. Liquid Crystals Group. CEMDATIC. Polytechnic University of Madrid. Madrid. Spain
Research: RF Engineering; Millimeter-Wave Communications; High Frequency Antenna Design; Device Fabrication
Contact: amanda.garcia@imdea.org

Borja FERNÁNDEZ VICO

Research Engineer

BSc: Telecommunication Engineering. Specialization: Telematics. Polytechnic University of Madrid. Madrid. Spain
Previous Position: Lead Software Developer Engineer & Project Manager. MOBILIFE S.L. Madrid. Spain
Research: Agile Development; Business Intelligence; Ruby on Rails; Test Automation; Best Practices
Contact: borja.fernandez@imdea.org

Neftalí GONZÁLEZ

Systems Administrator

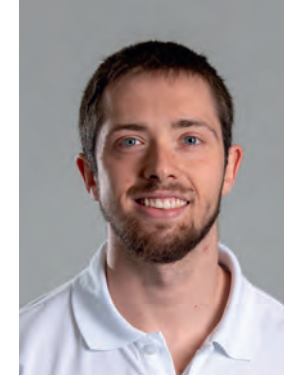
BSc: IT Systems Engineer. Universidad Rey Juan Carlos. Móstoles. Spain
Previous Position: IT Infrastructure Consultant. AstraZeneca Spain. Madrid. Spain
Contact: neftali.gonzalez@imdea.org

Dr. José HERRERA
Research Engineer

BSc: Computer Science Engineering. Polytechnic University of Madrid. Madrid. Spain
MSc: Computer Science. Complutense University of Madrid. Madrid. Spain
PhD: Computer Science. Complutense University of Madrid. Madrid. Spain
Previous Position: Honourable Collaborator. Rey Juan Carlos University. Madrid. Spain
Research: Privacy; Access Control; Cloud computing; Edge/Fog Computing
Contact: jose.herrera@imdea.org

Diego JUARA
Research Engineer

BSc: Telecommunication Systems Engineering. University of Alcalá. Spain
Previous Position: Engineer. Indra Sistemas. Spain
Research: Wireless Communications; Visible Light Communication (VLC); Electronics; SDR; High Speed Systems
Contact: diego.juara@imdea.org



Norbert LUDANT
Laboratory Technician

BSc: Communication Systems Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Double Master's Degree. Telecomunications Engineering & Multimedia and Communications. University Carlos III of Madrid. Madrid. Spain
Previous Position: Internship Student. IMDEA Networks Institute. Spain (Dec 2016 - Jul 2017)
Research: Network Optimization, Network Measurements, Localization Systems
Contact: norbert.ludant@imdea.org

Francisco Javier HERVÁS
Project Administrator

BSc: Bachelor's Degree in Business Administration
MSc: Master in Management of Human Resources. Universidad Autónoma de Madrid. Spain
Qualifications: Bachelor's Degree in Business Administration. Universidad Autónoma de Madrid. Spain
Previous Position: R&D Consultant. CYTSA. Spain
Contact: franciscojavier.hervas@imdea.org

Dr. Jesús Omar LACRUZ
Research Engineer

BSc: Electrical Engineering. University of the Andes. Mérida. Venezuela
MSc: Electronic System Engineering. Polytechnic University of Valencia. Valencia. Spain
PhD: Electronic Engineering. Polytechnic University of Valencia. Valencia. Spain
Previous Position: Assistant Professor. Electrical Engineering Department. University of the Andes. Mérida. Venezuela
Research: FPGA; VLSI; Error Correcting Codes; Digital Signal Processing; Digital Communications
Contact: jesusomar.lacruz@imdea.org

Sergio N. TAMUREJO MORENO
Research Engineer

BSc: Audiovisual Systems Engineering. University Carlos III of Madrid. Madrid. España
MSc: Telematics Engineering. University Carlos III of Madrid. Madrid. España
Previous Position: Enterprise Architect. INDRA Systems. Madrid. España
Research: Software Defined Networking; Large Scale Networks Measurement, Analytics and Virtualization
Contact: sergio.tamurejo@imdea.org

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 a special consideration for future positions on our PhD Student team.

We also have a program in place for Visiting PhD Students from partner universities or research organizations to undertake an internship at IMDEA Networks under the direction of one of our faculty members. This program enables them to develop new skills and gain expertise in an enriching new environment.

Margherita BERGAMASCHI
Supervisor: Domenico Giustiniano
University of origin: University of Modena (Modena, Italy)

Jona BEYSENS
Supervisor: Domenico Giustiniano
University of origin: KU Leuven (Leuven, Belgium)

Kayomars BILIMORIA
Supervisor: Adrian Loch
University of origin: MIT (Cambridge, Massachusetts, USA)

Vincenzo COMITE
Supervisors: Vincenzo Mancuso, Marco Ajmone Marsan
University of origin: University of Rome La Sapienza (Rome, Italy)

José Ignacio DE TORRES
Supervisor: José Félix Kukielka
University of origin: Universidad Carlos III (Madrid, Spain)

Hossein DOROUD
Supervisor: Narseo Vallina
University of origin: Universidad Carlos III (Madrid, Spain)

José Ignacio ENRIQUEZ
Supervisor: José Félix Kukielka
University of origin: Universidad Carlos III (Madrid, Spain)

Irene HERNÁNDEZ
Supervisor: José Félix Kukielka
University of origin: Universidad Carlos III (Madrid, Spain)

Boram JIN
Supervisor: Joerg Widmer
University of origin: Korea Advanced Institute of Science and Techonology, KAIST (Yuseong, Daejeon, South Korea)

Saad KHALID
Supervisor: Rebeca De Miguel
University of origin: Universidad Carlos III (Madrid, Spain)

Norbert LUDANT
Supervisor: Joerg Widmer
University of origin: University Carlos III (Madrid, Spain)

Enrique LLORENTE
Supervisors: Joerg Widmer & Adrian Loch
University of origin: Universidad Carlos III (Madrid, Spain)

Kaouther MANSOUR
Supervisor: Joerg Widmer
University of origin: Ecole Nationale d'ingenieurs de Tunis (Tunis, Tunisia)

Patrizio MARCOCCI
Supervisor: Domenico Giustiniano
University of origin: University of Florence (Florence, Italy)

Carlos MENDOZA
Supervisor: Joerg Widmer
University of origin: Universidad Carlos III (Madrid, Spain)

Laudin Alessandro MOLINA
Supervisor: Vincenzo Mancuso
University of origin: IMT Atlantique (Rennes, France)

Mohamed MOULAY BRAHIM
Supervisor: Vincenzo Mancuzo
University of origin: Universidad Carlos III (Madrid, Spain)

Victor RAMÍREZ
Supervisor: Rebeca De Miguel
University of origin: Universidad Carlos III (Madrid, Spain)

Esther RITUERTO
Supervisor: Rebeca De Miguel
University of origin: Universidad Carlos III (Madrid, Spain)

Bana SHEHADEH
Supervisor: Joerg Widmer
University of origin: Universidad Carlos III (Madrid, Spain)

David YAGÜE
Supervisor: José Félix Kukielka
University of origin: Universidad Carlos III (Madrid, Spain)

research team structure

networked systems&algorithms

Research Director
· Dr. Arturo Azcorra

Researcher Professors
· Dr. Sergey Gorinsky
· Dr. José F. Kukielka
· Dr. Kirill Kogan

Pre-Doc & Post-Doc Researchers
· Patricia Callejo
· Pavel Chuprikov
· Vitalii Demianiuk
· Roderick Fanou
· Pablo Jiménez Mateo
· Yonas Mitike Kassa
· Vadim Kirilin
· Jorge Martín Pérez
· Nuria Molner
· José A. Ruipérez-Valiente
· Víctor Sánchez Agüero
· Lucía Uguina

wireless networking

Research Director
· Dr. Joerg Widmer

Researcher Professors
· Dr. Nicholas Maxemchuk
· Dr. Domenico Giustiniano
· Dr. Paolo Casari
· Dr. Marco Ajmone-Marsan

Pre-Doc & Post-Doc Researchers
· Dr. Jesús Omar Lacruz
· Dr. Claudio Fiandrino
· Dr. Amanda García-García
· Elnaz Alizadeh Jarchlo
· Hany Assasa
· Constantine Ayimba
· Guillermo Bielsa
· Alejandro Blanco
· Nicola Bui
· Roberto Calvo-Palomino
· Evgenia Christoforou
· Elizaveta Dubrovinskaya
· Aymen Fakhreddine
· Ander Galisteo
· Pablo Jiménez
· Joan Palacios Beltran
· Maurizio Rea

network measurements&analytics

Research Director
· Dr. Albert Banchs

Researcher Professors
· Dr. Antonio Fernández-Anta
· Dr. Vincenzo Mancuso
· Dr. Narseo Vallina-Rodríguez

Pre-Doc & Post-Doc Researchers
· Dr. José Herrera
· Amr AbdelKhalek Abdelnabi
· Edgar Arribas
· Dario Bega
· Julien Gamba
· Ginés García Avilés
· Noelia Pérez Palma
· Pelayo Vallina-Rodriguez
· Christian Vitale

Our current team

administrative unit

The Institute is managed by the Director – Dr. Arturo Azcorra – and the Deputy Director – Dr. Albert Banchs –. They are accountable to the Board of Trustees to whom they report regularly.

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.

Ramón GIRONA
General Manager

Qualifications: BSc: Computer Science. Universidad de las Palmas de Gran Canaria (ULPGC). Canary Islands. Spain; Industrial Engineering. Universidad Politécnica de Canarias (UPC). Canary Islands. Spain; MBA: Instituto de Empresa. Madrid. Spain
Contact: ramon.girona@imdea.org

Rebeca DE MIGUEL
Senior 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
Senior Human Resources Manager

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

Ana GONZÁLEZ
Senior 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

Sonia BALAGUER PETROVA
Human Resources Project Administrator

Qualifications: BSc: Economics and Law. University Carlos III of Madrid. Madrid. Spain. (Erasmus Scholarship. Economics. Université Paris I Panthéon-Sorbonne. Paris. France). MSc: International Cooperation, Management of Public Policies, Programs and Projects of Development. Universidad Internacional Menéndez Pelayo. Madrid. Spain | Professional Development. Universidad de Alcalá de Henares. Madrid. Spain.
Contact: sonia.balaguer@imdea.org

alumni network

The Institute's Alumni Network is built upon graduate PhD Students 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 PhD Students can maintain a long-term collaborative relationship with the Institute. Alumni are IMDEA Networks Institute's 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 2017.

Dr. Roderick FANOU

Current Position: Post Doc. San Diego SuperComputer Center (SDSC). Center for Applied Internet Data Analysis (CAIDA)/University of California San Diego (UCSD). San Diego. USA
Ph.D. Thesis: *Methods for revealing and reshaping the African Internet ecosystem as a case study for developing regions: From isolated networks to a connected continent*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematics Engineering
Ph.D. Date: 14 December 2017
Ph.D. Supervisor(s): Dr. Pierre FRANCOIS & Dr. Francisco VALERA PINTOR, University Carlos III of Madrid

Dr. Christian VITALE

Current Position: Post Doc. Department of Electronics and Telecommunications. Politecnico di Torino. Turin. Italy
Ph.D. Thesis: *Analytical Characterization of In-band and Out-band D2D Communications for Network Access*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematics Engineering
Ph.D. Date: 9 June 2017
Ph.D. Supervisor(s): Dr. Vincenzo MANCUSO

Dr. José A. RUIPÉREZ-VALIENTE

Current Position: Postdoctoral Associate. Massachusetts Institute of Technology (MIT). Cambridge. Massachusetts. USA
Ph.D. Thesis: *Analyzing the Behavior of Students Regarding Learning Activities, Badges, and Academic Dishonesty in MOOC Environments*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematics Engineering
Ph.D. Date: 31 May 2017
Ph.D. Supervisor(s): Dr. Pedro J. MUÑOZ-MERINO

Dr. Evgenia CHRISTOFOROU

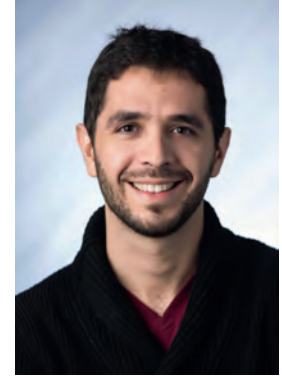
Current Position: Post Doc. Department of Electronics and Telecommunications. Politecnico di Torino. Turin. Italy
Ph.D. Thesis: *Achieving Reliability and Fairness in Online Task Computing Environments*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematics Engineering
Ph.D. Date: 25 May 2017
Ph.D. Supervisor(s): Dr. Antonio FERNÁNDEZ ANTA, IMDEA Networks Institute & Dr. Ángel SÁNCHEZ, University Carlos III of Madrid

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*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 25 November 2016
Ph.D. Supervisor(s): Dr. Vincenzo MANCUSO

Dr. Syed Anwar UL HASAN

Current Position: Product developer/ Co-founder. PriceFlier. Hyderabad. Telangana. India
Ph.D. Thesis: *The Role of Topology and Contracts in Internet Content Delivery*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 20 June 2016
Ph.D. Supervisor(s): Dr. Sergey GORINSKY



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*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 6 May 2016
Ph.D. Supervisor(s): Dr. Pierre FRANCOIS

Dr. Nicola BUI

Current Position: Senior Research Scientist. College of Computer & Information Science. Northeastern University. Boston. Massachusetts. USA
Ph.D. Thesis: *Prediction-Based Techniques for the Optimization of Mobile Networks*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematics Engineering
Ph.D. Date: 12 May 2017
Ph.D. Supervisor(s): Dr. Joerg WIDMER

Dr. Elli ZAVOU

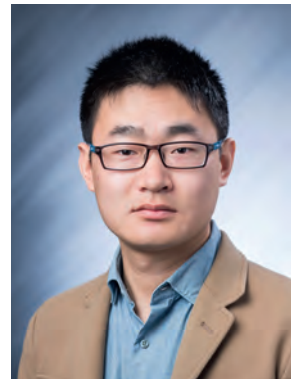
Current Position: Postdoc. Inria Grenoble - Rhône-Alpes & INSA Lyon. Lyon. France
Ph.D. Thesis: *Online Scheduling in Fault-prone Systems: Performance Optimization and Energy Efficiency*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 30 September 2016
Ph.D. Supervisor(s): Dr. Antonio FERNÁNDEZ ANTA

Dr. Qing WANG

Current Position: Postdoc Researcher. University of Leuven - KU Leuven. Leuven. Belgium
Ph.D. Thesis: *Visible Light and Device-to-Device Communications: System Analysis and Implementation*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 19 May 2016
Ph.D. Supervisor(s): Dr. Domenico GIUSTINIANO

Dr. Pablo SALVADOR

Current Position: Senior 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*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 8 April 2016
Ph.D. Supervisor(s): Dr. Pablo SERRANO YÁÑEZ-MINGOT

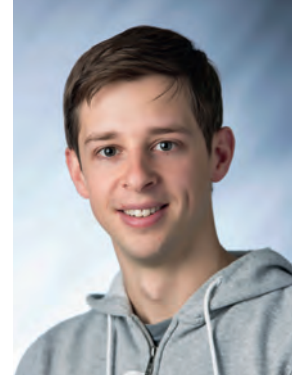


Dr. Gek Hong SIM

Current Position: Post-doc Researcher. TU Darmstadt. Germany
Personal Site: https://www.seemoo.tu-darmstadt.de/team/allyson-sim/
Ph.D. Thesis: *Algorithm Design for Scheduling and Medium Access Control in Heterogeneous Mobile Networks*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 30 March 2016
Ph.D. Supervisor(s): Dr. Joerg WIDMER

Dr. Arash ASADI

Current Position: Post-doc Researcher. TU Darmstadt. Germany
Personal Site: https://www.seemoo.tu-darmstadt.de/team/arash-asadi/
Ph.D. Thesis: *Opportunistic Device-To-Device Communication In Cellular Networks: From Theory To Practice*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 8 March 2016
Ph.D. Supervisor(s): Dr. Vincenzo MANCUSO



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*
University: University Carlos III of Madrid. Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 25 September 2015
Ph.D. Supervisor(s): 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*
University: University Carlos III of Madrid. Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 5 March 2015
Ph.D. Supervisor(s): Dr. Carlos Jesús BERNARDOS CANO

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*
University: University Carlos III of Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 8 March 2016
Ph.D. Supervisor(s): Dr. Antonio DE LA OLIVA

Dr. Vincenzo SCIANCALEPORE

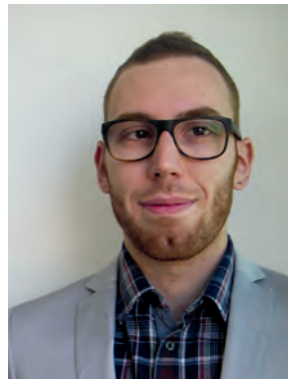
Current Position: Research Scientist. NEC Laboratories Europe. Heidelberg. Germany
Ph.D. Thesis: *Enhancement in Spectrum Management Techniques for Heterogeneous 5G Future Networks*
University: University Carlos III of Madrid. Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 27 November 2015
Ph.D. Supervisor(s): 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*
University: Open University of Catalonia (UOC). Barcelona. Spain
Doctoral Program: Information and Knowledge Society
Ph.D. Date: 20 July 2015
Ph.D. Supervisor(s): Dr. Sergey GORINSKY

Dr. Jordi ARJONA AROCA

Current Position: Project Technician.Fundación Valenciaport. Valencia. Spain
Ph.D. Thesis: *Structural Issues and Energy Efficiency in Data Centers*
University: University Carlos III of Madrid. Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 13 February 2015
Ph.D. Supervisor(s): Dr. Antonio FERNÁNDEZ ANTA



Dr. Andra LUTU

Current Position: Researcher. Telefonica Research and Development. Barcelona. Spain
Ph.D. Thesis: *A system for the detection of Limited Visibility in BGP*
University: University Carlos III of Madrid. Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 11 November 2014
Ph.D. Supervisor(s): Dr. Marcelo BAGNULO

Dr. Michal KRYCZKA

Current Position: Senior Consultant. Accenture. Warsaw. Poland
Ph.D. Thesis: *Experimental analysis of the socio-economic phenomena in the BitTorrent ecosystem*
University: University Carlos III of Madrid. Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 7 February 2013
Ph.D. Supervisor(s): Dr. Arturo AZCORRA & Dr. Rubén CUEVAS

Dr. Paul PATRAS

Current Position: Chancellor's Fellow / Lecturer. School of Informatics. University of Edinburgh. Scotland
Personal Site: http://homepages.inf.ed.ac.uk/ppatras/
Ph.D. Thesis: *Control-Theoretic Adaptive Mechanisms for Performance Optimization of IEEE 802.11 WLANs: Design, Implementation and Experimental Evaluation* (Extraordinary Doctoral Award Universidad Carlos III de Madrid – Academic year 2011/2012)
University: University Carlos III of Madrid. Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 18 March 2011
Ph.D. Supervisor(s): Dr. Albert BANCHS

Dr. Agustín SANTOS

Current Position: Public Officer. Spanish Public Administration. Madrid. Spain
Ph.D. Thesis: *Quid Pro Quo: Mecanismos para la asignación de tareas en entornos distribuidos*
University: Rey Juan Carlos University. Madrid. Spain
Doctoral Program: Department of Telematic Systems and Computation (GSYC)
Ph.D. Date: 3 June 2013
Ph.D. Supervisor(s): Dr. Antonio FERNÁNDEZ ANTA & Dr. Luis LÓPEZ FERNÁNDEZ

Dr. Alex BIKFALVI

Current Position: Software Engineer. Schibsted Media Group. Barcelona. Spain
Personal Site: http://alex.bikfalvi.com/
Ph.D. Thesis: *Peer-to-Peer Television for the IP Multimedia Subsystem* (Extraordinary Doctoral Award Universidad Carlos III de Madrid – Academic year 2011/2012)
University: University Carlos III of Madrid. Madrid. Spain
Doctoral Program: Telematic Engineering
Ph.D. Date: 18 July 2012
Ph.D. Supervisor(s): Dr. Jaime GARCÍA-REINOSO

headquarters and research laboratories infrastructure

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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.

In 2016 the area of the building already remodeled amounted to 1488 m^2.

In 2017 the physical space was created for the Innovation and Research Laboratory in 5G, 5TONIC, which consists of two offices for equipment preparation, a lobby, and the server room. In addition, adjacent facilities have been adapted to perform mechanical / electronic industrial experiments.

Its implementation has been completed before January 23, 2017, in time for the first 5G technology Plugtest event, led by the ETSI (European Telecommunications Standards Institute) and where the members of the 5TONIC have participated.

Additionally, the 1st floor East wing has been refurbished to increase the number of available offices, as well as the central module of the 1st floor of the main building, creating a dining room and a room for racks. In addition, the number of laboratories has been increased through the union of offices on the ground floor of the South wing, and a new meeting room has been created on the 2nd floor of the East wing using a glass enclosure.

The public tender for the construction of the Transformation Center has begun, necessary to have more than 100 kW of electrical power consumption.

These changes increase the renovated space of offices and laboratories to 2,245 m^2.

8.2. Research laboratories

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.

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.

For 2017,

In computer equipment, the purchase of several Dell R730, R630 and R430 high-performance servers has been made for studies on 5G, as well as 2 power supplies of -48V DC and 2,400 W to power radio heads.

We have invested in the purchase of several special 60 GHz WiFi stations for wireless studios.

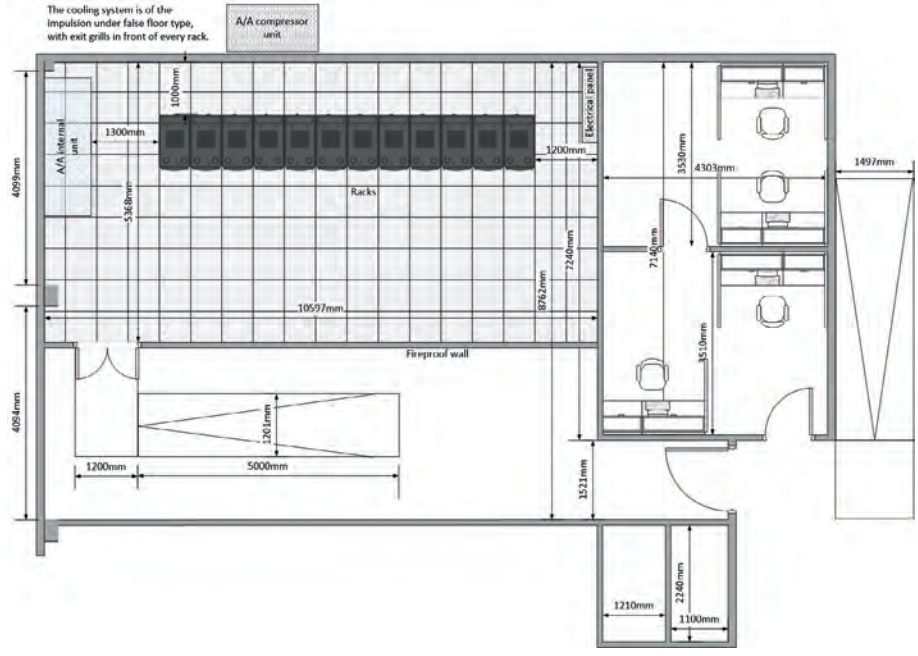
A baseband TX-RX system based on FPGAs has been purchased for use in a millimeter wave development platform.

The 5TONIC Laboratory

The 5TONIC Laboratory provides **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.

5TONIC supports a wide range of systems, functionality, services and applications, including user terminals and outdoors equipment, as well as edge and cloud based



A floor plan of the 5TONIC lab

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**
  - 4 LTE-A eNodeBs from CommScope
  - 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.

Other relevant activities are:

- Deployments and testing of the OneCell LTE Advanced radio infrastructure, that is able to support mobility without handover in indoor environments. Four radio points and one OneCell controller have been deployed in IMDEA Networks premises for these purposes.
- Testing of the point-to-point solution by Cohere Technologies that use their new waveform OTFS, which is a candidate waveform for future developments of 5G. The tests were carried out at IMDEA Networks, University Carlos III and Telefónica headquarters.
- Support to the activities of IFEMA Lab, associated to 5TONIC, which is exploring the use of 5G in the tourism sector and trade fairs. IFEMA Lab has developed new applications for the so called "Augmented Fair", that make use of the Virtual/Augmented Reality capabilities to support a new way of experiencing and interacting for people attending a fair.
- Testing of FlexiRAN virtualized Radio Access Network solution developed by Intel, using a high performance platform provided by Artesyn.

organization

annual report

2017

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.

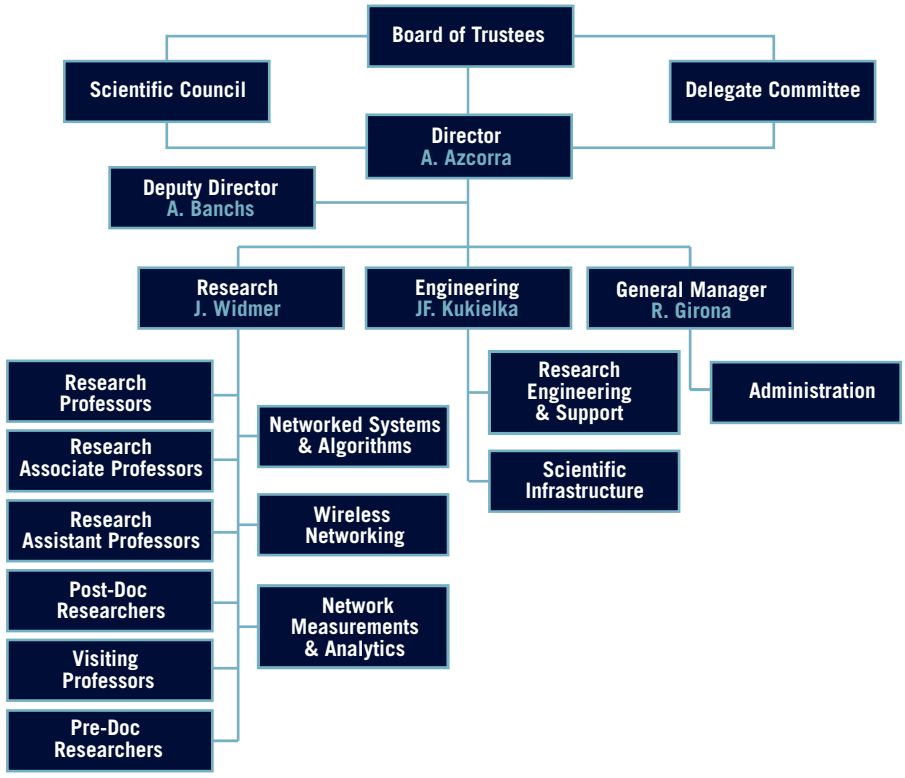
The full, registered name of the Institute is Fundación IMDEA Networks. The Institute is registered in the Register of Foundations of the Autonomous Region of Madrid (Registro de Fundaciones de la Comunidad de Madrid), personal sheet number 476.

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**

EX OFFICIO TRUSTEES

Excmo. Sr. D. Rafael van Grieken Salvador
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Counsellor of Education and Research
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Regional Government of Madrid
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Directorate General of Research and Innovation
Department of Education and Research
Regional Government of Madrid
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Deputy Director of Research
Sub-directorate General of Research
Directorate General of Universities and Research
Department of Education and Research
Regional Government of Madrid
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Ilmo. Sr. D. José Manuel Torralba Castelló
Director General of Universities and Higher Arts Education
Directorate General of Universities and Higher Arts Education
Department of Education and Research
Regional Government of Madrid
(Madrid, Spain)

Sr. D. José de la Sota Ríus
Scientific-Technical Coordinator
Madrimasd Foundation for Knowledge
(Madrid, Spain)

ELECTIVE TRUSTEES - PRESTIGIOUS SCIENTISTS

Prof. Dr. Ralf Steinmetz
President of the Board of Trustees
Full Professor & Managing Director of Multimedia Communications Laboratory (KOM)
Technische Universität Darmstadt
(Darmstadt, Germany)

Prof. Dr. Gustavo de Veciana
Cullen Trust Professor, Department of Electrical and Computer Engineering
The University of Texas at Austin
(Austin, Texas, USA)

Dr. Huw Oliver
Former Technical Director, European Research Consortium
Hewlett-Packard Laboratories
(Bristol, United Kingdom)

Prof. Dr. Mario Gerla
Full Professor, Computer Science Department
University of California (UCLA)
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Dr. Heinrich J. Stüttgen
Deputy Vice President
NEC Laboratories Europe
(Heidelberg, Germany)

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Mr. Isaac Gil Rabadán
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Mr. Ignacio Villaseca Costero
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Designated representative
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OHL concesiones *(Madrid, Spain)*
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Mr. Diego de Lapuerta Montoya
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Innovation Expert
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Mr. Carlos Nieva Martínez
Director of Tactical Planning and Implementation
Ericsson
(Madrid, Spain)

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(Madrid, Spain)
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Vice-President for Scientific Policy

Universidad Rey Juan Carlos
(Madrid, Spain)
Designated representative
Prof. Dr. Luis Pastor Pérez
Professor of Computer Architecture and Technology

Universidad de Alcalá
(Madrid, Spain)
Designated representative
Prof. Dr. Juan Ramón Velasco Pérez
Vice-Rector of Postgraduate Studies and Continuing Education

Universidad Complutense de Madrid
(Madrid, Spain)
Designated representative
Prof. Dr. Ignacio Martín Llorente
Professor and Head of the Data-Intensive Cloud Lab
Faculty of Computer Science & Engineering

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.

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 at 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 at the 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 at the 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

Sheafor-Lindsay Professor of Electrical and Computer Engineering at 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. Ralf STEINMETZ

President of Board of Trustees of IMDEA Networks Institute; Full Professor & Managing Director of Multimedia Communications Lab (KOM) at 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 at the 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

Dr. Heinrich J. STÜTTGEN

Deputy Vice President at NEC Laboratories Europe. Heidelberg. Germany

PhD: Computer Science, Associative Memory Architecture, University of Dortmund. Germany
Research: Network Architecture and Protocols; Software Defined Networking; Internet of Things (IoT)

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graphic design
base 12 diseño y comunicación

D.L.
M-17775-2018

Comunidad de Madrid

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