ARIADNE

Newsletter 2/2021

Second half of ARIADNE

Reconfigurable Intelligent Surfaces

IEEE MeditCom2021 in Athens

... and more

Editorial

Second half of ARIADNE – towards demonstrating D band technologies

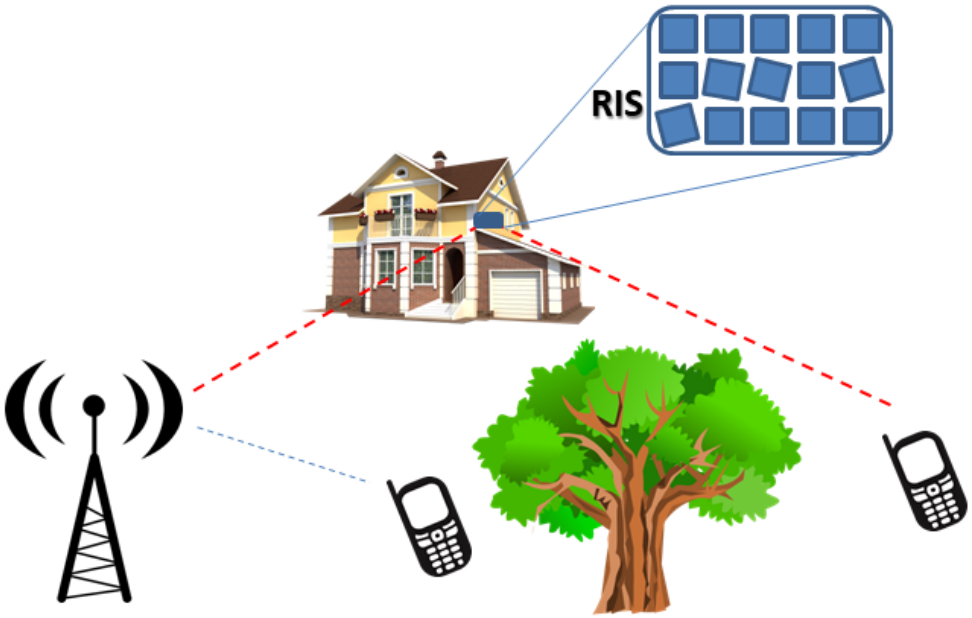
ARIADNE is now beyond its half-time. In July, the project had a very successful intermediate project review. In the second half, ARIADNE is moving towards implementation of the gathered D band knowledge and technologies within project demonstrators. ARIADNE will demonstrate the D band connectivity in outdoor and indoor scenarios, supported by usage of Reconfigurable Intelligent Surfaces (RIS) and Artificial Intelligence (AI) techniques. The ARIADNE demonstrators are expected to be available in summer 2022.

Halid Hrasnica, Eurescom

Research Results

Reconfigurable Intelligent Surfaces

Reconfigurable Intelligent Surfaces (RIS), which are made of materials able to arbitrarily shape the electro-magnetic wave front, are nearly passive devices that can adapt or change the radio signals between the transmitters and receivers. As explored in the ARIADNE project, one of the pioneer European actions in the area, the dynamically controlled RIS open a new dimension in designing and operating the future wireless networks – towards 6G.



The recent research results confirm that effective deployment of RIS as controllable surfaces can enhance network capacity and coverage, but also create opportunities for future applications such as positioning and localization. The RIS can be designed as a self-configuring and part of a wireless network infrastructure, adjusting its electromagnetic characteristics in response to dynamic traffic demand and propagation characteristics.

The main advantage of the RIS usage is that they are so-called almost passive elements involving very low-power electronics, representing an environment friendly and low-cost solution which can be easily deployed at walls, ceilings, billboards, lampposts, event vehicles, etc. On the other hand, the absence of power amplifiers and digital signal processing capabilities at RIS naturally pose some design challenges and a trade-off consideration between the coverage range of the surface, its size, and number of RIS elements that need to be deployed on it.

Even the RIS application is a promising solution to enhance the future 6G communications networks, there is still need to conclude related research on channel characterization, signal processing, physical RIS design, etc. Here, beside related world-wide research activities, the ARIADNE project is working towards establishment of the related research framework establishing a novel network concept, so-called Beyond Shannon smart radio environment.

In this context, the ARIADNE project has been organizing a series of international workshops, dedicated to research around RIS for future network, as presented below.

Halid Hrasnica, Eurescom

Event Reports

ICT 2021 – Workshop on Reconfigurable Intelligent Surfaces

The 28th edition of the International Conference on Telecommunications (ICT) in London was held as a virtual event on 1-3 June 2021. ICT 2021 focused on promoting new ideas, state-of-the-art research and development as well as visionary future directions in telecommunications. ICT 2021 hosted highly innovative and state-of-the-art contributions in the form of original technical papers for presentations at the conference and publication in the conference proceedings.

The ARIADNE project co-organised a Special Session, together with EU research projects AIMM and RISE-6G, on Reconfigurable Intelligent Surfaces (RIS). RIS have fast emerged as a beyond-5G candidate technology. RIS correspond to smart radio surfaces with many small antennas or reflecting metamaterial elements that receive and relay electromagnetic (EM) waves with the capability of controlling the phase-shifts. The distinctive characteristics of RIS in terms of reconfiguration of the propagation environment has motivated a host of potential new use cases. These include utilising RIS as repeaters to enhance performance of field deployments and for implementing low-complexity multiple-input multiple-output (MIMO) radios.

The special session brought together academic and industrial researchers to stimulate and shape further development of RIS technology towards incorporation onto B5G/6G cellular standards, and eventually commercialisation. The Special Session hosted 3 invited talks by experts and a thought-provoking panel discussion, attended by all invited speakers:

- Basic channel modelling for reconfigurable intelligent surfaces and related misconceptions by Emil Bjornson, KTH, Sweden
- How to achieve spatial modulation using an IRS? by Michalis Matthaiou, Queen's University Belfast
- A network operator's requirements for Reconfigurable Intelligent Surfaces by Fraser Burton, BT, UK

Further information

ICT 2021 workshop page

Angeliki Alexiou, University of Piraeus

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Network Management workshop at EUCNC 2021

EuCNC 2021 was held virtually in Portugal on 7-11 June 2021. It was the 30th edition of a successful series of a conference in the field of telecommunications, sponsored by the IEEE Communications Society and the European Association for Signal Processing, and supported by the European Commission. EuCNC 2021 was intended to introduce 6G.

The conference focused on various aspects of 5G communications systems and networks, including cloud and virtualisation solutions, management technologies, and vertical application areas. It targeted to bring together researchers from all over the world to present the latest research results, and it was one of the main venues for demonstrating the results of research projects, especially from successive European R&D programmes co-financed by the European Commission.

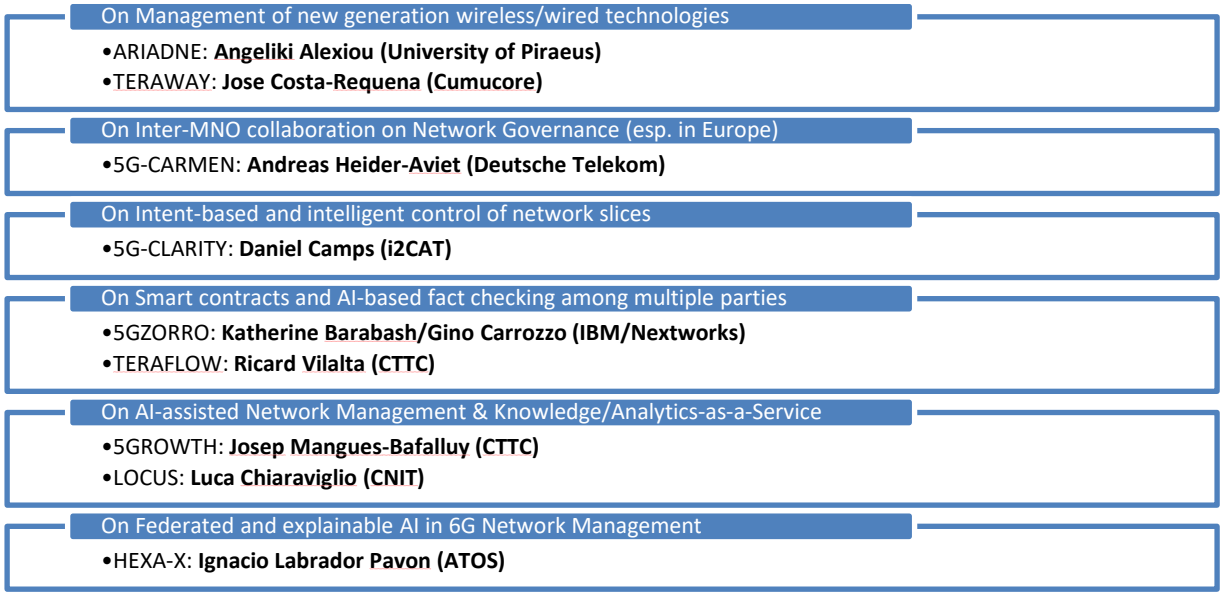
A Special Session on Autonomous Network Management Towards 6G was organised on June 11, 2021, originating from several 5G PPP projects, participating in the 5G PPP Technology Board.

A clear vision on requirements and challenges for Autonomous Network Management was attempted in this Special Session. It was observed that networks will require a more efficient use of heterogeneous virtualisation technologies from multiple radio, edge and core domains, also from multiple operators. Moreover, highly automated management and orchestration solutions will be needed to implement data-driven network management to exploit advanced analytics techniques. Zero-touch solutions and intent-based approaches to network slicing will take critical role in order to manage the huge scale of software-defined network functions. Heterogeneous resource trading and sharing (extended to spectrum) will need to be used to implement networks and service pervasiveness, at acceptable CAPEX for Operators and fully integrated with end-to-end trust and security.

The first part of the Special Session hosted 4 invited presentations with a solution focus target:

- **Zero-Touch AIOps in Multi-Operator 5,** Katherine Barabash,David Breitgand, Gino Carrozzo, Dean Lorenz, Kalman Meth, Shuaib M. Siddiqui
- **EMF and QoS Evaluation of Localization-Enhanced Pencil Beamforming**, Luca Chiaraviglio, Matteo Arciuli, Stefania Bartoletti, Nicola Blefari Melazzi
- **Predictive Network Management and Orchestration Towards 6G**, Josep Martrat, Ignacio Labrador Pavon, Aurora Ramos, Mikko Uusitalo, Vilho Räisänen, Amina Boubendir
- **Cloud-Native SDN Network Management for Beyond 5G Networks with TeraFlow**, Ricard Vilalta, Raul Munoz, Ramon Casellas, Ricardo Martínez, Juan-Pedro Fernandez-Palacios, Georgios P. Katsikas, Thomas Zinner, Harald Øverby , Sergio Gonzalez-Diaz, Hakon Lønsethagen, Jose-Miguel Pulido, Daniel King, Nicola Carapellese

The second part of the Special Session consisted of a panel discussion, to which ARIADNE also contributed:



Angeliki Alexiou, University of Piraeus

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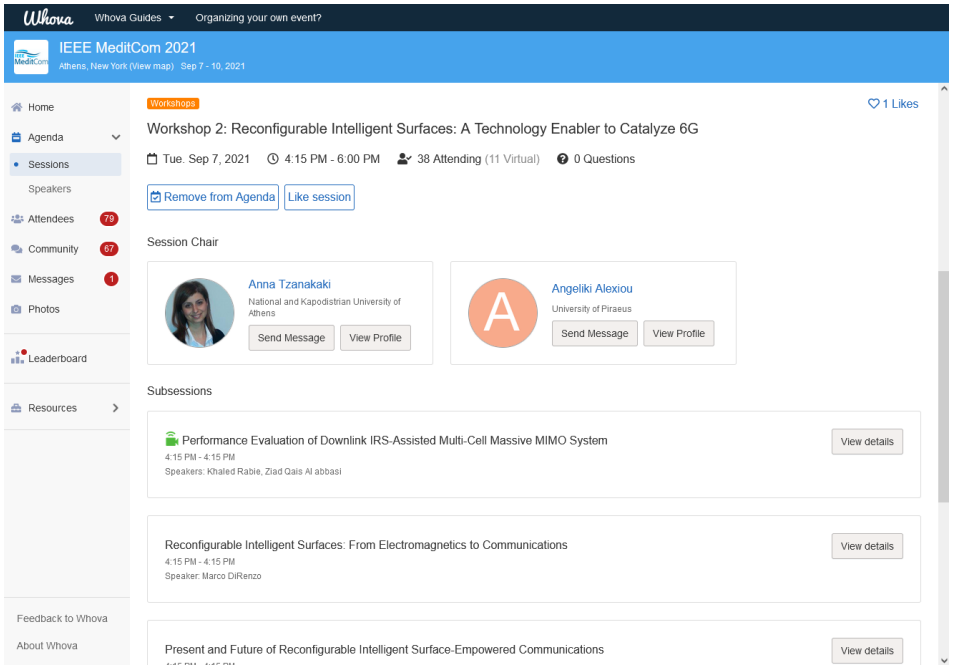
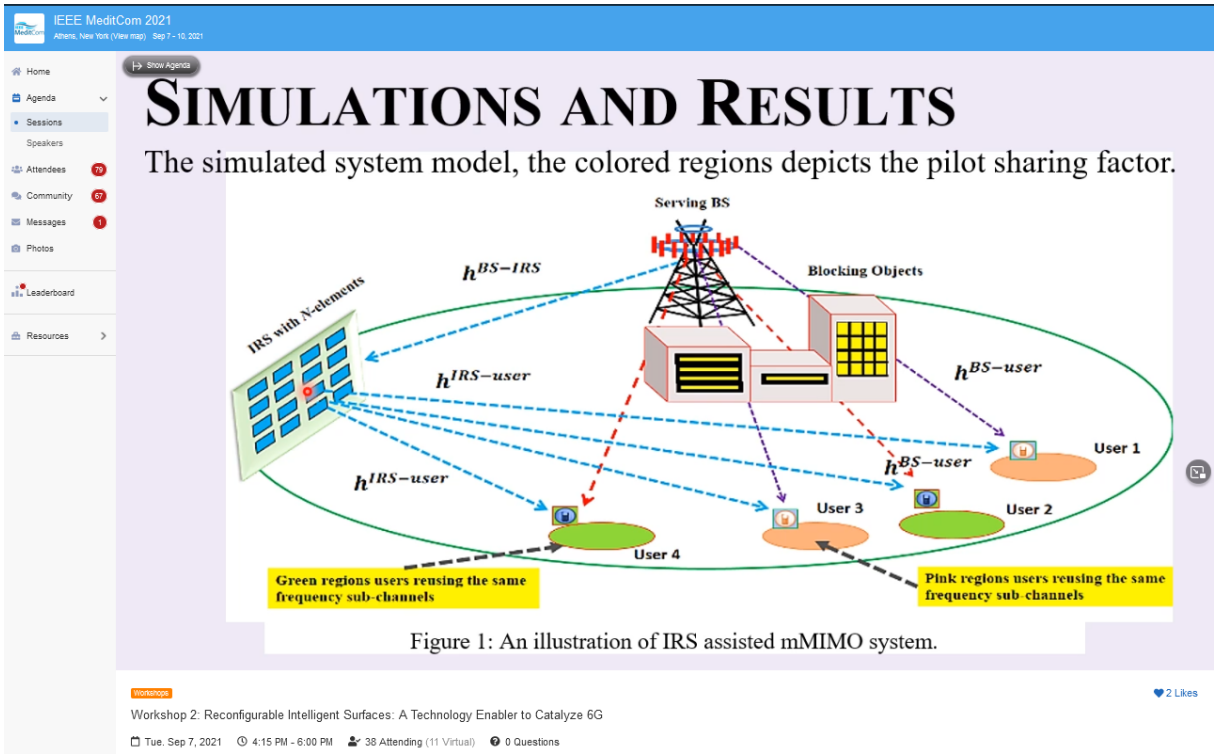
ARIADNE Workshop at IEEE MeditCom in Athens

The first edition of IEEE International Mediterranean Conference on Communications and Networking (IEEE MeditCom) was held in Athens in 7–10 September 2021 as a Hybrid event (In-Person and Virtual Conference). IEEE MeditCom brought together visionaries in academia, research labs and industry from all over the world to the shores of the Mediterranean Sea, with an agenda that addressed many of the outstanding challenges that exist in the areas of communications and networking. The conference solicited research papers on a wide range of research topics, spanning both theoretical and systems research along with vertical technologies.

Through IEEE MeditCom, IEEE Communications Society aims at engaging local IEEE Sections, ComSoc Chapters, and possibly Sister Societies, from all Mediterranean region, including Spain, France, Monaco, Italy, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Albania, Greece, Turkey, Syria, Lebanon, Israel, Egypt, Libya, Tunisia, Algeria, Morocco, Malta, and Cyprus.



ARIADNE project organised a workshop under the theme "Reconfigurable Intelligent Surfaces: A Technology Enabler to Catalyze 6G". The adoption of a RIS based system concept in 6G networks opens up a wealth of research and technological opportunities and at the same time introduces several theoretical, algorithmic and hardware challenges. This workshop aspired to bring together academic and industrial researchers in an effort to identify and discuss the major technical challenges and recent breakthroughs related to RIS.



Presentations included:

- Performance Evaluation of Downlink IRS-Assisted Multi-Cell Massive MIMO System, Ziad Qais Abdulkareem Al Abbasi (Middle Technical University & Baquba Technical Institute, Iraq); Mustafa Khamis (Middle Technical University, Iraq); Khaled M. Rabie (Manchester Metropolitan University, United Kingdom)
- Reconfigurable Intelligent Surfaces: From Electromagnetics to Communications, Marco Di Renzo (Paris-Saclay University / CNRS, France)
- Present and Future of Reconfigurable Intelligent Surface-Empowered Communications, Ertugrul Basar (Koc University, Turkey)
- The impact of electromagnetic noise in RIS-aided communications, Luca Sanguinetti (University of Pisa, Italy)
- When Reconfigurable Intelligent Surfaces Meet Terahertz Communications, Nan Yang (The Australian National University, Australia

Further information

IEEE MeditCom workshop page

Angeliki Alexiou, University of Piraeus

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Workshop on Reconfigurable Intelligent Surfaces at PIMRC 2021

On 13 September, ARIADNE co-organised an online workshop on 'Reconfigurable Intelligent Surfaces for B5G/6G' at the IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC). [https://pimrc2021.ieee-pimrc.org/]

The workshop was jointly organized by the EU research projects AIMM, RISE-6G, and ARIADNE. It brought together academic and industrial researchers to stimulate and shape further development of Reconfigurable Intelligent Surfaces (RIS) technology towards incorporation in B5G/6G cellular standards, and eventually commercialization. The workshop agenda covered several R&D aspects of RIS-based communications for frequency ranges between 6 - 100 GHz.

The workshop included three insightful keynotes:

- "Rebuilding the theoretical foundations of Communications and Computing", by Prof. Mérouane Debbah, Technology Innovation Institute, Abu Dhabi,
- "Reconfigurable Intelligent Surfaces for Wideband Communications: Challenges and Possible Solutions", by Prof. Emil Björnson, Linköping University, Sweden, and
- "Network Operator requirements and use-cases for Reconfigurable Intelligent Surfaces", by Fraser Burton, British Telecommunications plc, United Kingdom.

In addition, the following two papers were accepted for presentation at the workshop and publication in the conference proceedings:

- "Impact of Reconfigurable Intelligent Surface Size on Beamforming Efficiency", by Giorgos Stratidakis (University of Piraeus, Greece), Sotiris Droulias (University of Piraeus Greece, Greece), and Angeliki Alexiou (University of Piraeus, Greece)

- "Reconfigurable Intelligent Surface (RIS): Eigenvalue Decomposition-Based Separate Channel Estimation", by Salah Eddine Zegrar and Liza Afeef Omar Shehab El Din (Istanbul Medipol University, Turkey), Huseyin Arslan (University of South Florida & Istanbul Medipol University, USA)

The workshop attracted the highest attendance within the IEEE PIMRC 2021 workshop program, highlighting the importance of RIS to the community as a key candidate technology trend for B56/6G wireless systems.

The workshop was led by General Chairs Dr. Alain Mourad, InterDigital, Dr.-Ing. Halid Hrasnica, Eurescom, Dr. Emilio Calvanese Strinati, CEA Leti and Technical Program Committee Chairs Dr. Arman Shojaeifard, InterDigital; Prof. Marco Di Renzo, CentraleSupélec; Prof. George C. Alexandropoulos, National and Kapodistrian University of Athens.

Further information

PIMRC 2021, WS8 – Reconfigurable Intelligent Surfaces for B5G/6G

Upcoming Events

Tutorial on Reconfigurable Intelligent Surfaces at IEEE GLOBECOM 2021

Hybrid in-person and virtual conference in Madrid, Spain / 7 December 2021

On 7 December, 14:00 - 17:30 CET, ARIADNE will co-organize a technical tutorial on 'Reconfigurable Intelligent Surfaces for Future Wireless Communications' (TUT-01) at IEEE GLOBECOM 2021. This year, GLOBECOM will be held as a hybrid in-person and virtual conference in Madrid, Spain. The motto of the conference is 'Connecting Cultures around the Globe'.

At the workshop, ARIADNE will present its advances on IRS. As 5G networks take their final form, connectivity demands continue to increase exponentially and new services pose more constraints on the performance that end-users expect. A recent technological breakthrough that holds the potential to meet these demands is that of reconfigurable intelligent surfaces. We believe that a tutorial on the principles and latest approaches of reconfigurable intelligent surfaces for beyond 5G wireless communications will be of great value for both academics and industry practitioners.

Presenters are: Alessio Zappone (University of Cassino and Southern Lazio, Italy); Shi Jin (Southeast University, China); Mérouane Debbah (Huawei, France); Marco Di Renzo (Paris-Saclay University / CNRS, France)

Further information

IEEE GLOBECOM Tutorial page

Marco Di Renzo, CNRS

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