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iMdea
networks

developing the
science of networks

annual report
2019
www.networks.imdea.org

# foreword

annual report

2019

www.networks.imdea.org

Arturo Azcorra
Director of the
IMDEA Networks Institute
September 2020

IMDEA Networks Institute is a top research institute in the Science of Networks and Communication Technology worldwide. It focuses on an area that has a profound impact on people's lives. Over the last decades, 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 importance of networks has made itself even more evident during the current crisis of COVID-19. In this crisis, networks have played a fundamental role to substitute the physical interaction between people. Indeed, during this period networks have allowed that work, social interactions, entertainment and life in general continue in spite of the drastic confinement measures that have been adopted. Without networks, the impact of the pandemic would have been unthinkable.

"WE HAVE SEEN THAT THOSE SOCIETIES THAT ARE MORE ADVANCED IN TERMS OF DIGITAL TRANSFORMATION HAVE BEEN ABLE TO COPE WITH THE CRISIS MUCH MORE EFFECTIVELY, SUFFERING A MUCH SMALLER ECONOMIC AND SOCIETAL IMPACT."

It is worth highlighting that the response of network technology during the crisis has been excellent. At IMDEA Networks, we have been monitoring the overall performance of telematics services during this exceptional period, and have observed that there has been an overall 30% traffic increase on the network. Networks have been able to cope with this traffic increase and have kept delivering a good service. This is thanks to the technological advances pushed by networking researchers over the last decade, which have resulted in the very robust and flexible network technology that we enjoy nowadays. There is no other

network in the world that could have supported such a drastic increase in demand. For instance, if the demand of electricity suddenly increased by even a much smaller amount, the electricity network would collapse, and the same would happen with the road system, public transportation, or any other existing network.

Beyond networks, the COVID-19 crisis has also taught us a lesson on the importance of digital transformation. Digital transformation deals with the digitalization of the society as a whole, involving areas such as teleworking, electronic commerce, telemedicine, teleteaching, digital administration and connected industry, among others. We have seen that those societies that are more advanced in terms of digital transformation have been able to cope with the crisis much more effectively, suffering a much smaller economic and societal impact. This highlights the importance of advancing the digital transformation of our society, in order to develop an economy that is both much more productive, and at the same time more robust to crises.

Last but not least, I would like to highlight the contributions of IMDEA Networks to mitigate the impact of the COVID-19 crisis. Networks can be very effective to track contacts between people and thus monitor and control the spread of the disease. An early study conducted by IMDEA Networks on crowdsourced data from 400K mobile phones has allowed to analyse the behaviour of people during the lockdown, identifying indicators to infer the vulnerability of different provinces in case of second wave. Some of these results made it to national press and TV, with an estimated media impact worth 1 M€.

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

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summary

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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 2019, the Institute has continued to reinforce its research team. Among the researchers added to our team, it is worth highlighting the incorporation of Marco Fiore as a Research Associate Professor. Dr. Fiore is a highly reputed researcher with extensive experience in top academic institutions such as University College London, Rice University and Politecnico of Torino. He is a highly impactful researcher, widely cited and has numerous top publications. When joining, he brought to the institute a substantial amount of funding in the form of a recently awarded European Innovative Training Network (ITN).

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 2019 the Institute graduated 5 new PhD Students, who joined companies such as Telefonica (Spain) and Adlink (France), among others. The steady flow of highly qualified doctors produced by the institute is an important contribution to the national and European economy.

The awards and prizes received by our researchers for their research work and achievements testify to their international reputation. In 2019, Joerg Widmer was named "Distinguished Member" of ACM and IEEE Fellow, very high distinctions reserved to the very top professionals of these associations. Antonio Fernandez Anta was awarded the National Computer Science Award ARITMEL by the Spanish Computer Science Association (SCIE) – BBVA. Narseo Vallina received the Research Award Emilio Aced on Protection of Personal data, granted by the Data Protection Spanish Agency. Other awards received by our researchers include the 2020 Norton LifeLock Fellowship, the First Prize at the SAS Hackathon 2019 and the 3rd position in the Positioning Algorithm Competition of the IEEE Communication Theory Workshop (CTW).

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 2019, in addition to prizes for the high quality of our scientific results. In particular, two important paper awards were granted to IMDEA Networks researchers at conferences: the Best Practical Paper Award at the IEEE Symposium on S&P and the Distinguished Paper Award at USENIX Security 2019.

It is particularly worth highlighting the impact that IMDEA Networks had this year on the best conferences in our area. We published two papers at IEEE INFOCOM (out of a total of three papers authored by Spanish researchers) and had 7 members in the Technical Program Committee of IEEE INFOCOM (out of 10 researchers from Spain). We further published 3 papers at ACM MOBICOM and 3 papers at ACM Mobisys, including us among the institutions in the world with most publications in these two very prestigious conferences. IMDEA Networks has published consistently in these venues for many years.

The excellence of IMDEA Networks' results has been recognized by Computer Science Rankings (csrankings.org), which provides a metrics-based ranking of top computer science institutions around the world based on their presence at the most prestigious publication venues. In the five-year period comprised between 2015 and 2019, CS Rankings place IMDEA Networks in the 2nd position in Europe on Measurement & Performance Analysis, the 3rd position in Mobile Computing and the 17th in Computer Networks. This puts IMDEA Networks among the selected few topmost European institutions in the area of networking.

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 researchers are currently contributing to 26 ongoing research projects that have attracted funding from various sources: 9 European projects, 2 national projects and 3 financed by the regional government of Madrid, in addition to 12 contracts with industrial partners and other projects funded by international bodies.

Among industry collaborations, it is worth highlighting the strategic partnerships maintained by IMDEA. Telefonica co-founded 5TONIC with IMDEA Networks and has a Joint Research Unit (JRU), in addition to participating in many research projects together.

Ericsson is a key partner of 5TONIC and collaborates with IMDEA in multiple fronts, including research projects as well as in of the leading Masters in the world on SDN and NFV. NEC collaborates with IMDEA Networks on many fronts and has established a Joint Research Unit (JRU) with IMDEA Networks. The 5TONIC initiative, which is among the most prominent European efforts to deploy and exploit 5G technology. It gathers key players in the 5G ecosystem and is closely collaborating with vertical industries in order to bring 5G to different economic sectors.

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, 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.

Over the last years we have been consistently appearing in national and international, specialized and generic media with a large outreach, and this year has been no exception.

Media impacts on several sources as El País, ABC, are some of the circa 160 unique media outlets that carried our news during 2019.

Most interest has been garnered by the study of how thousands of the most popular apps and games available in the Google Play Store, most of them free of charge, carry out potentially illegal tracking of children's use habits and share the data without consent with third-party services. The activities of 5TONIC, in particular our report on the key role awarded to the lab in a €50m EU sponsored 5G program and its participation in the world's first Master's degree in 5G, have contributed to positioning it as one of Europe's foremost 5G digital innovation centers. As well as the collaboration in a joint proof of concept project with Celling 5G; the presentation, together with SAMUR-PC and the University Carlos III of Madrid (UC3M), of a new system for situations 5G-based emergency plan, developed under the European innovation project 5G-TRANSFORMER; new deployments; presences in great events as Mobile World Congress 2019 and 5G Core Summit: new collaborators incorporated, as Innovalia and Nokia Bell Labs...

Building on our results of 2019, in the year ahead we look forward to making more impactful scientific discoveries, establishing fruitful collaborations, launching exciting new research initiatives and increasing our outreach, all in the interest of society.

about us

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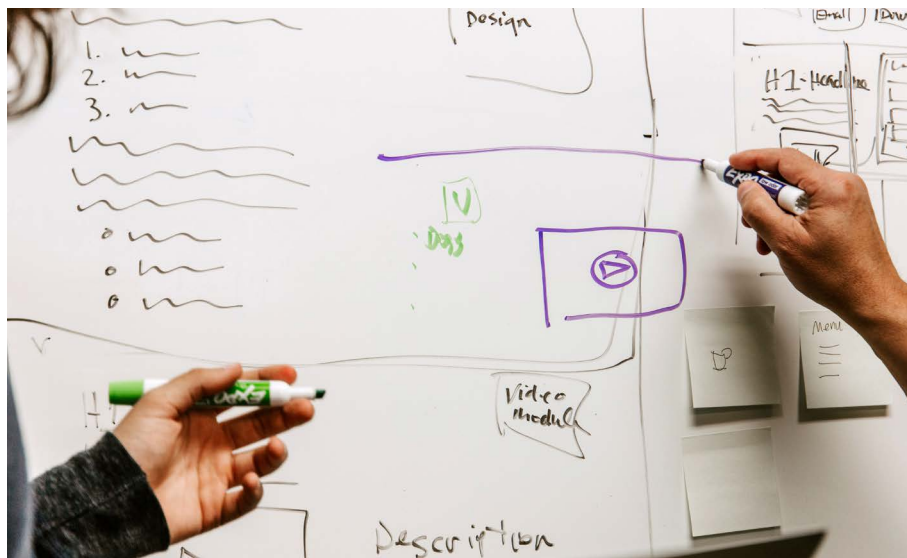
2.1. Profile

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
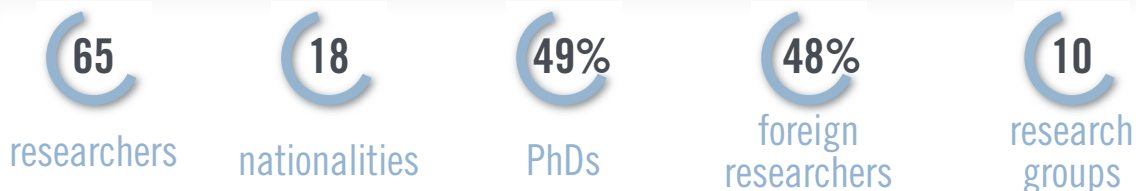
Our mission is to create value by **leading research in protocol, algorithm and systems developments** that enable the **Digital Knowledge Society**. We do this by conducting research and developing innovative and useful scientific and technical advances in the above areas, while actively **promoting 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.

RESEARCH PROGRAMMES
- Global Computing Group [Antonio Fernández Anta]
- Internet Analytics Group [Narseo Vallina-Rodríguez]
- NETCOM Lab [Arturo Azcorra, Albert Banchs and José Félix Kukielka]
- NetEcon Group [Sergey Gorinsky]
- Opportunistic Architectures Lab [Marco Ajmone Marsan and Vincenzo Mancuso]
- Pervasive Wireless Systems Group [Domenico Giustiniano]
- Wireless Networking Group [Joerg Widmer]
- Ubiquitous Wireless Networks Group [Paolo Casari]
- Networked Systems Group [Kirill Kogan]
- Data Transparency Group (DTG) [Nikolaos Laoutaris]

2.5. The Institute in figures

The core strength of the Institute is its international **research team, consisting of talented researchers from 18 different nationalities,** which carries out new scientific discoveries in Computer Networks, and foster the development of emerging technologies.

65	**18**	**49%**	**48%**	**10**
researchers	nationalities	PhDs	foreign researchers	research groups

The facilities of IMDEA Networks Institute
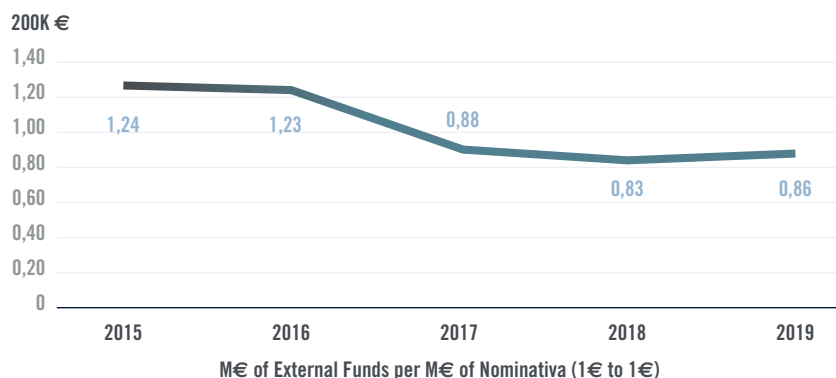
The building and laboratories of IMDEA Networks Institute are located at Leganés, Madrid

402 m² of research labs
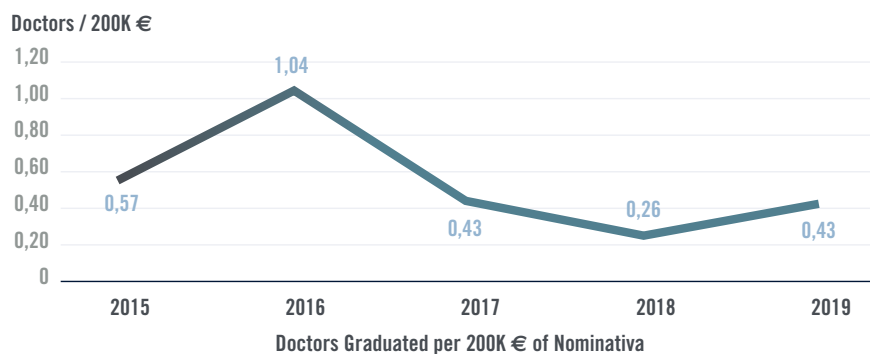
In order to support cutting-edge research, IMDEA Networks invests in the latest, **state-of-the-art laboratories and laboratory test equipment**, endowing the Institute with the capacity of transforming research into high added value products and services.
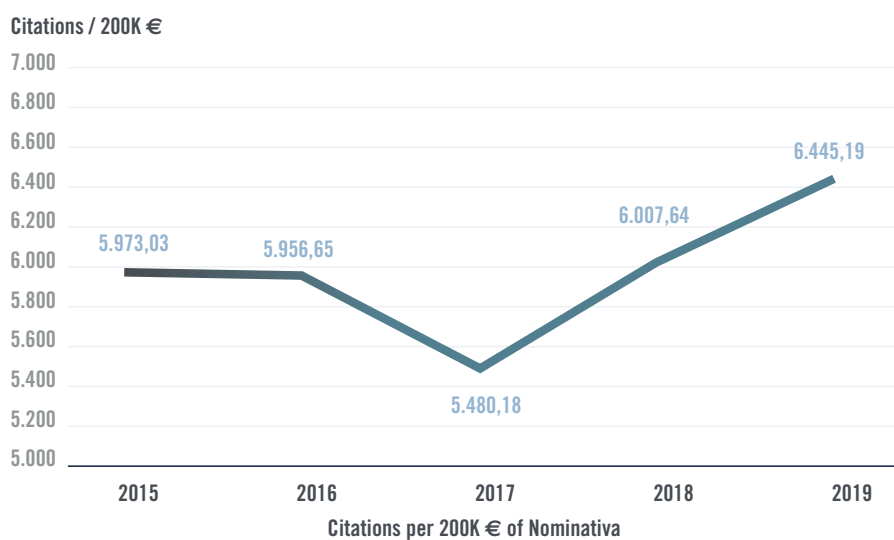
**We produce <u>Money</u>
for Madrid' GDP:
Self Funding**

200K €

1,24   1,23   0,88

0,83   0,86

1,40
1,20
1,00
0,80
0,60
0,40
0,20
0

2015   2016   2017   2018   2019

M€ of External Funds per M€ of Nominativa (1€ to 1€)

**We produce <u>Talent</u>:
Doctors graduated**

Doctors / 200K €

1,04

0,57

0,43   0,26   0,43

1,20
1,00
0,80
0,60
0,40
0,20
0

2015   2016   2017   2018   2019

Doctors Graduated per 200K € of Nominativa

**We produce <u>Leadership</u>
for Madrid: Citations**

Citations / 200K €

5.973,03   5.956,65

5.480,18

6.007,64

6.445,19

7.000
6.800
6.600
6.400
6.200
6.000
5.800
5.600
5.400
5.200
5.000

2015   2016   2017   2018   2019

Citations per 200K € of Nominativa

**Those who can imagine
anything, can create
the impossible**
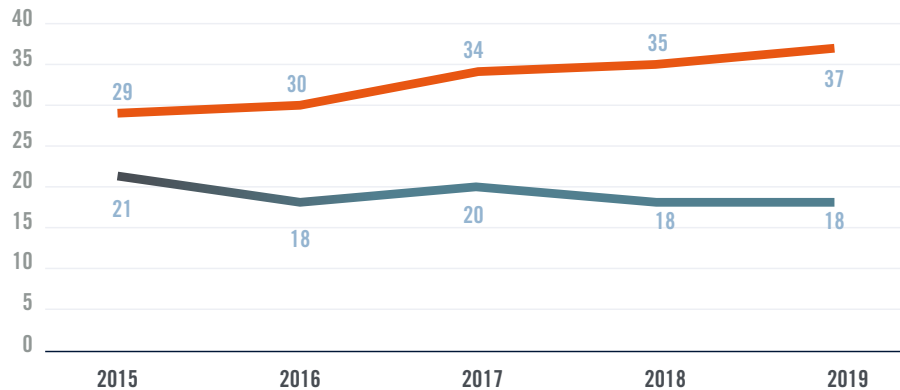
Alan Turing

institute
iMdea
networks
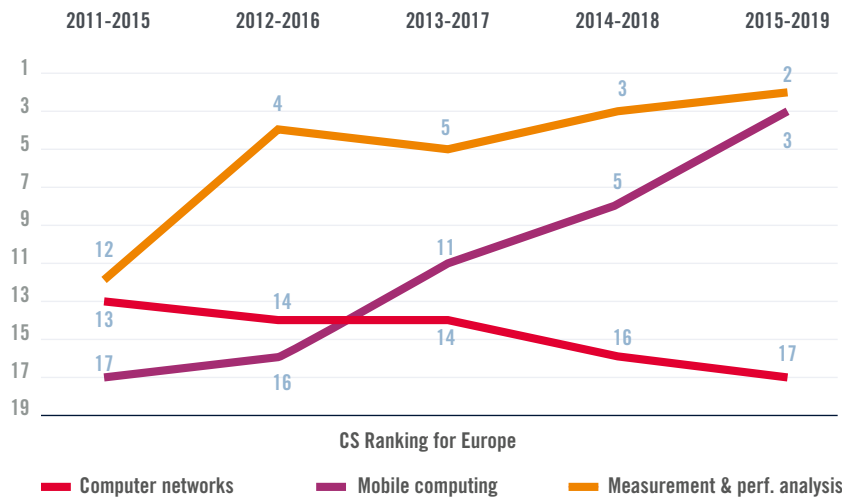
We produce internationalization of Madrid: Nationalities Current / Cumulative

Nationalities / 200K €

Nationalities per year (in blue): 21, 18, 20, 18, 18 (2015–2019)
Cumulative per 200K € (in red): 29, 30, 34, 35, 37 (2015–2019)

Nationalities: per year (in blue), and cumulative (in red) per 200K € of Nominativa

We produce Leadership for Madrid: CS-Ranking (Europe)

	2011-2015	2012-2016	2013-2017	2014-2018	2015-2019
Measurement & perf. analysis	12	4	5	3	2
Mobile computing	17	16	11	5	3
Computer networks	13	14	14	16	17

CS Ranking for Europe

— Computer networks — Mobile computing — Measurement & perf. analysis

Computer Networks
- ETH Zurich ► 1
- University College London ► 2
- Hebrew University of Jerusalem ► 3
- Max Planck Society ► 3
- University of Cambridge ► 3
- Technion ► 6
- EPFL ► 7
- Universidade de Lisboa ► 8
- University of Kent ► 9
- TU Berlin ► 10
- University of Edinburgh ► 10
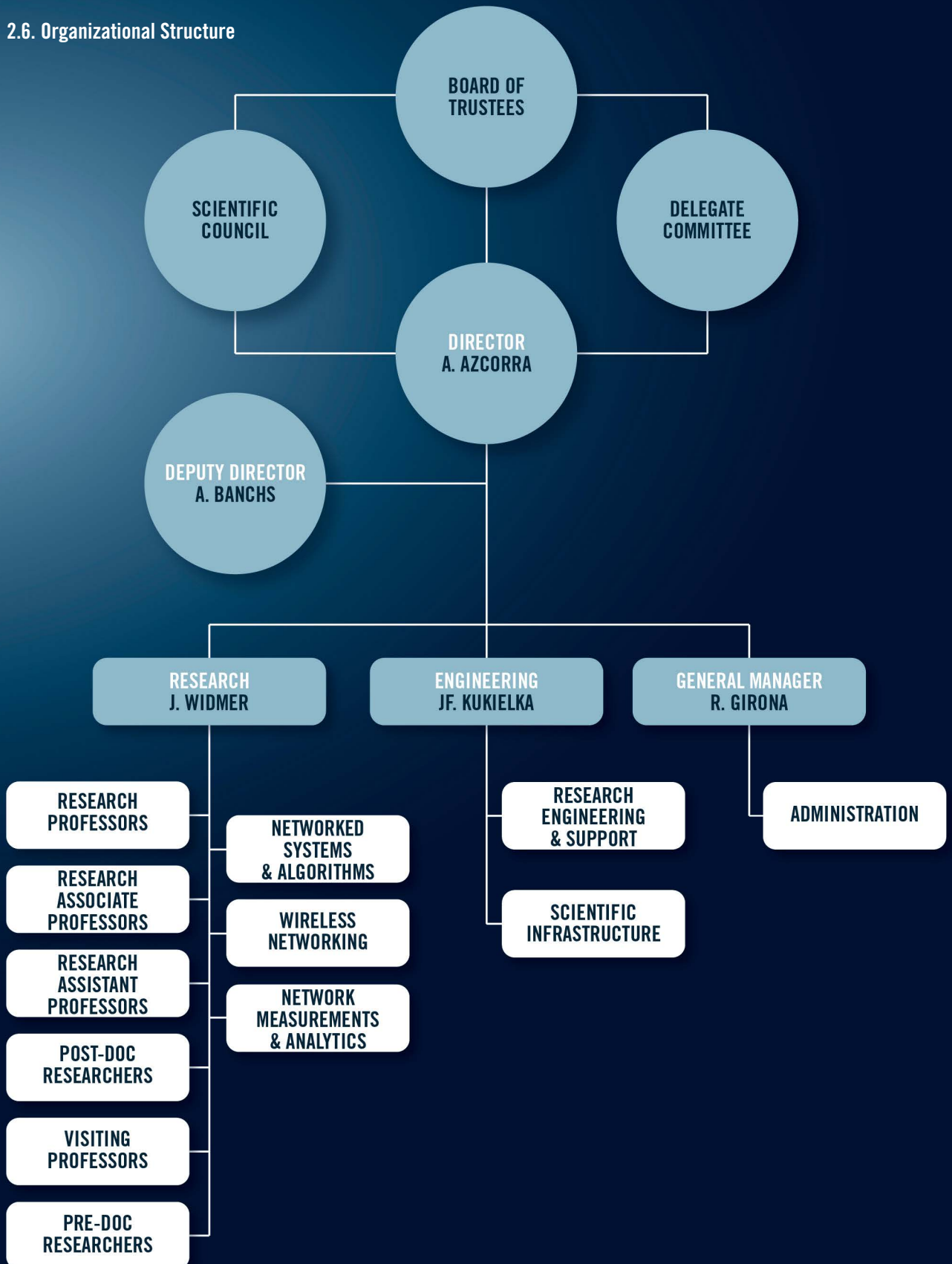
Mobile Computing
- University of Oxford ► 1
- ETH Zurich ► 2
- IMDEA Networks Institute ► 3
- Uppsala University ► 4
- University of Cambridge ► 5
- TU Darmstadt ► 6
- TU Delft ► 6
- Max Planck Society ► 8
- Politecnico di Milano ► 9
- University of Kiel ► 10

Measurement & perf. analysis
- ETH Zurich ► 1
- IMDEA Networks Institute ► 2
- Max Planck Society ► 2
- EPFL ► 4
- Brandenburg University of Technology ► 5
- University of Vienna ► 6
- University of Warwick ► 7
- Imperial College London ► 8
- Technion ► 9
- University College London ► 9
- University of Cambridge ► 9

2.6. Organizational Structure

BOARD OF TRUSTEES

SCIENTIFIC COUNCIL

DELEGATE COMMITTEE

DIRECTOR A. AZCORRA

DEPUTY DIRECTOR A. BANCHS

RESEARCH J. WIDMER

ENGINEERING JF. KUKIELKA

GENERAL MANAGER R. GIRONA

- RESEARCH PROFESSORS
- RESEARCH ASSOCIATE PROFESSORS
- RESEARCH ASSISTANT PROFESSORS
- POST-DOC RESEARCHERS
- VISITING PROFESSORS
- PRE-DOC RESEARCHERS

- NETWORKED SYSTEMS & ALGORITHMS
- WIRELESS NETWORKING
- NETWORK MEASUREMENTS & ANALYTICS

- RESEARCH ENGINEERING & SUPPORT
- SCIENTIFIC INFRASTRUCTURE

- ADMINISTRATION

2.6.1. 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. Eduardo Sicilia Cavanillas

Ex Officio Trustees

Excmo. Sr. D. Eduardo Sicilia Cavanillas
Vice-President of the Board of Trustees
Counsellor of Science, Universities and Innovation
Department of Science, Universities and Innovation
Regional Government of Madrid
(Madrid, Spain)

Ilma. Sra. Dña. María Luisa Castaño Marín
Director General of Research and Innovation
Directorate General of Research and Technological Innovation
Department of Science, Universities and Innovation
Regional Government of Madrid
(Madrid, Spain)

Ilma. Sra. Dña. Bárbara Fernández-Revuelta Fernández-Durán
Deputy Director of Research
Sub-directorate General of Research
Directorate General of Universities and Research
Department of Science, Universities and Innovation
Regional Government of Madrid
(Madrid, Spain)

Ilma. Sra. Dña. Sara Gómez Martín
Director General of Universities and Higher Arts Education
Directorate General of Universities and Higher Arts Education
Department of Science, Universities and Innovation
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)

Prof. Dr. Mario Gerla
Full Professor, Computer Science Department
University of California (UCLA)
(Los Angeles, USA)
Prof. Dr. Gerla passed away on February 9th, 2019

Prof. Dr. Ioannis Stavrakakis
Full Professor & Head, Department of Informatics and Telecommunications
National and Kapodistrian University of Athens
(Athens, Greece)
From June 2018

Dr. Heinrich J. Stüttgen
Deputy Vice President
NEC Laboratories Europe
(Heidelberg, Germany)

2.6.2. Scientific Council

The Scientific Council is a very important organ of IMDEA Networks, advising us on all aspects of the Institute's scientific activities. Among many other things, the Council proposes the incorporation and renewal of Scientific Expert members of the Board of Trustees; reviews and approves scientific appointments, and generally provides support to the Director – Dr. Arturo Azcorra and the Deputy Director – Dr. Albert Banchs – in determining scientific research strategy and policies.

The Institute's Scientific Council is composed of internationally prestigious researchers in the field of Telematics and Internet technologies. IMDEA Networks is greatly strengthened by the participation of these eminent scientists. The current members are:

Dr. Gonzalo CAMARILLO

Position: Standardization Director, Ericsson. Finland

PhD: Aalto University. Helsinki. Finland

Research: Signaling; Multimedia applications; Transport protocols; Network security; Networking architectures

Prof. Dr. Jon CROWCROFT

Position: 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

Position: 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

Position: 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

Period of service:
Dec 2015 to Feb 2019.
Prof. Dr. Gerla passed away on February 9th, 2019

Prof. Dr. Edward KNIGHTLY

Position: 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. Pablo RODRIGUEZ RODRIGUEZ

Position: 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

Prof. Dr. Ralf STEINMETZ

Position: 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. Ioannis STAVRAKAKIS

Position: Full Professor & Head Department of Informatics and Telecommunications. National and Kapodistrian University of Athens. Athens. Greece

PhD: Electrical Engineering. University of Virginia. Charlottesville. USA

Research: Analysis and Design aspects of Networking Technologies ranging from Link to Application Layers: Social, Mobile, Ad Hoc, Autonomic, Information Centric, Delay-tolerant and Future Internet Networking; Network Resource Allocation Algorithms & Protocols, Traffic Management & Performance Evaluation; Content Dissemination, Placement & (Cooperative) Replication in Unstructured P2P and Social Networks; (Human-Driven) Decision Making in Competitive Environments

Dr. Heinrich J. STÜTTGEN

Position: 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)

NODE 01

NODE 04

NODE 05

NODE 06

NODE 02

BLOCK 01

NODE 03

BLOCK 01

NODE 01

NODE 02

BLOCK

```
or_mod = modifier_ob.
mirror_object to mirror
mirror_mod.mirror_object
operation == "MIRROR_X":
mirror_mod.use_x = True
mirror_mod.use_y = False
operation_z = False
mirror_mod.use_x = False
mirror_mod.use_y = True
operation == "MIRROR_Y":
mirror_mod.use_z = False
operation == "MIRROR_Z":
mirror_mod.use_x = False
mirror_mod.use_y = False
mirror_mod.use_z = True

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-- OPERATOR CLASSES ----

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ject.mirror_mirror_x"
ror X"

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research areas

3

annual report
2019
w w w . n e t w o r k s . i m d e a . o r g

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:

networked
systems&algorithms

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.

3.2. Wireless Networking

Scientific Director of "Wireless Networking": Joerg Widmer.

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

IMDEA Networks is involved in a number of different wireless research areas. We are investigating emerging wireless technologies such as extremely high frequency communication for 5G and wireless LAN and Visible Light Communication, which promise to increase wireless data rates by an order of magnitude or more. Our work on capacity improvements 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. 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.

network measurements&analytics

3.3. Network Measurements and Analytics

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

The rapid evolution of the Internet, comprising the fixed network, 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 analyze 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.
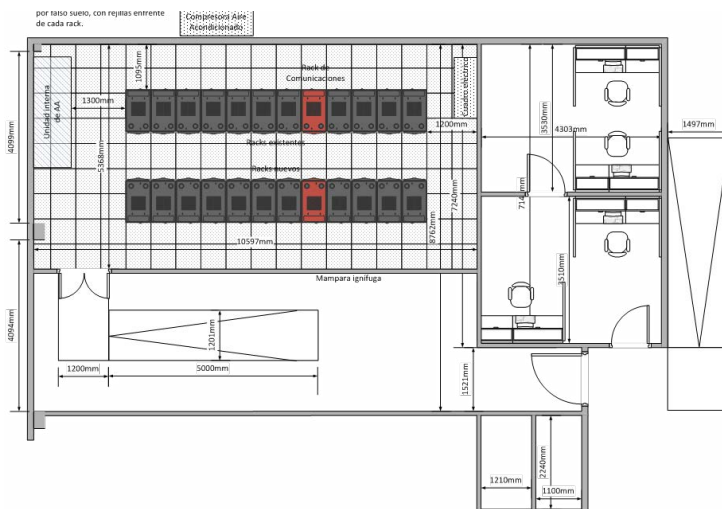
3.4 Headquarters and research laboratories infrastructure

3.4.1 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 Mediterráneo in Leganes (Madrid) in order to furnish it with renovated and extended facilities. The new spaces are conceived primarily with researchers' needs and preferences in mind, including spacious premises with state-of-the-art facilities and equipment, labs adapted to the needs of our lines of research, with excellent communications and ICT infrastructure, and specific research equipment.

The area of the building already remodeled in 2019 amounted to 2.278 m^2.

- **Transformation Center**: In 2018 was installed the sectioning center and the medium voltage transformation center. In the second quarter of 2019 it came into operation, with a capacity of 630 KVA that will satisfy the Institute´s increase in future demand for electricity.

- **5 Tonic**: In 2019, Phase 2 of the 5 TONIC laboratory was implemented, which consisted of the expansion of 12 additional racks, interconnection wiring, electrical protections and electronic equipment.

- **High-speed fiber connection**: At the beginning of the third quarter of 2019, the connection to REDIMadrid, the Community of Madrid's research data network, was made through a 10Gb/s redundant fiber for the exclusive use of IMDEA Networks. The fiber serves both, IMDEA Networks and 5 TONIC laboratory.

- **Auditorium**: In 2019, the tender for the refurbishment of the auditorium and the audiovisual system was launched, and the project will be executed and completed in the second half of 2020. The auditorium will have an area of 200 m2 and can be converted into two separated meeting rooms by means of a mobile acoustic panel. It will include a warehouse where equipment and furniture can be stored.

3.4.2 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.

The acquisition of a new generation Fortigate FG-501E firewall and router with redundant power supply has been completed in 2019, which will provide advanced cyber security services to all IMDEA Networks' data networks.

- Scientific equipment: A high-capacity Dell R540 server has been purchased to migrate the network services currently residing on two Linux servers in two different networks, IMDEA Networks and UC3M University, providing greater robustness and with the capacity to host future services and systems.

A Dell R440 high performance server has been purchased for carrying out use case studies and tests to validate the performance of 5G networks providing solutions for industry, health services, transport and media, in collaboration with other entities.

For the development of new techniques to analyze the behavior of network systems and applications and their impact on security and privacy, a high-capacity Dell PowerEdge T640 server for data analysis has been acquired, together with as a high-performance storage solution for Synology R3617xs+ rack, to store data from active Internet searches and to collect data from Android firmware versions and Android applications on a global scale.

Two EVK06002/00 evaluation cards have been purchased for sending and receiving millimeter waves used for the development of experimental platforms that allow the in-depth study of signal processing algorithms that can be used in modern and future communications systems.

ASUS RT-AC86U high-speed wireless connectivity routers have been purchased to conduct studies to understand modern indoor positioning algorithms and their implementation in commercial devices used for Internet of Things solutions.

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 driving the 5G development. 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.

In 2019 carried out a number of activities in order to pursue two objectives:

1. Support for the development of new technological solutions for 5G.

2. Support for the implementation and deployment of new use cases that take advantage of 5G capabilities.

As an example of the projects launched for pursuing the first objective, 5TONIC members Telefónica, Ericsson, CommScope, IMDEA Networks, and UC3M collaborated in a joint proof of concept project with Celling 5G, in order to test the solution proposed and help further in the development of any equipment required to support the initiative. The project included the deployment of a small cell within the 5TONIC lab with the enclosure provided by Celling 5G, in order to carry out feasibility testing and a performance assessment of the solution. The technology is designed to overcome some of the problems that have so far held back the widespread deployment of outdoor small cells, in order to carry out feasibility testing and a performance assessment of the solution.

In terms of new use cases, 5TONIC presented, together with SAMUR-PC and the University Carlos III of Madrid (UC3M), a new system for situations 5G-based emergency plan, developed under the European innovation project 5G-RANSFORMER.

The demo showed a 5G 100% automatic system that allows to reduce the time of action and minimize errors, which implies a higher percentage of survival in emergency situations. The system allowed personalized attention to have the patient's medical data such as, among others, the pulse and blood test values. These values are shown in real time to the doctor in 5G augmented reality glasses to facilitate their flow of decisions when attending to the patient.

In another use case, Unmanned Teknologies Applications (UTEK), in cooperation with 5TONIC members Telefónica, Ericsson and IMDEA Networks, carried out the first world experience of a remotely controlled unmanned surface vessel (USV) using the connectivity provided by the Telefónica commercial 4G network. The trial was carried out at the Pantano de San Juan in Madrid in early December and the results fulfilled all the expectations.

In order to fulfill these objectives, 5TONIC has continued the expansion of its infrastructure. In this sense, on June 13, Ericsson and Telefónica successfully implemented 5G NSA technology at the 5TONIC open innovation lab. This new deployment includes a new 5G Massive MIMO Radio running on 3.5GHz band along with 5G virtual Evolved Packet Core and User Data Consolidation. The first 5G data transmission has been completed using a 5G WNC Pocket Router and tests will continued with commercial 5G-capable routers and phones to cater for new uses cases at 5TONIC.

During the year, 5TONIC has continued having an important presence in different events, like the participation of Arturo Azcorra in the Mobile World Congress 2019 and in the 5G Core Summit, or the presence of Telefónica and Intel representatives in the 2019 edition of the South Summit, the most important event on entrepreneurship and innovation in Spain.

During 2019, 5TONIC also has incorporated several new collaborators to cooperate in several use cases, including Innovalia and Nokia Bell Labs.

research projects, grants and fellowships

4

annual report
2019
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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)

4.1.2 National

Ramón y Cajal Grants
(Programa Ramón y Cajal)

Awardee
- 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 Formation Grants 2017

Awardees
- Dr. Claudio FIANDRINO, Post-Doc Researcher
- Dra. Amanda GARCÍA-GARCÍA, Research Engineer

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

Juan de la Cierva Incorporation Grants 2015

Awardees
- 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
- Dolores GARCÍA, PhD Student
- Joan PALACIOS BELTRÁN, PhD Student

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

Grants to promote youth employment and the implementation of the Youth Guarantee system in R&D+I (2018)

(Ayudas para la promoción de empleo joven e implantación de la garantía juvenil en I+D+I (2018)

Awardees:

- Elvira CONTI Junior Project Administrator
- Marta DORADO Junior Science Communicator
- Rubén RUPÉREZ R&D laboratory technician

Funded by:

Ministry of Economy and Competitiveness

4.1.3 Regional

Youth Employment Initiative (YEI) – Programa de Empleo Juvenil

(Convocatoria de ayudas para la contratación de investigadores predoctorales e investigadores postdoctorales cofinanciadas por Fondo Social Europeo a través del Programa Operativo de Empleo Juvenil y la Iniciativa de Empleo Juvenil (YEI)
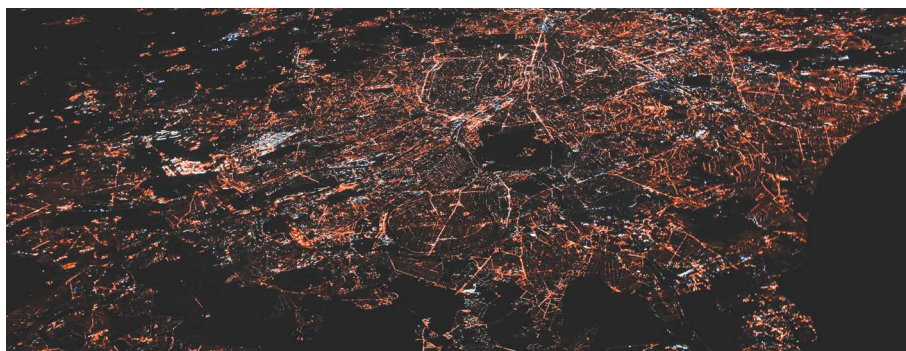
Awardee

- Dr. Marius PARASCHIV, Post-Doc Researcher

Funded by

European Social Fund (Youth Employment Initiative), Department of Education, Youth and Sports, Regional Government of Madrid

4.2 Ongoing projects

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.

PIMCITY
(Construyendo las plataformas de datos personales de próxima generación)

Funded by: European Union H2020-ICT-2018-2020 (Tecnología de la información y la comunicación).
Duration: December 2019 to November 2023.

Web economy has been revolutionized by unprecedented possibility of collecting massive amounts of user personal data, which lead the web to become the largest data market and created the biggest companies in our history.

Unfortunately, this change has deep consequences for users, who, deprived of any negotiation power, are compelled to blindly provide their data for free access to services. Data collection is opaque, fragmented and disharmonic, so that users have no control over their personal data, and, thus, on their privacy. Personal Information Management Systems (PIMS) aim to give users back control over their data, while creating transparency in the market. However, so far, they have failed to reach business maturity and sizeable user bases. PIMCity offers tools to change this scenario.
More info

MINTS

Funded by: European Union H2020-MSCA-ITN-2019 (Marie Skłodowska-Curie Innovative Training Networks)
Duration: November 2019 to October 2023

The global telecommunications market has become tremendously competitive due to the emergence of new Asian players and saturation of traditional products (e.g., mobile broadband), which has decelerated the growth of the EU's telecommunications market. Thus, without dramatic innovation to open up new markets, EU's telecommunications industry is at risk. However, new markets such as industry 4.0 and autonomous driving demands extremely high data rates which can only be provided at mmWave frequencies. To successfully overcome mmWave challenges, a closely integrated, skilled and multi-disciplinary team is needed to co-create innovative technology and applications. The ETN for MIllimeter-wave NeTworking and Sensing for Beyond 5G (MINTS) offers the first training program on mmWave networks that covers the full stack from physical layer to application.
More info

ENLIGHT'EM

Funded by: European Union H2020-MSCA-ITN-2018 (Marie Skłodowska-Curie Innovative Training Networks) Grant.
Duration: June 2019 to May 2023

An Innovative Training Networks (ITN) project, type which aims to train a new generation of creative, entrepreneurial and innovative early-stage researchers, able to face current and future challenges and to convert knowledge and ideas into products and services for economic and social benefit. Light Emitting Diodes (LEDs) are driving a revolution in lighting systems (superior energy efficiency), and are already entering the Internet of Things (IoT) market with embedded sensory functionalities. By bringing connectivity to every LED bulb, Visible Light Communication (VLC) offers the opportunity to write the next chapter of the LED revolution with the language of ubiquitous networks VLC systems for the IoT to design and demonstrate sustainable networking solutions. ENLIGHT'EM will train a new generation of innovators and provide them with the know-how to contribute to the development of the IoT in the world of 5G and beyond.
More info

EDGEDATA-CM

Funded by: Department of Education and Research of the Regional Government of Madrid, through the 2018 R&D technology program for research groups, co-financed by the Operational Programs of the European Social Fund (ESF) and the European Regional Development Fund (ERDF).
Duration: January 2019 to December 2022

Innovation technologies, cloud computing, IoT, big data and high speed WIFI networks have made possible applications that were inconceivable few decades ago. As a result, the quality of life is improving and better commercial decisions are taken thanks to data analysis. In recent years, as a result of the innovation and new needs there was a boom in distributed systems applied to different contexts such as IoT that has led to new computational paradigms (fog computing, edge computing, cloud computing, blockchain…). Its main goal is to go beyond the state of the art in terms of new architectures for these technologies as well as to propose hybrid solutions combining them.
More info

TAPIR-CM

Funded by: Department of Education and Research of the Regional Government of Madrid, through the 2018 R&D technology program for research groups, co-financed by the Operational Programs of the European Social Fund (ESF) and the European Regional Development Fund (ERDF)
Duration: January 2019 to December 2022

Its aim is to design architectural solutions for 5th generation (5G) and beyond mobile networks. To this end, the project will leverage as enablers SDN (Software Defined Networking) and network functions virtualization (NFV) to boost the transformation of current networks into software-centric paradigm, enabling flexibility and agility in the whole system lifecycle. The evolution of the SDN architecture itself enables high scalability and programmability and, therefore, it is an important objective of the project. The second enabler component will resort to is machine learning. The capability to forecast with high accuracy the behavior and characteristics of data traffic that mobile users will consume through machine learning techniques is pillar to improve the performance of multiple of network functions, including scheduling, mobility management, orchestration and resource allocation, among the others.
More info

PinPoint 5G+

Funded by: Spanish Ministry of Science, Innovation and Universities
Duration: January 2019 to December 2021

Positioning data is the cornerstone to enable data analytics and applications in the location-based service (LBS) market. At the same time, positioning data can bring dramatic benefits to the 5th generation of cellular networks and beyond (5G+) for the management and control of networks that are getting increasingly denser and more heterogeneous. Yet todays cellular systems fail to provide accurate, pervasive and low-latency localization. The result is a plethora of fragmented localization systems based on diverse radio technologies and protocols that do not interoperate. This project aims to extend the functionalities of network to (i) provide accurate and ubiquitous locations of physical entities as a network-native service based on the integration of 5G+ technologies, and (ii) exploit position data to optimize the allocation of network resources based on anticipatory networking concepts.

More info

LOCUS

Funded by: European Union H2020-ICT-2018-2020 (Information and Communication Technology) Grant.
Duration: November 2019 to April 2022

Context-awareness is essential for many existing and emerging applications. Context information greatly relies on location information of people and things. But navigation satellite systems are denied in indoor environments, current cellular systems fail to provide high-accuracy localization, other local localization technologies (e.g. WI-FI or BT) imply high deployment/maintenance/integration costs. Raw spatiotemporal data are not sufficient by themselves and need to be integrated with tools for the analysis of the behaviour of physical targets, to extract relevant feature of interests. LOCUS will improve the functionality of 5G infrastructures to: i) provide accurate and ubiquitous location information as a network-native service and ii) derive more complex features and behavioural patterns out of raw location and physical events, and expose them to applications via simple interfaces.

More info

MYP-SOCRATES

Funded by: NATO Emerging Security Challenges Division – Science for Peace and Security Programme (SPS). Grant G5461.
Duration: June 2018 to September 2021

Create the foundations for an accurate, autonomous, fast and secure system that identifies intruders in the electromagnetic space, before the threat can become serious, learning about its physical layer features and its geographic location.
More info

5G-EVE

Funded by: European Union. H2020-ICT-2018-1
Duration: July 2017 to June 2021

We are at the "eve" of a fundamental transition in 5G, and the aspiration of 5G-EVE is to create the foundations for a pervasive roll-out of end-to-end 5G networks in Europe. It is one of three 5G PPP infrastructure projects started on 1st July 2018, whose goal is to implement and test advanced 5G infrastructures in Europe. The 5G-EVE concept is based on further developing and interconnecting existing European sites in Greece, Spain, France, and Italy to form a unique 5G end-to-end facility, which will enable experiments with: (a) heterogeneous access, including NR, licensed/unlicensed spectrum, advanced spectrum management; (b) Mobile Edge Computing, backhaul, core/service technologies; (c) means for site interworking and multi-site/domain/technology slicing/orchestration. 5G-EVE will be initially compliant with 3GPP Rel. 15 and, later on, with Rel. 16.
More info

COLLABORATE

Funded by: Cyprus Research Promotion Foundation. RPF/POST-DOC/0916/0090 - COL-LABORATE.
Duration: May 2019 to October 2021

Distributed Storage Systems (DSS) encompass the technology powering modern cloud data storage services such as DropBox and Google Drive that are used by millions of users as networked platforms for collaborative applications and data storage. Algorithms for DSS ensure data availability and survivability by replicating data in geographically dispersed network locations. However, a major problem with data distribution is consistency, especially when the storage is accessed concurrently by multiple processes; a key to enabling collaboration. Numerous strategies have been devised to mitigate these issues, however, a robust and efficient solution remains elusive. This project proposes a novel atomic DSS built on top of asynchronous message-passing, failure-prone, commodity devices and its goal is to enhance the practicality of atomic data storage by combining three services: (i) Fragmentation, (ii) Reconfiguration, and (iii) Failure Prediction.
More info

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

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.
More info

SMOOTH
GDPR Compliance Cloud Platform for Micro Enterprises

Funded by: European Union. H2020 Cibersecurity PPP
Duration: May 2018 to October 2020

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. 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 addresses this challenge from two complementary focuses, with the aim of becoming the reference tool platform to adopt the GDPR in this context: creating awareness on the importance of being compliant with the GDPR (SMOOTH will deliver a practical GDPR interactive handbook tailored specifically to MEnts) and assisting to effectively adopt and comply with the GDPR.
More info

SYMBIOSIS

A Holistic Opto-Acoustic System for Monitoring Marine Biodiversities

Funded by: European Union. H2020-BLUE GROWTH 2017
Duration: November 2017 to October 2020

SYMBIOSIS is devised as a blend of cost effective autonomous optical and acoustic components 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 their own environment. The acoustic unit includes an active underwater acoustic array of 15+10 elements, to detect, classify, evaluate the biomass of, and localize the chosen pelagic fish species within a range of 500 m. Acoustics trigger the optical component (encompassing two frames of six underwater optical cameras each), and will perform machine learning-based classification and biomass evaluation in low light conditions, thus validating acoustic detections.

More info

NIST

Funded by: The National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce
Duration: September 2019 to August 2020

Wireless communications in the millimeter-wave (mmWave) band bring unprecedented capabilities to achieve wireline performance in wireless networks and alleviate the congestion problem of current wireless technologies. However, efficient wireless networking in this band is extremely challenging compared to wireless technologies operating in the microwave band. IEEE 802.11ay is the next generation multi-gigabit standard to support wireless networking at 60 GHz. It is envisioned to achieve extremely high data-rates of up to 300 Gbps, using sophisticated physical layer techniques including multiple-input and multiple-output (MIMO) communication, channel bonding and aggregation, advanced beamforming techniques, and high order modulation schemes.

More info

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

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 pro-

totype 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.
More info

DiSCOEdge

Funded by: Spanish Ministry of Science, Innovation and Universities (Ministerio de Ciencia, Innovación y Universidades)
Duration: January 2018 to December 2019

An alternative to the highly centralised cloud computing model, fog computing is becoming widespread: aims to leverage an ecosystem of computing resources distributed all over the communication devices at the edge of the network (e.g., base stations and CPEs), even considering end user devices (e.g. smartphones) and resource-constrained devices (e.g., IoT sensors). As a result, fog-computing aims to complement the existing cloud-computing model by leveraging diverse and richer resources otherwise underused. DiscoEdge will study opportunities, technologies, marketing strategies and policies to advance the fog-computing paradigm, and will explore challenges so that end user devices, applications and access network devices can dynamically and securely share and access any computational resource (storage, networking, sensing and computing power) available in their vicinity (e.g., WiFi islands, home network deployments, trusted devices forming a personal or community cloud and even 5G-and-beyond mobile radio networks). It will also explore economic and sociological challenges to guarantee user trust, fairness and security when accessing resources from third-party services.
More info

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

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 builds 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, and 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 by self-configurable cloud computing systems.

More info

MyBubble
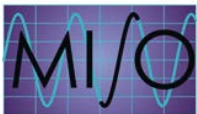
MyBubble: Influence of Algorithms in Users' Filter Bubbles

Funded by: MISTI Global Seed Funds | MIT-SPAIN - "la Caixa" Foundation SEED FUND
Duration: January 2018 to August 2019

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. Its goal 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 mimic the browsing patterns of users with specific profiles.

More info

MISO

Project website: https://www.networks.imdea.org/research/projects/miso
Funded by: European Union H2020 project ORCA (IMDEA Networks is a subcontracted entity)
Duration: September 2018 to May 2019

MISO is an extension project of the H2020 project ORCA to develop a mixed hardware-software millimeter-wave experimentation platform based on software-defined radios (SDR). It implements the basic blocks for a single carrier system integrated into the GNU Radio + RFNoC framework, allowing for a step-by-step translation of blocks from software to hardware implementation in future extensions. The flexibility of the system design will be demonstrated by testing the developed blocks on USRP X310 radios as well as the more powerful Vadatech AMC599 providing 2GHz of bandwidth. This allows to extend the basic platform towards a fully IEEE 802.11ad transceiver. This project will provide the research community with a highly flexible open platform for mm-wave experimentation, ensuring that future extensions to the receiver and transmit model can easily translate more blocks to hardware implementation and add further functionality.

More info

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

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: location-independence; time-independence; scale independence and hardware independence.

More info

SEARCHLIGHT
A new communication paradigm for future very high speed

Project website: https://www.networks.imdea.org/research/projects/searchlight
Funded by: European Union. European Research Council (Consolidator Grant)
Duration: April 2014 to March 2019

SEARCHLIGHT is pursuing a radical rethinking of wireless architectures for highly scalable ultra-dense millimeter-wave networks. To deal with the extremely dynamic radio environments where channels may appear and disappear over very short time intervals, SEARCHLIGHT uses angle information from lower frequency interfaces to rapidly align the directional millimeter-wave antennas. Access points are deployed ubiquitously to provide continuous connectivity even in face of mobility and blockage and the project is designing the corresponding low overhead and scalable network management mechanisms. The architecture integrates a location system and learns a map of the radio environment, which allows to rapidly select the most suitable access point and antenna beam pattern and allocate radio resource using predicted location as context information. Such a design provides key elements for the scalability of future wireless networks.

More info

scientific activities

5

annual report

2019

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

'AEPD EMILIO ACED AWARD 2019 ('DATA PROTECTION AWARDS 2019')
(Spanish Senate, 28 Jan 2019, Madrid)
Gamba, Julien and Rashed, Mohammed and Razaghpanah, Abbas and Tapiador, Juan and Vallina-Rodriguez, Narseo
An Analysis of Pre-installed Android Software

CNIL-INRIA PRIVACY PROTECTION AWARD 2019
(41st IEEE Symposium on Security and Privacy, 18-20 May 2020, San Francisco, CA, USA)
Gamba, Julien and Rashed, Mohammed and Razaghpanah, Abbas and Tapiador, Juan and Vallina-Rodriguez, Narseo
An Analysis of Pre-installed Android Software

DISTINGUISHED PAPER AWARD WINNER
(28th USENIX Security Symposium, August 14–16, 2019 • Santa Clara, CA, USA)
Joel Reardon, Álvaro Feal, Primal Wijesekera, Amit Elazari Bar On, Narseo Vallina-Rodriguez, Serge Egelman
50 Ways to Leak Your Data: An Exploration of Apps' Circumvention of the Android Permissions

BEST CONFERENCE PAPER AWARD
(37th IEEE International Conference on Computer Communications (IEEE INFO-COM 2018), 15-19 April 2018, Honolulu, HI, USA -IEEE ComSoc Technical Committee on Communications Systems Integration and Modeling 2019-)
Paolo Castagno, Vincenzo Mancuso, Matteo Sereno, Marco Ajmone Marsan
A Simple Model of MTC in Smart Factories

5.1.2. Researcher Awards

DISTINGUISHED MEMBER BY ASSOCIATION FOR COMPUTING MACHINERY (ACM)
Joerg Widmer (October 2019)
Prize award for his outstanding scientific contributions to the field of computing. The advanced member grade level of Distinguished Member was initiated in 2006 to recognize ACM Professional Members who have achieved a significant accomplishment in, or made a significant impact on, the computing field.
Widmer received this appointment along 61 longstanding ACM members. All 2019 inductees were selected by their peers for a range of accomplishments that have contributed to technologies that underpin how we live, work and play.

MEMBERSHIP OF THE ACADEMIA EUROPAEA
Ralf Steinmetz (October 2019)
Founded in 1988, the Academy of Europe is the only pan-European academy encom-

passing all branches of knowledge. It is composed of eminent scientists and scholars working towards the advancement and propagation of excellence in scholarship and education for the public benefit.

This appointment recognizes Steinmetz's role as one of the world leaders in the research and development of adaptive seamless multimedia communications.

NATIONAL COMPUTER SCIENCE AWARD ARITMEL, SPANISH COMPUTER SCIENCE ASSOCIATION (SCIE) – BBVA FOUNDATION 2019

Antonio Fernández Anta (May 2019)

Research Awards jointly granted by the Spanish Computer Science Association (SCIE) and the BBVA Foundation. Modality: National Computer Science Awards.

Awarded to Antonio Fernández Anta for "his outstanding scientific contributions in a wide range of areas within Computer Engineering, such as adversarial network models, implementation of failure detectors in distributed computing, fundamental results in networks for multiprocessors or optimization of energy consumption in computer systems, all of which have achieved significant international impact."

FIRST PRIZE SAS HACKATHON 2019

Patricia Callejo, Antonio Pastor, Ignacio Martín, Harold Fernández (April 2019)

1st position granted to the IBiDat (the Research Institute UC3M-Santander of Financial Big Data) team, composed by researchers from Universidad Carlos III de Madrid and IMDEA Networks, to the best initiative in artificial intelligence applied to the environmental efficiency of Correos, the Spanish operator of postal and Courier services.

5.13. R&D Awards

IEEE CTW 2019 – POSITIONING ALGORITHM COMPETITION – 3RD PLACE

Alejandro Blanco, Héctor Cordobés de la Calle, Joerg Widmer, Dolores Garcia Marti (May 2019)

The contestants were asked to develop an algorithm for transmitter positioning based on measurements from a MIMO array. The IMDEA Networks team ranked 3rd in the competition.

(IEEE Communication Theory Workshop – Selfoss, Iceland, 26-29 May 2019)

5.2. Publications

IMDEA Networks presented its scientific work in various formats and venues during 2019. There were **114** publications, out of which **92** were peer reviewed. This is how they are structured:

32 Journal Articles | 4 Magazine Articles | 54 Conference and Workshop Papers | 11 Conference and Workshop Posters & Demos | 17 Invited Papers, Keynotes, Invited Talks, Tutorials, Lectures, etc.

As well as the previous there were:

6 PhD Theses

According to **Google Scholar**, IMDEA Networks' researchers have received around **75.867 citations in total** along their research career, which corresponds to an **aggregated H-index of 121**.
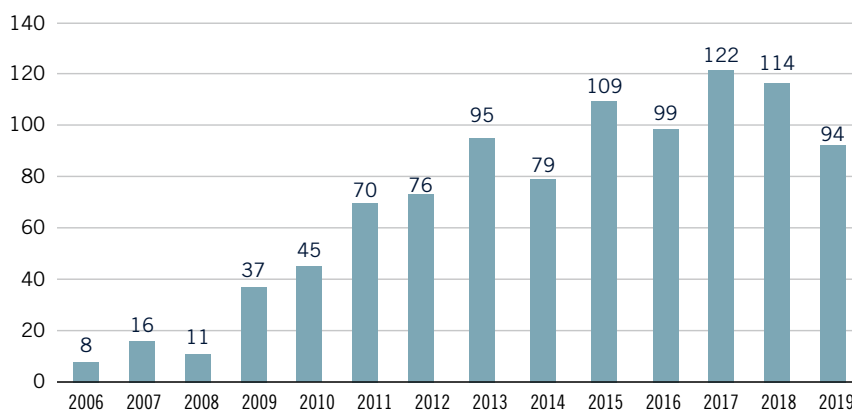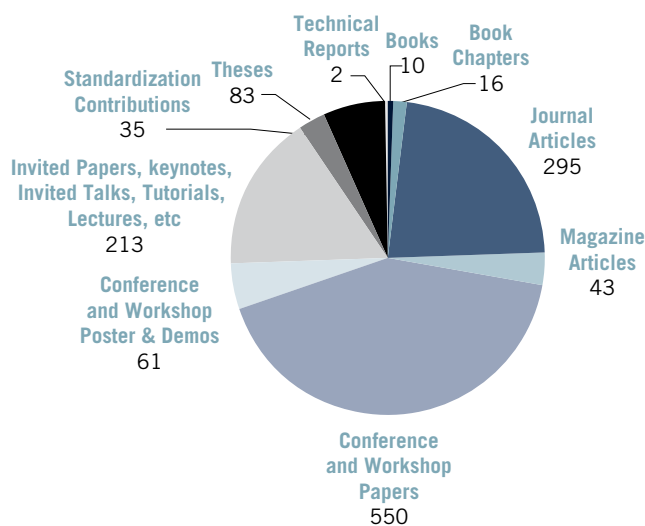
publications

2006-2019

number of publications (peer-reviewed)

Bar chart showing number of publications by year:
- 2006: 8
- 2007: 16
- 2008: 11
- 2009: 37
- 2010: 45
- 2011: 70
- 2012: 76
- 2013: 95
- 2014: 79
- 2015: 109
- 2016: 99
- 2017: 122
- 2018: 114
- 2019: 94

all publications by type

Pie chart showing all publications by type:
- Technical Reports: 2
- Books: 10
- Book Chapters: 16
- Journal Articles: 295
- Magazine Articles: 43
- Conference and Workshop Papers: 550
- Conference and Workshop Poster & Demos: 61
- Invited Papers, keynotes, Invited Talks, Tutorials, Lectures, etc: 213
- Standardization Contributions: 35
- Theses: 83

2019

total number of publications per month

Total = 125

publications by type (peer reviewed)

Conference
and Workshop
Poster & Demos
3

Books
1

Book
Chapters
0

Journal
Articles
32

Conference
and Workshop
Papers
54

Magazine
Articles
4

Total = 94

Genius is one percent inspiration, ninety-nine percent perspiration

Thomas Edison

institute
iMdea
networks

Publications 2019

Books [1]

1. Iván Vidal, Ignacio Soto, Albert Banchs, Jaime García-Reinoso, Ivan Lozano, Gonzalo Camarillo (January 2019)
Multimedia Networking Technologies, Protocols, and Architectures
pp. 300 , Artech House. January 2019

Journal Articles [32]

1. Patricia Callejo, Rubén Cuevas, Ángel Cuevas (December 2019)
An Ad-Driven Measurement Technique for Monitoring the Browser Marketplace
IEEE Access. IEEE. ISSN 2169-3536.

2. Paolo Casari, Filippo Campagnaro, Elizaveta Dubrovinskaya, Roberto Francescon, Amir Dagan, Shlomo Dahan, Michele Zorzi, Roee Diamant (December 2019)
ASUNA: A Topology Dataset for Underwater Network Emulation
IEEE Journal of Oceanic Engineering. IEEE. ISSN 0364-9059.

3. Elizaveta Dubrovinskaya, Paolo Casari, Roee Diamant (December 2019)
Bathymetry-aided Underwater Acoustic Localization using a Single Passive Receiver
Journal of the Acoustical Society of America. 146 (6). pp. 4774-4789. AIP Publishing on behalf of the Acoustical Society of America. ISSN 0001-4966.

4. Francesco Gringoli, Pablo Serrano, Iñaki Ucar, Nicolò Facchi, Arturo Azcorra (November 2019)
Experimental QoE evaluation of multicast video delivery over IEEE 802.11aa WLANs
http://eprints.networks.imdea.org/1756/
IEEE Transactions on Mobile Computing. 10.1109/TMC.2018.2876000. Volume 18 , IEEE Communications Society. ISSN: 1536-1233. N

5. Iván Vidal, Francisco Valera, Borja Nogales, Victor Sanchez-Aguero, Diego R. Lopez (November 2019)
Transport-Layer Limitations for NFV Orchestration in Resource-Constrained Aerial Networks
MDPI Sensors. MDPI AG, Basel, Switzerland. ISSN 1424-8220.

6. Borja Nogales, Iván Vidal, Victor Sanchez-Aguero, Francisco Valera, Luis F. Gonzalez, Arturo Azcorra (November 2019)
Automated Deployment of an Internet Protocol Telephony Service on Unmanned Aerial Vehicles Using Network Functions Virtualization
Journal of Visualized Experiments.

7. Patricia Callejo, Rubén Cuevas, Narseo Vallina-Rodríguez, Ángel Cuevas (October 2019)
Measuring the Global Recursive DNS Infrastructure: A View From the Edge
IEEE Access. IEEE. ISSN 2169-3536.

8. Victor Sanchez-Aguero, Francisco Valera, Iván Vidal (October 2019)
VENUE: Virtualized Environment for multi-UAV network emulation
IEEE Access. 7. pp. 154659-154671. IEEE. ISSN 2169-3536.

9. Andrea Capponi, Claudio Fiandrino, Burak Kantarci, Luca Foschini, Dzmitry Kliazovich, Pascal Bouvry (September 2019)
A Survey on Mobile Crowdsensing Systems: Challenges, Solutions, and Opportunities
IEEE Communications Surveys Tutorials. 21 (3). pp. 2419-2465. IEEE.

10. Thang Le Duc, Rafael García Leiva, Paolo Casari, Per-Olov Östberg (September 2019)
Machine Learning Methods for Reliable Resource Provisioning in Edge-Cloud Computing: A Survey
ACM Computing Surveys. 52 (5). pp. 94:1-94:39. ACM. ISSN 0360-0300.

11. Claudio Fiandrino, Alejandro Blanco, Pablo Jimenez Mateo, Carlos Andrés Ramiro, Norbert Ludant, Joerg Widmer (September 2019)

openLEON: An End-to-End Emulation Platform from the Edge Data Center to the Mobile User
Computer Communications. Elsevier.

12. Vincenzo Sciancalepore, Xavier Costa-Perez, Albert Banchs (August 2019)

RL-NSB: Reinforcement Learning-Based5G Network Slice Broker
http://eprints.networks.imdea.org/2196/
IEEE/ACM Transactions on Networking. DOI: 10.1109/TNET.2019.2924471. Volume 27 , 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.

13. Rafael García, Antonio Fernández Anta, Vincenzo Mancuso, Paolo Casari (July 2019)

A Novel Hyperparameter-Free Approach to Decision Tree Construction That Avoids Overfitting by Design
IEEE Access. 7. pp. 99978-99987. IEEE. ISSN 2169-3536.

14. Marco Ajmone Marsan, Foroogh Mohammadnia, Christian Vitale, Marco Fiore, Vincenzo Mancuso (June 2019)

Towards mobile radio access infrastructures for mobile users
http://eprints.networks.imdea.org/2210/
Ad Hoc Networks. https://doi.org/10.1016/j.adhoc.2019.03.007. Elsevier. ISSN: 1570-8705.

15. Cristina Márquez, Marco Gramaglia, Marco Fiore, Albert Banchs, Xavier Costa-Pérez (June 2019)

Resource Sharing Efficiency in Network Slicing
IEEE Transactions on Network and Service Management . IEEE Communications Society. ISSN 1932-4537.

16. Jorge Martín Pérez, Luca Cominardi, Carlos Jesús Bernardos, Antonio De la Oliva, Arturo Azcorra (June 2019)

Modeling Mobile Edge Computing Deployments for Low Latency Multimedia Services
IEEE Transactions on Broadcasting. 65 (2). pp. 464-474. IEEE Broadcast Technology Society. ISSN 0018-9316 .

17. Edgar Arribas, Antonio Fernández Anta, Dariusz R. Kowalski, Vincenzo Mancuso, Miguel A. Mosteiro, Joerg Widmer, Prudence W. H. Wong (June 2019)

Optimizing mmWave Wireless Backhaul Scheduling
IEEE Transactions on Mobile Computing. IEEE Communications Society. ISSN 1536-1233.

18. Pablo Caballero Garcés, Albert Banchs, Gustavo de Veciana, Xavier Costa-Perez (April 2019)

Network slicing games: enabling customization in multi-tenant mobile networks
http://eprints.networks.imdea.org/2203/
IEEE/ACM Transactions on Networking. https://doi.org/10.1109/TNET.2019.2895378 . Volume 27 , 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.

19. J.M. Català-Pérez, Jesús Omar Lacruz, F. García-Herrero, J. Valls, David Declerq (April 2019)

Second minimum approximation for Min-Sum decoders suitable for high-rate LDPC codes
Circuits Systems and Signal Processing. pp. 1-13. Springer Science+Business Media, LLC. ISSN 1531-5878.

20. Filippo Campagnaro, Paolo Casari, Michele Zorzi, Roee Diamant (April 2019)

Optimal Transmission Scheduling in Small Multimodal Underwater Networks
IEEE Wireless Communications Letters. 8 (2). pp. 368-371. IEEE Communications Society. ISSN 2162-2337.

21. **Roderick Fanou, Victor Sanchez-Aguero, Francisco Valera, Michuki Mwangi, Jane Coffin (March 2019)**
A System for Profiling the IXPs in a Region and Monitoring their Growth: Spotlight at the Internet Frontier
International Journal of Network Management. 29 (2). John Wiley & Sons, Ltd.. ISSN 1099-1190.

22. **Joan Palacios, Guillermo Bielsa, Paolo Casari, Joerg Widmer (March 2019)**
Single- and Multiple-Access Point Indoor Localization for Millimeter Wave Networks [PDF]
IEEE Transactions on Wireless Communications. 18 (3). pp. 1927-1942. IEEE. ISSN 1536-1276.

23. **Victor Sanchez-Aguero, Francisco Valera, Iván Vidal (February 2019)**
An NFV-Based Energy Scheduling Algorithm for a 5G Enabled Fleet of Programmable Unmanned Aerial Vehicles
Wireless Communications and Mobile Computing. 2019. Wiley. ISSN 1530-8677 (online).

24. **Roee Diamant, Paolo Casari, Stefano Tomasin (February 2019)**
Cooperative Authentication in Underwater Acoustic Sensor Networks
IEEE Transactions on Wireless Communications. 18 (2). pp. 954-968. IEEE. ISSN 1536-1276.

25. **Elnaz Alizadeh Jarchlo, Xuan Tang, Hossein Doroud, Victor P. Gil Gimenez, Bangjiang Lin, Paolo Casari, Zabih Ghassemlooy (February 2019)**
Li-Tect: 3D Monitoring and Shape Detection using Visible Light Sensors
IEEE Sensors Journal. 19 (3). pp. 940-949. IEEE. ISSN 1530-437X.

26. **Nuria Molner, Antonio De la Oliva, Ioannis Stavrakakis, Arturo Azcorra (February 2019)**
Optimization of an integrated fronthaul/backhaul network under path and delay constraints
Ad Hoc Networks. 83. pp. 41-54. Elsevier. ISSN 1570-8705.

27. **Vincenzo Mancuso, Miguel Peón-Quirós, Cise Midoglu, Mohamed Moulay, Vincenzo Comite, Andra Lutu, Ozgu Alay, Stefan Alfredsson, Mohammad Rajiullah, Anna Brunstrom, Marco Mellia, Ali Safari Khatouni, Thomas Hirsch (January 2019)**
Results from Running an Experiment as a Service Platform for Mobile Broadband Networks in Europe
Computer Communications. 133. pp. 89-101. Elsevier. ISSN 0140-3664.

28. **Claudio Fiandrino, Nicholas Allio, Dzmitry Kliazovich, Paolo Giaccone, Pascal Bouvry (January 2019)**
Profiling Performance of Application Partitioning for Wearable Devices in Mobile Cloud and Fog Computing
IEEE Access. 7. pp. 12156-12166. IEEE. ISSN 2169-3536.

29. **Gaetano Manzo, Marco Ajmone Marsan, Gianluca Rizzo (January 2019)**
Analytical Models of Floating Content in a Vehicular Urban Environment
Ad Hoc Networks. 88. pp. 65-80. Elsevier. ISSN 1570-8705.

30. **Antonio Fernández Anta, Dariusz R. Kowalski, Miguel A. Mosteiro, Prudence W. H. Wong (January 2019)**
Scheduling Dynamic Parallel Workload of Mobile Devices with Access Guarantees
ACM Transactions on Parallel Computing. 5 (2). ACM. ISSN 2329-4949.

31. **Tobias Rueckelt, Ioannis Stavrakakis, Tobias Meuser, Imane Horiya Brahmi, Doreen Böhnstedt, Ralf Steinmetz (January 2019)**
Data Transmission Plan Adaptation Complementing Strategic Time-Network Selection for Connected Vehicles
Ad Hoc Networks. 82. pp. 146-154. Elsevier. ISSN 1570-8705.

32. **Claudio Fiandrino, Hany Assasa, Paolo Casari, Joerg Widmer (January 2019)**

Scaling Millimeter-Wave Networks to Dense Deployments and Dynamic Environments
Proceedings of the IEEE. 107 (4). pp. 732-745. IEEE. ISSN 0018-9219.

Magazine Articles [4]

1. **Joel Reardon, Álvaro Feal, Primal Wijesekera, Amit Elazari Bar On, Narseo Vallina-Rodriguez, Serge Egelman (December 2019)**

50 Ways to Leak Your Data: An Exploration of Apps' Circumvention of the Android Permissions System
USENIX. 44 (4). USENIX.

2. **Albert Banchs, David Gutierrez-Estevez, Manuel Fuentes, Mauro Boldi, Silvia Provvedi (December 2019)**

A 5G Mobile Network Architecture to Support Vertical Industries
IEEE Communications Magazine . 57 (12). pp. 38-44. IEEE.

3. **Nikolaos Laoutaris (September 2019)**

Why Online Services Should Pay You for Your Data? The Arguments for a Human-Centric Data Economy
IEEE Internet Computing. 23 (5). pp. 29-35. ISSN 1089-7801.

4. **Borja Nogales, Iván Vidal, Jaime José García-Reinoso, Diego R. López, Juan Rodríguez, Arturo Azcorra (January 2019)**

Design and Deployment of an Open Management and Orchestration Platform for Multi-site NFV Experimentation
IEEE Communications Magazine. IEEE Communications Society. ISSN 0163-6804.

Conference and Workshop Papers [54]

1. **Matthias Schafer, Roberto Calvo-Palomino, Franco Minucci, Brecht Reynders, Gerome Bovet, Vincent Lenders (December 2019)**

Higher than a kite: ADS-B communication analysis using a high-altitude balloon
In: Proceedings of the 7th OpenSky Workshop 2019, 21-22 November 2019, Zurich.

2. **Maurizio Rea, Traian Emanuel Abrudan, Domenico Giustiniano, Holger Claussen, Veli-Matti Kolmonen (December 2019)**

Smartphone Positioning with Radio Measurements from a Single WiFi Access Point
In: CoNEXT 2019. Conference on emerging Networking EXperiments and Technologies, December 9-12, 2019, Orlando, Florida, U.S..

3. **Costas Iordanou, Nicolas Kourtellis, Juan Miguel Carrascosa Amigo, Claudio Soriente, Rubén Cuevas, Nikolaos Laoutaris (December 2019)**

Beyond content analysis: Detecting targeted ads via distributed counting
In: ACM CoNEXT, December 9-12, 2019, Orlando, FL.

4. **Patricia Callejo, Antonio Pastor, Rubén Cuevas, Ángel Cuevas (December 2019)**

Q-Tag: A transparent solution to measure ads viewability rate in online advertising campaigns
In: CoNEXT 2019. Conference on emerging Networking EXperiments and Technologies, December 9-12, 2019, Orlando, Florida, U.S.

5. **Joan Palacios, Javier Rodríguez-Fernández, Nuria González-Prelcic (December 2019)**

Hybrid Precoding and Combining for Full-Duplex Millimeter Wave Communication
In: IEEE Global Communications Conference (Globecom 2019), 9-13 December 2019, Waikoloa, HI, USA.

6. **Piergiorgio Vitello, Andrea Capponi, Claudio Fiandrino, Guido Cantelmo, Dzmitry Kliazovich (December 2019)**

The Impact of Human Mobility on Edge Data Center Deployment in Urban Environments
In: IEEE Global Communications Conference (Globecom 2019), 9-13 December 2019, Waikoloa, HI, USA.

7. **Federico Montori, Emanuele Cortesi, Luca Bedogni, Andrea Capponi, Claudio Fiandrino, Luciano Bononi (November 2019)**
CrowdSenSim 2.0: A Stateful Simulation Platform for Mobile Crowdsensing in Smart Cities
In: Proceedings of the 22Nd International ACM Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems, November 25 - 29, 2019, Miami Beach, FL, USA.

8. **Carlos Guimarães, Antonio de la Oliva, Arturo Azcorra (November 2019)**
5G-DIVE: eDge Intelligence for Vertical Experimentation
In: Global Experimentation for Future Internet (GEFI) 2019, November 7-8, 2019, Coimbra, Portugal.

9. **Joan Palacios, Nuria González-Prelcic, Joerg Widmer (November 2019)**
Managing Hardware Impairments in Hybrid Millimeter Wave MIMO Systems: A Dictionary Learning-based Approach
In: IEEE Asilomar Conference on Signals, Systems, and Computers Search form Search (ACSSC 2019), 3-6 November 2019, Pacific Grove, CA, USA.

10. **Amr AbdelKhalek Abdelnabi, Vincenzo Mancuso, Marco Ajmone Marsan (October 2019)**
On the Outage Probability of Millimeter Wave Links with Quasi-deterministic Propagation
In: mmnets 19, 25 October 2019, Los Cabos, Mexico.

11. **Maurizio Rea, Héctor Cordobés de la Calle, Domenico Giustiniano (October 2019)**
Time-of-flight Wireless Indoor Navigation System for Industrial Environment
In: The 13th ACM Workshop on Wireless Network Testbeds, Experimental evaluation & CHaracterization (ACM WiNTECH 2019), 21-25 October 2019, Los Cabos, Mexico,

12. **Jose A. Ayala-Romero, Andres Garcia-Saavedra, Marco Gramaglia, Xavier Costa-Perez, Albert Banchs, Juan J. Alcaraz (October 2019)**
vrAIn: A Deep Learning Approach Tailoring Computing and Radio Resources in Virtualized RANs
In: The 25th Annual International Conference on Mobile Computing and Networking (MobiCom 2019). 21-25 October 2019, Los Cabos, Mexico.

13. **Yijing Zeng, Varun Chandrasekaran, Suman Banerjee, Domenico Giustiniano (October 2019)**
A Framework for Analyzing Spectrum Characteristics in Large Spatio-temporal Scales
In: ACM Mobicom 2019, October 21–25, 2019, Los Cabos, Mexico.

14. **Arturo Azcorra, Luis F. Chiroque, Rubén Cuevas, Antonio Fernández Anta, Henry Laniado, Rosa Elvira Lillo, Juan Romo, Carlo Sguera (October 2019)**
Unsupervised Scalable Statistical Method for Identifying Influential Users in Online Social Networks
In: XIV Jornadas de Ingeniería Telemática (JITEL 2019), 22-24 October 2019, Zaragoza, Spain.

15. **Pelayo Vallina, Álvaro Feal, Julien Gamba, Antonio Fernández Anta, Narseo Vallina-Rodríguez (October 2019)**
Tales from the Porn: A Comprehensive Privacy Analysis of the Web Porn Ecosystem
In: ACM Internet Measurement Conference (IMC 2019), AMSTERDAM.

16. **Tobias Meuser, Ioannis Stavrakakis, Antonio Fernández Anta, Ralf Steinmetz (October 2019)**
Dynamic Vehicle Path-Planning in the Presence of Traffic Events
In: The 44th IEEE Conference on Local Computer Networks (LCN 2019), 14-17 October 2019, Osnabrück, Germany.

17. **Vitalii Demianiuk, Sergey Gorinsky, Sergey Nikolenko, Kirill Kogan (October 2019)**
Robust Distributed Monitoring of Traffic Flows
In: The 27th IEEE International Conference on Network Protocols (IEEE ICNP), 07-10 Oct 2019, Chicago, Illinois, USA.

18. **Vicent Cholvi, Antonio Fernández Anta, Chryssis Georgiou, Nicolas Nicolaou (October 2019)**
Brief Announcement: Implementing Byzantine Tolerant Distributed Ledger Objects
In: The 33rd International Symposium on DIStributed Computing (DISC) 2019, October 15-17th, 2019, Budapest, Hungary.

19. Swetank Kumar Saha, Shivang Aggarwal, Rohan Pathak, Dimitrios Koutsonikolas, Joerg Widmer (October 2019)

MuSher: An Agile Multipath-TCP Scheduler for Dual-Band 802.11ad/ac Wireless LANs

In: ACM International Conference on Mobile Computing and Networking (MobiCom19), 21-25 October, Los Cabos, Mexico.

20. Alejandro Blanco, Norbert Ludant, Shi Zhenyu, Wang Yi, Joerg Widmer (September 2019)

Performance Evaluation of Single Base Station ToA-AoA Localization in an LTE Testbed

In: The 30th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (IEEE PIMRC 2019) - Track 3, 8-11 September 2019, Istanbul, Turkey.

21. Vadim Kirilin, Aditya Sundarrajan, Sergey Gorinsky, Ramesh K. Sitaraman (August 2019)

RL-Cache: Learning-Based Cache Admission for Content Delivery

In: ACM SIGCOMM 2019 Workshop on Network Meets AI & ML (NetAI 2019), 23 August 2019, Beijing, China.

22. Joel Reardon, Álvaro Feal, Primal Wijesekera, Amit Elazari Bar On, Narseo Vallina-Rodriguez, Serge Egelman (August 2019)

50 Ways to Leak Your Data: An Exploration of Apps' Circumvention of the Android Permissions Systems

In: The 28th USENIX Security Symposium (USENIX Security 2019), 14-16 August 2019, Santa Clara, CA, USA.

23. Gaetano Manzo, Sebastian Otálora, Marco Ajmone Marsan, Torsten Braun, Hung Nguyen, Gianluca Rizzo (August 2019)

DeepFloat: Resource-Efficient Dynamic Management of Vehicular Floating Content

In: 2019 31st International Teletraffic Congress (ITC 31), August 27–29, 2019, Budapest, Hungary.

24. Ana Paula Couto da Silva, Daniela Renga, Michela Meo, Marco Ajmone Marsan (August 2019)

Small Solar Panels Can Drastically Reduce the Carbon Footprint of Radio Access Networks

In: 2019 31st International Teletraffic Congress (ITC 31), August 27–29, 2019, Budapest, Hungary.

25. Andrea Capponi, Piergiorgio Vitello, Claudio Fiandrino, Guido Cantelmo, Dzmitry Kliazovich, Ulrich Sorger, Pascal Bourvry (July 2019)

Crowdsensed Data Learning-Driven Prediction of Local Businesses Attractiveness in Smart Cities

In: IEEE Symposium on Computers and Communications (ISCC), June 30 - July 3rd, 2019, Barcelona.

26. Hany Assasa, Joerg Widmer, Jian Wang, Tanguy Ropitault, Nada Golmie (June 2019)

An Implementation Proposal for IEEE 802.11ay SU/MU-MIMO Communication in ns-3

In: Workshop on Next-Generation Wireless with ns-3 (WNGW 2019), 19-20 June 2019, Florence, Italy.

27. Hany Assasa, Joerg Widmer, Tanguy Ropitault, Nada Golmie (June 2019)

Enhancing the ns-3 IEEE 802.11ad Model Fidelity: Beam Codebooks, Multi-antenna Beamforming Training, and Quasi-deterministic mmWave Channel

In: Workshop on ns-3 (WNS3 2019), 19 June 2019, Florence, Italy.

28. Hany Assasa, Joerg Widmer, Tanguy Ropitault, Anuraag Bodi, Nada Golmie (June 2019)

High Fidelity Simulation of IEEE 802.11ad in ns-3 Using a Quasi-deterministic Channel Model

In: Workshop on Next-Generation Wireless with ns-3 (WNGW 2019), 19-20 June 2019, Florence, Italy.

29. Elizaveta Dubrovinskaya, Paolo Casari (June 2019)

Underwater Direction of Arrival Estimation using Wideband Arrays of Opportunity

In: MTS/IEEE OCEANS 2019, 17-20 June 2019, Marseille, France.

30. Pelayo Vallina, Antonio Fernández Anta, Rubén Cuevas, Ángel Cuevas (June 2019)

How does Google know my gender if I didn't say it? Measuring how Google infers the gender of the users

In: Complex Systems perspectives on Algorithmic Bias (CSAB 2019), 11 June 2019, Munich, Germany.

31. Guillermo Bielsa, Adrian Loch, Joerg Widmer (June 2019)

Optimizing mmWave Spatial Reuse: Signal-to-Interference Aware Beamtraining

In: The 8th IEEE Workshop on the Internet of Things: Smart Objects and Services (IoT-SoS 2019), 10-12 June 2019, Washington DC, USA.

32. Guillermo Bielsa, Adrian Loch, Joerg Widmer (June 2019)

Optimizing mmWave Spatial Reuse: Signal-to-Interference Aware Beamtraining

http://eprints.networks.imdea.org/2002/
In: The 8th IEEE Workshop on the Internet of Things: Smart Objects and Services (IoT-SoS 2019). 10-12 June 2019, Washington DC, USA.

33. Guillermo Bielsa, Marco Mezzavilla, Joerg Widmer, Sundeep Rangan (June 2019)

Performance Assessment of Off-the-Shelf mmWave Radios for Drone Communications

In: The 20th IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (IEEE WOWMOM 2019), 10-12 June 2019, Washington DC, USA.

34. Catherine Han, Irwin Reyes, Amit Elazari Bar On, Joel Reardon, Álvaro Feal, Serge Egelman, Narseo Vallina-Rodriguez (May 2019)

Do You Get What You Pay For? Comparing the Privacy Behaviors of Free vs. Paid Apps

In: Workshop on Technology and Consumer Protection (ConPro 2019), in conjunction with the 39th IEEE Symposium on Security and Privacy, 23 May 2019, San Francisco, CA, USA., 23 May 2019, San Francisco, CA, USA.

35. Ehimare Okoyomon, Nikita Samarin, Primal Wijesekera, Amit Elazari Bar On, Narseo Vallina-Rodriguez, Irwin Reyes, Álvaro Feal, Serge Egelman (May 2019)

On The Ridiculousness of Notice and Consent: Contradictions in App Privacy Policies

In: Workshop on Technology and Consumer Protection (ConPro 2019), in conjunction with the 39th IEEE Symposium on Security and Privacy, 23 May 2019, San Francisco, CA, USA.

36. Pablo Jimenez Mateo, Claudio Fiandrino, Joerg Widmer (May 2019)

Analysis of TCP Performance in 5G mm-wave Mobile Networks

In: IEEE International Conference on Communications (ICC 2019), 20-24 May 2019, Shanghai, China.

37. Mohammad Rajiullah, Andra Lutu, Ali Safari Khatouni, M. Fida, Marco Mellia, Anna Brunstrom, Ozgu Alay, Stefan Alfredsson, Vincenzo Mancuso (May 2019)

Web Experience in Mobile Networks: Lessons from Two Million Page Visits

http://eprints.networks.imdea.org/1974/
In: The Web Conference 2019 (WWW 2019). 13-17 May 2019, San Francisco, CA, USA.

38. Antonio Pastor, Matti Pärssinen, Patricia Callejo, Pelayo Vallina, Rubén Cuevas, Ángel Cuevas, Mikko Kotila, Arturo Azcorra (May 2019)

Nameles: An intelligent system for Real-Time Filtering of Invalid Ad Traffic

In: The Web Conference 2019, 13-17 May 2019, San Francisco, CA, USA.

39. Antonio Fernández Anta, Chryssis Georgiou, Nicolas Nicolaou (May 2019)

Atomic Appends: Selling Cars and Coordinating Armies with Multiple Distributed Ledgers

In: International Conference on Blockchain Economics, Security and Protocols (Tokenomics 2019), 6-7 May 2019, Paris, France.

40. Joan Palacios, Paolo Casari, Hany Assasa, Joerg Widmer (May 2019)

LEAP: Location Estimation and Predictive Handover with Consumer-Grade mmWave Devices

In: The 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 Apr - 02 May 2019, Paris, France.

41. Vitalii Demianiuk, Kirill Kogan, Sergey Nikolenko (April 2019)

Approximate Classifiers with Controlled Accuracy

In: The 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 Apr - 02 May 2019, Paris, France.

42. Dario Bega, Marco Gramaglia, Marco Fiore, Albert Banchs, Xavier Costa-Perez (April 2019)

DeepCog: Cognitive Network Management in Sliced 5G Networks with Deep Learning

In: The 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 Apr - 02 May 2019, Paris, France.

43. Edgar Arribas, Vincenzo Mancuso, Vicent Cholvi (April 2019)

Fair Cellular Throughput Optimization with the Aid of Coordinated Drones

In: Mission-Oriented Wireless Sensor, UAV and Robot Networking Workshop (MiSARN 2019), in conjunction with the 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 April 2019, Paris, France.

44. Luis. F Gonzalez, Iván Vidal, Francisco Valera, Victor Sanchez-Aguero, Borja Nogales, Diego R. López (April 2019)

NFV orchestration on intermittently available SUAV platforms: challenges and hurdles

In: 2019 IEEE INFOCOM WKSHPS: MiSARN 2019: Mission-Oriented Wireless Sensor, UAV and Robot Networking,

45. Vincenzo Mancuso, Paolo Castagno, Matteo Sereno, Marco Ajmone Marsan (April 2019)

Slicing Cell Resources: The Case of HTC and MTC Coexistence

In: The 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 Apr - 02 May 2019, Paris, France.

46. Rens Bloom, Marco Zuniga, Qing Wang, Domenico Giustiniano (April 2019)

Tweeting with Sunlight: Encoding Data on Mobile Objects

In: The 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 Apr - 02 May 2019, Paris, France.

47. Dario Bega, Marco Gramaglia, Marco Fiore, Albert Banchs, Xavier Costa-Perez (April 2019)

α-OMC: Cost-Aware Deep Learning for Mobile Network Resource Orchestration

In: The 2nd International Workshop on Network Intelligence (NI 2019), in conjunction with the 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 April - 2 May 2019, Paris, France.

48. Foroogh Mohammadnia, Christian Vitale, Marco Fiore, Vincenzo Mancuso, Marco Ajmone Marsan (April 2019)

Mobile Small Cells for Adaptive RAN Densification: Preliminary Throughput Results

In: The 17th IEEE Wireless Communications and Networking Conference (IEEE WCNC 2019), 15-18 April 2019, Marrakech, Morocco.

49. Ander Galisteo, Diego Juara, Domenico Giustiniano (April 2019)

Research in Visible Light Communication Systems with OpenVLC1.3

In: The IEEE 5th World Forum on Internet of Things (WF-IoT), 15-18 April 2019 , Limerick, Ireland.

50. Roberto Calvo-Palomino, Héctor Cordobés de la Calle, Fabio Ricciato, Domenico Giustiniano, Vincent Lenders (April 2019)

Collaborative Wideband Signal Decoding using Non-coherent Receivers

In: The 18th ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN 2019), in conjunction with CPS-IoT WEEK 2019, 14-16 April 2019, Montreal, Canada.

51. Hossein Ajorloo, Cormac J. Sreenan, Adrian Loch, Joerg Widmer (April 2019)

On the Feasibility of Using IEEE 802.11ad mmWave for Accurate Object Detection

In: The 34th ACM/SIGAPP Symposium On Applied Computing (SAC 2019), 8-12 April 2019, Limassol, Cyprus.

52. Vitalii Demianiuk, Kirill Kogan (April 2019)

How to deal with range-based packet classifiers

In: The 5th Symposium on SDN Research (ACM SOSR 2019), 3-4 April 2019, San Jose, CA, USA.

53. Pablo Jimenez Mateo, Alejandro Blanco, Norbert Ludant, Matteo Marugan Borelli, Amanda García-García, Adrian Loch, Zhenyu Shi, Yi Wang, Joerg Widmer (February 2019)

A Comprehensive Study of Low Frequency and High Frequency Channel Correlation

In: International Conference on Computing, Networking and Communications (ICNC 2019), 18-21 February 2019 , Honolulu, Hawaii, USA.

54. Constantine Ayimba, Paolo Casari, Vincenzo Mancuso (February 2019)
Adaptive Resource Provisioning based on Application State
In: The 8th International Conference on Computing, Networking and Communications (ICNC 2019), 18-21 February 2019, Honolulu, Hawaii, USA.

Conference and Workshop Posters & Demos [11]

1. Ander Galisteo, Diego Juara, Héctor Cordobés de la Calle, Domenico Giustiniano (July 2019)
Demo: Video Transmission Using Low-Cost Visible Light Communication **(Demo, peer-reviewed)**
In: The 20th International Symposium on Mobile Ad Hoc Networking and Computing (ACM MobiHoc 2019), 2-5 July 2019, Catania, Italy.

2. Chris Pearson, Arturo Azcorra, Flávio de Oliveira Silva, Ryo Inohara, Shaoli Kang, Sung Ho Choi
Panel: Beyond 5G: Realizing Smart Networks (Other)
http://eprints.networks.imdea.org/2002/
In: 7th Global 5G Event. 18-19 June 2019, Valencia, Spain.

3. Antonio Fernández Anta, Chryssis Georgiou, Nicolas Nicolaou.
Atomic Appends: Selling Cars and Coordinating Armies with Multiple Distributed Ledgers (Other, peer-reviewed)
http://eprints.networks.imdea.org/2030/
In: XXVI JORNADAS DE CONCURRENCIA Y SISTEMAS DISTRIBUIDOS. 18-19 June 2019, Zaragoza, Spain.

4. Katia Leal, José Herrera, Virginia Escuder
Dynamic Windows Scheduling for Virtual Machine Placement (Other, peer-reviewed)
http://eprints.networks.imdea.org/2011/
In: The 5th MadSESE Seminar. 5 June 2019, Madrid, Spain

5. Seth Elliot, Arturo Azcorra, Klaus Schaaf, Daniel Marco
Panel: Let's take stock of Mobility ecosystems development and rollout (Other)
http://eprints.networks.imdea.org/2268/
In: Digital Enterprise Show 2019. 22 May 2019, Madrid, Spain

6. Merouane Debbah, Riku Jantti, Anthony Ephremides, Monisha Ghosh, Anna Brunstrom
Panel: Smart Networks: What is Next? (Other)
http://eprints.networks.imdea.org/2269/
In: The 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019). 29 April- 2 May 2019, Paris, France

7. Phil Kendall, Arturo Azcorra, Heng Oiu, Olof Henricsson
Panel: Capitalising on Operators' Assets for the Industry 4.0 Value Chain (Other)
http://eprints.networks.imdea.org/2270/
In: Mobile World Congress 2019 (MWC 2019). 25-28 February 2019, Barcelona, Spain

8. Robert Gazda, Rolf Schuster, Laurent Depersin, Arturo Azcorra, Todd Spraggins, Dirk Trossen
Panel: Beyond 5G communications (Other)
http://eprints.networks.imdea.org/2271/
In: Mobile World Congress 2019 (MWC 2019). 25-28 February 2019, Barcelona, Spain

9. Arturo Azcorra
Panel: How to deploy and run connected Industry 4.0 (Other, peer-reviewed)
http://eprints.networks.imdea.org/2040/
Panel: "Capitalising on operator's assets for the industry 4.0 value chain", MWC Barcelona 2019. 25-28 February 2019, Barcelona, Spain

10. Dolores Garcia Marti, Alejandro Blanco, Héctor Cordobés de la Calle, Joerg Widmer (May 2019)
Enhancing ToA positioning with a hybrid deep learning approach **(Poster, peer-reviewed)**
In: IEEE Communication Theory Workshop, 26-29 May 2019, Selfoss, Iceland.

11. Jesús Omar Lacruz, Diego Juara, Joerg Widmer (January 2019)
Wideband Millimeter-Wave Open Experimentation Platform **(Poster, peer-reviewed)**
In: The Fifth Millimeter-Wave RCN Workshop, 28-29 January 2019, Railegh, NC, USA

Invited Papers, Keynotes, Invited Talks, Tutorials, Lectures, etc. [17]

1. **Antonio Fernández Anta (November 2019)**
Atomic Appends: Selling Cars and Coordinating Armies with Multiple Blockchains **(Invited talk)**
In: Postgraduate conference, November 21st, 2019, Universidad Complutense de Madrid.

2. **Arturo Azcorra**
5TONIC Laboratory: a leading 5G Ecosystem (Invited Talk)
http://eprints.networks.imdea.org/2264/
In: 5G Core Summit. 24-25 September 2019 Madrid, Spain

3. **Arturo Azcorra**
What is 5G and why is disruptive: the case of the 5TONIC Laboratory (Invited Talk)
http://eprints.networks.imdea.org/2265/
In: II Engineering Conference - Technological Trends. 19 September 2019, San José, Costa Rica

4. **Sergey Gorinsky (September 2019)**
RL-Cache: Learning-Based Cache Admission for Content Delivery **(Invited talk)**
In: Knowledge and Information Sharing Seminar (KISS), Ericsson Hungary, 5 Sep 2019, Budapest, Hungary.

5. **Sergey Gorinsky (August 2019)**
Paths and Interconnectivity: An Internet Trend and an Architectural Proposal **(Invited talk)**
In: ETH Zurich, 14 Aug 2019, Zurich, Switzerland.

6. **Arturo Azcorra (July 2019)**
The 5G Revolution and its impact on the Railway Sector **(Keynote)**
In: Passenger Global Forum - UIC - RENFE, 12 July 2019, Madrid, Spain.

7. **Antonio Fernández Anta, Paul Rimba, Andrés Abeliuk, Manuel Cebrian, Ioannis Stavrakakis,**

An Binh Tran, Oluwasegun Ojo, Iyad Rahwan (June 2019)
Miner Dynamics on the Ethereum Blockchain **(Invited talk)**
In: XXVI Jornadas de Concurrencia y Sistemas Distribuidos (JCSD 2019), 19-21 June 2019, Zaragoza, Spain.

8. **Arturo Azcorra (June 2019)**
Smart Networks **(Invited talk)**
In: The 7th Global 5G Event | Session 4: Looking Forward, in conjunction with the EuCNC 2019, 17-18 June 2019, Valencia, Spain.

9. **Antonio Fernández Anta (May 2019)**
Atomic Appends: Selling Cars and Coordinating Armies with Multiple Distributed Ledgers **(Invited talk)**
In: Invited talk at ICT, Chinese Academy of Sciences, 27 May 2019, ICT, Chinese Academy of Sciences, Beijing, China.

10. **Arturo Azcorra**
The SLICES ESFRI Proposal (Invited Talk)
http://eprints.networks.imdea.org/2267/
In: Research Infrastructures Conference. French Ministry of Science, 27 May 2019, Paris, France.

11. **Oluwasegun Ojo, Antonio Fernández Anta, Rosa Elvira Lillo (May 2019)**
Improvements to the Massive Unsupervised Outlier Detection (MUOD) Algorithm **(Invited talk)**
In: III International Workshop on Advances in Functional Data Analysis, 23–24 May 2019, Castro Urdiales, Spain.

12. **Joerg Widmer (April 2019)**
Challenges in Designing Future High Speed Wireless Networks **(Lecture)**
In: Humboldt Colloquium "Research without Borders – Alexander von Humboldt's Legacy Today", 11 – 13 April 2019, Alexander von Humboldt Foundation, Madrid, Spain.

13. Antonio Fernández Anta, Paul Rimba, Andrés Abeliuk, Manuel Cebrian, Ioannis Stavrakakis, An Binh Tran, Oluwasegun Ojo (March 2019)

Miner Dynamics on the Ethereum Block-chain **(Invited talk)**

In: Workshop on Complex Sociotechnical Systems, 26-27 March 2019, Universidad de Alcalá, Acalá de Henares, Spain.

14. Sergey Gorinsky (March 2019)

Highlights of SIGCOMM 2018 **(Invited talk)**

In: IMDEA-UC3M Research Seminar Series, IMDEA Networks Institute, 13 March 2019, Leganes, Madrid, Spain.

15. Sergey Gorinsky (March 2019)

Highlights of SIGCOMM 2018 **(Invited talk)**

In: National Research University of Electronic Technology (MIET), 5 March 2019, Moscow, Russia.

16. Sergey Gorinsky (March 2019)

Highlights of SIGCOMM 2018 **(Invited talk)**

In: Moscow State University (MSU), 1 March 2019, Moscow, Russia.

17. Claudio Fiandrino, Antonio De la Oliva, Joerg Widmer, Kirill Kogan (January 2019)

pDCell: an End-to-End Transport Protocol for Mobile Edge Computing Architectures **(Invited paper)**

In: The 20th International Conference on Distributed Computing and Networking (ICDCN 2019), 14-17 January 2019, Bangalore, India.

PhD Theses [6]

1. Carlos Donato (November 2019)

Analysis, characterization and optimization of the energy efficiency on softwarized mobile platforms

PhD thesis, Department of Telematic, Universidad Carlos III de Madrid, Spain

Director: Dr. Pablo Serrano Yañez-Mingot , University Carlos III de Madrid

1. Pavel Chuprikov (November 2019)

Theoretical and Empirical Analysis of Fundamental Bottlenecks in Networking and Distributed Computing

PhD thesis, Department of Computer Science, National Research University Higher School of Economics, Moscow, Russia

Director: Dr. Kirill Kogan, IMDEA Networks Institute, Madrid, Spain | Dr. Sergey Nikolenko, Steklov Institute of Mathematics at St. Petersburg, Russia

2. Guillermo Bielsa (July 2019)

Analysis and Performance Improvement of Consumer-Grade Millimeter Wave Wireless Networks

PhD thesis, Department of Signal Theory and Communications, Universidad Carlos III de Madrid, Spain

Director: Joerg Widmer, IMDEA Networks Institute, Madrid, Spain

3. Hany Assasa (July 2019)

Robust and Reliable Millimeter Wave Wireless Networks

PhD thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain

Director: Joerg Widmer, IMDEA Networks Institute, Madrid, Spain

4. Roberto Calvo-Palomino (July 2019)

Towards Large-Scale and Collaborative Spectrum Monitoring Systems using IoT Devices

PhD thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain

Director: Domenico Giustiniano, IMDEA Networks Institute, Madrid, Spain

5. Luca Cominardi (March 2019)

Enhanced Connectivity in Wireless Mobile Programmable Networks

PhD thesis, Department of Telematics Engineering, Universidad Carlos III de Madrid, Spain

Director: Carlos Jesús Bernardos, Universidad Carlos III de Madrid, Spain

5.3. Scientific service

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

Marco AJMONE

Professional posts & activities
- 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)
- Editorial Board member: Springer Nature Computer Science (Springer)

TPC Memberships
- 11th International Conference on Computing, Networking and Communications (ICNC 2019), 18-21 February 2019, Honolulu, USA.
- 2nd International Conference on Recent Advances in Signal Processing, Telecommunications & Computing (SigTelCom 2019), 21-22 March 2019, Ha Noi, Vietnam
- 26th International Conference on Telecommunications (ICT 2019), 8-10 April 2019, Ha Noi, Vietnam
- 17th IEEE Wireless Communications and Networking Conference (IEEE WCNC 2019), 15-18 April 2019, Marrakech, Morocco.
- 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), Paris, France, May, 2019
- 53rd IEEE International Conference on Communications (ICC 2019), 20-24 May, 2019, Shanghai, China
- 8th IEEE International Conference on Communication, Networks and Satellite (COM-NETSAT 2019), 1-3 August 2019, Makassar, Indonesia
- 31st International Teletraffic Conference (ITC 2019), 27-29 August 2019, Budapest, Hungary
- 10th Symposium on Green Networking and Computing (SGCN 2019), 19-21 September 2019, Split, Croatia
- 2019 IEEE Asia Pacific Conference on Wireless and Mobile (APWIMob 2019), 5-7 November 2019, Bali, Indonesia
- 25th Asia-Pacific Conference on Communications (APCC'19), 6-8 November 2019, Ho Chi Minh City, Vietnam
- 29th International Telecommunication and Applications Conference (ITNAC 2019), 27-29 November 2019, Auckland, New Zealand

- 11th ITU Kaleidoscope 2019 - ICT for Health: Networks, standards and innovation, 4-6 December, Atlanta, USA
- IEEE Global Communications Conference (GLOBECOM 2019), 9-13 December 2019, Waikoloa, USA
- Vice-chair of the Steering Committee of MedComNet
- Corporate Sponsorship chair ACM MobiHoc 2019

Hany ASSASA

TPC Memberships
- 2020 Workshop on ns-3 (ACM WNS3 2019), 19-20 June 2019, Florence, Italy
- 15th International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT 2019), December 9-12, 2019, Orlando, Florida
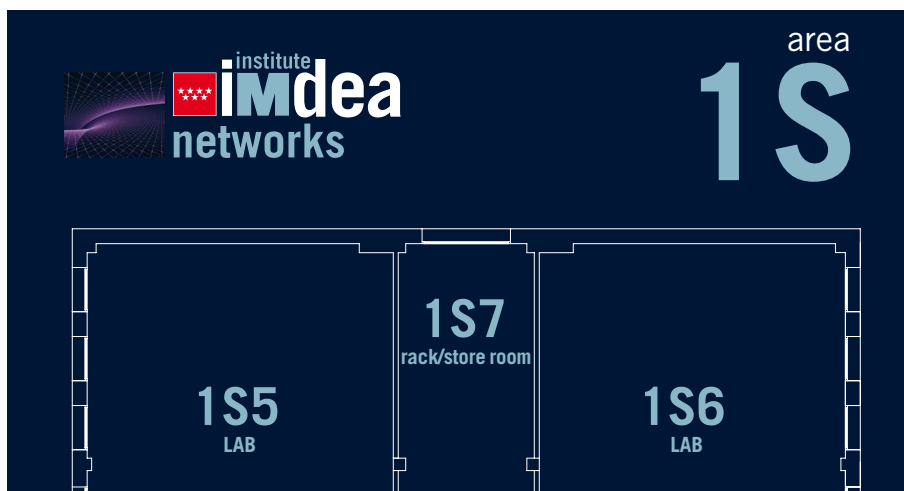
Arturo AZCORRA

Professional posts and activities
- Chairman of the Vision Group of 5GIA. December 2018 - present.
- Chair of the "Vision and Societal Challenges" workgroup of the 5G Infrastructure Association. November 2018 – present
- Member of the Board of Directors of the National Scientific Society for Telematics (ATEL). January 2016 – present
- Vice-President of the 5TONIC Laboratory. October 2015 – present
- Conference Co-Chair for IEEE CSCN 2019, 28-30 October 2019, Granada, Spain
- Deputy Director of the Master in Connected Industry 4.0, Universidad Carlos III de Madrid, 2018 to present
- Member of the Executive Committee of the Doctorate School of Univ. Carlos III of Madrid. 9 December 2015 – present
- Deputy Director of the Master in Network Function Virtualization and Sofware Defined Networks for 5G, Universidad Carlos III de Madrid

Technical Program Committees
- Comité del Programa de las Jornadas Tecnicas de RedIRIS 2019
- TPC member of IEEE INFOCOM 2019

Albert BANCHS

Journal editorial boards

- Editor: IEEE Transactions on Wireless Communications, 2014 – present
- Editor: IEEE/ACM Transactions on Networking, 2016 – present

TPC memberships

- 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 April - 2 May 2019, Paris, France
- 20th IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (IEEE WoWMoM 2019), 10-12 June 2019, Washington, USA
- European Conference on Networks and Communication (EuCNC 2019), 17-18 June 2019, Valencia, Spain

Paolo CASARI

Journal editorial boards

- Co-Guest Editor: Special Section on «Underwater Wireless Communications and Networking», IEEE Access Journal
- Associate Editor: IEEE Transactions on Mobile Computing, May 2018 – present
- Associate Editor: IEEE Transactions on Wireless Communications, December 2018 - present

Organization committees

- Workshop co-chair: The 2nd International Workshop on Edge Computing and Networking (ECN) 2019, attached to the International Conference on Computer Communications and Networks (ICCCN) 2019
- Local Arrangements Chair: the 15th International Conference on Embedded Wireless Systems and Networks (EWSN 2018)

TPC memberships

- 11th IFIP Wireless Days 2019, 24-26 April 2019, Manchester, United Kingdom
- 89th IEEE Vehicular Technology Conference (VTC 2019-Spring), 28 April – 1 May 2019, Kuala Lumpur, Malaysia
- 3rd IEEE International Workshop on Wireless Communications and Networking in Extreme Environments (WCNEE'19-INFOCOM 2019 workshops), 29 April 2019, Paris, France
- The 28th International Conference on Computer Communications and Networks (ICCCN 2019), July 29 - August 1, 2019, Valencia, Spain
- 90th IEEE Vehicular Technology Conference (VTC 2019-Fall), 22-25 September 2019, Honolulu, USA
- 14th International Conference on Underwater Networks & SystemsACM (WUWNet 2019), 23-25 October, Atlanta, USA
- 17th ACM International Conference on Embedded Networked Sensor Systems (SenSys) (External), 10-13 November 2019, New York, USA

Antonio FERNÁNDEZ ANTA

Journal editorial boards
- Editor of The Computer Journal, Oxford Journals

TPC Membership
- Principles and Practice of Parallel Programming 2019 (PPOPP 2019), Washington, USA, February 16-20
- 15th Theory and Applications of Models of Computation (TAMC 2019), Kitakyushu, Japan, April 13-16, 2019.
- International Conference on Blockchain Economics, Security and Protocols (Tokenomics 2019), Paris, France, May 6-7,
- 13th ACM International Conference on Distributed and Event-Based Systems (DEBS 2019), Darmstadt, Germany, June 24-28 2019
- 33rd International Symposium on Distributed Computing (DISC 2019), Budapest, Hungary, October 14-18

Organization committees
- Co-chair of The 2nd International Workshop on Edge Computing and Networking (ECN 2019), collocated with ICCCN 2019

Claudio FIANDRINO

Journal editorial board
- IEEE Networking Letters

Organization committees
- Publicity Chair: the 14th ACM/IEEE Symposium on Architectures for Networking and Communications Systems (ANCS 2018)
- Workshop Co-Chair: 9th Workshop on Management of Cloud and Smart City Systems (MOCS), in conjunction with IEEE ISCC 2019
- * TPC Co-Chair: 24th IEEE International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD) 2019

TPC Memberships
- 53rd IEEE International Conference on Communications (ICC 2019), 20-24 May, 2019, Shanghai, China
- 2nd International Workshop on Edge Computing and Networking (ECN 2019) -colocated with ICCCN 2019-, 1 August 1 2019, Valencia, Spain
- 26th IEEE International Conference on Parallel and Distributed Systems (ICPADS 2019). 4-6 December 2019, Tianjin, China
- IEEE Global Communications Conference (GLOBECOM 2019), 9-13 December 2019, Waikoloa, USA

Domenico GIUSTINIANO

Editorial board
- Editorial Board of Computer Networks (Elsevier) as an Area Editor.

TPC Memberships
- 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 April - 2 May 2019, Paris, France
- 16th IEEE International Conference on Sensing, Communication and Networking, 10-13 June 2019, Boston, USA
- 25th Annual International Conference on Mobile Computing and Networking (Mobicom 2019), October 21-25 2019, Los Cabos, Mexico
- 13th ACM Workshop on Wireless Network Testbeds, Experimental evaluation \& Characterization (WiNTECH 2019), 25 October, Los Cabos, Mexico

Sergey GORINSKY

Professional posts & activities
- Funding Proposal Evaluator: ERC Starting Grants, European Research Council
- Funding Proposal Evaluator: EDGE MSCA COFUND Postdoctoral Fellowships
- Project Evaluator: Horizon 2020, European Commission
- Project Evaluator: CMU Portugal Program, Science and Technology Foundation, Portugal

Journal editorial boards
- Editorial Board Member: ACM SIGCOMM Computer Communication Review

Organization committees
- Steering Committee Member: COMSNETS Association
- General Chair: ICNP 2020
- Best-Paper Award Committee Member: INFOCOM 2019

TPC Memberships
- 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 April - 2 May 2019, Paris, France
- 27th IEEE International Conference on Network Protocols (ICNP 2019), 7-10 October, Chicago, USA
- 15th International Conference on emerging Networking Experiments and Technologies (ACM CoNEXT 2019), 9-12 December, Orlando, USA

Kirill KOGAN

TPC Memberships

- 11th International Conference on Communication Systems & Networks (Netsoft 2019), 7-11 January, Bengaluru, India
- 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 April - 2 May 2019, Paris, France
- 5th IEEE Conference on Network Softwarization (Netsoft 2019), 24-28 June 2019, Paris, France
- 27th IEEE International Conference on Network Protocols (ICNP 2019), 7-10 October, Chicago, USA

Nikolaos LAOUTARIS

Professional posts & activities

- General Chair ACM CoNEXT'20
- ACM SIGCOMM Doctoral Dissertation Award Committee Chair (2018)

TPC Memberships

- ACM Conference on Fairness, Accountability, and Transparency '19, ACM SIGCOMM'19
- ACM Conference on Fairness, Accountability, and Transparency (SIGCOMM 19), 19-24 August, Beijing, China

Vincenzo MANCUSO

Journal editorial boards

- Editor for IEEE Transactions on Green Communications and Networking (TGCN) for the "Energy Efficiency in Wireless Communications and Networking" area.
- Editor for special section of TGCN on Energy Efficiency for Internet of Things

Organization committees

- Poster and Demo co-chair for ICNP'20

TPC Membership

- 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 April - 2 May 2019, Paris, France
- 7th IEEE International Black Sea Conference on Communications and Networking (Black-SeaCom 2019), 3-6 June 2019, Sochi, Russia
- 16th IEEE International Conference on Sensing, Communication and Networking (IEEE SECON 2019), 10-13 June 2019, Boston, USA
- 3rd– Workshop on Mobile Network Measurement TMA Conf. 2019 (MNM'19), June 17-21, Paris, France
- 7th International Workshop on Cloud Technologies and Energy Efficiency in Mobile
- Communications Networks (CLEEN 2020) (virtual workshop)

- IFIP Networking 2020, 22-25 June 2020, (virtual conference)
- 39th IEEE International Conference on Computer Communications (IEEE INFOCOM 2020) (virtual conference)

Narseo VALLINA-RODRÍGUEZ

TPC membership

- 20th International Conference on HotMobile Passive and Active Measurements Conference (PAM 2019), 27-29 March, Puerto Varas, Chile
- 12th IEEE/IFIP TMA Conference (TMA), 19-21 June, Paris, France
- 19th Privacy Enhancing Technologies Symposium (PETS 2019), 16-20 July, Stockolm, Sweden
- 19th ACM Internet Measurements Conference (IMC 2019), October 21 - 23, 2019, Amsterdam, Netherlands

Joerg WIDMER

Professional posts & activities

- Chair of working group IFIP TC 6 WG 6.2 - Network and Internetwork Architectures

Journal editorial boards

- Associate Editor: IEEE Transactions on Mobile Computing
- Editor: Computer Networks Journal (Elsevier)
- Guest Editor of IEEE Journal on Selected Areas in Communications Special Issue on ``Millimeter-Wave Networking''

TPC Memberships
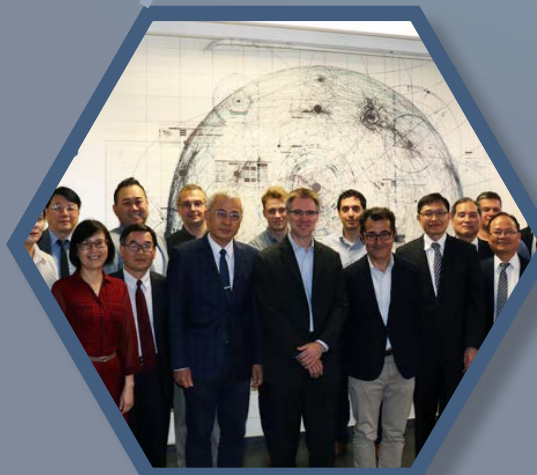
- International Conference on Networked Systems (NetSys) 2019, 18-21 March 2019, Munich, Germany
- 38th IEEE International Conference on Computer Communications (IEEE INFOCOM 2019), 29 April - 2 May 2019, Paris, France
- 18th IFIP Networking Conference 2019, 20-22 May 2019, Warsaw, Poland
- ACM Workshop on Autonomous Mobile Air¬Ground Edge Computing, Systems, Networks, and Applications (MAGESys) 2019, 19 August 2019, Beijing, China
- 13th ACM Workshop on Wireless Network Testbeds, Experimental evaluation \& Characterization (WiNTECH) 2019, 25 October, 2019, Los Cabos, Mexico
- ACM Workshop on Millimeter Wave Networks and Sensing Systems (ACM mmNets) 2019, 25 October, 2019, Los Cabos, Mexico

dissemination events

11th IMDEA Networks Annual International Workshop

Networking Research: Present, Future and Beyond

5.4. Outreach

5.4.1 Major events

The magic of 5G and industry 4.0 (MWC 2019)
(February)

During his presentation on the operator's assets and opportunities to deliver Connected Industry 4.0 applications across 5G networks, 5TONIC VP and 'Chief Wizard' Arturo Azcorra used a clip from the "Sorcerer's Apprentice" scene in the Disney's 'Fantasia' movie to highlight what happens if the magic is not controlled properly

More info

IMDEA Networks at the Madrid Fair for Science and Innovation
(March)

IMDEA Networks' demos encouraged attendees to explore the workings of FM radio with which we are all familiar to the Internet of Things, at the cutting edge of technological innovation.

More info

IMDEA Networks researcher ranks first in T3chFest – La Nave (Spain) hub of Google Hash Code competition
(March)

A team of IMDEA Networks predoctoral researchers achieved the first and third positions within the hub "T3chFest – La Nave (Spain)" that took part in the international Google Hash Code competition. The event was convened globally, opened to Europe, USA, Middle East and Africa.

More info

Secondary school students joined IMDEA Networks for educational training

(April)

Five bilingual 16 year-old students from the secondary school 'IES Isaac Albéniz', located in Leganés, Madrid, joined IMDEA Networks Institute for a period of two days on an educational stay. IMDEA Networks enlisted for the fourth consecutive year on '4ESO+empresa', a learning and training program promoted by the Regional Government of Madrid.

More info

First Prize in Hackathon SAS-Correos goes to joint IMDEA Networks/UC3M multidisciplinary team

(April)

CORREOS and SAS España awarded a team from IMDEA Networks and University Carlos III of Madrid (UC3M) for the best initiative in Artificial Intelligence applied to environmental efficiency with the aim of improving their service to citizens.

More info

Presentation of the Czech Republic in the 'Networks' sector

(April)

The Czech Republic Embassy in Madrid, in collaboration with the CzechTrade Center and IMDEA Networks Institute, organized an event to present their science and research projects in the area of communication networks and explore possible synergies and collaboration opportunities

More info

11th IMDEA Networks International Workshop: Networking Research: Present, Future and Beyond

(May)

A group of renowned experts delivered keynotes and participated in panels to assess where networking research stands up to date, and more important, where it is heading in the future.

More info

Taiwanese delegation visited IMDEA Networks

(July)

A taiwanese delegation composed of high-level officials and scientists made a tour of some of the top research institutions in Madrid, making a stop at IMDEA Networks. They were seeking to identify synergies and establish strategic transnational partnerships.
More info

7th 5G Global Event

(July)

Future 5G research trends was the topic of an invited presentation given by IMDEA Networks' director and 5G IA Vision WG Chairman at the 5G-PPP, Arturo Azcorra, during the 7th 5G Global Event, organised by the 5G IA/5G PPP and the European Commission.
More info

A team of Spanish girls finalist of the Technovation Challenge with a geolocation app for women

(July)

The LPSN team, formed by 5 students of Madrid's secondary school IES Velázquez de Móstoles, was selected to represent Spain in the final of the Technovation Challenge (San Francisco, USA). Cristina Márquez Colás, an external PhD student at IMDEA Networks Institute who is undertaking the doctoral program at the University Carlos III of Madrid together with Oscar Amador Molina, mentored the team.
More info

Visit of a Brazilian delegation

(October)

A Brazilian delegation, in official mission to Portugal and Spain, were seeking to witness personally the innovation ecosystems and successful experiences in smart cities and business internationalization.
More info

Science Week of Madrid

(November)

Going beyond online advertising, Dr. Laoutaris presented, in a seminar celebrated at IMDEA Networks within the Science Week of Madrid, an earlier work on detecting online price discrimination as well as his community building efforts in setting up and growing the Data Transparency Lab.

More info

5G-based emergency plan, developed under the European innovation project 5G-TRANSFORMER

(November)

5TONIC laboratory presented at IMDEA Networks venue, together with SAMUR-PC and the UC3M, a revolutionary system for health emergencies based on 5G.The demonstration shows a personalized 5G automatic system that allows to reduce the time of action in case of an emergency, minimizing errors.

More info

5.4.2. 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 **37** total number of events in which the Institute participated during 2018, **16** were conducted by invited speakers. We list the latter here:

Scaling Distributed Machine Learning with In-Network Aggregation
Marco Canini, Associate professor in Computer Science at KAUST, Saudi Arabia
17 December 2019

5G Positioning and Mapping
Henk Wymeersch, Professor, Chalmers University of Technology, Sweden
25 November 2019

How Virtual and Augmented Reality Will Transform Healthcare
Walter Greenleaf, Professor, Stanford University, USA
14 November 2019

Data management and modeling for improved system design and user privacy
Nicolas Kourtellis, Research Scientist in the Telefonica R&D team in Barcelona
12 November 2019

Scalable and Adaptive Monitoring for Programmable Networks
Daphne Tuncer, Research Fellow, Department of Computing, Imperial College London, UK
24 October 2019

Cooperative Automated Driving: From Assistance Systems to Networking to Human Interaction
Falko Dressler, Full Professor, Heinz Nixdorf Institute, Paderborn University, Paderborn, Germany
26 July 2019

Multiple-Relay Slotted ALOHA: Performance Analysis and Bounds
Andrea Munari, Visiting Senior Researcher, Institute of Communications and Navigation, German Aerospace Center (DLR), Munich, Germany…
4 July 2019

Orchestration of Software-Defined Infrastructures for Edge Computing Applications
Flavio Esposito, Assistant Professor, Department of Computer Science, Saint Louis University, USA
01 July 2019

Cooperative Offloading in Context-Aware Networks: A Game-Theoretic Approach
Tobias Meuser, Multimedia Communications Lab (KOM), Technische Universität Darmstadt, Germany
19 June 2019

Databox as a Platform for Monitoring IoT Devices at the Edge
Anna Maria Mandalari, Research Associate, Dyson School of Design Engineering, Faculty of Engineering, Imperial College London, UK
12 June 2019

Double Spend Races
Ricardo Pérez-Marco, Directeur de Recherches, CNRS (IMJ-PRG), Paris, France
5 June 2019

End-to-end service optimization and control in next generation cloud-integrated networks
Jaime Llorca, Senior Research Scientist, Algorithms, Analytics, and Augmented Intelligence Lab, Nokia Bell Labs, New Jersey, USA
10 May 2019

Back to the Future: Enabling Sustainable and Ubiquitous Sensing Systems
Ambuj Varshney, Postdoctoral Researcher, Uppsala University, Sweden
8 May 2019

Mobile robots, from gram scale to aquatic flying vehicles
Raphael Zufferey, Research Postgraduate, Aerial Robotics Lab, Imperial College London, UK
5 March 2019

You and your research...in the cloud
Israel Herraiz, Google, Madrid, Spain
22 February 2019

The Roaming Edge
Suman Banerjee, Professor, University of Wisconsin-Madison, USA; Visiting Professor IMDEA Networks; Chair of Excellence University...
30 January 2019

Media impact 2019

5.4.3 Media impact

33

Web news

27

Press releases

943

Social
networks posts

4.702

Social networks followers 2019
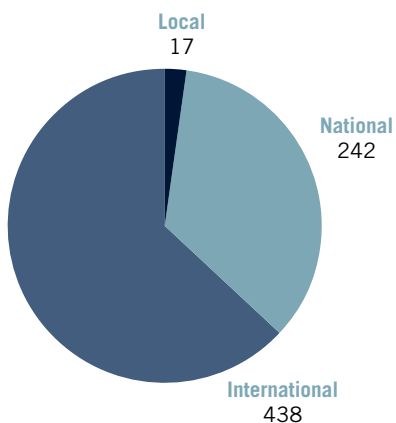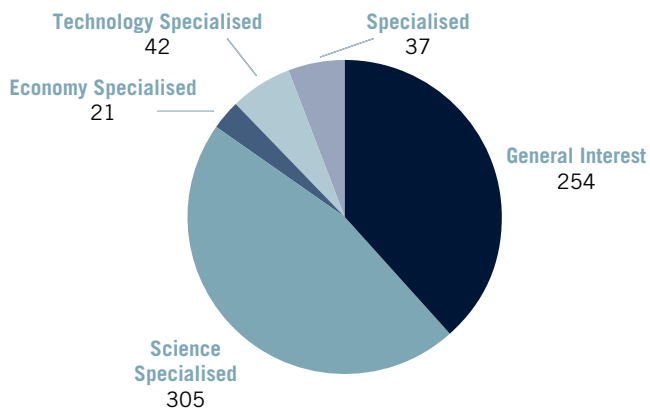
1.090   140   161   2.830   481

national, international, local

Local
17

National
242

International
438

media content

Technology Specialised
42

Specialised
37

Economy Specialised
21

General Interest
254

Science
Specialised
305

AlphaGalileo Foundation

EurekAlert! AAAS
The Global Source for Science News

sinc
La ciencia es noticia

notiweb
Boletín de noticias de I+D+i

Globedia

PHYS.ORG

10 años | dcyt

total telecom

Expansión

TICbeat

NCYT Amazings
Noticias de la Ciencia y la Tecnología
Divulgando la Ciencia por Internet desde 1997

EL PAÍS

elEconomista.es

LA VANGUARDIA

ABC.es | AGENCIAS

BioPortfolio
Biotech, Healthcare and Medical Resources

economiadehoy.es

5TONIC

fundación para el conocimiento madrid

EFE:

conectrónica
tecnología y elementos de conexión y conectividad

LE FIGARO

The Register®
Biting the hand that feeds IT

europa press

ScienceDaily

c|net

Some media impacts

TeleMadrid

5TONIC, UC3M and SAMUR-PC presentation of a new system for situations 5G-based emergency plan under the European innovation project 5G-TRANSFORMER.

More info

EL PAÍS
EL PERIÓDICO GLOBAL

Report about *An Analysis of Pre-installed Android Software*

More info

TECNOLOGÍA

MÓVILES REDES SOCIALES BANCO DE PRUEBAS RETINA MERISTATION

Te quedan artículos gratis este mes   SUSCRÍBETE POR SE

Cómo le vigilan los móviles Android sin que lo sepa

Un estudio dirigido por dos académicos españoles de más de 1.700 dispositivos de 214 fabricantes descubre los sofisticados modos de rastreo del 'software' preinstalado en este ecosistema

JORDI PÉREZ COLOMÉ
20 MAR 2019 - 09:06 CET

Juan Tapiador (izquierda) y Narseo Vallina-Rodríguez, directores de la investigación sobre el software preinstalado en los móviles Android. KIKE PARA

Santander

LAS REMONTADAS
no son una cosa mía,

rtve

Lab 24 **report about Internet-XXI Century (with statements from IMDEA Networks researchers, 5Tonic consortium, IMDEA Software…)**

More info

PHYS·ORG

Joerg Widmer, Research Director at IMDEA Networks, explain TIGRE5 Project

More info

Project delivers low-cost future network architecture for mobile operators

by IMDEA Networks Institute
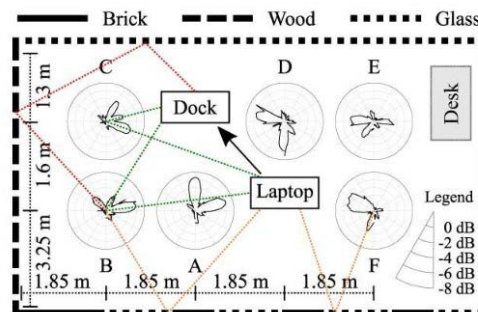
Fig. 1. Analysis of the impact of reflections patterns in a realistic mm-wave wireless setting (conference …

The 4-year TIGRE5-CM project, coordinated by IMDEA Networks Institute in Madrid, delivers an architecture designed for future mobile networks, based on the SDN (Software Defined Networking) paradigm. TIGRE5-CM simplifies deployment, configuration and management in both the access and core networks, integrating cutting-edge technologies.

Joerg Widmer, Research Director at IMDEA

Arturo Azcorra´s statements about 5G
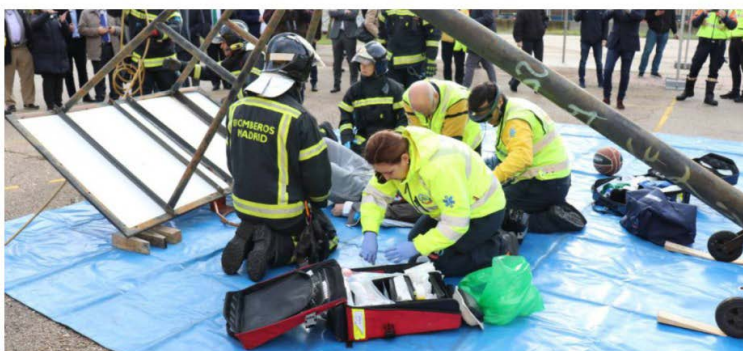
More info Cadena Ser

More info rne

TECNOLOGÍA

IMDEA Networks: "El 5G es el sueño de la medicina"

El director del instituto madrileño de investigación, Arturo Azcorra, cree que potenciará la asistencia y los tratamientos individualizados

Arturo Azcorra explica el 5G en RNE

"El cambio al 5G no va a ser tan impactante para el usuario particular como para la industria"

Abril 29, 2019

Arturo Azcorra, director del instituto de investigación IMDEA Networks y catedrático en la Universidad Carlos III de Madrid, es entrevistado por Radio Nacional de España sobre las comunicaciones 5G.

mdo madridiario

Report about IMDEA Networks performance

EL MADRID SOCIAL: RSC Y FUNDACIONES

Ampliar

IMDEA Networks, instituto de investigación en redes de computación y comunicación. (Foto: IMDEA NETWORKS)

IMDEA Networks: Tecnología líder en redes y comunicación

Por **MDO**

Domingo 28 de julio de 2019, 09:06h

5.5 Local Scientific Partnership

IMDEA Networks Institute has established a strong scientific partnership with a number of the local universities in the Madrid region. Among those, it is worth highlighting the partnerships with University Carlos III of Madrid (UC3M) and University of Alcalá (UAH). This partnerships involve stable research collaboration in joint activities and projects as well as an institutional collaboration in the form the participation of UC3M and UAH on the Institute's Board of Trustees.

Among other activities, the cooperation between IMDEA Networks and the local universities involve their joint participation in funded research projects. The regional project TAPIR-CM, currently ongoing, counts with the participation of UC3M and UAH under the coordination of IMDEA Networks. Furthermore, UC3M and IMDEA Networks jointly participate in several ongoing European projects, such as 5G-EVE and SMOOTH. In addition to projects, IMDEA Networks is also conducting several research activities in partnership with UC3M and UAH. As a result of this common undertaking, several results have been produced, including publications and patents.

On the teaching front, IMDEA Networks is delivering, jointly with Ericsson and UC3M and with the participation of UAH, a M.Sc. degree on SDN and NFV. This Master was one of the first ones in the world on this topic, and it had a lot of success on the academic side as well as a very substantial media impact.

Another important activity where IMDEA Networks is collaborating with the local universities is in the context of the National Association of Telematics (ATEL). IMDEA Networks, UC3M and UAH are very important members of this association, and are organizing various activities in the context of this association, such as the national conference on Telematics (JITEL).

Besides the above activities, IMDEA Networks, UC3M and UAH are also taking advantage of the physical proximity between the three institutions to share many of their daily labors, such as the biweekly scientific seminars organized by IMDEA Networks, which count with the participation of UC3M and UAH, as well as the annual workshop organized by IMDEA Networks.

Through these collaborations with local scientific partners, IMDEA Networks is importantly contributing to strengthen the scientific standing of the Madrid region in the area of Telematics.

impact and technology transfer

6

annual report
2019
w w w . n e t w o r k s . i m d e a . o r g

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.

USA Patent Application (March 2019)

Title: *Method for determining geometric information on 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: 16/365,953 (27.03.2019).

6.2. Technology transfer & impact

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. Our projects include both types of partnerships with specific listings of those enterprises and organizations currently working with us. A remarkable result in 2019 worth highlighting in terms of industrial impact are our efforts on demonstrating the presence of covert and side-channels to access sensitive data on the Android platform, which influenced significant changes in Android 10's permission model.

6.2.1. Ongoing Industry contracts

User level traffic prediction in cellular network

Funded by: Huawei Technologies (China)
Duration: Duration: November 2019 to November 2020

Massive MIMO (MM) is an important technique in (beyond) 5G that greatly improves spectral efficiency by increasing the number of antenna elements. This increases the overhead of Channel State Information (CSI) estimation and obtaining accurate CSI is a fundamental problem in massive MIMO systems. In this project, we focus on scheduling uplink Sounding Reference Signals (SRS) that carry pilot symbols for CSI estimation. In high loaded scenarios, the amount of resources available for SRS is limited and would be vastly inefficient because of the unability to refresh outdated channel estimates frequently. To this end, we design a solution that leverages ML to estimate future traffic allocations and triggers SRS to obtain a channel estimate right before the traffic arrives.
More info

AEPD SDK

Funded by: Agencia Española de Protección de Datos (AEPD)
Duration: September to December 2019

As in the web and desktop software, most app developers rely on third-party components —e.g., libraries or software development kits (SDKs)—that they integrate into their apps to add particular desired functionalities. This project aims to bring light to the issues and challenges that third-party SDKs bring to the mobile ecosystem, from a privacy, transparency and regulatory compliance standpoint. We conclude with a series of recommendations—applicable to different stakeholders—that could contribute to mitigate the privacy risks associated with third-party SDKs embedded in mobile applications.
More info

SPECTRUMCOP PROGRAM: LOCATE IT

Funded by: Armasuisse – Science and Technology
Duration: March 2019 to November 2019

Investigate enabling technologies to localize signal emitters by using low-cost and software-defined radio receives, which synchronize among them to estimate the transmitter localization using lossy compression techniques to optimize the amount of data exchanged

or a compression layer in the data spectrum pipeline, and operating with different types of RF front-ends (re-configurable spectrum sensor code).
More info

NETPREDICT

Funded by: Nokia Spain
Duration: June 2019 to July 2019

Determine predictive variables (quality indicators) of anomalies in network traffic based upon data QoS and communication network assessment experiments, including data pre-processing, statistical descriptive analysis, performing regression studies and assessing clustering machine learning models using different supervised classification methods.
More info

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 June 2019

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.
More info

SPECTRUMCOP PROGRAM: SPECSALE IT

Technologies for Collaborative Detection of Spectrum Anomalies

Project website: https://www.electrosense.org/
Funded by: Armasuisse – Science and Technology
Duration: February 2019 to June 2019
Project partners

Investigate scalability and secure access to sensors ensuring fully operability: running status, connectivity, system load, etc. Specific use cases will also be analyzed for detection and location, extending the current capabilities of Spectrumcop to mobile spectrum devices, improving the compression mechanisms, GPS spoofers in the roads and extension of the work of high precision time of arrival to localize aircrafts

More info

SPECTRUMCOP PROGRAM: MONTEBIANCO

Technologies for Collaborative Detection of Spectrum Anomalies

Funded by: Armasuisse – Science and Technology
Duration: March 2018 to February 2019

Large networks to monitor the spectrum present problems of scalability across several dimensions: capability to swiftly detect events with an increasing amount of data to be processed, management of the network, and handling priority access to users that want to enjoy specific services through spectrum sensors. SpecScale will address the scalability problem with an innovative architecture while ensuring secure access for large scale spectrum monitoring. (Part of the SPECTRUMCOP PROGRAM, which was launched in March 2016).

More info

LF ASSISTS HF IN BEAM AND MOBILITY

Funded by: Huawei Technologies (China)
Duration: July 2017 to January 2019

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.

More info

6.2.2. 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** Diego R. López from Telefónica I+D and Arturo Azcorra, Joerg Widmer and Albert Banchs, from IMDEA Networks, focuses on key 5G enablers such as flexible functional split, joint handover optimization, 60GHz wireless networks, network function operating systems, secure virtual computing and green networking.

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

5TONIC is an open research and innovation laboratory focusing on 5G technologies that was **founded by Telefonica and IMDEA Networks Institute** in 2015. The **first laboratory of 5G excellence in Spain** also counts with **Ericsson Spain**, **INTEL**, **Commscope**, **University Carlos III of Madrid, InterDigital and Altran** amongst its members. In 2019 **Innovalia, UTEK Teknologies and Nokia Bell Labs** 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. Among 5G research projects carried out by the Madrid Institute are the ongoing **5G EVE and 5G Vinni,** as well as **5G Transformer, 5GInFire and 5GEx,** concluded during 2019.

5TONIC Members

New 5TONIC Collaborators

NEC-IMDEA Networks Joint Research Unit in 5G Technologies

In May 2019, IMDEA Networks Institute (Madrid, Spain) and NEC Laboratories Europe (Heidelberg, Germany) launched a Joint Research Unit (JRU) in 5G technologies. The JRU foster multidisciplinary joint team **works in 5G research and development projects** (both entities have been strongly involved from the start in the European effort to create 5G). Located at IMDEA Networks' headquarters, this private-public alliance establishes an operational framework for **close collaboration amongst a highly specialized team in a variety of scientific activities**.
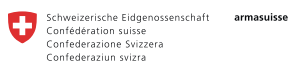
The JRU team share a wealth of know-how and capabilities to **jointly deliver 5G solutions, architectures, technologies and standards**. Includes joint participation in R&D programs and projects, selection and training of personnel, development of platforms, applications, services and software tools, exploration and technological evaluation, technology transfer activities and enhancement of R&D through internal and external programs, and research dissemination activities.

Work led by experienced scientists Roberto González Sánchez and Andrés García Saavedra, both senior researchers from NEC Laboratories Europe, together with Arturo Azcorra, Joerg Widmer and Albert Banchs, from IMDEA Networks, focus on key 5G and beyond enablers such as the usage of Artificial Intelligence technologies to improve the **performance and usability of the 5G networks** or the generation and study of **new Internet services**.

6.2.3 Industry partners

Our technology transfer activities have led to a significantly increased portfolio of companies we collaborate with. During 2018 they were the following:

Armasuisse – Science and Technology

Ares2T

Assosiazione PIIU

Automatismos y Sistemas de Transporte Interno S.A.

British Telecommunications Public Limited Company (BT)

Celerway Communications AS

certSIGN S.A.

De Productizers B.V.

EvoLogics GmbH

Electricite de France

Ericsson España S.A

Ericson Hellas S.A

Ericsson telecomunicazioni

Eurescom-European Institute for Research and Strategic Studies in Telecommunications

European Small Business Alliance Of Small and Medium Independent Enterprises-ESBA

Exus Software Ltd.

Fundingbox Accelerator Sp z o.o

Hellenic telecommunications organization S.A.,

Huawei Technologies (China)

Idc Italia srl

Intel Research and
Development Ireland Limited

Linknovate Science SL

Lstech España SL

NEC Europe Ltd.

Nextworks Engineering
Forward

Nokia Bell Labs France

Nokia Spain S.A

**Nokia Liseis
Kaidiktia Ellas
Anonimi Etaireia**

Orange

Orange Romania SA

**Orange Polska
Spolka Akcyjna**

Sistemas Avanzados
de Tecnología SA (SATEC)

Sociedad Mercantil Estatal para
la gestión de la innovación
y las tecnologías
turísticas S.A

Studio Professionale
Associato a
Baker & McKenzie

Telcaria Ideas S.L.

Telenor ASA

Trenitalia Spa

Telecom Italia S.p.a.

Telefónica I+D

Tieto Sweden Support
Services AB

Upcom BvBa

Verizon Nederland B.V.

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.

personnel

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annual report
2019
www.networks.imdea.org

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 Deputy Director, the Research Director and the General Manager also assist the Director..

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. Arturo AZCORRA
Director

Research: 5G Networks and Services; Network Virtualization and Softwarization; Drone Communications; On-line Social Networks Data Analytics; Mammal Brain Cartography and Topology
More info

Short Bio
Dr. Arturo Azcorra graduated in 1980 from Loy-Norrix High School, Michigan. He received his Telecommunication Engineering degree from Universidad Politécnica de Madrid in 1986, and the Doctor degree in 1989 from the same University. He currently is a full professor at Universidad Carlos III de Madrid, and he's also Director of the International Research Institute IMDEA Networks, a very relevant research institution in Europe. On the professional area, Arturo Azcorra is an IEEE Communications Society Senior Member, an Internet Society member, an ACM-SIGCOMM member, a founding member of the Association for Telematics, and also president of the said Association.

Dr. Albert BANCHS
Deputy Director

Research: Wireless Networks; 5G Networks; Performance Evaluation; Algorithm Design
More info

Short Bio
Dr. Albert Banchs received his M.Sc. and Ph.D. degrees from the Polytechnic University of Catalonia (UPC-BarcelonaTech) in 1997 and 2002, respectively. He is currently a Full Professor with the University Carlos III of Madrid (UC3M), with double affiliation as Deputy Director of the IMDEA Networks institute. Before joining UC3M, he was at ICSI Berkeley in 1997, at Telefonica I+D in 1998, and at NEC Europe Ltd. from 1998 to 2003. Prof. Banchs authors over 100 publications in international conferences and journals, and is the co-inventor of several patents. He is the editor of IEEE Transactions on Wireless Communications and IEEE/ACM Transactions on Networking..

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

Research: Computer Networks; in particular Wireless Networking; Extremely High Frequency Communication (60GHz); Network Coding; Mobile Network Architectures; Transport Protocols
More info

Short Bio

Dr. Joerg Widmer is Research Professor and Research Director of IMDEA Networks in Madrid, Spain. Before, he held positions at DOCOMO Euro-Labs in Munich, Germany and EPFL, Switzerland. His research focuses on wireless networks, ranging from extremely high frequency millimeter-wave communication and MAC layer design to mobile network architectures. He authored more than 150 conference and journal papers, 3 IETF RFCs, and 13 patents.

He received an ERC consolidator grant, the Friedrich Wilhelm Bessel Award of the Humboldt Foundation, a Ramon y Cajal grant, as well as eight best paper awards. He is senior member of IEEE and ACM.

Dr. Marco AJMONE MARSAN
Research Professor

Research: Cellular Networking; Green Networking; Network and Protocol Performance; Crowdsourcing Systems
More info

Short Bio

Marco Ajmone Marsan is full professor at Politecnico di Torino and research professor at IMDEA Networks Institute. He obtained degrees from Politecnico di Torino, UCLA, and Budapest University of Technology and Economics (honorary). His main research fields are performance evaluation and networking. He was member of the editorial board and chair of the steering committee of the "ACM/IEEE Transactions on Networking" and is now in the editorial boards of "Computer Networks", "Performance Evaluation", and "ACM TOMPECS". He is Fellow of the IEEE, member of the Academy of Sciences of Torino and Academia Europaea, general chair of Infocom 2013 and ICC 2023.

Dr. Antonio FERNÁNDEZ ANTA
Research Professor

Research: Communications and Networks; Parallel and Distributed Processing; Algorithms; Discrete and Applied Mathematics; Distributed Ledgers; Data Analysis
More info

Short Bio

Antonio Fernandez Anta is Research Professor at IMDEA Networks. Previously he was a on the Faculty of the Universidad Rey Juan Carlos (URJC), and the Universidad Politécnica de Madrid (UPM), where he received a research performance award. He was a postdoc at MIT (1995-1997), and spent sabbatical years at Bell Labs and MIT Media Lab. He has been awarded the Premio Nacional de Informática "Aritmel" in 2019 and is Mercator Fellow of the SFB MAKI in Germany since 2018. He received his M.Sc. and Ph.D. from the University of Louisiana. He is a Senior Member of ACM and IEEE.

Dr. Nikolaos LAOUTARIS
Research Professor

Research: Privacy; Transparency/ Data Protection; Economics of Networks and Information; Intelligent Transportation; Distributed Systems; Protocols; Network Measurements
More info

Short Bio

Dr. Nikolaos Laoutaris is a research professor at IMDEA Networks Institute in Madrid. Prior to that, he was director of data science at Eurecat and chief scientist of the Data Transparency Lab, which he co-founded in 2014 during his 10-year tenure as a researcher and senior researcher of Telefonica Research in Barcelona. Before Telefonica, he was a postdoc fellow at Harvard University and Marie Curie postdoc fellow at Boston University. He got his PhD in computer science from the University of Athens in 2004.

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

Research: Next Generation Wireless Networks; Cyber-physical Systems; Visible Light Communication Systems; Mobile Indoor Localization Systems; Distributed Spectrum Monitoring Systems; mmWave Communication Systems
More info

Short Bio

Dr. Domenico Giustiniano is Research Associate Professor (tenured) at IMDEA Networks Institute and leader of the Pervasive Wireless Systems group. Dr. Giustiniano is leader of the OpenVLC project, an open-source platform for research in visible light communication networks and co-founder of the non-profit Electrosense association, a crowd-sourcing initiative to collect and analyze spectrum data. 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 (2008).

Dr. Sergey GORINSKY
Research Associate Professor

Research: Computer Networks; Distributed Systems; Network Economics
More info

Short Bio

Dr. 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. He served as an evaluator of research proposals and projects for the European Research Council (ERC StG), European Commission (Horizon 2020, FP7), and numerous other funding agencies.

Dr. José Félix KUKIELKA
Research Associate Professor

Research: Wideband Access to Private Networks; Quality of Service in Wireless networks; Service-aware Wireless Routing; Wireless Protocol Optimization for High-throughput Data and Voice
More info

Short Bio

Dr. José Félix Kukielka is Senior Researcher at IMDEA Networks and Lecturer at the University Carlos III of Madrid (UC3M) (Madrid, Spain). 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). Technical Director of REDIMadrid from 2007 until 2009, a regional research network for education and research institutions based in the Madrid Region. He was elected Associate Member of the Technical Team for Alcatel-Lucent Technical Academy (ALTA) and he is the creator of the "Kukielka Configuration".

Dr. Vincenzo MANCUSO
Research Associate Professor

Research: Design of Opportunistic Mobile Networks; Measurements and Assessment of Mobile Networks; Wireless Access; IoT; Performance Evaluation
More info

Short Bio

Dr. Vincenzo Mancuso is tenured Research Associate Professor at IMDEA Networks Institute, Madrid, Spain, and recipient of a Ramon y Cajal research grant. 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 PhD. He authored more than 120 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 opportunistic wireless access networks, and on the measurements and assessment of mobile 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

Research: Underwater Communications and Networking; Cloud Computing; Machine Learning; Passive Sensing and Localization in Wireless Networks
More info

Short Bio

Dr. Paolo Casari joined IMDEA Networks in 2015, and now leads the Ubiquitous Wireless Networks group. His research focuses 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, and Scientific Manager for the H2020 RECAP and SYMBIOSIS projects. He serves on the editorial board of the IEEE Transactions on Wireless Communications and of the IEEE Transactions on Mobile Computing, and regularly collaborates to the organization of international conferences. He received two best paper awards. He was awarded his PhD in Information Engineering in 2008.

Dr. Kirill KOGAN
Research Assistant Professor

Research: Admission Control and Buffer Management; Packet Classification; Software-Defined Networking; Network Functions Virtualization; Self-Driving Networks and In-Network Data Processing
More info

Short Bio

Dr. Kirill Kogan is a Research Assistant Professor at IMDEA Networks Institute. He spent over a decade at Cisco Systems as a Technical Leader, where he worked on design of two major routing platforms C12000 and ASR1000. At Cisco, he completed a Ph.D. study at Ben-Gurion University, Israel (2008-2012) and one year as a Postdoctoral Fellow at the University of Waterloo, Canada (he worked with Srinivasan Keshav in ISS4E group and Alejandro Lopez-Ortiz -Algorithms and Complexity-), and worked with Patrick Eugster in DPDS group at the Purdue University, USA. Recent interests: self-driving networks and in-network data processing (research results formalized at top venues as SIGCOMM, INFOCOM, PODC, etc.).

Dr. Narseo VALLINA-RODRÍGUEZ
Research Assistant Professor

Research: Network and Traffic Measurements; Protocol Analysis; Mobile Privacy and Security; IoT
More info

Short Bio

Narseo Vallina-Rodriguez (Ph.D in CS at the University of Cambridge, 2014) is an Assistant Research Professor at IMDEA Networks, and a Research Scientist at ICSI, USA. His research interests fall in the areas of network measurements, and online privacy and security. Narseo has received several industry grants (e.g., Google Faculty Research Awards, DataTransparencyLab Grant), and best paper awards at the 2020 IEEE Symposium on Security and Privacy (S&P), USENIX Security'19, and ACM IMC'18.
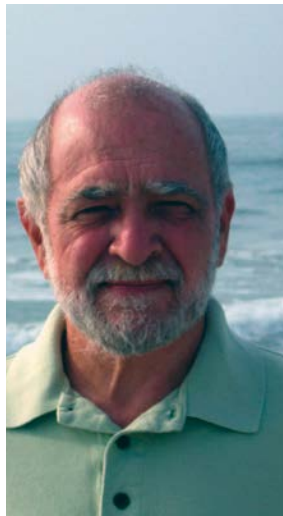
His ground-breaking work in the mobile privacy domain has influenced policy changes and security improvements in the Android platform, and has been recognized by EU regulators through the AEPD Emilio Aced Award and the CNIL-INRIA Privacy Protection Award, both in 2019. International media like The Washington Post, The NYT, The Guardian, or the Financial Times have covered Narseo's research.

IMDEA Networks Faculty researchers

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
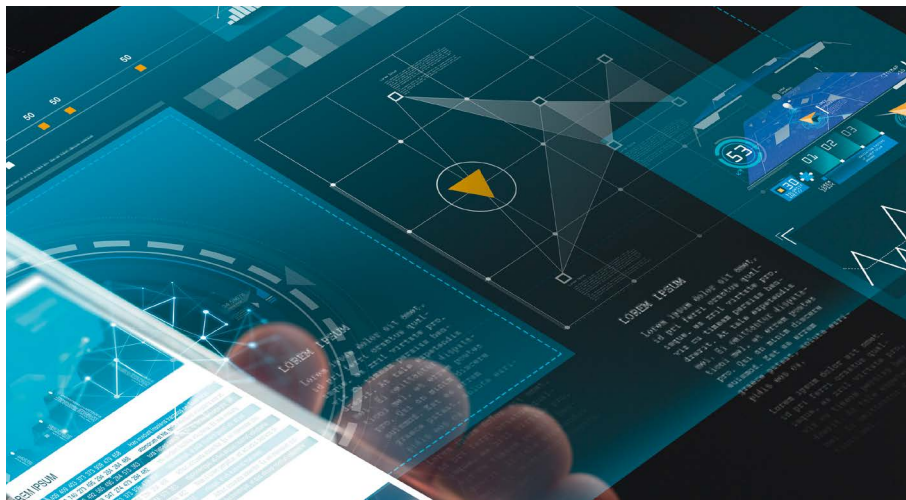
Research: Random Coding Network Services; Advanced Network Design for QoS Deployment; Traffic Engineering in Wireless Networks
More info

Short Bio

Dr. 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).

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 (PhD students).

Dr. Hany ASSASA
Post-Doc Researcher

Research: Millimeter-Wave Networking, WiGig/IEEE 802.11ad, Network Simulation (ns-3), Wireless MAC Layer Design, Wireless Networking, Next Generation Networks Architecture, and Software Defined Radio and Networking
More info

Short Bio
Dr. Hany Assasa joined the Wireless Networking Group at IMDEA Networks in August 2019 as a post-doc researcher. His main research interests are primarily in the field of wireless systems covering various disciplines such as wireless networking protocols, prototypes and testbeds, communication, and signal processing techniques. He obtained his Ph.D. in Telematics Engineering from Universidad Carlos III de Madrid in July 2019. During his Ph.D., he was a research assistant at the Wireless Networking Group at IMDEA Networks, working on millimeter-wave wireless networks. Before his Ph.D., he completed a double degree master program at both Politecnico di Torino and the Royal Institute of Technology (KTH).

Dr. Roberto CALVO-PALOMINO
Post-Doc Researcher

Research: Collaborative Spectrum Sensing, Collaborative Algorithms, Distributed Systems, large scale deployments
More info

Short Bio
Dr. Roberto Calvo-Palomino is a postdoctoral researcher working at IMDEA Networks Institute of Madrid in the Pervasive Wireless Systems Group. He received his Ph.D (2019) at IMDEA Networks Institute associated to Universidad Carlos III of Madrid (UC3M). He worked as senior software engineer for 5 years in the industry. His main interests are related to IoT, data analysis, collaborative-smart systems deployed at large scale and collaborative/distributed algorithms to build smart crowd-sourcing platforms. Nowadays his research lines are focused on collaborative wideband spectrum monitoring, spoofing signal detection, effective spectrum data compression and signal transmitter localization using software defined radios.

Dr. Claudio FIANDRINO
Post-Doc Researcher

Research: Cloud RAN; mm-Wave Communications; Mobile Crowd-sensing; Ultra-Reliable Low Latency Communications; Multi-Access Edge/Fog Computing
More info

Short Bio
Dr. Claudio Fiandrino joined the Wireless Networking Group led by Dr. Joerg Widmer at IMDEA Networks in December 2016. His primary research interests include ultra-reliable and low latency communications, multi-access edge/fog computing and crowdsensing. Obtained Ph.D. degree at the University of Luxembourg working on the ECO-CLOUD project with a focus on energy efficient communications in cloud, mobile cloud and fog computing. Awarded with the Spanish Juan de la Cierva grant and the Best Paper Awards in IEEE Cloudnet 2016 and in ACM WiN-TECH 2018, is a member of IEEE and ACM, served as Publication and Web Chair at IEEE CloudNet 2014 and as Publicity Chair in ACM/IEEE ANCS 2018.

Dr. Borja GENOVÉS-GUZMÁN
Post-Doc Researcher
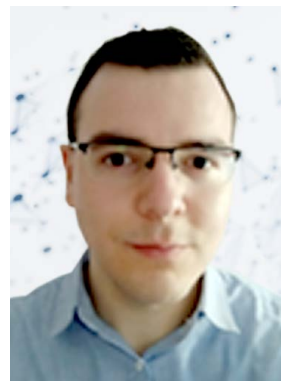
Research: Next Generation Wireless Networks; Visible Light Communication (VLC); LiFi systems; Mobile Communications
More info

Short Bio
Postdoctoral researcher in the Pervasive Wireless Systems Group of IMDEA since September 2019. My research interests focus on new techniques to improve the efficiency of visible light communication systems. I manage the MSCA-ITN ENLIGHT'EM project. In 2019, I obtained my Ph.D. in Multimedia and Communications of the University Carlos III of Madrid. I was a Visiting Scholar with The University of Southampton and The University of Edinburgh. I have participated in several national and European projects, and I received the First Prize in Graduation National Awards from the Ministry of Education, Culture and Sports of Spain.

Dr. Marius PARASCHIV
Post-Doc Researcher

Research: Data Valuation; Statistical Learning; Optimization Algorithms
More info

Short Bio
Joined the Human Centric Data Economy group of Prof. Nikolaos Laoutaris in April 2019. His primary research interests are in geometric deep learning (application of machine learning algorithms to graph data). Prior to this, he has worked on a series of projects and collaborations with other IMDEA faculty members, including a comprehensive study of domain classification services and their relative inconsistencies as well as producing a computer vision model. A second research interest is related to the notions of "data value" and the value of individual data providers to a particular service, from an economic but also an information-theoretic perspective.

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. Suman BANERJEE
Visiting Professor

University of origin: University of Wisconsin-Madison. WI. USA

Short Bio

Suman Banerjee received his PhD in Computer Science from the University of Maryland in 2003 and went on to join the faculty of University of Wisconsin-Madison, both in the USA. His early career achievements in the field of mobile computing and wireless networking granted him the 2013 ACM SIGMOBILE Rockstar Award. He served as chair of ACM SIGMOBILE, the flagship conference of the ACM's Special Interest Group on Mobility of Systems, Users, Data and Computing, between 2013 and 2017.

Dr. Deepak GANESAN
Visiting Professor

University of origin: University of Massachusetts Amherst. MA. USA

Short Bio

Deepak Ganesan received his PhD in Computer Science from UCLA in 2004 and is now a Professor in the Department of Computer Science at UMASS Amherst (USA). He received the IBM Faculty Award in 2008 and that same year was selected as a UMass Junior Faculty Fellow, going on to become a UMass Lilly Teaching Fellow in 2009. His recent scientific work has been recognized by a Best Paper Runner-up Award at MobiCom 2014, a Best Paper Award at CHI 2013, and two honorable mentions at Ubicomp 2013

Dr. Gianfranco NENCIONI
Visiting Professor

University of origin: University of Stavanger, Stavanger. Norway

Short Bio

Gianfranco Nencioni is an Associate Professor at the Department of Electrical Engineering and Computer Science, University of Stavanger, Norway. He received his Ph.D. in Information Engineering from the University of Pisa, Italy, in 2012. In 2011, he was a visiting Ph.D. student with the Computer Laboratory, University of Cambridge, U.K. He was a Post-Doctoral Fellow with the University of Pisa from 2012 to 2015 and with the Norwegian University of Science and Technology, Norway, from 2015 to 2018. His research activity is focused on modeling and resource allocation in emerging networking technologies.

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

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

Santiago ANDRES
Pre-Doc Researcher

BSc: Telecommunication Engineering. Universidad Politécnica of Madrid. Spain
Previous Position: Principal Consultant. Axon Consulting. Madrid. Spain
Research: Data Economics; Privacy; Transparency & Data Protection; Economics of Networks

Edgar ARRIBAS
Pre-Doc Researcher

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

Giulia ATTANASIO
Pre-Doc Researcher

BSc: Telecommunication Engineering. Politecnico di Torino. Turin. Italy
MSc: Communications and Computer Networks Engineering. Politecnico di Torino. Turin. Italy
Research: Low-latency communications; machine learning

Constantine AYIMBA
Pre-Doc Researcher

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

Dario BEGA
Pre-Doc Researcher

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; Reinforcement Learning; Machine Learning; Neural Networks; Network Economics; Scheduling Algorithm; Wireless Networks

Guillermo BIELSA
Pre-Doc Researcher

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

Alejandro BLANCO
Pre-Doc Researcher

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

Patricia CALLEJO
Pre-Doc Researcher

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

Pavel CHUPRIKOV
Pre-Doc Researcher

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

Vitalii DEMIANIUK
Pre-Doc Researcher

BSc: Applied Mathematics and Computer Science. National Research University of Informational Technologies, Mechanics and Optics. Saint Petersburg. Russia
MSc: Applied Mathematics and Computer Science. National Research University of Informational 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

Elizaveta DUBROVINSKAYA
Pre-Doc Researcher

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

Álvaro FEAL
Pre-Doc Researcher

BSc: Computer Engineering. Universidade da Coruña. A Coruña. Spain
MSc: Software and Systems. Polytechnic University of Madrid. Madrid. Spain
Previous Position: Research intern. IMDEA Software Institute. Madrid. Spain
Research: Privacy and Security; Regulatory Compliance; Mobile Computing

Ander GALISTEO
Pre-Doc Researcher

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

Julien GAMBA
Pre-Doc Researcher

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
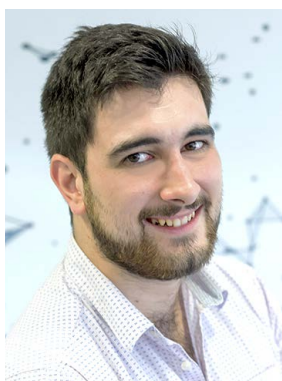
Dolores GARCIA MARTI
Pre-Doc Researcher

BSc: Mathematics. University of Valencia. Burjasot. Spain
MSc: Quantum Fields and Fundamental Forces. Imperial College London. London. UK
Research: Machine Learning; mm-wave

Nina GROSHEVA
Pre-Doc Researcher

BSc: Telecommunication and Information Engineering. Ss. Cyril and Methodius University. Skopje. North Macedonia
MSc: Communications Engineering. RWTH Aachen University. Aachen. Germany
Previous Position: Intern. German Aerospace Center. Oberpfaffenhofen. Germany
Research: Network Simulation (ns-3); Millimeter Wave Networking; Performance Analysis

Pablo JIMÉNEZ MATEO
Pre-Doc Researcher

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

Yago LIZARRIBAR
Pre-Doc Researcher

BSc: Industrial Technologies Engineering. University of Navarra. San Sebastián. Spain
MSc: Mechanical Engineering. University of Navarra. San Sebastián. Spain
Previous Position: Research Assistant. Massachusetts Institute of Technology. Cambridge. MA. USA
Research: Collaborative Spectrum Sensing; Distributed Systems; Machine Learning

Yonas Mitike KASSA
Pre-Doc Researcher

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

Nuria MOLNER
Pre-Doc Researcher

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 Communication Tehcnologies). Paterna. Valencia. Spain
Research: Fronthaul/Backhaul Integration and Optimization; NFV Placement Optimization; 5G Networks

Adriana MORENO
Pre-Doc Researcher

BSc: Electrical Engineering. Universidad de los Andes. Mérida. Venezuela
Previous Position: Lecturer on Electronics and Digital Systems. Universidad de los Andes. Mérida. Venezuela
Research: FPGA; GNU Radio and Millimeter Wave Communications

Oluwasegun OJO
Pre-Doc Researcher

BSc: B.Tech in Statistics. Federal University of Technology. Akure. Nigeria
MSc: Mathematical Sciences. African Institute for Mathematical Sciences. Limbe. Cameroon
Previous Position: Freelance Data Scientist. Upwork
Research: Data Science; Data Visualization; Machine Learning; Statistics; Social Networks

Joan PALACIOS BELTRAN
Pre-Doc Researcher

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

Noelia PÉREZ PALMA
Pre-Doc Researcher

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

Maurizio REA
Pre-Doc Researcher

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

Víctor SÁNCHEZ AGÜERO
Pre-Doc Researcher

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

Francesco SPINELLI
Pre-Doc Researcher

BSc: Cinema and Media Engineering. Politecnico di Torino. Torino. Italy
MSc: Communications and Computer Network Engineering. Politecnico di Torino. Torino. Italy
Previous Position: R&D Engineer. Telecom ParisTech. Paris. France
Research: Multi-Access Edge Computing; AI; NFV

Lucía UGUINA
Pre-Doc Researcher

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

Pelayo VALLINA-RODRIGUEZ
Pre-Doc Researcher

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

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).

Luis F. CHIROQUE
External PhD Student

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
Personal site: http://people.networks.imdea.org/~luis_nunez/

Carlos DONATO
External PhD Student

BSc: Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Telematics Engineering. Telematics Engineering Department. University Carlos III of Madrid. Madrid. Spain
Research: Wireless Communications; Mobile Networks; Computer Networks; Network Programming
Personal site: http://people.networks.imdea.org/~carlos_donato/

Cristina MÁRQUEZ
External PhD Student

BSc: Telecommunication Technologies Engineering (bilingual degree). University Carlos III of Madrid. Madrid. Spain
MSc: Double Master Degree in Telecommunications Engineering and Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Research: 5G Networks; Wireless and Mobile Networking; Big Data

Antonio PASTOR VALLES
External PhD Student

MSc: Telematics Engineering. University Carlos III of Madrid. Madrid. Spain
Research: Complex Networks; Machine Learning; Connectomics; Brain-Machine Interfaces
Personal site: https://www.networks.imdea.org/es/personas/antonio-angel-pastor-valles

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 Páez University. Venezuela
MSc: Informatics Engineering. University Carlos III of Madrid. Spain

Alejandro AMARO
Junior Software Developer

BSc: Computer Engineering. Specialization: Computing. Universidad Carlos III de Madrid. Madrid. Spain

Ignacio BERBERANA
Senior Research Engineer

MSc: Mining Engineer. School of Mining Engineering. Polytechnic University of Madrid. Madrid. Spain
Research: 5G; Radio Communications; RAN Virtualization

Antonio COBOS
Position: Research Engineer

BSc: Telecommunications Engineering Technology. University of Seville. Seville. Spain
MSc: Telecommunications Engineering. University of Seville. Seville. Spain; Information and Communication Technologies Security. University of Seville. Seville. Spain
Research: 5G Networks; IoT; Wired Networks; Wi-Fi Networks; IT Security

Elvira CONTI
Junior Project Administrator

BSc: International Relations. Rey Juan Carlos University. Madrid. España

Héctor CORDOBÉS DE LA CALLE
Senior Research Engineer

MSc: Telecommunications Engineering. University Carlos III of Madrid. Spain, Communications and Multimedia. University Carlos III of Madrid. Spain
Research: Distributed IoT systems; Localisation systems; Data Science applied to Machine and Deep Learning

Marta DORADO
Junior Science Communicator

BSc: Dual Bachelor's degree in Journalism and Audiovisual Communication. University Carlos III of Madrid (UC3M). Madrid. Spain
MSc: Journalism and Digital Communication ABC. Complutense University of Madrid (UCM). Madrid. Spain

Rafael GARCÍA
Research Engineer

BSc: Computer Science. University of Córdoba. Spain
MSc: Computational Sciences. University of Amsterdam. The Netherlands
Research: Machine learning; Data science; Dig data; Artificial intelligence.

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
Research: RF Engineering; Millimeter-Wave Communications; High Frequency Antenna Design; Device Fabrication

Neftalí GONZÁLEZ
Systems Administrator

BSc: IT Systems Engineer. Universidad Rey Juan Carlos. Móstoles. Spain

Susana HERNÁNDEZ
Project Administrator

BSc: Biology (Specialization: Biotechnology) - EQF Level 7 Certificate (Master). Complutense University of Madrid. Madrid. Spain / Food Science and Technology - EQF Level 7 Certificate (Master). Complutense University of Madrid. Madrid. Spain

Dr. José HERRERA
Research Engineer

BSc: Computer Science Engineering. Polytechnic University of Madrid. Madrid. Spain
MSc: Computer Science. Complutense University of Madrid. Madrid. Spain
Research: Privacy; Access Control; Cloud computing; Edge/Fog Computing

Manuel HERRERA
Junior Analyst Programmer

BSc: Higher Degree in Cross-Platform Application Development. IES Zaidín Vergeles. Granada. Spain

Francisco Javier HERVÁS
Project Administrator

BSc: Bachelor's Degree in Business Administration
MSc: Master in Management of Human Resources. Universidad Autónoma de Madrid. Spain

Anna IANNARELLA
Program Manager

BSc: Electrical Engineering. Simón Bolívar University. Caracas. Venezuela
MSc: Corporate Finance Specialist. Simón Bolívar University. Caracas. Venezuela

Diego JUARA
Position: Research Engineer

BSc: Telecommunication Systems Engineering. University of Alcalá. Spain
Research: Wireless Communications; Visible Light Communication (VLC); FPGA; Embedded Systems; IoT

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
Research: mm-Wave; FPGA design; Signal Processing; Digital Communications

Mohamed Lamine MOULAY
Research Engineer

BSc: Communication and Electronics Engineering. Applied Science University. Amman. Jordan
MSc: Multimedia and Communications. University Carlos III of Madrid. Madrid. Spain
Research: AMC; Wireless Communications; Docker: Python; Linux

Ricardo PADRINO
Research Engineer

BSc: Electronic Engineering. Universidad Complutense de Madrid. Madrid. Spain; Physics (3-years). Universidad Complutense de Madrid
Research: Deep Learning; Computer Vision; Automatic Algorithms; Autonomous Robot-Vehicles; Electronic Design
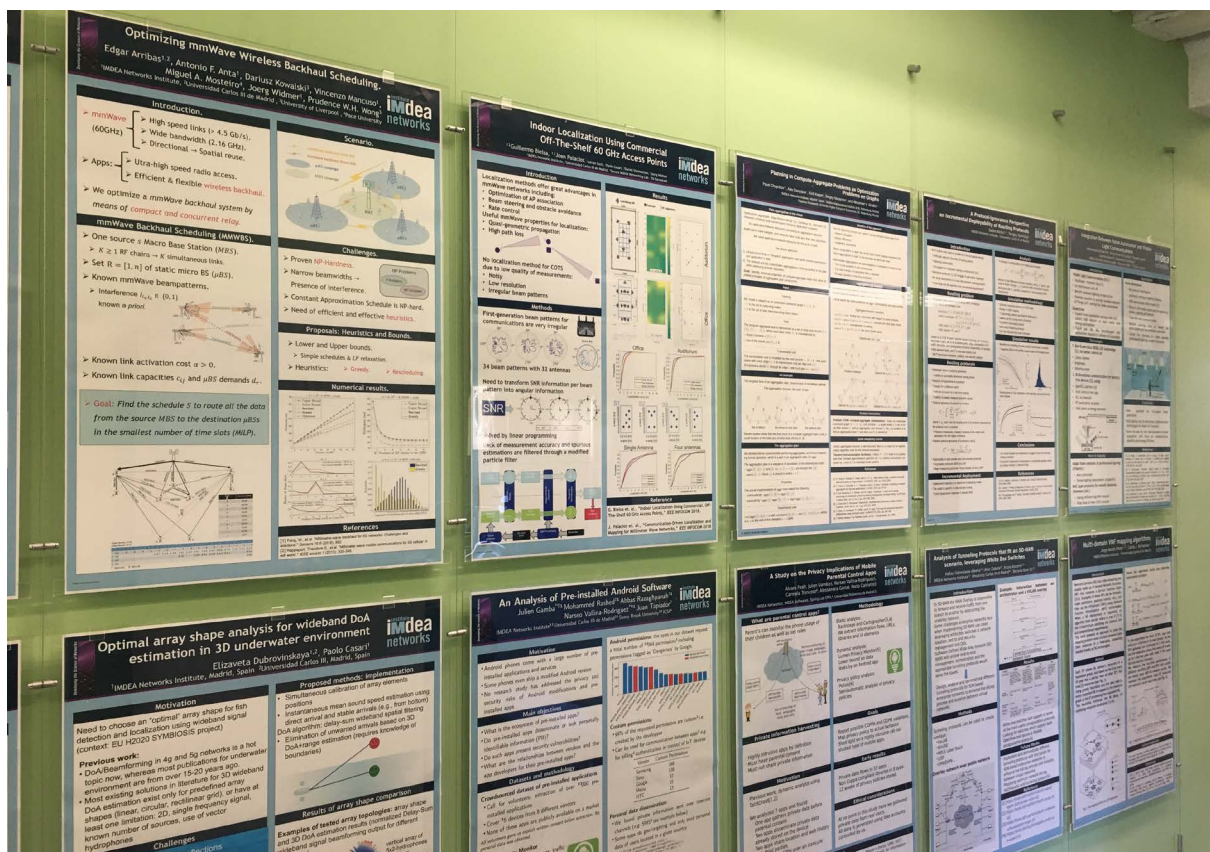
Rafael RUIZ
Systems Administrator
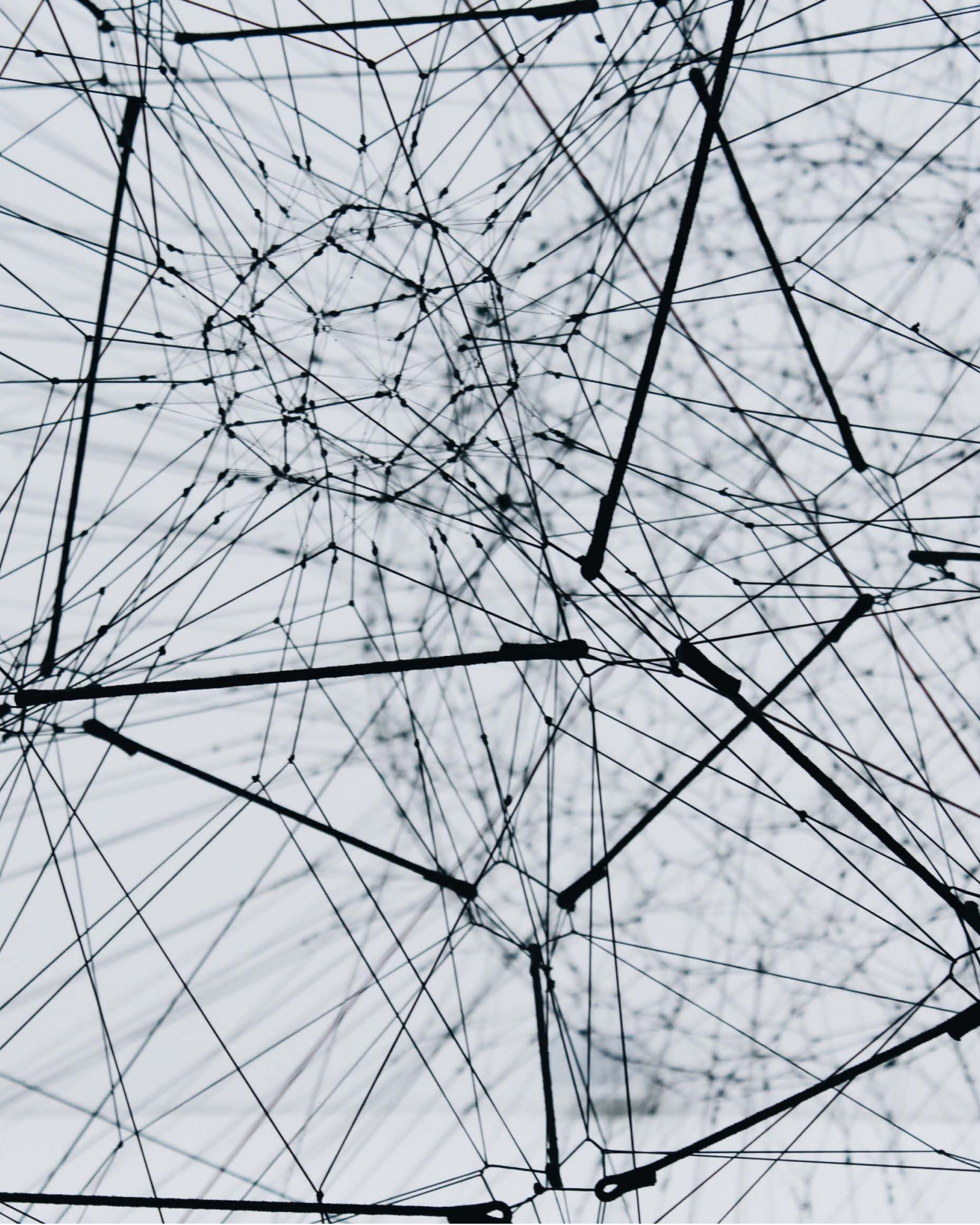
BSc: Industrial Electronics and Automation Engineering. Universidad Politécnica de Cartagena. Spain
**MSc:** (Finishing the Master's Degree) Industrial Electronics. Universidad Politécnica de Madrid. Madrid. Spain

Rubén RUPÉREZ
R&D laboratory technician

BSc: Industrial Technology Engineering. University Carlos III of Madrid. Madrid. Spain
MSc: Industrial Engineering. University Carlos III of Madrid. Madrid. Spain

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.

Almudena ALFARO
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Emilio AMAYA
massachusetts Institute of Technology- MIT (Cambridge, Massachusetts, United States)

Silva Luciana ARCILLA
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

David BADÍA
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Franck BOURZAT
University of origin: Institut National des Sciences Appliquées-INSA (Toulouse, France)

Candela CARRILLO
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Andrés CARRILLO
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Mattis CHOUMMANIVONG
University of origin: ENSTA ParisTech (Paris, France)

Patricia DURÁN
University of origin: Rey Juan Carlos University (Madrid, Spain)

Paula ENCINAR
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Andrés ESCALANTE
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Pablo ESCRIVÁ
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Michele GUCCIARDO
University of origin: University of Palermo (Palermo, Italy)

Kaspar David HAGEMAN
University of origin: Aalborg University (Aalborg, Danemark)

Sneha KUNDUR
University of origin: University of California San Diego (San Diego, USA)

Alexander LYNCH
University of origin: Massachusetts Institute of Technology- MIT, USA (Cambridge, Massachusetts, United States)

Tobias MEUSER
University of origin: Technische Universität Darmstadt (Darmstadt, Germany)

Baalázs NÉMETH
University of origin: University of Technology and Economics (BME) (Budapest, Hungary)

Foroogh MOHAMMADNIA
University of origin: Politecnico de Torino (Turin, Italy)

Leo PICUO
University of origin: Institut National des Sciences Appliquées de Toulouse- INSA (Toulouse, France)

Alejandro RODRÍGUEZ
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Miguel RODRÍGUEZ
University of origin: University Carlos III of Madrid (UC3M) (Madrid, Spain)

Sabrina ROMERO
University of origin: Massachusetts Institute of Technology- MIT, USA (Cambridge, Massachusetts, United States)

Rafael RUIZ
University of origin: Polytechnic University of Madrid-UPM (Madrid, Spain)

Miguel Ángel SÁNCHEZ
University of origin: Autonomous University of Madrid-UAM (Madrid, Spain)

Giuseppe SANTAROMITA
University of origin: University of Palermo (Palermo, Italy)

Gaetano SOMMA
University of origin: (INAPOLIO1 ERASMUS+ - Mobility for Traineeship 2018-19((Naples, Italy)

Ambuj VARSHNEY
University of origin: Uppsala University (Uppsala, Sweden)

administrative unit

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 Universitario de Empresa. Madrid. Spain

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

Brian DUNNE
Senior Human Resources Manager

Qualifications: BBS in Business Studies and French. Trinity College Dublin. Ireland

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

Admin and research support team

Pilar SÁEZ
HR Project Administrator

Qualifications: Labour Relations. Complutense University of Madrid. Madrid. Spain; Postgraduate Diploma in "Executive Compensation and Benefits". Centro de Estudios Garrigues. Madrid. Spain

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 2019.

Dr. Pavel CHUPRIKOV
Current Position: Post-Doc Researcher. Universita della Svizzera Italiana. Lugano. Switzerland
Ph.D. Date: 14 November 2019

Dr. Guillermo BIELSA
Current Position: Specialized Client Engineering- Connectivity and Networks. Telefónica España. Madrid. Spain
Ph.D. Date: 26 July 2019

Dr. Hany ASSASA
Current Position: Post-Doc Researcher. IMDEA Networks Institute. Madrid. Spain
Ph.D. Date: 23 July 2019

Dr. Roberto CALVO-PALOMINO
Current Position: XPost-Doc Researcher. IMDEA Networks Institute. Madrid. Spain
Ph.D. Date: 10 July 2019

Dr. Luca COMINARDI
Current Position: Research Assistant. University Carlos III of Madrid. Madrid. Spain
Ph.D. Date: 18 March 2019

Dr. Pablo CABALLERO GARCÉS
Current Position: HID Sensor Algorithm Engineer. Apple Inc. Cupertino. California. USA
**Ph.D. Date:** 18 July 2018

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. EE.UU.
Ph.D. Date: 14 December 2017

Dr. José A. RUIPÉREZ-VALIENTE
Current Position: Postdoctoral Associate. Massachusetts Institute of Technology (MIT). Cambridge. Massachusetts. USA
Ph.D. Date: 31 May 2017

Dr. Foivos MICHELINAKIS
Current Position: Postdoctoral Fellow. Simula Metropolitan Center for Digital Engineering (SimulaMet). Oslo. Norway
Ph.D. Date: 19 September 2018

Dr. Aymen FAKHREDDINE
Current Position: Senior Researcher. Institute of Networked and Embedded Systems, Alpen-Adria-Universität. Klagenfurt. Austria
Ph.D. Date: 14 June 2018

Dr. Christian VITALE
Current Position: Post Doc. Department of Electronics and Telecommunications. Politecnico di Torino. Turin. Italy
Ph.D. Date: 9 June 2017

Dr. Evgenia CHRISTOFOROU
Current Position: Post Doc. Department of Electronics and Telecommunications. Politecnico di Torino. Turin. Italy
Ph.D. Date: 25 May 2017
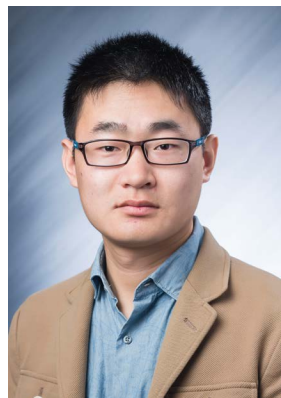
Dr. Nicola BUI
Current Position: Senior Research Scientist. College of Computer & Information Science. Northeastern University. Boston. Massachusetts. USA
Ph.D. Date: 12 May 2017

Dr. Elli ZAVOU
Current Position: Postdoc. Inria Grenoble - Rhône-Alpes & INSA Lyon. Lyon. France
Ph.D. Date: 30 September 2016

Dr. Qing WANG
Current Position: Postdoc Researcher. University of Leuven - KU Leuven. Leuven. Belgium
Ph.D. Date: 19 May 2016
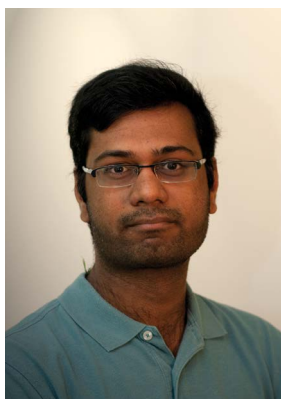
Dr. Pablo SALVADOR
Current Position: Technology Innovation Engineer. Fon Technology. Madrid. Spain
Ph.D. Date: 8 April 2016

Dr. Angelos CHATZIPAPAS
Current Position: Innovation Architect. Lloyds Banking Group. London. United Kingdom
Ph.D. Date: 25 November 2016

Dr. Syed Anwar UL HASAN
Current Position: Product developer/Co-founder. PriceFlier. Hyderabad. Telangana. India
Ph.D. Date: 20 June 2016

Dr. Juan Camilo CARDONA
Current Position: Software Engineer. Cisco Systems. Barcelona. Spain
Ph.D. Date: 6 May 2016

Dr. Gek Hong SIM
Current Position: Post-doc Researcher. TU Darmstadt. Germany
Ph.D. Date: 30 March 2016

Dr. M. Isabel SANCHEZ
Current Position: Postdoctoral Fellow. Simula Research Laboratory. Oslo. Norway
Ph.D. Date: 8 March 2016

Dr. Vincenzo SCIANCALEPORE
Current Position: Research Scientist. NEC Deutschland GmbH. Germany
Ph.D. Date: 27 November 2015

Dr. Ignacio CASTRO
Current Position: Post-doctoral Research Assistant. Queen Mary University of London. UK
Ph.D. Date: 20 July 2015

Dr. Jordi ARJONA AROCA
Current Position: Postdoctoral Researcher. Cloud Computing Group. Nokia Bell Labs.
Ph.D. Date: 13 February 2015

Dr. Arash ASADI
Current Position: Post-doc Researcher. TU Darmstadt. Germany
Ph.D. Date: 8 March 2016

Dr. Thomas NITSCHE
Current Position: Wissenschaftlicher Mitarbeiter/Research Fellow. Fraunhofer Institute for Embedded Systems and Communication Technologies ESK. Munich. Germany
Ph.D. Date: 25 September 2015

Dr. Fabio GIUST
Current Position: Research scientist. NEC Laboratories Europe. Heidelberg. Germany
Ph.D. Date: 5 March 2015
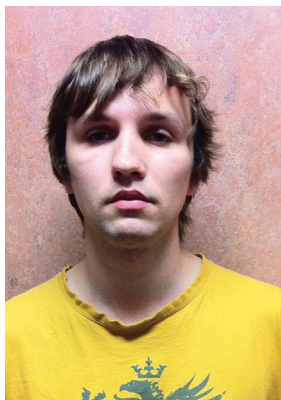
Dr. Andra LUTU
Current Position: Postdoctoral Fellow. Simula School of Research and Innovation (SSRI). Simula Research Laboratory. Fornebu. Norway
Ph.D. Date: 11 November 2014

Dr. Agustín SANTOS
Current Position: Public Officer. Spanish Public Administration. Madrid. Spain
Ph.D. Date: 3 June 2013

Dr. Michal KRYCZKA
Current Position: TGP Systems Integration Analyst. Accenture. Warsaw. Poland
Ph.D. Date: 7 February 2013

Dr. Alex BIKFALVI
Current Position: Software Engineer. Midokura. Barcelona. Spain; Part-time Lecturer. Network Technologies and Strategies Research Group. Pompeu Fabra University. Barcelona. Spain
Ph.D. Date: 18 July 2012

Dr. Paul PATRAS
Current Position: Chancellor's Fellow / Lecturer. School of Informatics. University of Edinburgh. Scotland
Ph.D. Date: 18 March 2011

Learning never exhausts the mind

Leonardo da Vinci

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
· Haftay Abreha
· Patricia Callejo
· Pavel Chuprikov
· Vitalii Demianiuk
· Pablo Jiménez Mateo
· Vadim Kirilin
· Yonas Mitike Kassa
· Nuria Molner
· Pablo Jiménez Mateo
· Nuria Molner
· Víctor Sánchez Agüero
· Lucía Uguina
· Antonio Cobos

wireless
networking

Research Director
· Dr. Joerg Widmer

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

Pre-Doc & Post-Doc Researchers
· Dr. Jesús Omar Lacruz
· Dr. Claudio Fiandrino
· Dr. Amanda Garcia
· Hany Assasa
· Constantine Ayimba
· Guillermo Bielsa
· Alejandro Blanco
· Roberto Calvo-Palomino
· Elizaveta Dubrovinskaya
· Ander Galisteo
· Dolores García
· Pablo Jiménez
· Joan Palacios
· Maurizio Rea
· Giulia Attanasio
· Adriana Moreno
· Nina Grosheva
· Yago Lizarribar
· Rafael Ruiz

network
measurements&analytics

Research Director
· Dr. Albert Banchs

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

Pre-Doc & Post-Doc Researchers
· Dr. José Herrera
· Amr Abdelnabi
· Edgar Arribas
· Dario Bega
· Álvaro Feal
· Julien Gamba
· Rafael García
· Olewasegun Ojo
· Noelia Pérez Palma
· Pelayo Vallina-Rodriguez
· Mohamed Lamine Moulay
· Ricardo Padrino
· Francesco Spinelli
· Santiago Andrés

Our current team

All outstanding work,
in art as well as in science,
results from immense zeal
applied to a great idea

Santiago Ramón y Cajal

institute
iMdea
networks

Comunidad de Madrid

EUROPEAN UNION
STRUCTURAL FUNDS

annual report
2019

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