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Abstract

This deliverable provides the information on the dissemination and exploitation activities that have taken place during the METIS project. Among the academic dissemination and exploitation activities, METIS has (co-)organised and participated at workshops, widely published research results, engaged in teaching and training of students, participated in EC activities, and setup a project website. Among the dissemination and exploitation in standardisation and regulation, METIS has provided contributions to 3GPP and ITU-R meetings, has participated in 5G industry forums, and has exchanged with the energy industry.

METIS is now recognized as the major global 5G activity with the broadest footprint. Its key papers and deliverables on use cases, requirements and concepts are widely accepted references for 5G in all regions of the world.

Keywords

Academic, dissemination, exploitation, journal, conference, workshop.



Executive summary

This deliverable reports on the activities for dissemination and exploitation of academic research that has been conducted in the METIS project. The project aims to lay the foundation for the 5G mobile and wireless system by providing technical components and other enablers needed to meet the foreseen requirements of the beyond 2020 information society.

The research results have been published in world leading journals and conferences. The number of publications is 23 journal papers and 170 conference papers. This report lists the details of where the results from METIS have been published. The research has also been disseminated through focused events and workshops. For example, METIS has organized the 5G Global Conference (5GGC) and the MWC2020 workshops at IEEE VTC-spring in 2013, 2014 and 2015.

Results from METIS have also been integrated into the training of students in the form of lectures, tutorials, and by conducting research work in M.Sc. and Ph.D. courses. In addition, general 5G talks and presentations together with more specific ones have been given in various fora such as in class rooms and panel discussions. Further, on the public website there is open access to some of the simulation platforms that were used in the project evaluations.

Finally one achievement of the METIS project is to impact and trigger further 5G research in both an European context and globally. Many topics studied in METIS will continue to be researched in the H2020 framework.



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List of Abbreviations

3GPP	Third Generation Partnership Project
5G	Fifth Generation
5G ARCH	5G Architectures
5G PPP	5G Infrastructure Public-Private Partnership
5GGC	5G Global Conference
5GNOW	5th Generation Non-Orthogonal Waveforms for asynchronous signalling
5GU	5G for Ubiquitous connectivity
AAU	Aalborg University
ADVANTAGE	Advanced Communications and Information processing in smart grid systems
ARTIST4G	Advanced Radio Interface Technologies for 4G Systems
ALUD	Alcatel Lucent Deutschland
AWG	APT Wireless Group
B.Sc.	Bachelor of Science
BMBF	Federal Ministry of Education and Research
BMW	Bayerische Motoren Werke
BTH	Blekinge Tekniska Högskola
BWA	Broadband Wireless Access
CEPT	European Conference of Postal and Telecommunications Administrations
CHASE	Chalmers Antenna Systems Excellence center
CMS	Content Management System
COMBO	Convergence of Fixed and Mobile Broadband Access/Aggregation Networks
COST	Cooperation in Science and Technology
CROWNCOM	International Conference on Cognitive Radio Oriented Wireless Networks
CTH	Chalmers University of Technology
D2D	Device-to-Device
DFG	Deutsche Forschungsgemeinschaft
DFKI	German Research Center

	for Artificial Intelligence
DUPLO	Full-Duplex Radios for Local Access
DySPAN	Dynamic Spectrum Access Networks
EC	European Commission
ERC	European Research Council
ERI	Ericsson
ETSI	European Telecommunications Standards Institute
ETSI RRS WG1	ETSI Reconfigurable Radio Systems Working Group 1
EuCAP	European Conference on Antennas and Propagation
EuCNC	European Conference on Networks and Communications
EU	European Union
EUSIPCO	European Signal Processing Conference
EW	European Wireless
F2F	Face-to-Face
FI-PPP	Future Internet Public-Private Partnership Programme
FINESCE	Future Internet Smart Utility Services
FuNeMS	Future Network Mobile Summit
FP7	Framework Program 7
GlobalSIP	Global Conference on Signal and Information Processing
Globecom	Global Communication Conference
GSMA	Groupe Speciale Mobile Association
HetNet	Heterogeneous Networks
HHI	Heinrich Hertz Institute
HT	Horizontal Topic
HTD	HT Driver
iJoin	Interworking and Joint design of an open access and backhaul network architecture for small cells based on cloud networks
ICASSP	International Conference on Acoustics, Speech, and Signal Processing
ICC	International Communications Conference
ICCS	International Conference on Communication



	Systems
ICCVE	International Conference on Connected Vehicles & Expo
ICT	Information and Communications Technology
IDMA	Interleave-Division Multiple-Access
IEEE	Institute of Electrical and Electronics Engineers
IMT-2020	International Mobile Telecommunications 2020
IoT	Internet of Things
ISBN	International Standard Book Number
ISIT	International Symposium on Information Theory
ISPACS	International Symposium on Intelligent Signal Processing and Communication Systems
ISPPC	International Conference on Signal Processing, Computing and Control
ISWCS	International Symposium on Wireless Communications Systems
ITG	Informationstechnische Gesellschaft
ITN-ETN	Innovative Training Networks - European Training Networks
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union -Recommendations
IWCMC	International Wireless Communications & Mobile Computing Conference
IWonCMM	International Workshop on Channel Measurement and Modelling
IWPC	International Wireless Industry Consortium
JRC	Joint Research Center
JRC-IPSC	JRC Institute for the Protection and Security of the Citizen
KKRRiT	Krajowa Konferencja Radiokomunikacji, Radiofonii i Telewizji
LTE-A	Long Term Evolution - Advanced
M.Sc.	Master of Science
MAMMOET	MAssive MiMO for Efficient Transmission

METIS	Mobile and wireless communications Enablers for the Twenty-twenty Information Society
MiWaveS	beyond 2020 heterogeneous wireless networks with Millimeter-Wave Small cell access and backhauling
MiWEBA	Millimeter-Wave Evolution for Backhaul and Access
MIMO	Multiple-Input and Multiple-Output
MU-MIMO	Multiple-Input Multiple-Output
MWC 2015	Mobile World Congress 2015
MWC2020	Mobile and Wireless Communication Systems for 2020 and beyond
NGMN	Next Generation Mobile Networks
NKUA	National and Kapodistrian University of Athens
NSN	Nokia Siemens Networks
NTT Docomo	Nippon Telegraph and Telephone DOCOMO
OneM2M	Standards for M2M and the Internet of Things
Ph.D.	Doctor of Philosophy
PhC	Phone Conference
PHY	Physical Layer
PIMRC	Personal Indoor and Mobile Radio Communications
PUT	Poznań University of Technology
R&D	Research and Development
RAS	Radio Access and Spectrum
RSP	Rapid System Prototyping
RSPG	Radio Spectrum Policy Group
RWTH	Rheinisch-Westfälische Technische Hochschule
SCC	Systems, Communications and Coding
SPAWC	Workshop on Signal Processing Advances in Wireless Communications
SUNSEED	Sustainable and robust networking for smart electricity distribution
SweCTW	Swedish Communication Technologies Workshop
TB	Telecom Bretagne
TC	Test Case
TI	Telecom Italia



TU	Technical University
UB	University of Bremen
UKL	University of Kaiserslautern
ULTRA	Ultra-Low Latency and Ultra-High Reliability in Wireless Communications
UOULU	University of Oulu
UPVLC	Universitat Politècnica de València
URC	Ultra-Reliable Communication
VDE	Verband der Elektrotechnik
VDE-ITG	Verband der Elektrotechnik - Informationstechnische Gesellschaft
VITAE	Conference on Vehicular Technology, Information Theory and Aerospace &

	Electronic Systems
VR	Vetenskapsrådet
VTC	Vehicular Technology Conference
WCNC	Wireless Communications and Networking Conference
Wi5G	Emerging Technologies for 5G Wireless Cellular Networks
WP	Work Package
WRC	World Radiocommunication Conference
WS	WorkShop
WWRF	Wireless World Research Forum



1 Introduction

This document provides information on the dissemination and exploitation activities that have taken place during the ongoing METIS project. The main objective of METIS is to lay the foundation for, and to generate a global consensus on the future global mobile and wireless communications system, 5G.

1.1 Objective of the document

Academic dissemination and exploitation objectives are a manifold including co-ordinating the interactions with external research fora, handling of external technical and non-technical aspects (related to e.g. standardisation, regulation, etc.) and ensuring an adequate exploitation plan of the project results and findings as well a continuous follow up of the plan. This document aims at describing the dissemination activities and the exploitation of the project. Additionally, the document aims to show that the plan set in [MET13-D71] has been followed.

Briefly, the objective of the document is to present:

- Dissemination activities in terms of publications (in journals and conferences), organization and participation in conferences and workshops,
- Interactions with EU and non EU research partners,
- Training and teaching activities,
- Interactions with business players,
- Interactions with the research community through the public website and social media.

1.2 METIS dissemination objectives

METIS aims to ensure global impact through dissemination of studies, standardisation and regulatory engagement. With respect to this objective, METIS, in particular, has:

- Organised and participated in several workshops, such as the MWC VTC-spring workshops in 2013, 2014 and 2015, and the 5G summit in Beijing 2013.
- Organised and participated in the 5G Global Conference in 2014.
- Participated in panel sessions in scientific conferences such as the panel session titled “The dawn of 5G” at VTC 2013-Fall and the panel session on “What is 5G” at 5G World Summit 2014.
- Organised and participated in EU forums such as the Future Network Mobile Summit 2013 and the European Conference on Networks and Communications (EuCNC) 2014.
- Participated in Mobile World Congress 2013 and 2015.
- Disseminated METIS scientific results related to technology components, by publishing 21 papers in major journals and 170 conference papers.
- Given several talks and presentations, e.g. on the METIS 5G Vision in Globecom 2013 and on Research towards a Flexible 5G PHY at VTC 2014-Spring.



- Contributed to regulatory and standardisation activities (CEPT, ETSI), e.g., via several invited talks at decision-maker level such as ETSI summit, EuCNC in Bologna and VTC 2013 in Dresden. In such events, the METIS views regarding 5G concept have been presented and discussed. Additionally, the METIS scenarios and test cases have been presented and are widely accepted as drivers for the 5G in such events.
- Brought METIS results and opinions into global regulations, by participating in and directly contributing to the ITU-R preparatory process towards the WRC-15, by e.g. giving a talk and participating in a panel session on the AWG workshop on Future Mobile Communications 2015, ITU-R WP5D workshop on research views on IMT beyond 2020 and also having a Liaison Relation with ITU-R WP5D.
- A Liaison Statement with regulatory bodies and industry fora NGMN.

In the following the dissemination and exploitation are grouped into activities.

1.3 Structure of the document

The rest of the document is organised as follows. In Section 2 of this report the above-outlined dissemination activities within METIS are presented in detail, containing workshops and conferences, publications, talks and presentations, training and teaching, participation in EC activities, global and various aspects covered, cooperation with other research projects, public website, other web activities, and finally further exploitation.

Section 3 contains evaluation of exploitation and impact.

Section 4 lists references to METIS.

Section 5 contains a summary.

In addition, this document has an Annex where more detailed descriptions of the activities are provided. Section A is on the workshops and conferences, Section B is on publications, Section C is on talks and presentations, Section D is on training and teaching, and finally Section E is on references to METIS.



2 METIS activities

At the early stages of METIS the partners have set a clear exploitation and dissemination plan aiming at specific objectives. The main objective is to impact globally the way research moves towards 5G and to trigger further research. To this direction, the dissemination and exploitation plan has been set including the organization of and participation in conferences and workshops, as well as the dissemination of the scientific results of the project through publications. Additionally, the exploitation plan included the integration of major results of the project into courses (undergraduate and post graduate) that the involved partners would give at their respective institutions. Furthermore, the training of Ph.D. and master students is a key objective of the project.

The following subsections incorporate the results of the dissemination outcomes related to workshops and conferences, publications, cooperation with EC entities, and other EU funded projects. Additionally, the dissemination of the project findings through its public website, as well as social media is being described in detail. Finally, the exploitation of the project outcomes for training of students, through courses, and Ph.D.s is presented in details.

2.1 Workshops and conferences

METIS has arranged a number of events throughout the project, some of the activities have been arranged together with other global partners. In the following, these events are briefly outlined. The details of these events can be found in Annex A.

The first workshop on Mobile and Wireless Communication Systems for 2020 and beyond (MWC2020) was held in Dresden, Germany in conjunction with IEEE Vehicular Technology Conference (VTC) 2013-Spring. The workshop was well attended and generally well received. The success of this first workshop motivated the follow-up workshops at the following conferences. Further, other global partners have shown interest in co-organizing this workshop in the future conferences.

METIS organised a workshop titled 'Research Challenges for 2020 in Communications' jointly with Wireless World Research Forum (WWRF) at Future Network Mobile Summit 2013 in Lisbon, Portugal. The workshop was well attended and generally well received. This workshop has contributed to the global consensus building in pointing out the technical challenges.

A panel session titled "The dawn of 5G" was held at IEEE VTC 2013-Fall in Las Vegas, USA, where discussions towards the future direction of communications industry took place.

METIS arranged the "5G summit" in Beijing, China together with FuTURE Forum. The 5G summit was a large event with attendees from all over the world interested in 5G work including key industry and academic partners as well as regulatory bodies from EU, China, Japan, and Korea.

METIS organised a successful networking session within the framework of Future Internet at ICT 2013 in Vilnius, Lithuania. The session was enriched by an exhibition on device-to-device (D2D) communications test bed as an example technology. The focus of the event was placed on challenges and technologies for future communication systems and how these may impact the ecosystem of communications



industry as well as vertical industries, such as consumer electronics, energy and transport.

Together with European Commission's Future Internet Public-Private Partnership Programme (FI-PPP) FINESCE (Future Internet Smart Utility Services), METIS organised a workshop on Smart Grid Requirements for 5G with a particular focus on the future requirements on communications technologies in the energy sector, in Zaventem, Belgium.

Following the successful workshop MWC2020 at IEEE VTC 2013-Spring, METIS organised the second workshop MWC2020 at IEEE VTC 2014-Spring, in Seoul, South Korea, together with the 5G Forum. The workshop was attended well by the conference participants as well as invited speakers from a wide range of branches.

With other European Union (EU) FP7 projects COMBO (Convergence of Fixed and Mobile Broadband Access/Aggregation Networks), MiWaveS (Beyond 2020 Heterogeneous Wireless Networks with Millimeter-Wave Small Cell Access and Backhauling), iJoin (Interworking and Joint Design of an Open Access and Backhaul Network Architecture for Small Cells Based on Cloud Networks) and 5GNOW (5th Generation Non-Orthogonal Waveforms for Asynchronous Signalling), METIS organised the workshop titled "Enablers on the road to 5G" at European Conference on Networks and Communications (EuCNC) 2014 in Bologna, Italy. The workshop included various technical presentations spanning from physical-layer aspects to system concept and architecture.

METIS organised the 5G Global Conference (5GGC) in Berlin, Germany, which was well attended and received. The conference focused on 5G insights and ideas as well as detailed technical research and development ideas with various technical presentations from METIS. This conference contributed to the strong alignment within the industry in its development of the new 5G technology, which is necessary in order to harmonize standards and to get the regulations in place.

METIS will organise the third workshop MWC2020 at IEEE VTC 2015-Spring together with 5G Forum, which will be held in Glasgow, UK. In the course of writing this deliverable, the workshop is in the preparation phase. The workshop is aimed to attract 5G frontier research work and provide vision for the way forward towards the 5G development.

2.2 Publications

METIS has produced a very large pile of publications since the project started. The Table 2.1 gives a summary of the numbers versus type of publication as have been achieved by the time when this report was released.

Table 2.1: METIS publications.

Type of publication	Number
Workshop and conference papers	170
Journal papers	23
Book chapters	3
Press releases	2



With about one third of publications being created in the first year the project had already a good start as the first year of a project is usually more focussed on getting the research work ramped up and less productive in terms of publications. The remaining two third have been produced during the second year and the first couple of month of the third year.

Naturally the biggest part of the publications is by conference contributions. These have been presented on totally 55 different conferences or public workshops organised adjacent to conferences. Also the number of 23 journal papers is a significant achievement given the relatively long time period for the review and acceptance process of journal and magazine articles. The invitation from reputable publishers to contribute to three book chapters proves the scientific reputation and quality of METIS work.

All partners have been involved in dissemination activities and have contributed to this remarkable result of totally 197 publications. Most of all papers have been generated by collaborating work of several authors; there is just a minority of only 7 papers generated by single authors. Concerning the cooperation of industry and academia, it is worth noting that a great many of the papers was created in collaboration of industry and academic partners. In fact the dissemination activity from industrial partners in METIS is quite significant as in more than 50% of publications at least one industrial partner was involved.

Apart from conference, journal and book contributions, METIS has launched two official press releases, on 27th November 2012 and 5th September 2013, respectively.

A full list of publications is given in Annex B and can be found additionally on the project website at <https://www.metis2020.com/documents/publications>.

2.3 Talks and presentations

METIS partners have participated in many events and presented the project or parts of the project results, or partner visions on 5G through invited talks and panel discussions at various conferences. METIS has e.g. been visible in the WP5D WS on Research views on IMT beyond 2020 HMC and in the RSPG#33. A list of talks, presentations and contributions to panel discussions is summarised in Annex C.

2.4 Training and teaching

METIS has contributed significant efforts to the training of students in the form of lectures, tutorials, and by conducting cutting edge research work in M.Sc. and Ph.D. courses.

Academic partners are actively incorporating research topics pursued in METIS in their teaching activities, in particular on master level. In new courses, 5G research directions are explained, being aligned with the main research pillars of the METIS project. One such new course has been developed and read out at UPVLC. At UB, Cooperative Communication, i.e. two-way relaying and IDMA technologies investigated in task T3.3, as well as Compressive Sensing, i.e. the multi-user detection approaches researched in task T2.3, are an integral part of the master level course "Advanced Topics in Digital Communications". At CTH, the following lectures were updated and influenced by METIS: "SSY135 Wireless Communication", SSY145 "Wireless Networks" and "SSY305 Kommunikationssystem".



Within the METIS project, also a number of technical tutorials based on prior work of the project partners have been presented during F2F or PhC meetings on, for example, multi-node transmission, context-awareness aspects, or massive MIMO. The contents of the tutorials have partly been based on results of prior research projects, e.g. the ARTIST4G FP7 project for the multi-node transmission tutorial. METIS tutorials may also summarise the progress made in standards bodies such as 3GPP.

In the course of the METIS project, a number of students have received technical training, both on M.Sc. and Ph.D. level, at academic partners and also as internship students at industry partners. Student internships have also served as a means to establish collaborations between METIS partners.

A summary of trained students, lectures and tutorials held is presented in Annex D.

2.5 Participation in EC activities

During the last year, METIS has been involved actively in EC activities. Such activities included both internal European interactions and interactions between European partners and external researchers. Regarding the first set of interactions, METIS has participated in RAS cluster meetings in Athens and Brussels focused on the Radio Access and Spectrum innovations for 5G on the one hand and the way to the standardisation on the other. Furthermore, METIS has participated in 5G PPP events for the presentation of the developed concepts, ideas, and scenarios to the EU partners. In an additional meeting, METIS partners presented the METIS demonstration activities to the EC and the European partners. The main purpose of this meeting was to provide input to the EU so as the latter may better plan the 5G PPP demo activities. Finally, regarding the spectrum considerations for 5G systems, METIS partners participated in the Radio Spectrum Policy Group (RSPG) for consulting the EU as experts for aspects related to 5G spectrum. Additionally, in the 9th annual EU Spectrum Management Conference, a short introduction of the ideas regarding the spectrum concepts has been given, followed by interactions on sharing and use of spectrum as well as migration of existing services.

Regarding the interactions of EU with partners from other countries and continents, METIS (as a European project) has presented the considered concepts in the 5th EU-Japan Symposium on ICT Research and Innovation. Additionally, METIS has participated in the EU-Taiwan coordination meeting for presenting both research concepts. More specifically, METIS views for 5G millimeter waves, as well as the METIS considered 5G scenarios, concept and architecture have been presented. Given that one of the aims of this meeting was to identify potential collaborations between EU and Taiwan research programs, the Taiwanese delegation consisted of government, academic, and industrial representatives.

2.6 Global and various aspects covered

One of the key objectives of METIS is to drive the global harmonization on 5G in order to prepare standardisation activities and to support the ITU processes towards 5G. In order to achieve this goal, METIS has, in particular,

- contributed actively to the ITU vision documents,
- supported national regulators by providing input and support for the WRC 2015 preparation process,



- contributed actively to the CEPT and ETSI work on spectrum management and sharing concepts (see ETSI FM groups on RRS and LSA),
- presented METIS visions and concepts at the leading international mobile communications fair in Barcelona,
- presented the METIS vision in two presentations at the ETSI Future Mobile Summit,
- organised international workshop with industry decision makers on 5G in Europe and Asia with representatives of all countries with major 5G programs,
- organised 5G workshops at the major international workshops and conferences.

METIS is now recognized as the major global 5G activity with the broadest footprint. Its key papers and deliverables on use cases, requirements and concepts are widely accepted references for 5G in all regions of the world (see below, in Section 3, the number of METIS citations).

2.7 Cooperation with other research projects

In the area of physical layer aspects, METIS is collaborating with the FP7 project 5GNOW – Non-Orthogonal Waveforms for Asynchronous Signalling (<http://www.5gnow.eu/>), where researchers of ALUD and HHI are engaged in both projects. Emphasis is on the design of novel waveforms to enable efficient support of Massive Machine Communications. The 5GNOW project got presented at METIS All #4 meeting, and in turn ALUD presented its METIS waveform activities at a 5GNOW meeting, both in October 2013. The exchange with 5GNOW at METIS All#4 meeting had the purpose of raising awareness of the work of 5GNOW within the METIS consortium and led to the joint workshops at EuCNC 2014. An information exchange on promising waveform candidates for 5G has been taken place at the 5GNOW meeting on Oct. 15th 2013. The 5GNOW consortium has been made aware of work being done in METIS on this topic followed by fruitful discussions. During the actual working phase, ALUD transferred results on multi-carrier waveforms from 5GNOW towards METIS and the results were discussed during METIS F2F meetings. Further, ALUD worked within METIS on complementary research questions concerning multi-carrier waveforms and in turn the results were transferred to the 5GNOW project.

Another FP7 project where information exchange with METIS is performed is COMBO – CONvergence of fixed and Mobile BrOadband access/aggregation networks (<http://www.ict-combo.eu>). In COMBO, also several METIS partners are actively involved (e.g., DT, Orange, Telefonica, Ericsson, and Alcatel-Lucent). A detailed overview of COMBO was presented during the METIS All #4 meeting in Berlin. DT has established a regular internal information exchange between departments involved in METIS and COMBO with primary focus on architectural and system concept topics. The COMBO reference network was taken into consideration w.r.t. deployment architecture for preparation of [MET15-D64].

In the area of spectrum management, METIS is collaborating with the German research project COMORA that addresses spectrum management, LSA schemes, and spectrum sensing topics. ERI, NSN, UKL, HHI, and Telefonica are working in METIS and COMORA so that a fruitful cooperation and alignment of views was possible.



AAU is participating in the “Dependable Wireless Bits for Machine-to-Machine (M2M) Communications” and “Massive array systems for high speed and green wireless communications” both supported by the Danish Council for Independent Research (Det Frie Forskningsråd) and the FP7 project SUNSEED. The first project is focused on the design of access protocols for M2M, while the second explores massive MIMO technologies, finally the third one explores and evaluates communication protocols for efficient smart grid communications. The results produced in these projects were incorporated in the METIS system concept, via researchers simultaneously working in these projects and METIS. The knowledge base developed during these projects has been used as input for the research work conducted in METIS, namely on the design of the proposed MMC access protocols and on the work focused on enabling Massive MIMO.

TID is participating in the FP7 project MAMMOET – MASSive MiMO for Efficient Transmission (<http://mammoet-project.eu/>), where researchers of TID and Ericsson are engaged in both projects. MAMMOET explores massive MIMO technology in both its theoretical and practical aspects, and particular emphasis is put on the scenarios definition and requirements. Some of the scenarios defined in METIS were the basis for the scenarios in MAMMOET.

METIS is also linked to the German national research project CONVERGE (<http://www.converge-online.de/>), to which BMW and ERI contribute. Activities include an information exchange on future vehicular communications.

CTH is participating in two Swedish national research projects VR and CHASE-VINNOVA, dealing with Dynamic Multipoint Wireless Transmission and Multi-Antenna Technologies for Wireless Access and Backhaul, respectively.

Activities of UB in METIS either provide or receive synergy effects from a number of nationally funded basic research projects at UB (DFG, German research foundation). Specifically, the project “Physical Layer Cooperation in Distributed Relaying Systems” is related to activities in WP3 and the two projects “Non-linear Compressive Sensing Multi-User Detection: Algorithms and Hardware Architectures” and “Compressive Sensing Multi-User Detection for Code-Multiplex Systems” are related to activities in WP2. Currently, a nationally funded research project is planned (BMBF, Federal Ministry of Education and Research), which is based on and will extend results and insights achieved in METIS.

UOULU is participating in the EU project DUPLO and in the Finnish national projects JULIET and 5Gto10G. In DUPLO and JULIET the primary focus is on full duplex communications and in 5Gto10G on 5G research at 10 GHz and beyond centre frequencies. Information between METIS and these projects is exchanged.

UPVLC is participating in a Spanish national research project dealing with the evolution of LTE-A. In this framework, the outcomes of METIS are taken into account for the identification of research trends and challenges.

KTH is leading two EIT ICT Labs projects which complement METIS. 5GrEEen is a joint project with ERI, Aalto, and TI. The objective of 5GrEEen is to complement METIS in energy efficient system architecture and network design while METIS is not specifically focusing on energy efficiency aspect. M2MRise is a joint project with ERI, Aalto, NOKIA, and FT. M2MRise will foster the development of a framework that enables services based on Machine-to-Machine (M2M) communications and Internet



of Things (IoT), by taking into account overall system, service and business model aspects. KTH also runs several small projects within Wireless@kth research center which utilize the use cases and technology components developed by METIS.

A summary of the information exchange with other research projects is presented in Table 2.1.

Table 2.2: Summary of information exchange with other research projects.

Related project	Presenter	Title	Event	Date
5GNOW	F. Schaich (ALUD)	5G Waveform and Radio Frame Design	5GNOW meeting	15-Oct-2013
5GNOW	G. Wunder (HHI)	5G Compressive Random Access	METIS All #4 Berlin	08-Oct-2013
5GrEEEn	Hugo Tullberg (ERI)	METIS project overview	5GrEEEn Kickoff meeting	16-Jan-2013
COMBO	H. Droste (DT)	METIS – The 5G Mobile and Wireless Communications: Views on System Architecture	EuCNC 2014 WS “Fixed-Mobile Convergent Networks: Solutions and Architectures Proposed in FP7”	June 29 to July 2-2015
COMBO	N. Lindqvist (ERI)	COMBO overview	METIS All #4 Berlin	08-Oct-2013
CONVERGE	P. Fertl (BMW)	METIS project and HT Moving Network Topics	CONVERGE meeting	2013
iJoin	Hans Schotten (UKL)	5G ARCH – METIS view	iJOIN workshop, Bremen	23/24-Feb-2015
M2MRise	Joachim Sachs (ERI)	METIS MMC	M2MRise kickoff meeting	23-Jan-2014

2.8 Public website

The public website, <https://www.metis2020.com/>, was published in November 2012 and has been used throughout the project. On this website, one can find general information about METIS, such as the ‘Project Structure’ description that is found under the ‘About METIS’ page. Further, in ‘Documents’ one can find information about the METIS ‘Deliverables’, ‘Publications’ and ‘Simulations’. In ‘Deliverables’ the public METIS deliverables are given. In ‘Publications’ references to the METIS publications in conferences, workshops and journals are presented. In ‘Simulations’ the ray-tracing results of test case one, two, three and four (TC1 to TC4) can be found together with some of the software implementations. These results have been computed within the project and thereafter been used in the evaluation of the test cases. From the ‘Press Room’ one can read the METIS press releases, and from ‘Events’ one is able to follow the major upcoming and previous events of interest to the project.

2.9 Other web activities

The other web activities, besides the public website, relate to both the internal work and towards communication outside the project.

In addition to the public project website, the METIS internal web activities are managed through Confluence, which is a Content Management System (CMS) tool.



To communicate outside of the project, METIS has established Twitter, Facebook and LinkedIn accounts where upcoming talks and events are announced:

- www.twitter.com/metis2020
- www.facebook.com/metis2020
- www.linkedin.com/groups/METIS-2020-4711622

METIS has also contributed actively to the creation of the 5G concept within Wikipedia (<http://en.wikipedia.org/wiki/5G>). Under this concept, the history and main outputs of METIS appear as key milestones in the activity towards the definition of the 5G. Moreover, the METIS project has been included as a valid meaning of the general METIS concept in Wikipedia.

In the organization of the 5G Global Conference (5GGC) a conference website was constructed (<http://5gglobalconference.com/>).

2.10 Further exploitation

Up to now METIS has encouraged the partners to exploit their results in several ways. More specifically, regarding to the outcomes further dissemination, effort has been spent so as to train M.Sc. and Ph.D. students, and further communicate the developed knowledge to other research entities and parties. Several talks have been provided up to know regarding the project's vision for 5G. It is worth mentioning the lecture at the TeliaSonera IT/IP Business Competence Development Programme, where the METIS outcomes have been presented to middle level managers and "rising stars". In terms of patents there have been some filings of joint patents among METIS partners in the research area of moving networks. For example, both UKL and UPVLC have joint patents with BMW.

Industrial partners were also able to demonstrate the achievements of the project in large commercial expositions, such as the Mobile World Congress 2015. In such occasion, panels were made available in several industrial partners' booths (Ericsson and Huawei), allowing a very high level of visibility to experts and business people.



3 Evaluation of exploitation and impact

The major objective of the dissemination and exploitation activities is the global consensus building. For that purpose 189 publications (166 conference papers and 23 journal papers) have been presented at and accepted in a number of world leading conferences and journals. This exceeds more than three times the total amount originally planned for the lifetime of the project (50). By this strong publication of scientific and technical results, the METIS solutions for new services and applications could be introduced appropriately in the research communities. In addition, the solutions, technical concepts and overall system concept have been disseminated through focused events like METIS 5G workshops collocated with the VTC'13 spring and fall, VTC'14 spring and coming VTC'15 spring. Furthermore, the joined organization of the 5G Future Forum workshop in China was part of the international consensus building in other regions. METIS has also worked together with 5G Forum Korea in joint dissemination activities and exchange of information. As a result, METIS has been and is mentioned in almost all public 5G events and referenced in several publications and press releases.

Due to the careful selection of appropriate journals and magazines where the overall system concept of METIS has been published and the common terminology introduced, the overall context of the technical details published in papers has been clearly communicated and could be easily understood by readers. In addition and in parallel to the published technically detailed papers, the overview papers allow the research community to catch up with the new ideas and concepts requiring deep scientific analysis and contribute to the research progress. Furthermore, besides building up a METIS Web page also press releases published e.g. in Facebook and Twitter and on the partner's web pages as well as the creation of the 5G concept within Wikipedia helped to address the research community and industry appropriately.

It is worth also highlighting that METIS partners are organizing, as lead editors, a special issue in IEEE Communications Magazine on 5G Spectrum, which is expected to be published in July 2015, being a clear reference for the incoming WRC conference in November this year.

Due to the high amount of publications and dissemination events and by efficient linking with other research projects, a very strong influence in the consensus building of a 5G vision could be achieved. In particular, thought leadership was achieved concerning the most relevant use cases, requirements and technical concepts of a 5G mobile and wireless communication system.

The impact of METIS on 5G research can be measured in terms of the number of publications (140, 46 of them from non-METIS members) referencing to documents on the METIS homepage, mainly deliverables. These figures demonstrate significantly the relevance and visibility METIS has gained in the international 5G research communities. The figures for other coetaneous projects on 5G are significantly lower (37 publications in the best case). These figures were generated by a "Publish or Perish" query for the project homepages at Feb 22, 2015, 17:12h CET.

Further, METIS led to the development of new courses and to the upgrading of existing lectures on M.Sc. and Ph.D. level at academic partners. Students were trained on cutting edge research topics, and got opportunities to participate in



internship projects. More than 50 early stage researchers have started their research careers in the framework of METIS, being thirteen of those PhD studies. Without any doubt, a great opportunity for them to establish strong network liaisons and get others views in the research activity.

Concerning academic dissemination, we conclude that a high impact of METIS on the 5G global mobile and wireless communications system and a very prominent perception of the results and concepts could be achieved. This leads to the overall conclusion that METIS has an excellent progress with respect to the dissemination plan.

Concerning the particular evaluation of the impact of the project, we list below the feedback received from the different academic and research partners:

- The METIS project has enabled Aalborg University (AAU) to create a visible research profile within the area of 5G wireless systems. The published output consists of 11 conference papers, 3 journal papers and 1 book chapter. The AAU research team has started two research areas within the METIS project, massive MIMO and Ultra-Reliable Communication (URC), respectively. Specifically, URC is a new research direction that was very much shaped through the METIS project. Since AAU is the Horizontal Topic Driver (HTD) on URC, it enabled our team to get an early start within this novel and increasingly important topic. At the educational side, the METIS project enabled to enhance the master and Ph.D. courses with aspects of 5G systems. At the project side, the visibility gained by AAU through METIS has brought multiple projects (FP7 SUNSEED and FP7 ADVANTAGE), as well as multiple invitations/opportunities for follow up project submissions within Horizon 2020. One such project is the recently granted ERC Consolidator grant, part of which was built up on the research and knowledge created in METIS. Last, but not least, the METIS project has given the AAU team the opportunity to create close industry contacts which are likely to lead to bilateral projects in the coming period.
- The University of Bremen (UB) has actively published the research conducted in METIS through several conference publications at international IEEE conferences (3 papers WP3, 7 papers WP2) and multiple journal manuscripts (1x accepted, 1x submitted, both WP2). Furthermore, UB has been promoting METIS research through talks at the Global 5G Conference, the EuCNC meeting at Bologna and several bi-lateral presentations with external partners from academia. In addition, UB has been active in multiple workshops and conferences related to 5G and METIS research as a member of technical program committees. In terms of teaching UB has extended the M.Sc. level lectures “Advanced Topics in Digital Communications” and “Next Generation Mobile Networks” towards 5G topics to include its METIS research topics “Two-way Relaying” (WP3) and “Compressed Sensing based Multi-User detection” (WP2). Additionally, two new additional Ph.D. projects as well as multiple M.Sc./B.Sc. projects on these topics either are or have been conducted. Finally, a UB internal workshop on compressed sensing including METIS topics is currently under preparation and is planned to take place on March 17th 2015. This workshop aims at education of Ph.D. level researchers at UB and the fostering of collaboration of different disciplines employing CS methods. In terms of standardisation & industrial exploitation plans, the University of



Bremen is participating in OneM2M as a full member and has been active in the NetWorld2020 platform to foster the evolution of communication technologies. In this context UB has contributed to two NetWorld2020 white papers and the NetWorld2020 meeting at the EuCNC conference in Bologna. Furthermore, multiple bi-lateral cooperation projects with industrial partners have either been started or are currently under preparation.

- Chalmers' main interests and exploitation plan in the project is to build on and further develop university's existing research strengths in targeted fields of the project. Project results have so far been disseminated in twelve scientific conferences papers and two journal articles. The involved senior researchers have increased their knowledge, and used the knowledge in our courses at Chalmers and also triggered new research. The involved Ph.D. students in the project have benefited extensively from the collaboration. Three of them will defend their Ph.D. thesis first half of 2015, and two of these have already got a researcher position by a vendor in the mobile communications industry. The third Ph.D. student has come far towards the Ph.D. thesis as well, expected Ph.D. defence is in 2016.
- Fraunhofer HHI has published 13 conference papers and one IEEE magazine article. During the project two Master theses were completed. HHI was involved in the preparation of the CoMP as well as in the Massive MIMO tutorial presented in Helsinki and Stuttgart, respectively. Based on the activities in WP1.2, HHI continued working on the Quadriga propagation model framework and submitted 6 contributions to 3GPP RAN 1 for RP-122034: Work Item Description for "Study on 3D-channel model for Elevation Beamforming and FD-MIMO studies for LTE". A MATLAB reference implementation is available under <http://quadriga-channel-model.de>. A consolidated reference implementation from METIS for stochastic propagation modelling will be available by end of May 2015. From the work in WPs 3 and 4, HHI extended its system level simulation platform to develop and evaluate latest interference management concepts for heterogeneous network layouts and supporting for Massive MIMO communication in a multi-cell layout. Finally, our achievements in the METIS project serve as a solid basis for new contracts/research projects in the field of 5G and beyond 2020 wireless solutions for the whole chain of conceptual work, simulation studies and prototyping.
- RWTH has published eight conference papers (plus two under peer-review) as a result of our research activities in METIS project. A summary of the business opportunities exploited in the project is as follows:
 - Opportunity # 1: *Consulting, development and project activities with industry in the field of future wireless technologies.* A new contract with ALUD was established in the context of WP2 activities. One joint paper has been published with METIS WP2 partners.
 - Opportunity # 2: *Patents derived from the institute research.* The research outcome of this project was not suitable for patents because rather than algorithmic innovations, our major contribution focused on performance evaluation. An example is the sensitivity analysis of FBMC systems to RF imperfections and synchronization loss (D2.4). However,



this does not rule out future patents from the ongoing collaboration with ALUD.

- Opportunity # 3: *Toolchain fundament for PHY layer simulation and development*. FBMC simulation platform was developed to facilitate comprehensive performance evaluation and solution verification. Furthermore, for comparison against state-of-the-art systems, an in-house implementation of reference 4G system was extended to suit METIS requirements.
- Opportunity # 4: *Knowledge transfer kogLTE and METIS*. Three presentations in METIS F2F meetings about related activities in kogLTE and METIS projects.
- Opportunity # 5: *Knowledge transfer by teaching activities*. New aspects focusing on 5G systems were introduced in the existing lecture content. Four master theses with topics directly linked to METIS have been successfully completed at ICE.
- KTH has published 11 conference papers and one journal paper, and also has several journal papers currently under review. It is notable that KTH's publication appears not only in technical conferences and journals but also in conferences for spectrum policy and telecommunications business for maximizing the impact of METIS. The knowledge obtained from the METIS project has been integrated to courses for Master's study. In particular, concepts and enablers for UDN and MMC are included in the courses. Two Ph.D. graduates and one post-doc who participated in METIS landed themselves to European industry. Also, several spin-off research projects have been created out of METIS. The spin-off projects are supported by EIT-ICT Labs, Vinnova, and Wireless@kth, and are used for a means to disseminate the METIS results to SMEs in Sweden.
- University of Oulu has published nine conference papers, one communication letter and one IEEE transactions on communications journal. One doctoral thesis and two Master theses have been completed in METIS too. Moreover, University of Oulu has participated in the creation of the tutorial on massive MIMO, presented in the Stuttgart meeting. On the other hand, results have been integrated in wireless communication courses delivered to Masters and doctoral students. Finally, it is worth noting that the participation in METIS allowed for one local project with inputs from METIS of 120 PM approximately and another one just approved of the same size.
- Impact of the METIS project on academic activities performed by PUT academic staff members is meaningful. In particular:
 - Two formal Ph.D. procedures started by the Faculty Council of the Faculty of Electronics and Telecommunications at Poznan University of Technology. Finalizing of two Ph.D. theses written by Mr. Krzysztof Bakowski and Mr. Marcin Rodziewicz - the project participants - are expected at the end of this year.
 - Competences gained within the METIS project are used in academic cooperation with Nokia R&D center in Wroclaw, Poland devoted projects on 5G problems.



- High requirements on simulation experiments have triggered further development of simulation capabilities realized by the continuously improved and extended computer cluster and improved competences of the project participants in the simulation methodology. As a result of them the book chapter has been published (K. Bąkowski, K. Wesolowski, M. Rodziewicz, "Simulation Tools for the Evaluation of Radio Interface Technologies for IMT-Advanced and Beyond", Chapter 13 in "Simulation Technologies in Networking and Communications: Selecting the Best Tool for the Test", CRC Press, 2015, ISBN 1482225492)
- The METIS activity of PUT is well recognized in Polish academic community working in the area of wireless communications. Prof. Krzysztof Wesolowski has been invited to present the plenary talk at the main national conference on wireless communications (KKRRiT 2015) on 5G system in view of the METIS project.
- UKL has exploited the declared knowledge transfer and opportunities as stated in the following:
 - Opportunity #1: Publishing results in international conferences, respected journals and popular magazines. This has been achieved with eight conference papers and three journal papers published or accepted for publication, which are directly related to the activities in METIS. UKL has held the guest editorship for a special issue on spectrum in IEEE Communications Magazine. Further, UKL was co-organiser of several international workshops, e.g. "Mobile and Wireless Communication Systems for 2020 and beyond" (MWC2020), "Ultra-Low Latency and Ultra-High Reliability in Wireless Communications" (ULTRA), and "5G Architectures" (5G ARCH). Moreover, two text books on 5G (Cambridge, Springer) are under preparation where UKL will contribute.
 - Opportunity #2: Filing joint patents with METIS partners. One joint patent on URC for automotive systems has been filed in collaboration with a METIS partner.
 - Opportunity #3: Creating novel courses and projects on beyond 2020 technologies. New seminars on 5G technologies have been offered for Master students. Further, two proposals for "Marie Skłodowska-Curie Innovative Training Networks (ITN-ETN)" have been prepared in collaboration with various METIS partners. Moreover, several B.Sc./M.Sc. projects related to 5G and METIS topics are or have been conducted.
 - Opportunity #4: Contributing to regulatory and standardisation activities (CEPT, ETSI). UKL held several invited talks on METIS at the following events: ETSI summit, 5G@Europe summit in Munich, EuCNC in Bologna, VTC 2013 in Dresden, Institute for the Protection and Security of the Citizen (JRC-IPSC) in Ispra, iJOIN workshop on 5G architecture in Bremen.
 - Opportunity #5: Consulting industrial partners in new domains that need expertise in wireless. Due to its association with the German Research



Center for Artificial Intelligence (DFKI) GmbH, UKL provided a link to the national research initiative on “Industry 4.0” and initiated discussions with railway, wireless automation, and automotive industrial partners.

- UPVLC has published two conference paper and four journal papers directly related to its activity in METIS. Concerning the business opportunities declared in the beginning of the project, the status is the following:
 - Opportunity #1: Licensing the use of the simulation platform. This has been achieved with one license sold during the project lifetime.
 - Opportunity #2: Consultancy on the design, testing and evaluation of beyond 2020 wireless solutions. Two new contracts for simulation consultancy have resulted from the activity in METIS.
 - Opportunity #3: Joint patents with other METIS partners. One joint paper has been presented in the European Patent Office on the inclusion of MU-MIMO with Grassmannian constellations.
 - Opportunity #4: Create novel courses on beyond 2020 technologies. Two new courses have been taught during 2013 and 2014.
- NKUA has published three conference papers and has recently submitted one magazine paper related to its activities in METIS. NKUA has been monitoring ETSI RRS WG1 and GreenTouch forum activities. Four Ph.D. and two master students have been participating in METIS and are expected to produce their Ph.D. and master theses respectively, based on the scientific knowledge obtained in METIS. One master university course has been proposed and has been incorporated in NKUA course program. NKUA has strengthened its cooperation with other universities and companies and has broadened its synergies based on the expertise and knowledge obtained in METIS activities. Finally, exploitable results of NKUA activities have set the basis for product development through the group’s spin-off company.
- Institut Mines-Telecom/Telecom Bretagne has gained wide research profile visibility within the area of 5G wireless system design and implementation through METIS. It has actively exploited the METIS project results for both educational and research purposes, besides technology transfer as follows:
 - Two Ph.D. students, three post-doctoral fellows, one R&D engineer, two Master students, several undergraduate students, besides several permanent researchers have been given the opportunity to work on cutting-edge research in a European collaborative effort.
 - The proof-of-concept hardware/software platform used in METIS for test-bed activities has triggered the creation of a new group of interest in PRACOM (Advanced Research Center in Communications) at the Institut Mines-Telecom. This group includes several French industrial partners who are interested to define a common cutting-edge platform for rapid proof-of-concept of their emerging activities related to 5G wireless communication systems.
 - Institut Mines-Telecom has been promoting METIS research through several talks, seminars, and demonstrations in several occasions: inside the institute itself with the presence of several external industrial and



academic partners, at the EuCNC'2014 in Bologna, at METIS F2F meetings, at the 5G & Beyond: Promises and Challenges workshop in Paris, at PRACOM industrial partners meeting, at 5G Global Conference in Berlin, at the IEEE RSP'2014 symposium in New Delhi, and at the MWC'2015 in Barcelona.

- Several scientific papers have been written and submitted or already published and presented in international conferences and journals. This includes four conference papers, including one presented at RSP'2014 symposium and one accepted at VTC-spring 2015 MWC2020 workshop, two journal papers in preparation, and two demonstrations of test-bed results at EuCNC'2014 and MWC'2015.
- Knowledge transfer by teaching activities has been initiated where new aspects issued from METIS research results are being introduced in the Master and last year engineering studies at Telecom Bretagne / Institut Mines-Telecom. This concerns courses related to advanced wireless communication systems and system design, in addition to several student projects.
- Visibility gained by Telecom Bretagne through METIS has brought several invitations/opportunities for follow up project submissions within Horizon 2020, besides close industry contacts which can lead to bilateral and collaborative projects in the coming period.



4 References to METIS

The METIS project has received remarkable attention in the media, in particular >50 articles have appeared online on technology websites published in Europe, the US and Asia, and an interview was broadcast by a radio program in Sweden. The online media include prominent members such as Digitimes of Taiwan, IEEE, FierceWireless and Forbes of US, and Heise and Golem of Germany. The majority of these references have reflected on the press releases published by the consortium or the individual partners, and have included interviews with researchers or managers of the partners involved in the project. Some articles have primarily targeted financial investors by providing information about a project partner, while others have discussed the 5G technology trends, where some have referred also to other ongoing 5G research initiatives. Further METIS was addressed in several press releases and memos by the European Commission concerning its research grants for 5G technology. METIS is also referenced in several white papers on 5G topic provided by companies and organisations of the telecommunications industry. 5G is also in focus of market research companies resulting in 10 reports with references to METIS.

This overview makes no claim to be complete especially with respect to online articles. Also with respect to scientific articles in journals and conferences authored by non-METIS members it is hard to compile all occurrences as in most cases not the METIS project itself, but sources provided by METIS partners in the scientific dissemination list are referenced.

An overview of sources with references to the METIS project is given in Table 4.1 with accumulated numbers according to different classification. Detailed lists of the different sources are presented in Annex E.

Table 4.1: (Non-exhaustive) Overview of public sources with references to the METIS project.

Type of reference	Number
EC press releases/memos	4
Online articles	52
Radio interviews	1
White papers	8
Market research reports	10
Scientific articles	3
Deliverables of other EC projects	6



5 Summary

Deliverable D7.3, entitled “Final report on Academic exploitation and dissemination” aims to describe the METIS project activities towards academic exploitation; the exploitation and dissemination plan has been defined in the early stages of the project [MET13-D71].

METIS partners have presented the project findings in scientific publications. As thoroughly described in the deliverable’s body and annex, the METIS partners have been very active producing numerous (above 190) high quality paper publications. Additionally, the project’s outcomes have been presented in METIS organised workshops and conferences. Also, METIS has actively interacted with the research community both within European Union (i.e., interactions with other EU-funded projects) and externally (i.e., interactions with Taiwan, Japan, US, etc.).

Furthermore, it should be highlighted that the results have been integrated into courses that the involved partners teach at their respective institutions. It should be also mentioned that, as planned, the partners have taken advantage of the project for training Ph.D. and master students.

It should also be noted that METIS has had a large impact on the industry. At the start of the METIS project 5G was not even a research topic and at the end of the project the whole mobile industry is focusing on 5G as the next big thing. This can be seen by the large number of interaction taking place with industry players and the METIS presence on large commercial expositions, e.g. Mobile World Congress.

Finally one of the achievements of the METIS project is to trigger further 5G research in an European context. In the H2020 framework the 5GPP will continue research on many topics studied in METIS. A large part of the requirements set in the call ICT14 has been derived from the METIS scenarios.



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Version: 1

6 References

- [MET13-D71] METIS D7.1. "Academic Dissemination & Exploitation Plans". *ICT-317669 METIS Deliverable 7.1 Version 1*, February 2013.
- [MET15-D64] METIS D6.4. "Final report on architecture". *ICT-317669 METIS Deliverable 6.4 Version 2*, February 2015.



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Security: Public

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Annex A



A. Workshops and conferences

METIS has identified related major events, as detailed in [MET13-D71]. Furthermore, throughout the project new relevant events are determined, organised or participated in. In the following, an overview of these events is provided.

A.1 METIS 1st MWC 2020 at VTC 2013-Spring

METIS organised the workshop titled 'International Workshop on Mobile and Wireless Communication Systems for 2020 and beyond (MWC 2020)' which was held in conjunction with VTC 2013-Spring. The workshop placed the focus on research work targeting 5G mobile and wireless communications systems. Detailed information regarding this event is outlined in the table below.

Date	Jun. 2, 2013
Place	Dresden, Germany
Scope	Beyond 2020 Technologies Technical Paper Presentations
Contributions	Organiser and Chair The foundation of the Mobile and Wireless Communications System for 2020 and beyond Challenges, Enablers and Technology Solutions
Organization Committee	METIS
Website	http://mwc2020.verkstad.net/

A.2 METIS-WWRF workshop at Future Network Mobile Summit 2013

The joint METIS-WWRF workshop was held at Future Network Mobile Summit 2013. The event comprised two sessions where the first session was organised and chaired by METIS and the second session was organised and chaired by WWRF. The workshop is titled as 'Research Challenges for 2020 in Communications.' Detailed information regarding this event is outlined in the table below.



Date	Jul. 3 – 5, 2013
Place	Lisbon, Portugal
Scope	The workshop addresses selected cross functional research challenges and their potential solutions in communication networks for 2020.
Contributions	Organiser and Chair Introduction & 5G Challenges: How the Future in 2020 will be like
Organization Committee	METIS (Session 1) and WWRF (Session 2)
Website	http://www.futurenetworksummit.eu/2013/default.asp?page=schedule-view&schedule.id=160&schedule.day.date=2013-07-03%2000:00:00.0&schedule.slot.time=14:30&schedule.event.pos=1&schedule.event.id=8008&schedule.day.pos=#slot2013-07-03%2000:00:00.0T14:30

A.3 Panel session at VTC 2013 Fall – The dawn of 5G

Detailed information regarding this event is outlined in the table below.

Date	Sep. 3, 2013
Place	Las Vegas, USA
Scope	Discussing the future direction of the communications industry among some of the large players
Contributions	Organiser Moderator
Organization Committee	METIS
Website	https://www.metis2020.com/press-events/vtc-2013-fall-5g-panel/

A.4 METIS and FuTURE Forum 5G Summit 2013

FuTURE Forum is a non-profitable international organization jointly initiated by 26 mobile telecommunication operators, mobile communication equipment manufacturers, research institutes, and universities from both outside and inside of China. The first active interaction was undertaken during the beginning 2013, where a METIS overview presentation was given at FuTURE Forum meeting, which highlights the METIS goals and METIS in general. Thereafter, the big 5G summit was jointly organised by METIS and FuTURE Forum attracting key industry players globally as well as regulatory bodies from EU and China sides. Detailed information regarding this event is outlined in the table below.



Date	Oct. 29 – 30, 2013
Place	Beijing, China
Scope	Exchange 5G Visions, Scenarios and Technology Components with relevant International Organizations and Forums
Contributions	Organiser and Chair European Commission views of 5G the METIS example METIS: Architectural challenges for 5G system Radio link concepts and Multi node multi antenna techniques in METIS
Organization Committee	METIS and FuTURE Forum
Website	https://www.metis2020.com/press-events/summit-on-5g-mobile-2013/

A.5 Networking Session and Exhibition at ICT 2013

The focus has been identified as Future Internet. The networking session organised and chaired by METIS highlighted the important scenarios and topics researched in the METIS project into 5G. The session is titled as ‘How the wireless future will look like? The 5G scenarios.’ Furthermore, as an example technology investigated within METIS, D2D communications was demonstrated comprising METIS D2D test-bed presentation. Detailed information regarding this event is outlined in the table below.

Date	Nov. 6 – 8, 2013
Place	Vilnius, Lithuania
Scope	Future Internet/5G Scenarios (Device-to-device (D2D) communications as example)
Contributions	Organiser and Chair Overview of METIS: Foundation of 5G How the wireless future will look like? The 5G scenarios D2Dcommunications: What is next? D2D communications: The METIS Test-bed at ICT-2013
Organization Committee	METIS
Website	http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=11545

A.6 METIS Workshop on Smart Grid requirements for 5G

METIS is organizing a workshop which aims to interact with energy sector and to share knowledge about current problems with communication technologies and future requirements on communication technologies in the energy sector. In addition, the purpose is to share the current state-of-the-art in 5G research and future evolution of communications technologies. Detailed information regarding this event is outlined in the table below.



Date	Jan. 17, 2014
Place	Brussels, Belgium
Scope	Interactions with vertical industry Knowledge exchange
Contributions	Organiser 5G requirements and scenarios MMC and URC related topics (being planned)
Organization Committee	METIS and FINESCE
Website	NA

A.7 METIS 2nd MWC 2020 at VTC 2014-Spring

METIS organised the second workshop MWC 2020 which was held in conjunction with VTC 2014-Spring. The workshop brought researchers and industry together to share their views on needs, possibilities and challenges in 5G communication systems. Around 100 participants were attracted from a wide range of branches, e.g., European Commission, China Mobile, Samsung, LG, 5G Forum, Korea Ministry of Science, ICT and Future Planning, various academic institutions, and METIS partners. Detailed information regarding this event is outlined in the table below.

Date	May 18, 2014
Place	Seoul, Korea
Scope	Possibilities and challenges in 5G communication systems Key enablers for 5G communications systems
Contributions	Organiser and Chair Technical Talks “Towards the METIS 5G Concept” and “Bending the Boundaries: METIS Research towards a Flexible 5G PHY”
Organization Committee	METIS , 5G Forum
Website	http://mwc2020.snu.ac.kr/

A.8 METIS Workshop on Enablers on the road to 5G at EuCNC 2014

METIS organised a workshop on 5G enablers together with some other EU FP7 projects, namely, COMBO, MiWaveS, iJoin and 5GNOW, which was held in conjunction with EuCNC 2014. The workshop presented the latest research in areas of interest for the development of 5G and gathered researchers working on 5G. Detailed information regarding this event is outlined in the table below.



Date	June 23 and June 26, 2014
Place	Bologna, Italy
Scope	5G Enablers on the Road to 5G
Contributions	Organiser and Chair Various technical talks "5G System concept," "5G Channel models," "Spectrum tools for 5G," "Multicarrier with filtering – A new waveform candidate for 5G," "Air interface on the Move: Tackling the challenges of future V2x communication," "Unified air interface design for dense deployments," "5G System architecture," "Future Fixed and Mobile Converged Network Architectures," "Utilization of context awareness," "Decentralized Coordinated Transceiver Design with Large Antenna Arrays," "5G architectures for small cells with wireless backhaul and two-way access," and "Dynamic clustering with multiple receive antennas in downlink CoMP systems."
Organization Committee	METIS , MiWaveS, iJoin, 5GNOW
Website	http://eucnc.eu/

A.9 METIS 5G Global Conference (5GGC)

METIS organised the 1st edition of 5GGC. The conference was well attended by a wide range of branches including industry, academia, EC representative, IMT-2020 promotion group China, ARIB Japan, and 5G Forum Korea. Detailed information regarding this event is outlined in the table below.



Date	Oct. 21 – 22, 2014
Place	Berlin, Germany
Scope	5G Insights, Ideas and Technical Research Activities
Contributions	<p>Organiser</p> <p>Various technical talks</p> <p>“The METIS 5G System concept,”</p> <p>“It’s all about the 5th G – or is it?,”</p> <p>“Trends and technologies for the networked society,”</p> <p>“5 ways of revolutionizing the G,”</p> <p>“Looking ahead to 5G,”</p> <p>“Evaluation of METIS 5G Network Level Solutions,”</p> <p>“The METIS 5G Architecture,”</p> <p>“Spectrum tools for 5G,”</p> <p>“5G Channel Modelling – Requirements, Recent Results, and Harmonization,”</p> <p>“Air interface design for dense deployment for 5G,”</p> <p>“Multi-service air interface,” and</p> <p>“FBMC for 5G air interface – METIS scenarios and testbeds,”</p> <p>“Modulation and access schemes for MMC,”</p> <p>“Combining eCIC with Coordinated Beamforming in Downlink Heterogeneous Networks,”</p> <p>“Energy Efficiency Optimization of Heterogeneous Networks,”</p> <p>“Research Towards Wireless Access Networking for 5G: Coping with the Curse of Energy Efficiency in Ultra-Dense,”</p> <p>“On the Coexistence of Utility Optimal and Legacy Power Control Schemes for Network Assisted Device-to-Device Communications,”</p> <p>“Radio link enablers for moving networks,”</p> <p>“Paradigm Shift towards Dynamic and Nomadic Wireless Networks,”</p> <p>“Interference Management for Moving Networks in Ultra-Dense Urban Scenarios,”</p> <p>“The Value of Inter-Node Cooperation in Ultra-Dense Networks,”</p> <p>“On the Pilot-Data Trade-Off with Block and Comb Type Arrangements in Massive MIMO Systems,”</p> <p>“Super High Bit Rate Massive MIMO Transmissions Using Higher Frequency Bands,”</p> <p>“Massive MIMO for Crowd Scenarios A Solution Based on Random Access,”</p> <p>“Massive MIMO challenges and solutions: Antennas, RF, Algorithms and Baseband Architecture.”</p>
Organization Committee	METIS
Website	http://5gglobalconference.com/



A.10 METIS 3rd MWC 2020 at VTC 2015-Spring

METIS has organised the third workshop MWC 2020 which will be held in conjunction with VTC 2015-Spring. The workshop is being prepared in the course of the writing of this deliverable. Nevertheless, the workshop is expected to follow the success of the previous ones.

Date	May 11, 2015
Place	Glasgow, UK
Scope	Requirements and Technical Enablers for 5G mobile and wireless networks
Contributions	Organiser and Chair Technical Talks are being planned in the course of the writing of this deliverable
Organization Committee	METIS , 5G Forum
Website	https://www.metis2020.com/event/3rd-mwc2020/



Annex B



B. Publications

In Annex B all publications are listed which have been produced within the project work by or in collaboration with METIS partners.

B.1 Conference papers

Table B.1: Workshop and conference papers.

Title	Author(s)	Event	Date
Spectrum Allocation for Multi-Operator Device-to-Device Communication	B. Cho, K. Koufos, R. Jäntti, Z. Li, M. A. Uusitalo	IEEE ICC 2015	2015-06-09
On the Impact of Antenna Correlation on the Pilot-Data Balance in Multiple Antenna Systems	G. Fodor, P. Di Marco, M. Telek	IEEE ICC 2015	2015-06-08
Increasing Coverage and Maximum CFO in DFT-s-OFDM for Machine-Type Communications	J. Lorca	IEEE ICC 2015	2015-06-08
Optimal Design of Energy-Efficient HetNets: Joint Precoding and Load Balancing	J. Li, E. Björnson, T. Svensson, T. Eriksson, M. Debbah	IEEE ICC 2015	2015-06-08
Mitigating Pilot Contamination by Pilot Reuse and Power Control Schemes in Massive MIMO Systems	V. Saxena, G. Fodor, E. Karipidis	IEEE VTC Spring 2015	2015-05-11
On the Sensitivity of SMT Systems to Oscillator Phase Noise over Doubly-Selective Channels	A. Ishaque, G. Ascheid	IEEE WCNC 2015	2015-03-09
Recent Advancements in M2M Communications in 4G Networks and Evolution Towards 5G	R. Ratasuk, A. Prasad, Z. Li, A. Ghosh, M. A. Uusitalo	18th International ICIN Conference 2015	2015-02-17
Compressed Sensing Neyman-Pearson Based Activity Detection for Sparse Multiuser Communications	F. Monsees, C. Bockelmann, A. Dekorsy	SCC 2015, Conference on Systems, Communications and Coding	2015-02-02
Compressed Sensing Based Multi-User Detection with Modified Sphere Detection in Machine-to-Machine Communications	Y. Ji, C. Bockelmann, A. Dekorsy	SCC 2015, Conference on Systems, Communications and Coding	2015-02-02
Power Efficient Scattered Pilot Channel Estimation for FBMC/OQAM	J. Bazzi, P. Weitkemper, K. Kusume	SCC 2015, Conference on Systems, Communications and Coding	2015-02-02
Uplink Contention Based SCMA for 5G Radio Access	K. Au, L. Zhang, H. Nikopour, E. Yi, A. Bayesteh, U. Vilaipornsawai, J. Ma, P. Zhu	Globecom 2014 (Workshop on Emerging Technologies for 5G Wireless Cellular Networks)	2014-12-08



Title	Author(s)	Event	Date
SCMA for Downlink Multiple Access of 5G Wireless Networks	H. Nikopour, E. Yi, A. Bayesteh, K. Au, M. Hawryluck, H. Baligh, J. Ma	Globecom 2014	2014-12-08
Massive MIMO for Crowd Scenarios: A Solution Based on Random Access	J. H. Sorensen, E. de Carvalho, P. Popovski	Globecom 2014 (Massive MIMO Workshop)	2014-12-08
Reliability Modeling and Analysis of a Wireless Transmission as a Repairable system	R. Sattiraju, P. Chakraborty, H. D. Schotten	Globecom 2014 Ultra2 Workshop	2014-12-08
D2D-based V2V Communications with Latency and Reliability Constraints	W. Sun, E. G. Ström, F. Brännström, Y. Sui, K. C. Sou	Globecom 2014 Ultra2 Workshop	2014-12-08
Towards Very Large Aperture Massive MIMO: a measurement based study	A. Oliveras Martinez, E. De Carvalho, J. Odum Nielsen	Globecom 2014 (Massive MIMO Workshop)	2014-12-08
Reliable Activity Detection for Massive Machine to Machine Communication via Multiple Measurement Vector Compressed Sensing	F. Monsees, C. Bockelmann, A. Dekorsy	Globecom 2014, BWA Workshop	2014-12-08
Practical Network-Channel Coding Schemes for Orthogonal Multiple Access Multiple-Relay Channel	A. Mohamad, R. Visoz, A. O. Berthet	Globecom workshop Emerging Technologies for 5G Wireless Cellular Networks (Wi5G)	2014-12-08
Performance Analysis of Network Assisted Two-Hop D2D Communications	J. M. B. da Silva, G. Fodor, T. F. Maciel	Globecom 2014 BWA WS	2014-12-08
METIS Research and Standardization - A path towards a 5G system	H. Tullberg, H. Droste, M. Fallgren, P. Fertl, D. Gozalvez-Serrano, E. Mohyeldin, O. Queseth, Y. Selén	Third IEEE workshop on Telecommunication Standards: From Research to Standards, Part of IEEE Globecom 2014	2014-12-08
Characterization of Coded Random Access with Compressive Sensing based Multi-User Detection	Y. Ji, C. Stefanovic, C. Bockelmann, A. Dekorsy, P. Popovski	Globecom 2014	2014-12-08
Load Estimation in LTE systems with the General Framework of Standard Interference Mappings	R.L.G. Cavalcante, E. Pollakis, S. Stanczak	GlobalSIP 2014	2014-12-03
PODWOJNA TRANSMISJA DWUKIERUNKOWA PRZEZ STACJE PRZEKAZNIKOWA	K. Ratajczak	National Symposium Telecommunications and Teleinformatics 2014	2014-11-27
MINIMALIZACJA INTERFERENCJI MIĘDZYKOMÓRKOWEJ W BEZPRZEWODOWEJ SIECI WIELOPOZIOMOWEJ PRZY UŻYCIU RÓWNOWAGI KORELACYJNEJ	P. Sroka	National Symposium Telecommunications and Teleinformatics 2014	2014-11-27



Title	Author(s)	Event	Date
Overview on initial METIS D2D Concept	Z. Li, M. Moiso, M. A. Uusitalo, P. Lundén, C. Wijting, F. Sanchez Moya, A.Yaver, V. Venkatasubramanian	5GU Conference (“1st International Conference on 5G for Ubiquitous Connectivity”)	2014-11-26
On the Flexible 5G Dense Deployment Air Interface for Mobile Broadband	E. Lähetkangas, K. Pajukoski, J. Vihriälä, E. Tirola	5GU Conference (“1st International Conference on 5G for Ubiquitous Connectivity”)	2014-11-26
Performance Analysis of Block and Comb Type Channel Estimation for Massive MIMO Systems	G. Fodor, P. Di Marco, M.Telek	5GU Conference (“1st International Conference on 5G for Ubiquitous Connectivity”)	2014-11-26
On the Deployment of Moving Networks in Ultra-dense Urban Scenarios	Y. Sui, I. Guvency, T. Svensson	5GU Conference (“1st International Conference on 5G for Ubiquitous Connectivity”)	2014-11-26
Ultra-Reliable Communication in 5G Wireless Systems	P. Popovski	5GU Conference (“1st International Conference on 5G for Ubiquitous Connectivity”)	2014-11-26
Elevation Analysis for Urban Microcell Outdoor Measurements at 2.3 GHz	A. Roivainen, V. Hovinen, J. Meinilä, N. Tervo, M. Sonkki, C. Dias	5GU Conference (“1st International Conference on 5G for Ubiquitous Connectivity”)	2014-11-26
One-shot games for spectrum sharing among co-located radio access networks	S. Hailu, A. Dowhuszko, O. Tirkkonen, L. Wei	IEEE ICCS 2014	2014-11-19
Co-primary inter-operator spectrum sharing using repeated games	B. Singh, K. Koufos, O. Tirkkonen	IEEE ICCS 2014	2014-11-19
Hardware prototyping of FBMC/OQAM baseband for 5G mobile communication	J. Nadal, C. A. Nour, A. Baghdadi, H. Lin	IEEE International Symposium on Rapid System Prototyping (RSP), 2014	2014-10-16
Hierarchical Precoding for Ultra-Dense Heterogeneous Networks	L. Thiele, M. Kurras	Asilomar 2014	2014-09-25
Cross-Device Signaling Channel for Cellular Machine-Type Services	C. Zhou, E. Schulz	VTC 2014 Fall	2014-09-14
SCMA Codebook Design	M. Taherzadeh, H. Nikopour, A. Bayesteh, H. Baligh	VTC 2014 Fall	2014-09-14
A spatially consistent radio channel model enabling dual mobility	V. Nurmela, P. Kyösti	VTC 2014 Fall	2014-09-14
Joint Fixed Beamforming and Eigenmode Precoding for Super High Bit Rate Massive MIMO Systems Using Higher Frequency Bands	T. Obara, S. Suyama, J. Shen, Y. Okumura	IEEE PIMRC 2014	2014-09-02



Title	Author(s)	Event	Date
On the Performance Gain of Flexible UL/DL TDD with Centralized and Decentralized Resource Allocation in Dense 5G Deployments	V. Venkatasubramanian, M. Hesse, P. Marsch, M. Maternia	IEEE PIMRC 2014	2014-09-02
Vehicle-to-Vehicle Radio Channel Characterization in Urban Environment at 2.3GHz and 5.25GHz	A. Roivainen, P. Jayasinghe, J. Meinila, V. Hovinen, M. Latva-aho	PIMRC 2014	2014-09-02
Widely Linear Receivers for SMT Systems with TX/RX Frequency-Selective I/Q Imbalance	A. Ishaque, G. Ascheid	PIMRC 2014	2014-09-02
Robust Linear Precoder for Coordinated Multipoint Joint Transmission Under Limited Backhaul With Imperfect Channel State Information	R. Apelfröjd, M. Sternad	ISWCS 2014	2014-08-26
A Simplified Scattered Pilot for FBMC/OQAM in Highly Frequency Selective Channels	Z. Zhao, N. Vucic, M. Schellmann	ISWCS 2014	2014-08-26
Energy Savings in Heterogeneous Networks with Clustered Small Cell Deployments	E. Ternon, P. Agyapong, L. Hu, A. Dekorsy	ISWCS 2014	2014-08-26
Spectral Shaping for Faster-Than-Nyquist Signaling	M. El Hefnawy, G. Dietl, G. Kramer	ISWCS 2014	2014-08-26
Optimized Mobile Connectivity for Bandwidth-Hungry, Delay-Tolerant Cloud Services toward 5G	O. N. C. Yilmaz, C. Wijting, P. Lundén, J. Hämäläinen	ISWCS 2014	2014-08-26
An efficient RAT selection mechanism for 5G cellular networks	A. Kaloxylos, S. Barbounakis, P. Spapis, N. Alonistioti	IWCMC 2014	2014-08-04
Net Degrees of Freedom of Decomposition Schemes for the MIMO IC with Delayed CSIT	Y. Lejosne, D. Slock, YiYuan-Wu	ISIT 2014	2014-07-29
A Context-Aware, User-Oriented RAT Selection Mechanism in Heterogeneous Wireless Networks	S. Barmounakis, P. Spapis, N. Alonistioti, A. Kaloxylos	MOBILITY 2014 conference	2014-07-20
Emulating wired backhaul with wireless network coding	H. Thomsen, E. de Carvalho, P. Popovski	General Assembly and Scientific Symposium (URSI GASS), 2014 XXXIth URSI	2014-07-06
Interference Aware Massive SDMA with a Large Uniform Rectangular Antenna Array	M. Kurras, L. Thiele, T. Haustein	EuCNC 2014	2014-06-23
Near-Optimal Practical Power Control Schemes for D2D Communications in Cellular Networks	A. Pradini, G. Fodor, G. Miao, M. Belleschi	EuCNC 2014	2014-06-23
Availability Indication as Key Enabler for Ultra Reliable Communication in 5G	H. D. Schotten, R. Sattiraju, D. Gozalvez Serreno, Z. Ren, P. Fertl	EuCNC 2014	2014-06-23
Coordination protocol for inter-operator spectrum sharing based on spectrum usage favors	B. Singh, K. Koufos, O. Tirkkonen	EuCNC 2014	2014-06-23



Title	Author(s)	Event	Date
Full Duplex Device-to-Device Communication in Cellular Networks	S. Ali, N. Rajatheva, M. Latva-aho	EuCNC 2014	2014-06-23
Rethinking the Mobile and Wireless Network Architecture: The METIS Research into 5G	J. F. Monserrat, H. Droste, Ö. Bulakci, J. Eichinger, O. Queseth, M. Stamatelatos, H. Tullberg, V. Venkatkumar, G. Zimmermann, U. Dötsch, A. Osseiran	EuCNC 2014	2014-06-23
On the Performance of Decentralized Cell Edge Coordinated Scheduling in Small Cell Clusters with Different Densities	O. Anjum, C. Wijting, M. A. Uusitalo, and K. Valkealahti	EuCNC 2014	2014-06-23
Towards the METIS 5G Concept - First view on Horizontal Topics Concepts	H. Tullberg, Z. Li, A. Höglund, P. Fertl, D. Gozalvez-Serrano, K. Pawlak, P. Popovski, G. Mange, Ö. Bulakci	EuCNC 2014	2014-06-23
Distributed Interference Mitigation in Two-Tier Wireless Networks Using Correlated Equilibrium and Regret-Matching Learning	P. Sroka, A. Kliks	EuCNC 2014	2014-06-23
Performance Analysis of Network Coding Schemes in Network Assisted D2D Communications	A. Pradini, G. Fodor	EuCNC 2014	2014-06-23
Waveform optimization for oversampled transmultiplexers in the presence of time-offset	D. Pinchon, P. Siohan, F. Labeau	IEEE SPAWC 2014	2014-06-22
System Capacity Optimization Algorithm for D2D Underlay Operation	J. Lianghai, A. Klein, N. Kuruvatti, H. D. Schotten	ICC workshop on 5G Technologies	2014-06-14
Comparison of network coding and MU-MIMO for two way relaying in IMT-Advanced channel model (title translated from Polish)	K. Bakowski, K. Ratajczak	KKRRIT 2014	2014-06-11
Underlay of Low-Rate Machine-Type D2D Links on Downlink Cellular Links	N. Pratas, P. Popovski	ICC 2014 IoT WS	2014-06-10
MMSE Interference Estimation in LTE Networks	F. Penna, S. Stanczak, Z. Ren, P. Fertl	IEEE ICC 2014	2014-06-10
Energy-Aware Activation of Nomadic Relays for Performance Enhancement in Cellular Networks	Z. Ren, S. Stanczak, P. Fertl, F. Penna	IEEE ICC 2014	2014-06-10
Achieving low latency and energy consumption by 5G TDD mode optimization	E. Lähetkangas, K. Pajukoski, J. Vihriälä, G. Berardinelli, M. Lauridsen, E. Tiirola, P. Mogensen	IEEE ICC 2014	2014-06-10
Decentralizing the Optimal Multi-cell Beamforming via Large System Analysis	H. Asgharimoghaddam, A. Tolli, N. Rajatheva	IEEE ICC 2014	2014-06-10
Linear and Non-linear Transceiver Processing for MIMO-FBMC Systems	M. Soysa, N. Rajatheva, M. Latva-aho	IEEE ICC 2014	2014-06-10
Delayed Channel State Information: Incremental Redundancy with Backtrack Retransmission	P. Popovski	IEEE ICC 2014	2014-06-10



Title	Author(s)	Event	Date
Uplink Power Control with MMSE Receiver in Multi-Cell MU-Massive-MIMO Systems	K. Guo, Y. Guo, G. Fodor, G. Ascheid	IEEE ICC 2014	2014-06-10
Frequency Allocation in Non-Coherent Joint Transmission CoMP Networks	T. Rajesh Lakshmana, B. Makki, T. Svensson	ICC'2014 Workshop	2014-06-10
Interference Constrained Device-to-Device Communications	S. Shalmashi, S. Ben Slimane	IEEE ICC 2014	2014-06-10
FBMC-based air interface for 5G Mobile: Challenges and proposed solutions	M. Schellmann, Z. Zhao, H. Lin, P. Siohan, N. Rajatheva, V. Luecken, A. Ishaque	Crown Com 2014	2014-06-02
Distributed Power Allocation in Cognitive Radio Networks under Network Power Constraint	F. Ahmed, O. Tirkkonen, A. A. Dowhuszko, M. Juntti	Crown Com 2014	2014-06-02
Achievable Performance Gains Using Movement Prediction and Advanced 3D System Modeling	A. Klein, Al. Rauch, N. P. Kuruvatti, H. D. Schotten	VTC-Spring workshop on "5G Mobile and Wireless Communication System for 2020 and Beyond"	2014-05-18
Dynamic Context-aware Optimization of D2D Communications	J. Lianghai, A. Klein, N. Kuruvatti, R. Sattiraju, H. D. Schotten	VTC-Spring workshop on "5G Mobile and Wireless Communication System for 2020 and Beyond"	2014-05-18
Reliability Modeling, Analysis and Prediction of Wireless Mobile Communications	R. Sattiraju, H. D. Schotten	VTC-Spring workshop on "5G Mobile and Wireless Communication System for 2020 and Beyond"	2014-05-18
Multi User Inter Cell Interference Alignment in Heterogeneous Cellular Networks	D. Aziz, M. Mazhar, A. Weber	VTC 2014 Spring	2014-05-18
Spectrum Requirement for Vehicle-to-Vehicle Communication for Traffic Safety	L. Shi, K. W. Sung	VTC 2014 Spring	2014-05-18
IRA Code Design for Iterative Detection and Decoding: A Setpoint-based Approach	F. Lenkeit, C. Bockelmann, D. W'ubben, A. Dekorsy	VTC 2014-Spring	2014-05-18
Clustering Schemes for D2D Communications Under Partial/No Network Coverage	L. Qianxi, M. Qingyu, G. Fodor, N. Brahmi	VTC 2014-Spring	2014-05-18
Waveform contenders for 5G – suitability for short packet and low latency transmissions	F. Schaich, T. Wild, Y. Chen	VTC 2014 Spring	2014-05-18
Dynamic Nomadic Node Selection for Performance Enhancement in Composite Fading/Shadowing Environments	Ö. Bulakci, Z. Ren, C. Zhou, J. Eichinger, P. Fertl, S. Stanczak	VTC 2014-Spring	2014-05-18
Bending the Boundaries: METIS Research towards a Flexible 5G PHY	M. Schellmann, Ö. Bulakci	MWC 2020 (at VTC 2014-Spring)	2014-05-18



Title	Author(s)	Event	Date
Performance of Asymmetric QPSK Modulation for Multi-Level ACK/NACK in LTE Uplink	V. Braun, U. Doetsch, A. Zimaliev, M. Bonomo, L. Vangelista	European Wireless (EW) 2014	2014-05-14
Precoding and Receiver Processing for Multiple Access MIMO FBMC Systems	M. Soysa, N. Rajatheva, M. Latva-aho	European Wireless (EW) 2014	2014-05-14
On Applying Network Coding in Network Assisted D2D Communications	G. Fodor, A. Pradini, A. Gattami	European Wireless (EW) 2014	2014-05-14
On the Pilot-Data Power Trade-Off in Single Input Multiple Output Systems	G. Fodor, M. Telek	European Wireless (EW) 2014	2014-05-14
Coordinated Distributed Precoding in Multicell Multiantenna Systems With Data Sharing	Y. Long, N. Vucic, M. Schubert	European Wireless (EW) 2014	2014-05-14
Coordinated Random Access Management for Network Overload Avoidance in Cellular Machine-to-Machine Communications	Y. Chang, C. Zhou, Ö. Bulakci	European Wireless (EW) 2014	2014-05-14
Resource Allocation for Network-assisted Device-to-Device Discovery	L. Hu	Wireless VITAE 2014	2014-05-11
An advanced multi-carrier modulation for future radio systems	H. Lin, P. Siohan	IEEE ICASSP 2014	2014-05-04
Location Dependent Resource Allocation for Mobile Device-to-Device Communications	M. Botsov, M. Klügel, W. Kellerer, P. Fertl	WCNC 2014	2014-04-06
Two-way Relaying for 5G Systems Comparison of Network Coding and MIMO Techniques	K. Ratajczak, K. Bakowski, K. Wesolowski	WCNC 2014	2014-04-06
Cooperative Device-to-Device Communications in the Downlink of Cellular Networks	S. Shalmashi, S. Ben Slimane	IEEE WCNC 2014	2014-04-06
Sum-Rate Analysis for Full-Duplex Underlay Device-to-Device Networks	K. T. Hemachandra, N. Rajatheva, M. Latva-aho	IEEE WCNC 2014	2014-04-06
Impact of Spectrum Sharing on the Efficiency of Faster-Than-Nyquist Signaling	M. El Hefnawy, G. Kramer	IEEE WCNC 2014	2014-04-06
Database-aided Energy Savings in Next Generation Dual Connectivity Heterogeneous Networks	E. Ternon, P. Agyapong, L. Hu, A. Dekorsy	IEEE WCNC 2014	2014-04-06
Smart mobility management for D2D communications in 5G networks	O. N. C. Yilmaz, Z. Li, K. Valkealahti, M. A. Uusitalo, M. Moio, P. Lundén, C. Wijting	WCNC 2014	2014-04-06
DFT based spatial multiplexing and maximum ratio transmission for mm-wave large MIMO	D.-T. Phan-Huy, A. Tölli, N. Rajatheva, E. de Carvalho	WCNC 2014	2014-04-06
DFT based spatial multiplexing and maximum ratio transmission for mm-wave large MIMO	D.-T. Phan Huy, A. Tölli, N. Rajatheva, E. De Carvalho	WCNC 2014	2014-04-06



Title	Author(s)	Event	Date
Channel Modelling for the Fifth Generation Mobile Communications	J. Medbo, K. Börner, K. Haneda, V. Hovinen, T. Imai, J. Järveläinen, T. Jämsä, A. Karttunen, K. Kusume, J. Kyröläinen, P. Kyösti, J. Meinilä, V. Nurmela, L. Raschkowski A. Roivainen, J. Ylitalo	EuCAP 2014	2014-04-06
On the Sharing Opportunities of Ultra-Dense Networks in the Radar Bands	E. Obregon, K. W. Sung, J. Zander	IEEE DySPAN 2014	2014-04-01
Multi-Carrier Waveform Based Flexible Inter-Operator Spectrum Sharing for 5G Systems	J. Luo, J. Eichinger, Z. Zhao, E. Schulz	IEEE DySPAN 2014	2014-04-01
Super High Bit Rate Radio Access Technologies for Small Cells Using Higher Frequency Bands	S. Suyama, J. Shen, A. Benjebbour, Y. Kishiyama, Y. Okumura	IEEE International Microwave Symposium 2014	2014-03-06
System-Level Performance of Downlink NOMA for Future LTE Enhancements	A. Benjebbour, A. Li, Y. Saito, Y. Kishiyama, A. Harada, T. Nakamura	Globecom 2013	2013-12-09
Distributed Clock Synchronization with application of D2D Communication without Infrastructure	W. Sun, M.-R. Gholami, E. G. Ström, F. Brännström	Globecom 2013	2013-12-09
A Reduced Complexity Receiver for Multi-Carrier Faster-Than-Nyquist Signaling	F. Schaich, T. Wild	Globecom 2013	2013-12-09
IRA Code Design for IDMA-based Multi-Pair Bidirectional Relaying Systems	F. Lenkeit, C. Bockelmann, D. Wübben, A. Dekorsy	Globecom 2013	2013-12-09
Fuzzy Q-Learning for Mobility Robustness Optimization in Wireless Networks	A. Klein, N. P. Kuruvatti, J. Schneider, H. D. Schotten	Globecom 2013	2013-12-09
Exploiting Diurnal User Mobility for Predicting Cell Transitions	N. P. Kuruvatti, A. Klein, J. Schneider, H. D. Schotten	Globecom 2013	2013-12-09
Uplink Enhancement of Vehicular Users by Using D2D Communications	Y. Sui, T. Svensson	Globecom 2013	2013-12-09
Interference Alignment via Adaptively Controlled Perturbations	H. Ghauch, T. Kim, M. Bengtsson, M. Skoglund	Globecom 2013	2013-12-09
Optimal Predictive Resource Allocation: Exploiting Mobility Patterns and Radio Maps	H. Abou-zeid, H. S. Hassanein, S. Valentin	Globecom 2013	2013-12-09
Adaptive Large MISO Downlink with Predictor Antennas Array for very fast moving vehicles	D.-T. Phan-Huy, M. Sternad, T. Svensson	ICCVE 2013 (International Conference on Connected Vehicles & Expo)	2013-12-02
Performance Study of Fixed and Moving Relays for Vehicular Users with Multi-cell Handover under Co-channel Interference	Y. Sui, Z. Ren, W. Sun, T. Svensson, P. Fertl	2nd International Conference on Connected Vehicles & Expo, ICCVE 2013, Las Vegas, USA, December 2-6	2013-12-02



Title	Author(s)	Event	Date
Concept and Practical Considerations of Non-orthogonal Multiple Access (NOMA) for Future Radio Access	A. Benjebbour, Y. Saito, Y. Kishiyama, A. Li, A. Harada, T. Nakamura	ISPACS 2013	2013-11-12
A System-Level Study on Multi-User MIMO Transmission for Dense FDD Networks	L. Thiele, M. Kurras, K. Börner, T. Haustein	Asilomar 2013	2013-11-05
Toward capacity efficient, cost efficient and power efficient deployment strategy for indoor mobile broadband	A. Awadelkarim Widaa Ahmed, J. Markendahl, A. Ghanbari	24th ITS European Regional Conference	2013-10-20
Business models and Investment options for use of Licensed Shared Access of Spectrum	J. Markendahl, A. Widda, B. G. Molleryd	24th ITS European Regional Conference	2013-10-20
Investment Strategies for Different Actors in Indoor Mobile Market in View of the Emerging Spectrum Authorization Schemes	A. Widaa, J. Markendahl, A. Ghanbari	24th ITS European Regional Conference	2013-10-20
Secondary Access to the Radar Spectrum Bands: Regulatory and Business Implications	E. Obregon, K. W. Sung, J. Zander	24th ITS European Regional Conference	2013-10-20
The Validity of Unlicensed Spectrum for Future Local High-capacity Services	D. H. Kang, K. W. Sung, J. Zander	24th ITS European Regional Conference	2013-10-20
Channel Modelling for Device-to-Device Scenarios	V. Nurmela, T. Jämsä, P. Kyösti, V. Hovinen, J. Medbo	COST IC1004	2013-09-26
METIS Propagation Scenarios	T. Jämsä, P. Kyösti, H. Taoka, V. Nurmela, V. Hovinen, J. Medbo	COST IC1004	2013-09-26
Clustering with multiple receiving antennas in downlink FDD CoMP systems	P. Baracca, F. Boccardi, N. Benvenuto	ISPC 2013	2013-09-26
Inter-Cell Interference-Coordination for Distributed MIMO-Systems based on Wideband Precoder Selection	J. Dommel, M. Kurras, L. Thiele	Africon 2013	2013-09-09
Massive SDMA with Large Scale Antenna Systems in a Multi-Cell Environment	M. Kurras, L. Raschkowski, M. Talaat, L. Thiele	Africon 2013	2013-09-09
Derivation of analytical expressions for flexible PR lowcomplexity FBMC systems	D. Pinchon, P. Siohan	EUSIPCO-2013 (European Signal Processing Conference), September 9-13, Marrakech, Morocco	2013-09-09
System-Level Performance Evaluation of Downlink Non-orthogonal Multiple Access (NOMA)	Y. Saito, A. Benjebbour, Y. Kishiyama, T. Nakamura	PIMRC 2013	2013-09-08
Outage Analysis of Various Cooperative Strategies for the Multiple Access Multiple Relay Channel	A. Mohamad, R. Visoz, A. O. Berthet	PIMRC 2013	2013-09-08
Optimal Feedback Updating Period for Coordinated Multi-Point Transmission Schemes	A. Osmane, H. Khanfir	PIMRC 2013	2013-09-08



Title	Author(s)	Event	Date
Virtual Full-Duplex Buffer-Aided Relaying - Relay Selection and Beamforming	S. M. Kim, M. Bengtsson	PIMRC 2013	2013-09-08
Performance of Coarse Relay Site Planning in Composite Fading/Shadowing Environments	Ö. Bulakci, J. Hämäläinen, E. Schulz	PIMRC 2013	2013-09-08
I/Q Imbalance and CFO in OFDM/OQAM Systems: Interference Analysis and Compensation	A. Ishaque, G. Ascheid	PIMRC 2013	2013-09-08
MIMO Physical Layer Network Coding based Underlay Device-to-Device Communication	L. K. S. Jayasinghe, P. Jayasinghe, N. Rajatheva, M. Latva-aho	PIMRC 2013	2013-09-08
On the Performance of EVD-Based Channel Estimations in MU-Massive-MIMO Systems	K. Guo, Y. Guo, G. Ascheid	PIMRC 2013	2013-09-08
Evaluation of Spectrum Access Options for Indoor Mobile Network Deployment	A. Awadelkarim Widaa Ahmed, J. Markendahl, A. Ghanbari	PIMRC 2013	2013-09-08
Spectrum Sharing Scenarios and Resulting Technical Requirements for 5G Systems	T. Irnich, J. Kronander, Y. Selén, G. Li	PIMRC 2013	2013-09-08
Joint routing and resource allocation for wireless self-backhaul in an indoor ultra-dense network	D. Hui, J. Axnäs	PIMRC 2013	2013-09-08
The Energy Efficiency Potential of Moving and Fixed Relays for Vehicular Users	Y. Sui, A. Papadogiannis, W. Yang, T. Svensson	VTC Fall 2013	2013-09-02
Performance Enhancement of Multiuser Multi Cell Interference Alignment with Pair Selection	D. Aziz, M. Mazhar, A. Weber	VTC Fall 2013	2013-09-02
Improving Group Orthogonal Matching Pursuit Performance with Iterative Feedback	H. F. Schepker, C. Bockelmann, A. Dekorsy	VTC Fall 2013	2013-09-02
Exploiting Sparsity in Channel and Data Estimation for Sporadic Multi-User Communication	A. Dekorsy, C. Bockelmann, H. Schepker	ISWCS 2013	2013-08-27
On the TDD Subframe Structure for Beyond 4G Radio Access Network	E. Lähetkangas, K. Pajukoski, E. Tiirola, G. Berardinelli, I. Harjula, J. Vihriälä	FuNeMS 2013	2013-07-03
Hardware Impairments in Large-scale MISO Systems: Energy Efficiency, Estimation, and Capacity Limits	E. Björnson, J. Hoydis, M. Kountouris, M. Debbah	Special Session on Signal Processing and Optimization for Green Energy and Green Communications DSP 2013	2013-07-01
Context-Aware Handover Optimization for Relay-Aided Vehicular Terminals	Q. Liao, F. Penna, S. Stanczak, Z. Ren, P. Fertl	SPAWC 2013	2013-06-16
Joint Activity and Data Detection for Machine to Machine Communication via Bayes Risk Optimization	F. Monsees, C. Bockelmann, A. Dekorsy	SPAWC 2013	2013-06-16



Title	Author(s)	Event	Date
MIMO Four-Way Relaying	H. Liu, F. Sun, E. de Carvalho, P. Popovski, H. Thomsen, Y. Zhao	SPAWC 2013	2013-06-16
A Comparative Study of Power Control Approaches for Device-to-Device Communications	G. Fodor, D. D. Penda, M. Belleschi, M. Johansson, A. Abrardo	ICC 2013	2013-06-09
On Clock Offset and Skew Estimation with Exponentially Distributed Delays	W. Sun, F. Brännström, E. G. Ström	ICC 2013	2013-06-09
Wireless Four-Way Relaying using Physical Layer Network Coding with Nested Lattices	H. Liu, E. de Carvalho, P. Popovski, Yuping Zhao	ICC 2013	2013-06-09
Application of a Leakage Based Precoding Scheme to Mitigate Intrinsic Interference in FBMC	U. Jayasinghe, N. Rajatheva, M. Latva-aho	ICC 2013	2013-06-09
On the Impact of Backhaul Channel Reliability on Cooperative Wireless Networks	Z. Mayer, J. Li, A. Papadogiannis, T. Svensson	ICC 2013	2013-06-09
Massive MIMO and Small Cells: How to Densify Heterogeneous Networks	K. Hosseini, J. Hoydis, S. ten Brink, M. Debbah	ICC 2013	2013-06-09
Non-Orthogonal Multiple Access (NOMA) for Future Radio Access	Y. Saito, Y. Kishiyama, A. Benjebbour, T. Nakamura, A. Li, K. Higuchi	VTC Spring 2013	2013-06-02
Overview of Faster-Than-Nyquist for Future Mobile Communication Systems	M. El Hefnawy, H. Taoka	VTC Spring 2013	2013-06-02
Street-Specific Handover Optimization for Vehicular Terminals in Future Cellular Networks	Z. Ren, P. Fertl, Q. Liao, F. Penna, S. Stanczak	VTC Spring 2013	2013-06-02
The foundation of the Mobile and Wireless Communications System for 2020 and beyond Challenges, Enablers and Technology Solutions	A. Osseiran, V. Braun, T. Hidekazu, P. Marsch, H. Schotten, H. Tullberg, M. A. Uusitalo, M. Schellman	VTC Spring 2013	2013-06-02
Complexity Reduction Strategy for RAID in Multi-User Relay Systems	F. Lenkeit, D. Wübben, A. Dekorsy	VTC Spring 2013	2013-06-02
On Feedback Requirements for CoMP Joint Transmission in the Quasi-Static User Regime	L. Thiele, M. Kurras, M. Olbrich, K. Börner	VTC spring 2013	2013-06-02
Space Time Interference Alignment Scheme for the MISO BC and IS with Delayed CSIT and Finite Coherence Time	Y. Lejosne, D. Slock, Y. Yuan-Wu	ICASSP 2013	2013-05-26
METIS: Mobile Communications for 2020 and beyond	N. Brahmi	VDE/ITG Fachtagung Mobilkommunikation	2013-05-15
Flexible scalable solutions for dense small cell networks	T. Ihalainen, P. Jänis, Z. Li, P. Lunden, M. Moision, V. Nurmela, M. A. Uusitalo, C. Wijting, O. N.C. Yilmaz	WWRF 30	2013-04-23
Net Degrees of Freedom of Recent Schemes for the MISO BC with Delayed CSIT and Finite Coherence Time	Y. Lejosne, D. Slock, Y. Yuan-Wu	WCNC 2013	2013-04-07



Title	Author(s)	Event	Date
Power Allocation for Multi-Point Joint Transmission with Different Node Activeness	J. Li, B. Makki, T. Svensson, T. Eriksson	WCNC 2013	2013-04-07
Scheduling for Backhaul Load Reduction in CoMP	T. R. Lakshmana, J. Li, C. Botella, A. Papadogiannis, T. Svensson	WCNC 2013	2013-04-07
Power Control Based Semi-Distributed Algorithm for MIMO Interference Channel	S. Ben Halima, A. Saadani	WCNC 2013	2013-04-07
Outage Achievable Rate Analysis for the Non Orthogonal Multiple Access Multiple Relay Channel	A. Mohamad, R. Visoz, A. O. Berthet	WCNC 2013	2013-04-07

B.2 Journal papers

Table B.2: Journal papers.

Title	Author(s)	Journal	Year
METIS Research Advances towards the 5G Mobile and Wireless System Definition	J. F. Monserrat, G. Mange, V. Braun, H. Tullberg, G. Zimmermann, O. Bulakci	EURASIP Journal on Wireless Communications and Networking	2015
MultiCarrier Modulation Analysis and WCP-COQAM	H. Lin, P. Siohan	EURASIP journal	2015
Device-to-Device Communications for National Security and Public Safety	G. Fodor, S. Parkvall, Qianxi Lu, N. Brahmi	IEEE Access	2015
Distributed Low Overhead Schemes for mutli-stream MIMO interference channels	H. Ghauch, T. Kim, M. Bengtsson, M. Skoglund	IEEE Transactions on Signal Processing (accepted for publication)	2015
Benchmarking Practical RRM Algorithms for D2D Communications in LTE Advanced	M. Belleschi, G. Fodor, D. D. Penda, A. Pradini, M. Johansson	Wireless Personal Communications (Springer)	2015
Interference Management for Moving Networks in Ultra-Dense Urban Scenarios	Y. Sui, I. Guvenc, T. Svensson	EURASIP Journal on Wireless Communications and Networking Special Issue on 5G Wireless Mobile Technologies (Submitted)	2015
Scenarios for 5G Mobile and Wireless Communications: The Vision of the METIS Project	A. Osseiran, F. Boccardi, V. Braun, K. Kusume, P. Marsch, M. Maternia, O. Queseth, M. Schellmann, H. Schotten, H. Taoka, H. Tullberg, M. A. Uusitalo, B. Timus, M. Fallgren	IEEE Comm. Mag., Special Issue on 5G	2015



Title	Author(s)	Journal	Year
Towards spectrum sharing: opportunities and technical enablers	K. Chatzikokolakis, P. Spapis, N. Alonistioti, A. Kaloylos	Submitted to IEEE Communication Magazine	2015
On the impact of control channel reliability on coordinated multi-point transmission	Z. Mayer, J. Li, A. Papadogiannis, T. Svensson	EURASIP Journal on Wireless communications and Networking	2015
Building a New Multi-Facial Architecture of 5G	J. Eichinger, Ö. Bulakci, G. Zimmermann, P. Marsch, H. Tullberg	IEEE MMTC E-Letter	2014
Using Wireless Network Coding to Replace a Wired with Wireless Backhaul	H. Thomsen, E. de Carvalho, P. Popovski	IEEE Wireless Communication Letters	2014
Multi-functional MIMO Communication in Multi-hop Cellular Systems	S. Roger, D. Calabuig, J. F. Monserrat and N. Cardona	EURASIP Journal on Advances in Signal Processing, 2014:165, 1-9	2014
Practical Coarse Relay Site Planning: Performance Analysis over Composite Fading/Shadowing Channels	Ö. Bulakci, J. Hämäläinen, E. Schulz	Springer International Journal of Wireless Information Networks	2014
A dynamic clustering algorithm for downlink CoMP systems with multiple antenna UEs	P. Baracca, F. Boccardi, N. Benvenuto	EURASIP Journal on Wireless Communications and Networking, 2014:125, 1-14	2014
Multi-user Non-coherent Detection for Downlink MIMO Communication	Sandra Roger, Daniel Calabuig, Jorge Cabrejas, and Jose F. Monserrat	IEEE Signal Processing Letters, Vol 21, Issue 10, 1225-1229	2014
Achieving Full Sum DoF in the SISO Interference Channel with Feedback Delay	Y. Lejosne, D. Slock, Y. Yuan-Wu	IEEE Communications Letter	2014
Non-coherent MIMO Communication for the 5th Generation Mobile: Overview and Practical Aspects	S. Roger, J. Cabrejas, D. Calabuig, J. F. Monserrat, Y. Fouad, R. H. Gohary, H. Yanikomeroglu	Waves Journal, Vol 6	2014
Impact of time and carrier offsets on FBMC/OQAM modulation scheme	H. Lin, M. Gharba, P. Siohan	Signal Processing	2014
The role of small cells, coordinated multi-point and massive MIMO in 5G	Volker Jungnickel, Konstantinos Manolakis, Wolfgang Zirwas, Berthold Panzner, Mikael Sternad, Tommy Svensson	IEEE Communications Magazine, May 2014.	2014
Towards Energy-Efficient 5G Wireless Communications Technologies	R.L.G. Cavalcante, S. Stanczak, M. Schubert, A. Eisenblätter, U. Türke	IEEE Signal Processing Magazine, Vol 31, Issue: 6, 24-34	2014
Device-to-Device Communications and Network Coding: Friends or Foes?	G. Fodor, A. Gattami and A. Pradini	IEEE 2014, MTC Letter	2014



Title	Author(s)	Journal	Year
Analysis of the LTE Access Reservation Protocol for Real-Time Traffic	Henning Thomsen, Nuno K. Pratas, Cedimir Stefanovic and Petar Popovski	IEEE Communication Letters, Vol 17, Issue: 8, 1616 - 1619	2013
Diversity-Multiplexing Trade-off for Coordinated Direct and Relay Schemes	Chan Dai Truyen Thai, Petar Popovski, Elisabeth de Carvalho and Fan Sun	IEEE Transactions on Wireless Communications, Vol 12, 7, 3289 - 3299	2013

B.3 Book chapters

Table B.3: Book chapters.

Title	Author(s)	Event	Year
Random access procedures and radio access network (RAN) overload control in standard and advanced long-term evolution (LTE and LTE-A) networks	Nuno K. Pratas, Henning Thomsen, Petar Popovski	Machine-to-machine (M2M) communications, architecture, performance and applications Editors: Carles Antón-Haro, Mischa Dohler, Published by: Woodhead Publishing	2015
Network Assisted D2D Communications: Use Cases, Design Approaches and Performance Aspects	G. Fodor, S. Sorrentino, S. Sultana	Book chapter in Smart Device to Smart Device Communication (Springer)	2014
Simulation Tools for the Evaluation of Radio Interface Technologies for IMT-Advanced and Beyond	Krzysztof Bakowski, Krzysztof Wesolowski, Marcin Rodziejwicz	Simulation Technologies in Networking and Communications: Selecting the Best Tool for the Test Editors: Al-Sakib Khan Pathan, Muhammad Mostafa Monowar, and Shafiullah Khan To be published by: CRC Press, Taylor & Francis Group, USA	2014

B.4 Press releases

Table B.4: Press releases.

Header	Link	Date
The 5G future scenarios identified by METIS	https://www.metis2020.com/press-events/press/the-5g-future-scenarios-identified-by-metis/	2013-09-05
METIS Paves the way for 2020 information society	https://www.metis2020.com/press-events/press/20121127-metis-paves-the-way/	2012-11-27



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Security: Public

Status: Final

Version: 1

Annex C



C. Talks and presentations

In Annex C all talks and presentations are listed which have been produced within the project work by or in collaboration with METIS partners.

Table C.1: Talks and presentations.

Date	Event	Title	Presenter
2014-12-16	The 7th International Workshop on Channel Measurement and Modeling (IWonCMM-2014)	5G Channel Models - Requirements, METIS Results, and Way Forward	Tommi Jämsä
2014-12-04	VDE-ITG Workshop "5G: Visions, Requirements, Solutions"	5G – Enabling a smart(er) world: The METIS approach	Jakob Belschner, Hans Einsiedler, Gerd Zimmermann
2014-10-24	EU-Taiwan coordination meeting	5G Scenarios, Concept and Architecture	Hugo Tullberg
2014-10-24	EU-Taiwan coordination meeting	5G millimeter waves and optic transport	Hugo Tullberg
2014-10-23	Net-Tech Future Coordination Meeting RAS Cluster Meeting	Radio access elements for 5G and the path towards standardization	Hugo Tullberg
2014-10-22	METIS 5G Global Conference (5GGC)	5G Channel Modelling - Requirements, Recent Results, and Harmonization	Tommi Jämsä
2014-10-22	METIS 5G Global Conference (5GGC)	Paradigm Shift towards Dynamic and Wireless Networks	Ömer Bulakci, Peter Fertl
2014-10-22	METIS 5G Global Conference (5GGC)	Spectrum tools for 5G	Mikko Uusitalo
2014-10-22	METIS 5G Global Conference (5GGC)	Energy Efficiency Optimization of Heterogeneous Networks	Tommy Svensson
2014-10-22	METIS 5G Global Conference (5GGC)	Interference Management for Moving Networks in Ultra-Dense Urban Scenarios	Tommy Svensson
2014-10-22	METIS 5G Global Conference (5GGC)	Radio Link Enablers for Moving Networks	Tommy Svensson
2014-10-22	METIS 5G Global Conference (5GGC)	Evaluation of METIS 5G Network Level Solutions	Michal Maternia
2014-10-22	METIS 5G Global Conference (5GGC)	Modulation and access schemes for MMC	Armin Dekorsy
2014-10-22	METIS 5G Global Conference (5GGC)	Air interface design for dense deployment in 5G	Eeva Lähetkangas



Date	Event	Title	Presenter
2014-10-22	METIS 5G Global Conference (5GGC)	FBMC for 5G air interface: METIS scenarios and testbeds	Zhao Zhao
2014-10-16	5th EU-Japan Symposium on ICT Research and Innovation	5G Enablers in the METIS concept	Olav Queseth
2014-10-08	Keynote at WPMC 2014 in Sydney	5G - Spectrum sharing below 6 GHz vs. new spectrum allocation above 6 GHz	Matti Latva-aho
2014-10-08	Introductory presentation at KTH	5G	Mikael Fallgren
2014-09-24	WWRF#33	METIS 5G Channel Models	Tommi Jämsä
2014-06-24	5G World Summit	5G key technology components - The first step toward a system concept	Olav Queseth
2014-06-24	5G World Summit	Panel session: What is 5G	Olav Queseth
2014-06-23	Enablers on the road to 5G Workshop at European Conference on Networks and Communications (EuCNC) 2014	Dynamic clustering with multiple receive antennas in downlink CoMP systems	Paolo Baracca
2014-06-23	Enablers on the road to 5G Workshop at European Conference on Networks and Communications (EuCNC) 2014	Compressive Sensing based Multi-User Detection joins Coded Random Access	Armin Dekorsy
2014-06-17	9th Annual EU Spectrum Management Conference	5G Spectrum	Olav Queseth
2014-05-21	Lecture at the TeliaSonera IT/IP Business Competence Development Programme	5G The next frontier in telecom	Olav Queseth
2014-05-18	MWC2020 at VTC2014-Spring, South Korea	Towards the METIS 5G Concept	Hugo Tullberg
2014-05-18	MWC2020 at VTC2014-Spring, South Korea	Bending the Boundaries: METIS Research towards a Flexible 5G PHY	Ömer Bulakci



Date	Event	Title	Presenter
2014-05-13	Johannesberg Summit	5G Architecture METIS and 5GPPP	Hugo Tullberg
2014-04-28	5G PPP Information day	METIS Concepts for 5G	Hugo Tullberg
2014-04-25	The Brooklyn 5G Summit	METIS Channel Modeling Activities	Tommi Jämsä
2014-04-24	The Brooklyn 5G Summit	METIS Channel Modeling Activities	Tommi Jämsä
2014-04-23	FITCE.be seminar on 5G	What is considered as 5G?	Olav Queseth
2014-03-17	RAS cluster workshop on "Radio Access and Spectrum innovations for 5G", Athens	5G requirements and challenges – a FP7 METIS perspective	Nancy Alonistioti
2014-03-12	5G-PPP demo meeting, EC, Brussels	METIS Demonstration' Activities	Afif Osseiran
2014-02-26	MWC2014, Barcelona	On the Simulation of HetNets for the 5G Definition – The METIS Proposal	Jose F. Monserrat
2014-02-19	RSPG#33, Brussels	Spectrum Consideration for 5G System	Magnus Madfors, Afif Osseiran and Emilio Strinati
2014-02-12	WP5D WS on "Research views on IMT beyond 2020" HMC	Mobile and Wireless Communications system for 2020 and beyond (5G)	Afif Osseiran
2013-12-13	International Workshop on Emerging Technologies for LTE-Advanced and Beyond-4G, in conjunction with IEEE Globecom, Atlanta, GA, USA	METIS 5G Vision	Hugo Tullberg
2013-12-10	The 6th International Workshop on Channel Measurement and Modeling (IWonCMM-13), Beijing, China	METIS 5G Channel Models	Tommi Jämsä
2013-04-24	SMARAD URSI Radio Science Days	What is there beyond 4G?	Mikko A. Uusitalo



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Date	Event	Title	Presenter
2013-02-07	COST IC 1004	Mobile and wireless communications Enablers for the 2020 Information Society	Afif Osseiran



Annex D



D. Training and teaching

In Annex D we summarise the main activities concerning the training and teaching activities in METIS. This includes the list of students, lectures and seminars and the tutorials prepared within the project.

Table D.1: Training of students.

Hosting partner	Student level	Student affiliation	METIS WP	Topic
AALTO	Ph.D.	AALTO	WP5	Coordination protocols
AALTO	Ph.D.	AALTO	WP5	Coordination protocols
AALTO	M.Sc.	AALTO	WP1	Testbed implementation
AALTO	M.Sc.	AALTO	WP1	Testbed implementation
AALTO	M.Sc.	AALTO	WP1	Testbed implementation
ALUD	M.Sc.	RWTH	WP2	MMC
ALUD	M.Sc.	Univ. of Padova, Italy	WP2	HARQ
ALUD	Ph.D.	Univ. of Toronto, Canada	WP3	Massive MIMO
ALUD	M.Sc.	RWTH	WP3	Interference alignment
ALUD	Ph.D.	Queens' Univ., Ontario, Canada	WP4	Mobility prediction
BMW	Ph.D.	TU Berlin, Germany	WP4	WP4, mobility management
BMW	M.Sc.	TU Berlin, Germany	WP4	WP4, energy efficiency
BMW	Ph.D.	TU Berlin, Germany	WP4	WP4, moving networks
CTH	Ph.D.	CTH	WP3	UDN resource allocation
CTH	Ph.D.	CTH	WP3	UDN partial CSI
CTH	Ph.D.	CTH	WP4	Moving networks
CTH	Ph.D.	CTH	WP4	V2V communications
CTH	M.Sc.	CTH	WP4	D2D communications
CTH	M.Sc.	CTH	WP3	UDN channel estimation
CTH	M.Sc.	BTH	WP3	CoMP PSO precoding
TB	Ph.D.	TB, Brest, France	WP2	WP2, HW impairments
UB	M.Sc.	UB	WP2	WP2, Massive machine communications
UB	M.Sc.	UB	WP2	WP2, MMC multiple access
UB	M.Sc.	UB	WP2	WP2, code design
UB	M.Sc.	UB	WP2	WP2, PHY aspects of MMC
UB	M.Sc.	UB	WP3	WP3, shared relaying
UB	M.Sc.	UB	WP3	WP3, code design for relaying
UB	M.Sc.	UB	WP3	WP3, multiple access for



				relaying
UB	M.Sc.	UB	WP3	WP3, network coding
UOULU		UOULU	WP1	Channel measurements
UOULU		UOULU	WP1	Channel modelling
UOULU		Univ. of California – San Diego, USA	WP2	Waveforms FBMC
UOULU		University of Alberta, Canada	WP2	Full duplex D2D
UOULU		UOULU	WP2	Full duplex D2D
UOULU		UOULU	WP2	Waveforms FTN
UOULU		UOULU	WP3	Massive MIMO
UOULU		UOULU	WP3	Network coding
UPVLC	Ph.D.	UPVLC, Spain	WP4	ICIC for UDN
UPVLC	M. Sc.	UPVLC, Spain	WP6	MN performance
UPVLC	M. Sc.	UPVLC, Spain	WP6	Universal caching
Chalmers	Ph.D.	Chalmers	WP3	Resource allocation in UDN
Chalmers	Ph.D.	Chalmers	WP3, WP4	Cooperative communications
Chalmers	Ph.D.	Chalmers	WP3	HO for moving cells
Chalmers	Ph.D.	Chalmers	WP2	V2V RRM
Chalmers	M.Sc.	Chalmers, Politecnico di Torino	WP4	D2D RRM
Chalmers	M.Sc.	Chalmers	WP3	Blind channel estimation
Chalmers	M.Sc.	Chalmers (internship from BTH)	WP3	Precoding in CoMP

Table D.2: Lectures and courses.

Presenter	Subject	Event	Date	METIS WP
T. Svensson (CTH)	Lecture " Hur mycket intelligens rymt i Internet? - Sakernas Internet ("Internet of Things")"	Chalmers Masterplan (open lecture for students)	2014-11-12	WP2-4
T. Svensson (CTH)	Lecture "Moving Cells/Networks"	SNOW Workshop, Åre, Sweden	2014-04-03	WP2-4
T. Svensson (CTH)	Guest lecture "Research towards Future Wireless Networks"	CTH, MSc program course SSY 145 Wireless Networks	2014-03-31	WP2-4
Jose Monserrat and Narcís Cardona (UPVLC)	Lecture on 5G mobile and wireless communications systems	UPVLC	2013, 2014	WP6
Armin Dekorsy (UB)	Master level course "Advanced Topics in Digital Communications"	UB	2013	WP2-3
T. Svensson (CTH)	Lecture "Challenges and Research Towards 5G"	Oulu University, Oulu, Finland	2013-12-19	WP2-4
T. Svensson	Lecture "Moving	Swedish Wireless	2013-12-17	WP4



(CTH)	Cells/Networks”	Workshop, Uppsala, Sweden		
T. Svensson (CTH)	Lecture “METIS Perspectives on Moving Networks in 5G”	Industry Forum – Telematics and Mobile Internet, ICCVE’2013, Las Vegas, USA	2013-12-05	WP4
T. Svensson, E. Ström (CTH)	Lecture “5G flyttar basstationen hem till dig”	Chalmers Masterplan (open lecture for students)	2013-11-28	WP2-4
T. Svensson (CTH)	Lecture “Challenges and Research Towards 5G”	Ericsson AB, Kista, Sweden	2013-11-05	WP2-4
T. Svensson (CTH)	Lecture “Challenges and Research Towards 5G”	Chalmers Communications Systems workshop, Gothenburg, Sweden	2013-10-24	WP2-4
T. Svensson (CTH)	Lecture “Challenges and Research Towards 5G”	EURECOM, Sophia-Antipolis, France	2013-09-26	WP2-4
T. Svensson (CTH), Mikael Sternad (Uppsala University), W. Zirwas (NSN)	Lecture “Coordinated Multi-Point in Cellular Networks – From Theoretical Gains to Realistic Solutions and Their Potentials”	ISWCS’2013, Ilmenau, Germany	2013-08-27	WP3
T. Svensson (CTH), M. Sternad (Uppsala University)	Lecture “Coordinated Multi-Point in Cellular Networks – From Theoretical Gains to Realistic Solutions and Their Potentials”	SweCTW’2013, Gothenburg, Sweden	2013-08-22	WP3
E. Ström (CTH)	Lecture “5G What is it and why is it important?”	Toyota Information Technology Center, Sunnyvale, CA	2013-08-16	WP2-4
J. Hoydis (ALUD)	Lecture on Massive MIMO	Crossfire Workshop at SUPELEC, Gif-sur-Yvette, France	July 2013	WP3
T. Svensson (CTH), M. Sternad (Uppsala University), W. Zirwas (NSN), M. Grieger (TU Dresden)	Lecture “Coordinated Multi-Point in Cellular Networks – From Theoretical Gains to Realistic Solutions and Their Potentials”	ICC’2012, Budapest, Hungary	2013-06-13	WP3
J. Hoydis (ALUD)	Lecture on Massive MIMO	Newcom# Summer School on Interference Management, Eurecom, Sophia Antipolis, France	May 28-31, 2013	WP3
E. Ström (CTH)	Lecture “METIS 5G Cellular Systems for V2X (and much more)”	Lunch Seminar, SAFER— Vehicle and Traffic Safety Center at Chalmers	2013-05-23	WP2-4
T. Svensson (CTH)	Guest lecture “Research towards Future Wireless Networks”	CTH, MSc program course SSY 145 Wireless Networks	2013-05-13	WP2-4
T. Svensson (CTH)	Lecture “Towards Agile Wireless Systems for	Beijing University of Posts and	2013-04-18	WP4



	Efficient Ubiquitous Wireless Access”	Telecommunications, Beijing, China		
E. Ström (CTH)	Lecture “Cellular and V2X—LTE, LTE-A, METIS”	V2X Communication Workshop, SAFER—Vehicle and Traffic Safety Center at CTH	2013-04-16	WP2-4
T. Svensson (CTH)	Lecture “Towards Agile Wireless Systems for Efficient Ubiquitous Wireless Access”	Huawei, Shanghai, China	2013-04-09	WP4
T. Svensson (CTH)	Lecture “Towards Agile Wireless Systems for Efficient Ubiquitous Wireless Access”	Swedish Wireless Workshop, Norrköping, Sweden	2012-12-17	WP4

Table D.3: METIS Tutorials.

Presenter	Subject	Event	Date	METIS WP
G. Fodor, N. Rajatheva, E. de Carvalho	Massive MIMO	METIS All#9 meeting	Dec. 2014	WP3
W. Zirwas (NSN)	Multi-node transmission in ARTIST4G	METIS All#5 meeting	Jan. 2014	WP3
D. Aziz (ALUD)	Interference alignment	METIS All#5 meeting	Jan. 2014	WP3
R. Fantini (TI)	Multi-node transmission	METIS All#4 meeting	Oct. 2013	WP3
S. Valentin (ALUD)	The Context-Aware Radio Access: A Brief Tutorial	METIS All#2 meeting	Feb. 2013	WP4



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Annex E



E. References to METIS

Annex E provides an overview about different sources where the METIS project or dedicated results were referenced to. The overview includes press releases and memos of the EC, radio interviews, online articles and webpages, white papers, market research reports and some selected scientific articles as well as deliverables of other EC R&D projects. This overview makes no claim to be complete especially with respect to online articles. Also with respect to scientific articles in journals and conferences it is hard to compile all occurrences as in most cases not the METIS project itself, but sources provided by METIS partners in the scientific dissemination list are referenced.

Table E.1: Press releases/Memos of EC.

Affiliation	Title & URL	Date	Comments
European Commission	5G networks will be a leap, not a step, forward http://europa.eu/rapid/press-release_MEMO-14-463_en.htm	4 July 2014	Memo of EC on 5G
European Commission	What 5G can do for you http://europa.eu/rapid/press-release_MEMO-14-129_en.htm	24 Feb. 2014	Memo of EC on 5G
European Commission	5G Infrastructure PPP: The next generation of communication networks will be "Made in EU". http://ec.europa.eu/research/press/2013/pdf/ppp/5g_factsheet.pdf	2013	Factsheet
European Commission	Mobile communications: Fresh €50 million EU research grants in 2013 to develop '5G' technology http://europa.eu/rapid/press-release_IP-13-159_en.htm	26 Feb. 2013	Interview with N. Kroes, European Commission

Table E.2: Radio interviews.

Author & Affiliation	Title & URL	Date	Comments
P. Gustafsson Sveriges-radio	Mobilnätens basstationer flyttar inomhus med 5G http://sverigesradio.se/sida/avsnitt/184367?programid=412	29 Apr. 2013	Interview with A. Osseiran, Ericsson, Prof. E. Ström, CTH, Prof. J. Zander, KTH (in Swedish)

Table E.3: White papers.

Affiliation	Title	Date	Comments
4G Americas	4G Americas' Recommendations on 5G Requirements and Solutions (White Paper)	Oct. 2014	Reference to METIS D1.1 (scenarios and test cases)
SK Telecom	5G (White Paper)	Oct. 2014	Candidate frequency bands for 5G based on METIS
NTT Docomo	5G Radio Access: Requirements, Concept and Technologies (White Paper)	July 2014	METIS noted as relevant pre-standardisation activity
4G Americas	Summary of Global 5G Initiatives	June	METIS noted



	(White Paper)	2014	as important initiative on 5G
IWPC	Evolutionary & Disruptive Visions Towards Ultra High Capacity Networks (White Paper)	Apr. 2014	Reference to METIS D1.1 (scenarios and test cases)
NSN	Looking ahead to 5G (White Paper)	Dec. 2013	METIS as 5G R&D project
Huawei	5G: A Technology Vision (White Paper)	Nov. 2013	METIS noted as important 5G R&D project
Ericsson	5G radio access (White Paper)	June 2013	METIS as 5G R&D project

Table E.4: Market research reports.

Affiliation	Title	Date	Comments
Signals and Systems Telecom	The 5G Wireless Ecosystem: 2015 - 2025 - Technologies, Applications, Verticals, Strategies & Forecasts (Market Research Report)	Jan. 2015	METIS listed as one of 3 European Commission initiatives on 5G
GSMA Intelligence	Understanding 5G: Perspectives on future technological advancements in mobile (Market Research Report)	Dec. 2014	METIS noted as 1 st R&D project at EC on 5G topic as well as METIS project start as 1st key event on time line
Visiongain	LTE-Advanced (LTE-A) Mobile Technologies Market Report 2015-2020: The Leading Companies Developing Next Generation 4G Networks & The 5G Roadmap (Market Research Report)	Dec. 2014	METIS noted as important R&D project on 5G
IDATE Research	New frequency bands for LTE and plans for 5G (Market Research Report)	Oct. 2014	Candidate frequency bands for 5G based on METIS
Analysys Mason	5G worldwide outlook: standardisation programmes and technology developments (Market Research Report)	Oct. 2014	METIS noted as one of the important initiatives on 5G
Strategy Analytics	5G: The First Cellular System to Natively Support Machine Type Communications (MTC) – The Path to IoT and M2M (Market Research Report)	Sep. 2014	METIS noted as relevant project on 5G topic
Ovum	Vendors starting to prepare for 5G (Market Research Report)	July 2014	METIS noted as one of the important projects where vendors are involved
IDATE Research	LTE-Advanced & 5G (Market Research Report)	May 2014	METIS as R&D initiative; spectrum candidates for 5G
Analysys Mason	5G is presenting challenges to standards organisations (Market Research Report)	Apr. 2014	METIS noted as important initiative



Strategy Analytics	Is the 5G Race Beginning? (Market Research Report)	May 2013	besides ITU-R METIS noted as one of the important initiatives on 5G
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Table E.5: Online articles.

Author & Affiliation	Title & URL	Date	Comments
NyTeknik	Nu sätter arbetet med 5G igång http://www.nyteknik.se/nyheter/it_telekom/mobiltele/article3593304.ece	25 Jan. 2015	Written in Swedish
OFCOM	Spectrum above 6 GHz for future mobile communications (Consultation Document) http://stakeholders.ofcom.org.uk/consultations/above-6ghz/	16 Jan. 2015	METIS listed as regional initiative on 5G. Frequency bands identified in D5.1 and D5.3 are included in the consultation.
VDE	Online article in VDE Dialog "Mobilfunk der nächsten Generation - 5G – Chancen und Herausforderungen" https://www.vde.com/de/InfoCenter/VDE-Informationen/Magazine/VDE%20Dialog/2015/Seiten/default.aspx	Jan. 2015	Written in German
5G News.org	5G News & Commentary: METIS http://5gnews.org/metis/	2015	
Share Technote	5G http://www.sharetechnote.com/html/5G_Definition.html	2014	Webpage with reference to METIS outputs
Elektronik-Kompendium	Elektronik-Kompendium.de > Kommunikationstechnik IMT-2020, METIS, iJOIN, TROPIC und MOTO / 5G-Mobilfunk http://www.elektronik-kompendium.de/sites/kom/1906281.htm	2014	Webpage (in German)
5G PPP	The 5G Infrastructure Public Private Partnership: EU Projects http://5g-ppp.eu/projects/	2014	METIS listed together with other FP7 projects towards 5G
James Dunn North Bay Business Journal	411 on 5G cell phone networks http://www.northbaybusinessjournal.com/103335/411-on-5g-cell-phone-networks/	29 Dec. 2014	
Broadband Wireless Networking Lab / Georgia Institute of Technology (US)	5G Cellular Systems http://www.ece.gatech.edu/research/labs/bwn/5G_systems/index.html	26 Nov. 2014	
Bernadette Buyens European Commission	EU Workshop on Spectrum Planning for 5G (Summary) http://ec.europa.eu/digital-agenda/en/news/eu-workshop-spectrum-planning-5g-0 METIS referenced in WS presentations e.g. by: <ul style="list-style-type: none"> Karl-Heinz Laudan (Deutsche Telekom) "Anticipated spectrum requirements for 5G" http://ec.europa.eu/information_society/newsroom/image/01-laudan_karl-heinz_presentation_-_2014-11-13_eu_workshop_5g_-_dtag_7835.pdf 	Nov. 2014	Summary of WS organised by EC: 5G flagship project METIS was often taken as a reference by speakers



	Eric Fournier (CEPT ECC Chairman): "Addressing the 5G requirement from the CEPT perspective" http://ec.europa.eu/information_society/newsroom/image/05_fournier-addressing_5g_requirements_cept_ecc_7846.pdf		
Phys.Org	Q&A: Working towards 5G http://phys.org/news/2014-11-qa-5g.html	5 Nov. 2014	Interview with Prof. Chenhao Qi (Southeast University, China, Columbia University, US)
Bernd Theiss Connect	Mobile Zukunft: Alles über den kommenden Standard 5G http://www.connect.de/ratgeber/alles-ueber-5g-mobiles-internet-2647244.html	17 Oct 2014	Written in German
Bruce Christian GlobalVison Magazine	METIS event explores 5G future http://www.globalvisionmag.com/metis-event-explores-5g-future/	15 Oct. 2014	
Friederike Maier Heise.de	Mobilfunk-Beschleuniger im Dutzend: Raffinierte Nachrichtentechnik zeigt Wege zum 5G-Mobilfunk auf http://www.heise.de/netze/artikel/Mobilfunk-Beschleuniger-im-Dutzend-2285566.html	6 Aug. 2014	Reference to results of METIS (written in German)
Cellular News	SK Telecom and Ericsson Show Off Elastic Cell, a Key Enabler for 5G http://www.cellular-news.com/story/Technology/66614.php	20 July 2014	
Friederike Maier Deutschlandfunk	5G-Netzwerk - Hunger nach Bandbreite http://www.deutschlandfunk.de/5g-netzwerk-hunger-nach-bandbreite.684.de.html?dram:article_id=291616	12 July 2014	Written in German
Horizon2020projects.com	5G networks will offer 'totally new possibilities' http://horizon2020projects.com/industrial-leadership/5g-networks-will-offer-totally-new-possibilities/	6 July 2014	
Mobile World Live	EC hails potential impact of 5G http://www.mobileworldlive.com/ec-hails-revolutionary-impact-5g	4 July 2014	
Friederike Maier Deutschlandfunk	5G - der Mobilfunk der Zukunft http://www.deutschlandfunk.de/telefontechnik-5g-der-mobilfunk-der-zukunft.676.de.html?dram:article_id=290529	30 June 2014	Written in German
Friederike Maier Heise.de	10 Jahre LTE World Summit: Der Blick Richtung 5G-Mobilfunk http://www.heise.de/netze/meldung/10-Jahre-LTE-World-Summit-Der-Blick-Richtung-5G-Mobilfunk-2238092.html	25 June 2014	METIS noted as important R&D project towards 5G (written in German)
PRNewswire	Anite-led METIS Task Group Defines World's First 5G Channel Models http://www.prnewswire.com/news-releases/anite-led-metis-task-group-defines-worlds-first-5g-channel-models-262823471.html	12 June 2014	
Telecoms.com	Inventing the future http://telecoms.com/opinion/inventing-the-future/	10 June 2014	
MASSM2M	Initial systems concepts for 5G wireless: The METIS perspective https://massm2m.wordpress.com/2014/04/23/initial-systems-concepts-for-5g-wireless-the-metis-perspective/	23. Apr. 2014	
LTE-Anbieter.com	EU Projekt "METIS" forscht für "5G" http://lte-anbieter.com/news/7434-eu-projekt-metis-forscht-fuer-5g/	25 Feb. 2014	Written in German
surfstick.cc	5G – erste Schritte hin zur nächsten Mobilfunkgeneration http://www.surfstick.cc/783/5g-erste-schritte-hin-zur-nachsten-mobilfunkgeneration/	1 Dec. 2013	Written in German



NyTeknik	5g-maktkampen på Xiangshan Hotel http://www.nyteknik.se/asikter/kronikor/article3789816.ece	27 Nov. 2013	Written in Swedish
5G News	Huawei wird 600 Millionen Dollar für die Forschung zu 5G investieren bevor 2018 http://www.5g-cell.com/tag/eu-metis/	6 Nov. 2013	Interview with Huawei CEO Xu Zhijun (written in German)
J.-P. Joosting	Anite leads 5G radio channel model development http://www.microwave-eetimes.com/en/anite-leads-5g-radio-channel-model-development.html?cmp_id=7&news_id=222904461	4 Nov. 2013	Interview A. Osseiran, Ericsson
G. Prophet	Anite lends T&M expertise to 5G radio channel model environment http://www.edn-europe.com/en/anite-lends-t-m-expertise-to-5g-radio-channel-model-development.html?cmp_id=7&news_id=10002705#	31 Oct. 2013	Interview with A. Osseiran, Ericsson
L. Hopperton	UK wireless specialist to head 5G project http://www.newelectronics.co.uk/electronics-news/uk-wireless-specialist-to-lead-5g-project/57342/	31 Oct. 2013	Interview with P. Beaver, products director at Anite
Launch 3 Telecom	5G could be the new 4G: Talks of 5G network in future for 2020 http://www.launch3telecom.com/news/5g2020/	28 Oct. 2013	
FierceWireless Tech	Ericsson, Huawei and others delve into 5G via METIS 2020 http://www.fiercewireless.com/tech/special-reports/ericsson-huawei-and-others-delve-5g-metis-2020	24 Oct. 2013	Interviews with N. Kroes, European Commission, and A. Osseiran, Ericsson
P. Goldstein FierceWireless	Ericsson, Huawei and others are pushing for 5G via METIS 2020 http://www.fiercewireless.com/story/ericsson-huawei-and-others-are-pushing-5g-metis-2020/2013-10-24	24 Oct. 2013	
Digitimes.com (Taiwan)	METIS: 5G to integrate solutions and diversified application http://www.digitimes.com/news/a20130726PD202.html	29 July 2013	Interview with A. Osseiran, Ericsson (please note: access to article requires subscription)
convergedigest.com	Huawei Collaborates in METIS Research for 5G http://www.cn-c114.net/583/a775049.html	24 June 2013	Interview with Dr. Wen Tong, Huawei Fellow and the head of Huawei Communications Technologies Labs
H. Shaughnessy Forbes	Who Should Be Scared Of Samsung's 1Gb+ Wireless Technology? http://www.forbes.com/sites/haydnshaughnessy/2013/05/17/who-should-be-scared-of-samsungs-1gb-wireless-technology/	17 June 2013	Interview with A. Osseiran, Ericsson
S. Curtis	David Willetts: UK could be 'world leader' in 5G http://www.techworld.com/news/mobile/david-willetts-uk-could-be-world-leader-in-5g-3452793/	14 June 2013	METIS noted as important EU-funded project on 5G
Bleicher, A. IEEE	Millimeter Waves May Be The Future of 5G Phones http://spectrum.ieee.org/telecom/wireless/millimeter-waves-may-be-the-future-of-5g-phones	13 June 2013	Interview with A. Osseiran, Ericsson
S. Adelman	Erste Gehversuche des 5G-Standards http://www.crn.de/netzwerke-tk/artikel-99529-2.html	6 June 2013	Written in German
c114.net	5G evolution looms clear: Commercial use in 2020 at a speed up to 10Gbps	May 2013	Written in Chinese



	http://www.c114.net/news/16/a767949.html		
D. Stoller ingenieur.de	Künftigeres Mobilfunknetz 5G soll einhundertmal schnellere Verbindungen bieten http://www.ingenieur.de/Themen/Mobiles-Internet/Kuenftiges-Mobilfunknetz-5G-einhundertmal-schnellere-Verbindungen-bieten	15 May 2013	Interviews with Prof. A. Dekorsy, Univ. Of Bremen, and T. Robrecht, Head of Network Systems at NSN (written in German)
M. Pieruschka	Samsung testet erfolgreich 5G http://www.4g.de/news/samsung-testet-erfolgreich-5g/	14 May 2013	Written in German
NyTeknik	Här är kraven på 5G http://www.nyteknik.se/nyheter/it_telekom/mobiltele/article3678633.ece	18 Apr. 2013	Interview with A. Osseiran, Ericsson (written in Swedish)
Kannenberg A heise.de	EU: 50 Millionen Euro Forschungsgelder für 5G-Netze http://www.heise.de/newsticker/meldung/EU-50-Millionen-Euro-Forschungsgelder-fuer-5G-Netze-1811394.html	26 Feb. 2013	Interview with N. Kroes, European Commission (written in German)
K. Schäfgen inside-handy.de	EU-Projekt Metis, Forschung: 5G kommt bis 2020 http://www.inside-handy.de/news/27601-eu-projekt-metis-forschung-5g-kommt-bis-2020	21 Feb. 2013	Interview with Prof. A. Dekorsy, Univ. of Bremen (written in German)
A. Burkitt-Gray	Fusion plasma physicist Sara Mazur leads Ericsson's research into 5G http://www.globaltelecomsbusiness.com/Article/3159622/Fusion-plasma-physicist-Sara-Mazur-leads-Ericssons-research-into-5G.html	21 Feb. 2013	Interview S. Mazur, head of Ericsson Research
M. Krux VDI Technologiezentrum GmbH	EU-Projekt „METIS“: Neuer Mobilfunkstandard für die Informationsgesellschaft 2020 http://www.innovations-report.de/html/berichte/informationstechnologie/eu_projekt_metis_neuer_mobilfunkstandard_209955.html	21. Feb. 2013	Interview with Prof. A. Dekorsy, Univ. Of Bremen (written in German)
A. Sawall Golem	Mit METIS will EU weltweiten 5G-Mobilfunkstandard schaffen http://www.golem.de/news/bis-2020-mit-metis-will-eu-weltweiten-5g-mobilfunkstandard-schaffen-1302-97721.html	20 Feb. 2013	Written in German
K. Fitchard Gigaom Research	EU investigates super-dense networking and other "5G" technologies http://gigaom.com/2012/12/19/eu-investigates-super-dense-networking-and-other-5g-technologies/	19. Dec. 2012	Interview with J. Färj, Head of Standardization and Industry for Ericsson
P. Panigrahi	5G Technology – Next Generation Wireless Access Technology http://www.3ginfo.com/5g-technology-next-generation-of-wireless-access-technology/	27 Nov. 2012	
Wikipedia	5G http://en.wikipedia.org/wiki/5G	Since Nov. 2012	METIS listed as one of the important 5G R&D projects

Table E.6: Scientific articles.

Author	Title & URL	Date	Comments
A Ghosh, T. A. Thomas, Mark	Millimeter-Wave Enhanced Local Area Systems: A High-Data-Rate Approach for Future Wireless Networks	June 2014	METIS simulation



C. Cudak, et al.	(IEEE Journal on Selected Areas in Communications)		reference scenarios listed in D6.1 were applied
J. G. Andrews, S. Buzzi, W. Choi, et al.	What Will 5G Be? (IEEE Journal on Selected Areas in Communications)	June 2014	METIS listed as 5G research project as well as deliverables D1.1 and D4.1
C.-L. I, C. Rowell, S. Han, et al.	Toward Green and Soft: A 5G Perspective (IEEE Communications Magazine)	Feb. 2014	METIS listed as EU lighthouse project together with 5GNOW

Table E.7: Deliverables of other EC R&D projects.

Project	Title of Deliverable	Date	Comments
MAMMOET	D1.1 "System Scenarios and Requirements Specifications"	Feb. 2015	Reference to METIS scenarios in deliverable D1.1
MiWEBA	D5.1 "Channel Modeling and Characterization"	June 2014	Reference to METIS radio channel models in deliverable D2.1
iJOIN	D5.1 "Revised definition of requirements and preliminary definition of the iJOIN architecture"	Nov. 2013	METIS listed as one of the important R&D projects on 5G
5GNOW	D3.1 "5G Waveform Candidate Selection"	Nov. 2013	METIS listed as a fundamental R&D project on 5G
COMBO	D2.2 "Roadmap for independent fixed and mobile network evolution"	Sep. 2013	METIS listed as one of the important R&D projects on 5G
DUPLO	D1.1 "System Scenarios and Technical Requirements for Full-Duplex Concept"	Apr. 2013	Reference to METIS scenarios and definitions for 5G