



Document Number: ICT-317669-METIS/D7.1

Project Name:
Mobile and wireless communications Enablers for the Twenty-twenty Information
Society (METIS)

Deliverable D7.1

Academic Dissemination & Exploitation Plans

Date of delivery: 01-02-2013
Start date of Project: 01-11-2012

Version 1
Duration 30-04-2015



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Project Number:	ICT-317669
Project Name:	Mobile and wireless communications Enablers for the Twenty-twenty Information Society

Document Number:	ICT-317669-METIS/D7.1
Document Title:	Academic Dissemination & Exploitation Plans
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Dissemination Level:	PU
Contractual Date of Delivery:	01/02/2013
Status:	Final
Version:	1.0
File Name:	METIS_D7.1_v1.docx

Revision History:

Revision	Date	Issued by	Description
1.0	2012-01-25	Olav Queseth	Final first version

**Abstract:**

This deliverable outlines the planned activities for academic dissemination and exploitation. The METIS project results will be disseminated through conferences and journals as well as focused events and workshops. The results will be exploited by integration in courses and commercially by partners. Some of the academic partners will use additional dissemination options as described in this report.

Keywords:

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



Executive summary

This report outlines the activities for dissemination and exploitation of academic research results from the METIS project. The project aims at developing technologies and an advanced overall system concept for "Beyond 2020"¹ mobile and wireless communications.

The research results from METIS will be disseminated in a number of world leading conferences and journals. This report lists the prime candidates and indicates where the output from work in the work packages (WPs) and horizontal topics (HTs) can be published. The research will also be disseminated through focused events and workshops.

In addition, results are planned to be integrated into courses that the involved partners teach at their respective institutions. Integration is planned at both Ph.D. and master course levels. Moreover, teaching will provide persons with Ph.D. and master's degrees with a deep knowledge of technologies for the 2020 timeframe.

Partners plan to commercially exploit the patents generated during the project. Options range from one time sale to starting new SME (small and medium enterprises). Partners also plan to exploit results by offering consultancy services. Furthermore, such tools as simulation platforms, can be commercially exploited.

¹ The terms "beyond 4G", "5G" and "beyond 2020" are used interchangeably in this document.



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List of Abbreviations, Acronyms, and Definitions

APNet	Antennas, Propagation and Radio Networking
CEPT	Conférence Européenne des administrations des Postes et des Télécommunications
CO	Confidential
CR	Cognitive Radio
D	Deliverables
DL	Downlink
D2D	Device-to-Device
ECC	Electronic Communications Committee
EIT	European Institute for Innovation and Technology
HT	Horizontal Topics
HTD	Horizontal Topic Driver
ICT	Information and Communications Technology
IEEE	Institute of Electrical and Electronics Engineers
IMT	International Mobile Communications
IP	Intellectual Property
IPR	Intellectual Property Rights
ITS	Intelligent Transport Systems
ITU	International Telecommunication

	Union
ITU-R	International Telecommunication Union-Radiocommunication
MAC	Medium-Access Control
MIMO	Multiple-Input Multiple-Output
MMC	Massive Machine Communication
M2M	Machine-to-Machine
PHY	PHYsical layer
QoS	Quality of Service
R	Research
RAN	Radio Access Network
RAT	Radio Access Technology
RF	Radio Frequency
R&D	Research and Development
RRM	Radio Resource Management
SME	Small and Medium Enterprises
TL	Task Leader
TPC	Technical Program Chair
UE	User Equipment
WLAN	Wireless Local Area Network
WNC	Wireless Network Coding
WP	Work Package
WPL	Work Package Leader
WRC	World Radio-communication Conference



1 Introduction

The ambition of METIS is to drive the evolution of mobile communication infrastructure by developing new technologies and by integrating them into an advanced and resource-efficient overall system concept for "Beyond 2020" mobile and wireless communications.

New concepts introduced by METIS (reflected by the so-called METIS "Horizontal Topics") will allow supporting new services and applications for example in the area of e-health, smart grids, public transportation, logistics, and Internet-of-Things which require functionalities not sufficiently provided today.

METIS aims to be one of the globally leading projects in its area with a significant impact on future roadmaps in related standardisation, regulatory, and industry activities. METIS also aims to be a leading platform for research and innovation in the area of mobile communications where existing concepts are further developed and completely new concepts are defined and integrated. Both areas need a well coordinated dissemination activities' plan in order to generate the required impact and visibility. Driving the harmonisation of views on the broad range of new topics addressed by METIS is a challenge since not only the ICT industry but many other industries and their research communities need to be addressed.

The academic dissemination strategy and planned activities described herein reflect the ambitions of METIS.

METIS is introducing completely new concepts that require a deep scientific analysis and need to be explained and justified to the academic and industrial communities. The academic METIS partners will therefore, in parallel to publishing papers with deep technical analysis, provide tutorials and overview papers that allow the research community to catch up with the new ideas and contribute to the research progress.

METIS provides solutions for new service and application domains. METIS partners will thus ensure that the scientific and technical results of METIS are presented to these communities and introduced in the related research communities in an appropriate way.

METIS is developing an overall system concept into which the new technical concepts are integrated. The academic METIS dissemination activities will make sure that the overall context of technical details published in papers is communicated and the relevance of the technical details for the overall system concept can be understood. It is also planned that publications use similar terminology (coordinated by WP7) that allows readers to easily understand the overall system context. In addition, some key conferences will be selected where overview papers will be submitted. These overview papers will provide the audience with an idea of the METIS overall system concept and will simplify communicating the context of more detailed technical papers.

1.1 Objective of the Report

This report will describe the project exploitation and dissemination plan that will be implemented to achieve the above-described ambitions. It will identify important organisations, events, meetings, workshops in which the project shall contribute and participate. Further on it will establish a strategic plan for dissemination of the project results.

This report is intended to inform third parties interested to follow METIS's outcome to understand where and how the academic dissemination activities of METIS are organised. It will provide information about planned coordinated dissemination activities that allow readers to get the whole picture comprising the METIS overall system concept and technical details.



1.2 Structure of the Report

The above-outlined dissemination activities are presented in detail in Section 2 of this report. It describes the METIS objectives and how this is implemented in the project structure. The METIS matrix organisation with technical work packages (WPs) hosting the research activities in the areas of link technologies, multi-link concepts, network aspects, and spectrum issues along with Horizontal topics (HTs) addressing the new concepts introduced by METIS are described.

Section 3 lists major dissemination events envisaged and highlights some key events where METIS aims to submit overview papers and tutorials.

Section 4 summarises per partner dissemination activities. This list is intended to help third parties to identify offers, results or publications of academic METIS partners they are interested in. A more detailed exploitation plan for the academic METIS partners is included in the Annex.



2 Project Overview

2.1 METIS Dissemination Objectives

The main objective of METIS is to respond to societal challenges beyond 2020 by providing the basis for the all-communicating world, and by laying the foundation for a future mobile and wireless communications system. More precisely, METIS will develop a concept for the future mobile and wireless communications system, and will identify and research into key building blocks of such a future system. The evaluation that will accompany research efforts will in parallel be used to build consensus ahead of future standardisation.

In order to build global consensus, METIS needs to ensure Global Impact through (academic and industrial) dissemination of studies, standardisation and regulatory engagement, and the project will:

- Participate in and contribute to the Road-Map overview for 2020 and beyond, in at least two major conferences;
- Organise at least two technical workshops at a major event/conference;
- Organise and participate in at least two global workshops with non-EU fora, and regulatory regional bodies;
- Disseminate METIS scientific results related to technology components, by publishing at least 40 papers in major conferences and/or journals;
- Contribute at the European level to CEPT, especially through ECC PT1, at which the European administrations are jointly preparing the agreed European contributions to the ITU-R, and towards the WRC-15;
- Bring METIS results and opinions into global regulations, by participating in and directly contributing to the ITU preparatory process towards the WRC-15.

2.2 Project Structure

To ensure that the project responds to the expected future needs and has the agility to adapt to unforeseen market, societal, technical and economical aspects of the studies, METIS pursues a two-fold research approach. This leads to a matrix organisation of the project as depicted in Figure 1. In particular, the two-dimensional structure combines a system-level design and evaluation through Horizontal Topics (HTs) coupled with the comprehensive technical research in Work Packages (WPs). In this context,

- the HTs ensure that the global challenges and system aspects are addressed appropriately, and that interaction and coordination across WPs are maintained for system-level functionality, and
- WPs conduct research within relevant areas and develop the technology components.

Accordingly, HTs will integrate technology components into the future mobile and wireless communications system while vertical WPs will provide the technology components that form the basis of the HTs.

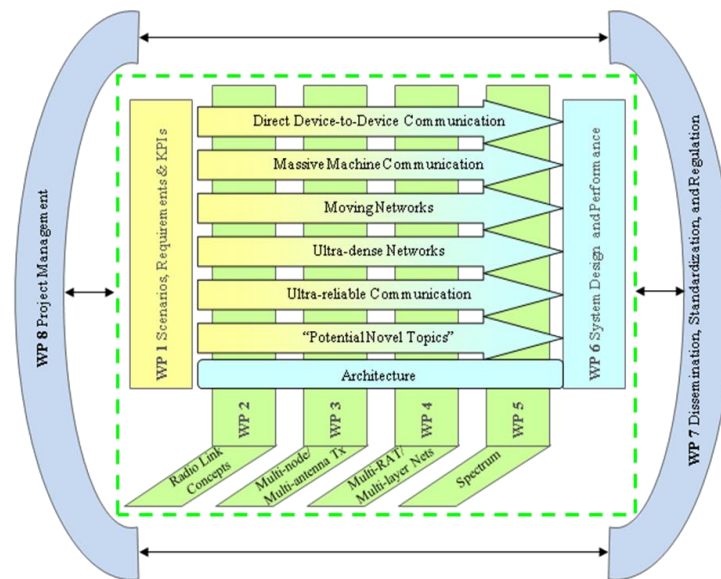


Figure 1 METIS project structure illustrating the matrix organisation

2.2.1 Horizontal Topics

The HTs go across all WPs as shown in Figure 1, to tie together key technology components into a system concept and solutions that adequately address the different use-cases of future mobile and wireless systems. The HTs provide a technical solution, i.e., a system sub-concept, to one or more scenarios developed in WP1. The HTs identified hitherto are briefly explained in what follows.

Direct Device-to-device (D2D) Communication refers to direct communication between devices, without going through any network infrastructure. The goals of this HT are to increase coverage (availability, reliability), to offload backhaul (cost efficiency), to provide a fall-back solution (reliability), to increase spectrum usage (spectrum efficiency), and capacity per area (capacity efficiency).

Massive Machine Communication (MMC) will be vital to the future mobile and wireless communications system where this HT aims to provide up- and down-scaling connectivity solutions for tens of billions of network-enabled devices (scalability). More precisely, machine-related communication will be associated with a wide range of characteristics and requirements (e.g., data rate, latency, cost, availability and reliability) that will often deviate substantially from those of current human-centric communication.

Moving Networks (MN) will enhance and extend linking together large populations of jointly moving communication devices. A moving network node (e.g., vehicles or buses with advanced communication and networking capabilities) or a group of such nodes can form a "moving network" that communicates with its outer or inner environment, i.e., other fixed or mobile nodes.

Ultra-dense Networks (UDN) will be the main driver to address the traffic demands of beyond 2020 where the goals are to increase capacity (capacity efficiency), to increase energy efficiency of radio links, and to enable better exploitation of under-utilised spectrum. Infrastructure densification is a path that has already been taken by, e.g., existing cellular radio-access technologies with inter-site distances in the order of 200 m.

Ultra-reliable Communication (URC) will enable high degrees of availability. In this context, METIS aims at providing scalable and cost-efficient solutions for networks that support services with extreme requirements on availability and reliability.

In addition to the innovative HTs mentioned above, *Architecture* is identified as a fundamental, technology-oriented HT that must be addressed by any wireless communications system.



Furthermore, “*Potential Novel Topics*” can be added if necessary to capture emerging market, societal, technical and economical needs.

2.2.2 Work Packages

The METIS work plan is structured into eight WPs, six of technical nature, one for dissemination of project results, and one for project management, as depicted in Figure 1. The work in the six technical WPs is selected to highlight the flow from user needs (WP1), to research on specific topics (WPs 2–5), to system-level synthesis and evaluation (WP6). The technical WPs are:

WP1 Scenarios, Requirements and Key Performance Indicators will survey and analyse future market and service trends for the global society that affect ICT requirements and that are relevant to future wireless communication systems for 2020 and beyond. WP1 also includes the propagation and test-bed activities.

WP2 Radio Link Concepts will develop and investigate new radio-link concepts, tailored to meet the demands of future applications arising from the identified scenarios and HTs, and create an understanding of the implications for the overall system design.

WP3 Multi-node/Multi-antenna Transmissions will design multi-node/multi-antenna technologies to achieve the targets in terms of performance and capabilities for future wireless communication systems. These include advanced inter-node transmission/coordination, multi-antenna transmission/reception schemes based on massive antenna configurations, and multi-hop technologies including wireless network coding.

WP4 Multi-layer/Multi-RAT Networks will investigate network-level aspects related to the efficient deployment, operation and optimisation of the future wireless communications system, with an emphasis on heterogeneous multi-layer and multi-RAT deployments.

WP5 Spectrum will investigate means to enable and secure sufficient access to spectrum for the future METIS wireless communications system by developing innovative spectrum-sharing concepts.

WP6 System Design and Performance will employ the HTs to integrate the most promising technology components developed in WPs 2–5 and develop an overall system concept.



3 Dissemination Activities for Academic Research

In the previous section a project overview was given along with presentation of Horizontal topics (HT) and Work Packages (WP). In order to disseminate the results from the project, a number of conferences and publications have been identified and selected, which can further be grouped into the following areas of interest:

- General communication: There are a number of conferences and publications where wireless communications in general are addressed e.g. the VTC conference and Communications magazine. Since the scope of these events is relatively broad, the results from all WPs could be presented. In addition, this is also a good platform to present findings from the HTs that span across multiple individual technologies. The results from WP1 as well as tutorial/overview papers are also considered suitable for this type of events.
- Signal processing: A number of the listed journals focus on the signal processing aspect of communication, e.g., IEEE transactions on signal processing and ICASSP. WP2 and WP3 research topics that are traditionally considered within the signal processing domain therefore the associated results may be presented in this kind of events.
- Communication networks: Many networking aspects are addressed in WP4. There are few conferences that only focus on communication networks where the results from WP4 could be presented.
- Spectrum management and new spectrum management techniques: WP4 and WP5 deal with novel techniques for managing spectrum. The main conferences focusing on this type of research are DySPAN and Crowncomm. There are however no dedicated magazines, but some of the listed journals occasionally have special issues on spectrum management..
- Business aspects: WP1 and WP6 as well as the HTs will generate results that also cover the business aspects of communication networks. Some of these results can be presented at certain industry events, e.g., NGMN industry conference.
- Finally, there are HTs studying moving networks and ultra reliable communication, which have relevance for the ITS sector. Those results are likely to be presented in the VTC conference which usually has a track on vehicular technologies.

3.1 Important Conference Events

The following list highlights the major events relevant to METIS. These conferences represent the main target for academic dissemination due to their broad reach. In addition, there is a number of small scale events ranging from university workshops to more local events where METIS results could be presented.

3.1.1 ASILOMAR

The Asilomar Conference on Signals, Systems, and Computers is a yearly conference held on the Asilomar Grounds. It provides a forum for presenting work in various areas of theoretical and applied signal processing. Topics include coding and modulation, MIMO communications and signal processing, ad-hoc and sensor networks, signal processing and adaptive systems, array signal processing, and speech, image and video processing.

3.1.2 IEEE Global Communications Conference (GLOBECOM)

GLOBECOM is IEEE Communications Society's premier flagship conference. It provides a unique opportunity to explore the leading areas of information and communications technology related to industry, academia, government, enterprise and other market segments



from around the world. It provides opportunities for networking with colleagues, customers and vendors from around the world. The conference offers technical sessions, tutorials, workshops as well as industry fora and exhibitions.

3.1.3 IEEE International Conference on Communications (ICC)

This is one of the flagship conferences of IEEE Communications Society. The conference features a large technical program including several symposia and a number of tutorials and workshops as well as technical presentations. In addition, it features keynote speeches, various industry fora and vendor exhibits.

3.1.4 IEEE International Conference on Computer Communications (INFOCOM)

This conference features papers of significant and innovative research contributions to the field of computer and data communication networks. The topics covered include network architecture, design, implementation, operations, analysis, measurement, performance, and simulation, and ad-hoc networks.

3.1.5 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)

The ICASSP conference is the world's largest and most comprehensive technical conference in the field of signal processing and its applications. The conference features tutorials, exhibits, and lecture and poster sessions. Topics typically include image and video signal processing, machine learning for signal processing, sensor arrays and multichannel signal processing as well as signal processing theory and methods.

3.1.6 IEEE International Symposium on Information Theory (ISIT)

ISIT is one of the major conferences in the information theory area. The conference covers a broad range of topics related to information theory.

3.1.7 IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN)

The main focus of this conference is dynamic spectrum access and cognitive radio. The topics covered include regulatory aspects of dynamic spectrum access, theoretical studies, algorithm and protocol design for cognitive radios and networks, as well as application-oriented contributions dealing with architectures, platforms, signalling and multiple access schemes. This is one of the main events for exchanging ideas about spectrum regulation and schemes for spectrum sharing.

3.1.8 IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)

This event is annual and it is one of the premier conferences in the wireless research arena and has a long history of bringing together academia, industry and regulatory bodies. Today, it has become one of the IEEE Communication Society's flagship conferences in wireless networking. It includes sessions, tutorials, workshops, and technology and business panels. The topics covered include all areas of wireless communications, networks, services, and applications.

3.1.9 IEEE International Workshop on Signal Processing Advances in Wireless Communications (SPAWC)

This workshop is focusing on recent advances in signal processing for wireless and mobile communications, information and network theory. The workshop features poster presentations and invited plenaries on recent advances in signal processing for wireless communications, as well as for communications and networking in general.



3.1.10 IEEE Vehicular Technology Conference (VTC)

The IEEE VTC conference is a semi-annual event that brings together researchers from academia, industry and government for exchanging ideas. The conference features world class speakers, tutorial sessions and technical presentation and poster sessions. Submissions include papers in fields of wireless, mobile, and vehicular technology.

3.1.11 IEEE Wireless Communications and Networking Conference (WCNC)

IEEE WCNC is the premier wireless event for researchers, industry professionals, and academics interested in the latest development and design of wireless systems and networks. Sponsored by the IEEE Communications Society, IEEE WCNC has a long history of bringing together industry, academia, and regulatory bodies.

3.1.12 International Conference on Cognitive Radio Oriented Wireless Networks (Crowncom)

The aim of this conference is to bring together researchers in both academia and industry to present their new solutions to cognitive radios. Cognitive radio, with the capability to flexibly adapt its parameters, has been proposed as the enabling technology for unlicensed secondary users to dynamically access the licensed spectrum owned by legacy primary users on a negotiated or an opportunistic basis.

3.1.13 Future Network & Mobile Summit

This is an annual Conference supported by the EU Commission to share experiences and research results, identify future trends, discuss business opportunities and identify opportunities for international research collaboration under the ICT Theme of Framework Programme 7 (FP7).

3.1.14 International Symposium on Wireless Communication Systems (ISWCS)

The objective of the International Symposium on Wireless Communication Systems (ISWCS) is to provide a recognised and dynamic forum for researchers and engineers from academia and industry to present and discuss original ideas and contributions in all fields related to mobile wireless communication systems. The program includes panel sessions, keynote speeches, paper and poster presentations as well as showcasing testbed implementations.

3.1.15 NGMN Industry Conference & Exhibition

The conference provides an in-depth update on the latest status of mobile broadband deployment and operations, upcoming network and device trends and on technology and service innovations. The conference includes presentations by prominent speakers from the world's leading operators and vendors. This is also a place to showcase the latest mobile broadband technology solutions.

3.2 Important Journals for Publications

3.2.1 EURASIP Journal on Wireless Communications and Networking

EURASIP JWCN is to bring together science and applications of wireless communications and networking technologies with emphasis on signal processing techniques and tools.

3.2.2 IEEE Communications Letters

IEEE Communications Letters provides researchers with an ideal venue for sharing their newest results in a timely manner. Every month this journal publishes 20-25 short (up to 4 pages) high-quality contributions on the theory and practice of communications.



3.2.3 IEEE Communications Magazine

This magazine covers current issues and advances in key areas of wireless, optical and wired communications. Written in tutorial applications-driven style by the industry's leading experts, IEEE Communications Magazine delivers practical and current information on hot topics, implementations, and best industry practices.

3.2.4 IEEE Journal on Selected Areas in Communications

Each issue of the IEEE Journal on Selected Areas in Communications (J-SAC) is devoted to a specific technical topic and thus provides to J-SAC readers a collection of up-to-date papers on that topic. These issues are valuable to the research community and become valuable references. The current list of planned topics includes Device-to-Device Communications in Cellular Networks.

3.2.5 IEEE Signal Processing Magazine

Signal Processing Magazine (SPM) publishes tutorial-style articles on signal processing research and applications, as well as columns and forums on issues of interest. Its coverage ranges from fundamental principles to practical implementation. Its mission is to bring up-to-date, emerging, and active technical developments, issues, and events to the research, educational, and professional communities.

3.2.6 IEEE Transactions on Signal Processing

The IEEE Transactions on Signal Processing covers novel theory, algorithms, performance analyses and applications of techniques for the processing, understanding, learning, retrieval, mining, and extraction of information from signals. The term "signal" includes, among others, audio, video, speech, image, communication, geophysical, sonar, radar, medical and musical signals.

3.2.7 IEEE Transactions on Vehicular technology

The IEEE transaction on vehicular technology is dedicated to vehicular technology. The areas covered include mobile communications, vehicular electronics and transportation systems. It is an important arena to share research and accelerate research in the mentioned areas. In addition to research papers it also publishes tutorials and surveys in the areas of interest. Recent special issues included topics such as self-organising networks and moving communication systems from the laboratory into reality.

3.2.8 IEEE Transactions on Wireless Communications

The IEEE Transactions on Wireless Communications is a major journal which is committed to the timely publication of, peer-reviewed, original papers that advance the state-of-the art and applications of wireless communications. In addition, papers on specific topics or on more non-traditional topics related to specific application areas are encouraged. Examples include OFDM, MIMO systems, Wireless over optical, and Ultra-wideband communications.

3.2.9 IEEE Vehicular Technology Magazine

This is a quarterly magazine that focuses on mobile communications, vehicular electronics and transportation systems. It features editorial columns, tutorials and survey papers in addition to original papers in these three areas.

3.2.10 IEEE Wireless Communications Letters

This journal publishes timely, novel and high-quality recent results on Wireless Communications in letter format. The journal's goal is rapid dissemination of original, cutting-edge ideas and timely, significant contributions in the theory and applications of wireless communications.



3.2.11 IEEE Wireless Communications Magazine

This magazine is targeted at researchers working in the wireless communications and networking communities. It covers technical, policy and standard issues relating to wireless communications in all media and at all protocol layers. The topics are interdisciplinary and include regulatory as well as technical aspects of wireless networking and communications.

3.2.12 Journal of Communications and Networks

This is an international journal published by the Korea Information and Communications Society. It is a bi-monthly publication which spans both theoretical and practical topics in communication and information networks. Examples of topics for special issues include "Massive MIMO". This journal has a large impact in Korea.

3.3 Other activities for Disseminating Results Continuously

METIS will create and maintain a web-site where papers, reports and presentations are available to the general public. In addition, there might be other channels that could be used for disseminating results in an academic context e.g., it might be possible to use social media for disseminating results and/or to get feedback on the ongoing research. However, these possibilities will have to be further evaluated as more results become available.

3.4 Workshops and Focused Events

3.4.1 Workshops Collocated with Conferences

At many conferences there are usually workshops or tutorial sessions collocated with the main conference the day before (or after) the main event. For METIS, this provides an opportunity to present the results of the project as well as soliciting feedback on the results and progress of the project.

METIS will hold a collocated workshop together with VTC'13 spring in Dresden in February 2013. The focus of the workshop is "Mobile and Wireless Communication Systems for 2020 and beyond." The workshop presents a forum for exchanging ideas among the stakeholders.

Similar events will be held together with other major conferences during and towards the end of the project.



4 Exploitation of Results

4.1 Integration in Courses

One of the important methods of disseminating results from research projects is to ensure that the knowledge created within the project will also be used in future research. One way of doing this is to ensure that the results are known to the people working in research. Many of the academic researchers involved in METIS teach at their respective institutions. Therefore, there is a need for an overall consensus among them in order to coordinate seminars, workshops and special courses. This will secure that the technologies and new ideas developed in METIS will reach master and Ph.D. students and by this influencing the leaders of tomorrow.

One natural way to do this is to integrate the results into courses taught at universities. This can be done by means of papers or presentations in undergraduate courses or using parts of the METIS questions and scenarios as project work by students. In addition, the results from METIS will provide a basic reference for future systems for mobile communications.

A common strategy will also contribute towards strengthening the academic community. Moreover, it is envisioned that this seminar effort could result in a joint application for a Marie Curie Initial Training Network (ITN), which could facilitate the continuation of these initiative after the end of the METIS project.

4.2 Partners' Plans for New Business

The Universities and R&D Centres participating in the METIS consortium are interested in building on and further developing existing research expertise in radio communications. Furthermore, the patent and licence rewards will help to undertake future European and international research and will contribute towards further collaborative research possibilities with the project partners and others. The University partners foresee considerable exploitation of potential in these areas. All the Universities participating in the METIS Project already have a long standing record of contributions to related research activities in the field of mobile communications, as well as numerous collaborations with the industry in this field. Concurrently, the gained expertise will permeate into the daily university life and will be disseminated within the academic education of future European mobile communication experts.

The main objective of the exploitation plan for academic partners in METIS is to outline a strategy and actions for exploitation of the Intellectual Property (IP) rights derived from the project. Academic partners will benefit from a common strategy to promote, exploit and commercialise the METIS project outcomes and the IPs achieved during the project.

This section presents the initial exploitation plan for the METIS project that will be revisited in the final exploitation plan at the end of the project. The principal goal is to describe the drivers for exploiting the METIS IPs from a consortium point of view. The specific analysis of the exploitation strategies for academic partners can be found in the Annex.

4.2.1 Exploitation in Start-ups

Most of the activities in METIS are foreseen to be reflected in real technologies. This provides a good starting point for product developments not only by the METIS partners, but also by SMEs and possible start-up companies. Some of the created IPRs, developed within METIS, but completely owned by academic partners, may be considered for creating university start-ups. This activity is strongly supported by the current innovation policy at the universities and research centres participating in METIS.



4.2.2 Organisation of Consultation Meetings

All the universities and research centres participating in METIS have a long standing record of contributions to research activities related with mobile communications. Some of them are supporting the big telecom stakeholders in their standardization efforts, and their influence shall increase due to the METIS project. Therefore, it is of METIS's strong interest to arrange periodic meetings with industrial partners in METIS to identify new ways of cooperation and to reinforce the influence of European industry on the mobile communications market.



5 Summary

This report outlines the activities for dissemination and exploitation of academic research results.

The research results from METIS will be disseminated in a number of world leading conferences and journals. The report lists the prime candidates and indicates where results and achievements of work packages (WPs) and horizontal topics (HTs) can be published. The research will also be disseminated through focused events and workshops.

In addition, results are planned to be integrated into courses that the involved partners teach at their respective institutions. Integration is planned at both Ph.D. and master course levels. Furthermore, this teaching will provide persons who will obtain their Ph.D. and master's degrees with a deep knowledge of technologies for the 2020 timeframe.

Partners also plan to commercially exploit the patents generated within the project with options range from one time sale to starting new SMEs. Another way to exploit results of METIS is offering consultancy services and exploiting commercial tools, e.g., simulation platforms.



6 Annex – Partner Specific Exploitation Plans

6.1 Individual exploitation strategy Aalborg University

6.1.1 Partner profile

Aalborg University (AAU) is a Danish public institution that offers education and research within the fields of natural sciences, social sciences, humanities, technical and health sciences. Aalborg University currently consolidates and further develops its profile as a dynamic and innovative research and educational institution oriented towards the surrounding world. It is characterised by combining a keen engagement in local, regional, and national issues with an active commitment to international collaboration. More than 14.000 students are enrolled at AAU, ranging from students at preparatory courses through doctoral-level candidates. AAU employs approximately 2000 faculty and 800 administrative and technical staff.

AAU comprises 4 faculties that are subdivided into 18 departments. The Department of Electronic Systems is one of the largest departments at AAU with a total of more than 300 employees. The department is internationally recognised in particular for its contributions within Information and Communication Technology (ICT). The research and teaching of the Department of Electronic Systems focus on electronic engineering and the activity areas are organised in eleven sections. The staff members involved in the project belong to the Antennas, Propagation and Radio Networking (APNet) section focusing on antennas and propagation transceiver solutions and networking concepts for emerging radio communication systems.

The APNet section has been in the forefront in antenna and experimental designs for small terminal equipped with MIMO. It has pioneered several schemes for wireless network coding and has been active in the area of relaying/multi-hop communications with publications, patents, and several funded projects. One of the biggest current research subgroups in APNet is dedicated to M2M communications.

6.1.2 Business model

As a public institution, AAU receives part of its funding from public authorities. All the sections in AAU are financially independent entities and are directly responsible for finding and managing their funds. The main funding sources of the APNet section are:

- Research Projects
 - National
 - Industrial
 - EU projects
- Education: Funding received from the government based in the student intake. Additional income from PhD courses and courses for industry.
- Patents.
- Publications: The funding received from the government that is used to cover the research time of the university employees is proportional to the most recent publication record of the research group.
- Spin-offs: The University has a technology transfer office (TTO) that is in close collaboration with several investment funds and works with the researchers on creating spinoff based on promising IPRs.



6.1.3 Exploitation strategy

As an education and research institution, AAU primary objectives for exploitation are the following to:

- Enhance University's educational offer
- Increase and extend research expertise in order to:
 - attract highly skilled students and staff
 - increase publication record
 - create new research projects that can obtain public funding
 - create new direct collaboration with industry
 - create IPRs
 - create possibilities for University spinoff

The results in the METIS project will contribute to reaching those goals by:

- Development of research expertise and knowledge
 - New research area: massive MIMO
 - Complementary research to recently started research activities: M2M
 - Consolidate AAU leadership and innovative position in wireless network coding
- Publications
- Consolidation of international collaborative network
- Intellectual Property, that could be further basis for spinoff or industrial collaboration

6.1.4 Identification of knowledge transfer opportunities

For AAU's research group, METIS provides a unique opportunity to work with the most relevant industry partners and research institutions that are shaping the future of wireless technology. Furthermore, it provides the university with an opportunity to design wireless technologies that can be applied to highly relevant use cases, identified early during the project. Within the METIS project, the research group expects to obtain major results in three areas: massive M2M communication, massive MIMO, and wireless architectures with relays/network coding. These results will use the following knowledge transfer opportunities:

- Opportunity #1: New direct collaboration with industry
- Opportunity #2: New publicly funded research projects
- Opportunity #3: Joint patents with other METIS partners
- Opportunity #4: Publications
- Opportunity #5: Spinoff companies
- Opportunity #6: New educational content

6.1.5 Description of business/transfer opportunities

- Opportunity #1: New direct collaboration with industry
 - Value proposition: based on the experience/insights from METIS, roadmaps for solving specific problems in industry using AAU's technology can be proposed.



- Value creation: technological solutions based on radically new ideas, which would usually be regarded sceptically by the industries, are likely to be accepted due to the fact that they have been developed in the context of METIS.
- Revenue expectation: research projects directly funded by the industry or paid consultancy from our group.
- Opportunity #2: New publicly funded research projects
 - Value proposition: carry out fundamental research inspired by the scenarios and technologies developed within METIS.
 - Value creation: participation in METIS is an excellent reference to provide a competitive advantage for a project proposal that is related to fundamental research, but with a clear relevance and implication for practical communication systems.
 - Revenue expectation: Publicly funded research project.
- Opportunity #3: Joint patents with other METIS partners.
 - Value proposition: new technology that is solving issues relevant for systems under standardisation.
 - Value creation: METIS consortium agreement allows the creation of joint side-ground resulting in joint patents. AAU can be represented in the relevant standardisation for a through the contribution of the companies that are based on the joint IPR.
 - Revenue expectation: license fee or one-time purchase of AAU rights on the IPR.
- Opportunity #4: Publications
 - The research group at AAU is very active in publishing its result in the top scientific journals. Besides the new publications out of the research in METIS, the METIS project will provide the university with an opportunity to make collaborative papers with industry that have the practical viewpoint and can be presented in publication venues other than where AAU usually publishes.
- Opportunity #5: Spinoff companies
 - Some of the created IPRs, developed within METIS, but completely owned by AAU, may be considered for creating university spinoff, by applying to some of the investment fund that collaborate with AAU. This activity is strongly supported by the current innovation policy at AAU.
- Opportunity #6: New educational content
 - Based on METIS, a new boost can be given to the master education in wireless communications by dedicating large part of it to the 2020 wireless technologies. PhD courses are planned in the area of massive MIMO, advanced relay architectures and M2M communications. These 2020 wireless technologies will also be taught via industrial courses and lifelong learning programs, well established at AAU.

6.1.6 Resulting SWOT analysis for exploitation

Table 1: Resulting SWOT Analysis for AAU

Strengths	Weakness
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Proven capacity to provide wireless innovation and new groundbreaking concepts. Advantage of being part of the team that works on relevant technologies for 2020 scenarios.	Lack of resources for commercialisation, no full-time patent attorneys at AAU.
Opportunities	Threats
The METIS scenarios represent an excellent platform to bring credibility to proposals of fundamentally new technologies. Insights in the industry view on the technological problems and their relative importance.	Some of the senior members that work on the METIS project are also funded by other sources and if the other sources stop, it is plausible that the senior person will not remain at AAU.

6.1.7 First steps in the exploitation plan

- Promote the approach multiflow optimisation of wireless relaying within WP3 and find ways to collaborate with the other partners that have slightly different the research agenda.
- Identify problems in the M2M arena that are related to the problems the university works on.
- Collaborate with the companies on building massive MIMO algorithms under practical constraints.
- Carry out a PhD course on wireless M2M communication in the autumn of 2013.
- Disseminate the main research results in conferences and journals.

6.2 Individual exploitation strategy Aalto University

Aalto University will actively disseminate results of METIS in major technical forums. The scientific knowledge gathered during METIS will be exploited in producing PhDs, and an important information dissemination avenue is technology transfer to the industrial sector in the form of these PhDs. In addition, the know-how on test-bed demonstration, acquired in METIS, will be exploited in both undergraduate and graduate courses at Aalto, as a part of the long-term educational strategy of the Information technologies study program which is aiming at bringing in hands-on experimenting and engineering components to the curriculum.

The involvement of AAU in the topic of massive MIMO in METIS will be consolidated and complemented by applying for a national funding, where the focus will be on building a prototype of a massive MIMO base station. This base station will be used for channel measurements and will serve to validate the communication methods that will be developed within the METIS project. Those measurement and validation phases are crucial as most of the existing research is based on theoretical and non-validated mathematical models.

AAU will act as a task leader for the topic of relay and wireless network coding. AAU sees the potential to research on cellular mobile solutions that use wireless network coding techniques in scenarios that are relevant for the industry, thus potentially leading to generation of Intellectual Property Reports in the area. This is in line with the strategy of AAU and its intensified connection to the industry.

AAU will act as a driver of the HT on ultra-reliable communication. This is a topic of great interest for attracting other industrial projects at AAU. In addition, there is an ongoing process at AAU to create a spinoff company related to ultra-reliable wireless links.



Regarding the topic of massive M2M communications, the research group at AAU has already received national funding for a related topic and METIS represents an excellent opportunity to link the research activities with the needs and the approaches of the industrial partners.

AAU has several international research partners outside EU working on the research topics related to METIS such as massive MIMO, massive M2M communications, and relay/network coding. The research activities and results obtained in METIS will help us to apply to a matching fund where those partners can get funding to have collaborations with AAU for the related topics, thereby creating opportunities for AAU to strengthen the relationship even with non-EU partners.

6.3 Individual exploitation strategy Chalmers University of Technology

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 will be disseminated in scientific conferences and journals. The involved senior researchers will increase their knowledge, which will permeate into the daily university life and will be disseminated within the academic education. For the involved post docs and assistant professors, the project provides a chance to qualify for further academic positions. For the new PhD students in the project, the research and knowledge gained during the project will take them far towards their PhD. Patent application might be considered for selected innovations.

6.4 Individual exploitation strategy Institut Mines-Telecom / Telecom Bretagne

6.4.1 Partner profile

The Institut Mines-Telecom (TB) is made up of "Grandes Ecoles" (prestigious French higher education establishments) in the field of information and communication technology (ICT) and will be represented by Telecom Bretagne inside the project. The Institut Telecom is under the authority of the French Ministry of Industry. Its mission is to provide education programs for engineers and managers, and to conduct research in ICT. The Institut Telecom features around 600 teaching and research staff and a number of 5000 students, including 700 doctoral students. Its research cover a broad spectrum of disciplines, ranging from fundamental technologies, information processing, networks, computing and software to the economic, social, and legal aspects, industrial strategies and new services and usages.

In the METIS project, the Institut Mines-Telecom will be represented by Telecom Bretagne, thanks to the Signal & Communications, and the Electronics Departments. They both have a large expertise in the development of new coding and modulation schemes, and they will participate in designing some of the new concepts of the physical layer for the future communication systems in 2020.

6.4.2 Business model

As a public educational institution, the Institut Mines-Telecom receives the main part of its funding from public authorities.

6.4.3 Exploitation strategy

The exploitation goals of Institut Mines-Telecom as an academic partner are different yet complementary to those of industrial partners in the METIS project. Institut Mines-Telecom aims at exploiting the project results for both educational and research purposes, besides technology transfer to leading-edge spin-offs.



- Institut Mines-Telecom will spread METIS results among academic and industrial communities by organising tutorial-style, summer schools and life-long learning courses.
- Institut Mines-Telecom will publish academic papers at international conferences and journals which will improve our international visibility and our position for attracting the best international PhD, Master and graduate level students.
- Institut Mines-Telecom will give Master and PhD students the opportunity to work on cutting-edge research in a European collaborative effort as well as by using the research results in the teaching process of undergraduate and graduate students, allowing courses and seminars to be taught using current technology and research results
- Institut Mines-Telecom will also make sure that the project developments will be carried into future national and international research (ANR, competitiveness clusters)
- Institut Mines-Telecom has a long tradition of spin-off creation for the transfer of innovative technologies from national and international projects. Potential means for Institut Mines-Telecom is to exploit the scientific and technological results obtained through its participation in the METIS project. More than 200 businesses in Institut Mines-Telecom incubators have been created since 2000 (Telecom area). Opportunities for patents will be considered before publications, in the course of the METIS project. Around 12 patents are filed per year at Institut Mines-Telecom (Telecom area).

6.4.4 Identification of knowledge transfer opportunities

The development of a new advanced coding and modulation scheme for beyond 2020 wireless communications, and the development of new concept in flexible hardware are a large research effort that not many groups/companies can handle. Moreover, the Institut Mines-Telecom might develop some technical solutions for decoding that could disrupt the current technological evolution. In this context, Telecom Bretagne has identified the following transfer knowledge opportunities:

- Opportunity #1: Joint patents with other METIS partners.
- Opportunity #2: Create novel courses on beyond 2020 technologies.

6.4.5 Description of business/transfer opportunities

The previously identified opportunities can be further developed as follows:

- Opportunity #1: Joint patents with other METIS partners.
 - Value proposition: companies pushing the standardisation process are heavily interested in getting new revolutionary ideas in the form of patents that could be defended in new standards. The know-how acquired by Telecom Bretagne in the framework of METIS could result in disruptive ideas that could create new business models.
 - Value creation: METIS consortium agreement allows the creation of joint side-ground resulting in joint patents. Telecom Bretagne could negotiate with other companies with capacity for defending the joint invention to share the revenues derived from the patent.
 - Revenue expectation: the revenues could be expected through the establishment of agreements between Telecom Bretagne and other companies sharing the invention.
- Opportunity #2: Create novel courses on beyond 2020 technologies.
 - Value proposition: further develop the training capabilities of Telecom Bretagne in the area of mobile and wireless communications, and in particular in beyond 2020 systems.



- Value creation: by integrating the knowledge acquired in METIS in its Master and Doctoral studies.
- Revenue expectation: by increasing the appeal of Master and Doctoral studies in telecommunications engineering, and increase the number of students.

6.4.6 Resulting SWOT analysis for exploitation

Table 1: Resulting SWOT Analysis for TB

Strengths	Weakness
Long experience in designing coding and modulation schemes for wireless communication systems	Lack of commercial force
Opportunities	Threats
METIS is a perfect showcase to demonstrate the Telecom Bretagne research potential. Develop and test advanced lattice codes and flexible hardware architecture for the research of beyond 2020 wireless systems	Resources needed for the adequate maintenance and evolution of the Telecom Bretagne capabilities to maintain its competitive advantages in the fast evolving field of mobile and wireless communications

6.4.7 First steps in the exploitation plan

According to the general exploitation strategy, short term actions comprise the following steps:

- Complete the state of the art regarding high spectral efficiency modulations.
- Make at least one significant contribution in standardisation forums in the framework of METIS to demonstrate the capabilities of Telecom Bretagne as associated partner.
- Adapt Master courses to include beyond 2020 technologies. Make publicity about these courses using Telecom Bretagne communication channels.
- Disseminate the main research results in conference and specialised journals.

6.5 Individual exploitation strategy University of Oulu

6.5.1 Partner profile

The Department of Communications Engineering (DCE) and CWC represent leading academic wireless communications research renowned by the world-wide research community. DCE started its operations as an independent department at the Faculty of Technology, the University of Oulu, on 1 August 2011. Formerly it was known as the Telecommunication Laboratory. The basic research conducted at DCE is divided into four research groups: Radio Access Technologies, Communication Signal Processing, Internetworking and Wireless Systems which concentrates mainly on application-oriented research. DCE aims to excel in academic performance by offering top-quality teaching and producing world-class graduates and top-level scientific publications. DCE runs its own international Master's programme "Wireless Communications Engineering" and offers a postgraduate curriculum under an international doctoral study programme.

The operations of the DCE are very international on all standards. Numerous double degree and research collaboration agreements ensure high mobility among the students and research staff. New forms of internationalisation include the establishing of a research unit in Japan, CWC Japan. The aim of CWC Japan is to better ensure the continuance of co-operation, to encourage new multi-disciplinary research topics, recognise new funding possibilities and to pilot a new form of international collaboration. The proposed research unit creates an ideal



opportunity to continue and extend the research cooperation between CWC and Japanese partners and to organise research visits, exchange researchers and produce joint publications. Another important form of international collaboration is the Finnish-US virtual institute called WIFIOUS (Wireless Innovation between Finland and US) which is funded by the National Science Foundation in U.S. and the Academy of Finland and Finnish Funding Agency for Technology, Tekes. In this collaboration joint research on cognitive radio technology and its applications is being funded. In five of the six funded projects DCE is having a central role.

CWC's own computing cluster has the capacity of 35 servers each containing 8 processors. Hardware design tools (like Mentor Graphics Catapult C and Xilinx AutoESL) are available for baseband implementation studies. For studies on infrastructure based access networks, DCE/CWC has acquired Elektrotbit's Radio Access Emulator (RACE) platform and PropSim F8 channel emulator which is a powerful tool supporting research as it combines MATLAB tool on real hardware, thus enabling fast and flexible testing of different solutions. The platform has been used, e.g. to demonstrate the WINNER+ radio concept aiming at IMT-A standard. The radio frequency antenna measurement laboratory is also well developed and under vivid development, because European Regional Development Fund enabled infrastructure investment activity RAMI will make the antenna and testbed environment more versatile for practical demonstrations and measurements of the RRM performance. CWC is also currently investing in experimental sensor network facilities which enable also practical demonstration of the concepts studied in this project.

6.5.2 Business model

The Department of Communication Engineering receive competitive funding from national agencies, industry and European sources. The annual budget is around 7M Euro. Numerous projects are undertaken in a given year and always new applications are being made. Traditionally therefore UOULU is known internationally as well as locally for its expertise in mobile communications through engagement in big EU projects such as WINNER, EARTH, BEFEMTO etc and local ones such as LOCON, COMIT, SGEM etc.

6.5.3 Exploitation strategy

- The research results will be published local, in international conferences and Journals.
- Several doctoral theses are expected to be produced.
- Several IPR applications are expected.
- Participation in workshops, sponsoring of tutorials.

6.5.4 Identification of knowledge transfer opportunities

- Training of doctoral students, postdocs through research work.
- Contribution to building of channel models through measurements which could be used in the future as a reference.
- Encouraging setting up of new start ups related to project outputs.

6.5.5 Description of business/transfer opportunities

Researcher training:

- Value proposition: further develop the training capabilities of DCE- UOULU in the area of mobile and wireless communications, and in particular in beyond 4G.
- Value creation: by integrating the knowledge acquired in METIS in its Master and Doctoral studies.
- Revenue expectation: by increasing the appeal of Master and Doctoral studies in communications engineering, and increase the number of students and also securing local complementary projects.



Contribution to building of channel models through measurements which could be used in the future as a reference:

- Value proposition: Use of new channel models for simulations in beyond 4G solutions.
- Value creation: Together with results from other activities produce a common platform
- Revenue expectation: the revenues could be expected through the establishment of research and consultancy contracts with telecom providers and manufacturers.

Encouraging setting up of new start ups related to project outputs:

- Value proposition: Support establishing new start ups to utilise results produced by the project
- Value creation: Utilise the joint patents to generate revenue.
- Revenue expectation: the revenues could be expected through the establishment of agreements between UOULU and start up companies.

6.5.6 Resulting SWOT analysis for exploitation

Table 3: Resulting SWOT Analysis for UOULU

Strengths	Weakness
Well connected local industry and research reputation with a team of good researchers and well known research tradition in the participation of big projects	General weakness of telecom industry due to challenges from competitors
Opportunities	Threats
METIS is a good opportunity to demonstrate the UOULU research potential in developing new technologies Develop new channel models to be used in beyond 4G environment	Attracting good researchers given the opportunities available elsewhere

6.5.7 First steps in the exploitation plan

According to the general exploitation strategy, short term actions comprise the following steps:

- Disseminate the main research results in conference and specialised journals.
- Participate in workshops
- Organise new courses and revise existing Masters and Doctoral course
- Integration of project work into doctoral theses

6.6 Individual exploitation strategy Poznan University of Technology

6.6.1 Partner profile

Poznan University of Technology (PUT) is one of the leading technical universities in Poland. It consists of ten faculties. More than 20000 students are educated within B.Ss., M.Sc. and Ph.D. studies. There are more than 1000 staff members working in education, science and administration. It is worth stressing that PUT is one of ten university-level schools located in Poznan.

Wireless Communication belongs in the main research areas within the Faculty of Electronics and Telecommunications. The research in this area is mainly performed in the Chair of Wireless Communications which consists of research groups focused on cellular radio and



digital communication systems (led by Prof. Krzysztof Wesolowski), WLANs (Prof. Pawel Szulakiewicz) and the Cognitive Radio (led by Prof. Hanna Bogucka). The research groups have gained a wide experience in research performed not only within the projects funded by the Polish Ministry of Science and Higher Education, but they have also participated in COST projects, the 5th Framework IST project WIND-FLEX, 6th Framework projects WINNER (IP), URANUS (STREP) and NEWCOM (NoE), 7th Framework projects NEWCOM++ (NoE), Galapagos and CELTIC/EUREKA project WINNER+. The research group which participates in METIS project is engaged in studies focused mainly on PHY and MAC layers, in particular on base-band processing algorithms, transceiver structures for wireless communications, radio resource management, scheduling algorithms, relaying issues, D2D communication and network coding. The research group has a wide experience in link and system level simulations of wireless systems and simulation and modelling of wireless channels. The research group members have also participated in the large national research project entitled "Future Internet Engineering" working on an advanced wireless access system.

6.6.2 Business model

As a public university, PUT receives a substantial part of its funding from Ministry of Science and Higher Education. However, higher and higher percentage of its funds originate from external sources gained in several competitions including call for projects announced by National Centre of Science, National Centre of Research and Development, agreements with industry and international projects, e.g. performed within the Seventh Framework Program of EU and COST initiatives. Currently, the staff members of the Faculty of Electronics and Telecommunications have tight contacts with several companies such as Nokia Siemens Networks, Samsung Electronics Poland, Orange Lab, Poland, Emitel Poland, several telecom operators, etc. It can be estimated that more than 70 percent of research funds originate from external sources different from the Ministry of Science and Higher Education.

6.6.3 Exploitation strategy

The exploitation strategy of PUT can be divided into the following areas:

- Academic & research exploitation plans:
 - The knowledge gained during research will be disseminated through publications in journals and conferences.
 - In case of developments having IPR and patent capabilities, especially obtained within the industrial partnership, PUT is going to preserve its IPR through common patents.
- Standardisation & industrial exploitation plans
 - PUT will participate in ITU-R and 3GPP forums offering its competence in PHY and MAC issues of beyond 2020 system technologies.
 - PUT will further develop its strong simulation capabilities within the research group with the possibility of acting as consulting team for external companies interested in a fair evaluation of system performance.

6.6.4 Identification of knowledge transfer opportunities

The PUT team members have identified the following transfer knowledge opportunities:

- Cooperation with external entities within the use of the developed system and link level simulation package.
- Consultancy on the design, testing and evaluation of beyond 2020 wireless solutions.
- Joint patents with other METIS partners.
- Updating curricula in the M.Sc. and post-diploma programs by inclusion of topics on beyond 2020 technologies.



6.6.5 Description of business/transfer opportunities

The details of above mentioned knowledge transfer opportunities are the following:

- Cooperation with external entities within the use of the developed system and link level simulation package.
 - The software package developed so far within the previous activities which will be further extended and enriched through the METIS project is a unique and valuable tool which can be used in solving several problems encountered by system developers and telecom operators.
 - The developed software package will allow evaluation of several relaying configurations, direct D2D links and radio resource management issues for newly developed systems beyond 2020.
 - PUT team members expect to increase the research and technological transfer contracts with industrial partners.
- Consultancy on the design, testing and evaluation of beyond 2020 wireless solutions.
 - The subject of expertise will be the simulation capabilities created by the PUT research team and its competence in new communication techniques.
 - It is expected that through the establishment of research and consultancy contracts with telecom operators and manufacturers interested in developing new techniques new revenues for the PUT research group will be created.
- Joint patents with other METIS partners.
 - PUT hopes to develop new communication techniques which will possess patent capabilities and can be incorporated into future system standards.
 - Patents can be developed within close cooperation with METIS industrial partners involved in the common research activities.
 - The revenues obtained by IPR protected by the jointly developed patents will be a subject of fair distribution among participating partners.
- Updating curricula in the M.Sc. and post-diploma programs by inclusion of topics on beyond 2020 technologies.
 - These activities will further develop the educational and training capabilities of PUT in the area of mobile and wireless communications, and in particular in beyond 2020 systems.
 - Offering new topics in Ph.D. and post-diploma courses will make their curricula more attractive to the participants and can bring some additional income on case of post-diploma studies for professionals.

6.6.6 Resulting SWOT analysis for exploitation

Table 4: Resulting SWOT Analysis for PUT

Strengths	Weakness
Strong capabilities of the developed simulation package enhancing its possibilities beyond current HSPA, LTE and LTE-A modelling	Insufficient prestige among industrial partners and insufficient PR activities
Opportunities	Threats
METIS is considered at PUT as a prestigious project to demonstrate general research capabilities of the university's research team and its simulation potential. Access and knowledge exchange with the	The necessity of continuous enhancement of material capabilities of PUT research tools, in particular computational capabilities (computer cluster allowing for multithread simulation runs)



best industrial and academic partners involved in the development of the future wireless systems which provides the possibility for being ahead of the majority of other academic institutions	
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6.6.7 First steps in the exploitation plan

According to the general exploitation strategy, short term actions consist of the following steps:

- Active dissemination of scientific results at high quality conferences and scientific journals
- Information on activities performed within METIS project (in conformance to the METIS publishing policy) in different conference and press fora.
- Presentation of METIS project on PUT webpage.
- Development of the short brochure describing possibilities and features of the simulation package developed at PUT.
- Participation in standardisation forums in the framework of METIS to demonstrate the capabilities of PUT as an associated partner.
- Adaptation of M.Sc., Ph.D. and post-diploma courses to include beyond 2020 technologies. Development of the proposal for new post-diploma studies devoted to beyond 2020 technologies.

6.7 Individual exploitation strategy Royal Institute of Technology KTH

6.7.1 Partner profile

The Royal Institute of Technology, KTH, in Stockholm is the largest, oldest and most international technical university in Sweden. No less than one-third of Sweden's technical research and engineering education capacity at university level is provided by KTH. Education and research spans from natural sciences to all the branches of engineering and includes architecture, industrial management and urban planning. The educational programmes lead to Bachelor, Master or PhD degrees in engineering, science, or architecture. There is a total of almost 14,000 undergraduate students and more than 1,700 active postgraduate students. KTH has just over 4,600 employees.

KTH was founded in 1827. It is an international university with many international researchers and students, especially at Master's level. Extensive international research and educational exchange programmes allow for exchange with universities and colleges in Europe, the U.S. and Australia, but also increasingly in Asia. KTH is a partner in several international university networks such as CLUSTER and T.I.M.E.

KTH is also a major partner in two out of three European Knowledge and Innovation Communities formed by the prestigious EU organisation EIT (European Institute of Innovation and Technology); InnoEnergy within the field sustainable energy and EIT ICT Labs within information and communication research. Five strategic multidisciplinary research platforms have been formed to further enhance KTH's attraction as a major strategic research partner.

Several national research centres are hosted by KTH among them: the ACCESS Linnaeus Center – "Autonomic Complex Communication nEtworks, Signals and Systems" – and Wireless@KTH – "KTH Center for Wireless Systems".

ACCESS Linnaeus Centre has enabled KTH to bring together 160 researchers from Electrical Engineering, Computer Science, and Mathematics in order to carry out long-term interdisciplinary research and joint PhD education on complex networked communication systems.



Wireless@KTH is an interdisciplinary research centre that connects more than 50 researchers in the areas of telecommunications and tele-economics at KTH, the Stockholm School of Economics and Stockholm University. Beside its main industry partners Ericsson and TeliaSonera, the centre brings together a network of around 40 industry partners, many of them SME.

6.7.2 Business model

KTH is a Swedish public educational institution and receives the main part of its funding from National public authorities. In addition KTH receives funding from the EU Commission and industry through donations and contract research.

6.7.3 Exploitation strategy

KTH exploitation plan can be categorised into three parts:

1. International conferences and journals are the most typical places to disseminate the knowledge to global research community. We have published a number of papers to renowned conferences and journals such as IEEE DySPAN, IEEE WCNC, IEEE PIMRC, IEEE ICC, IEEE ISIT, CROWNCOM, URSI GASS, ITS conferences, and IEEE Communications Letters. KTH will proceed with publication of papers to selected conferences and journals. The targets include IEEE DySPAN, IEEE Wireless Communications Magazine, IEEE Communications Magazine, IEEE Transactions on Communications, IEEE Transactions on Wireless Communications, IEEE Transactions on Vehicular Technology, IEEE Transactions on Information Theory, and Telecommunications Policy.
2. Secondly KTH will provide inputs to regulators, standardisation bodies, and policy discussion fora. KTH has a strong relationship with PTS, the Swedish regulator and believes that METIS results about spectrum may be an excellent input to the regulators for them to plan for system deployment beyond 4G.
3. Finally, the METIS results will be used as inputs to other research projects. In particular, KTH will be involved in the 5GrEEn project which is a EIT ICT Labs project starting in the beginning of 2013 with METIS as its carrier project. This activity will add the energy efficiency dimension in 5G Mobile network solutions based on converged wireless-fiber infrastructure considering the evolution of today's solutions such as LTE. In this regard, the METIS will be extended with energy-efficiency concern.

By applying the "Technology Transfer" catalyst, this know how will be transferred within partners to develop close-to-customer solutions. A few years from now the next generation system will be entering a standardisation process. Therefore, it is important to include energy awareness into this process.

METIS will also provide useful input to the project RAMCOORAN, where Ericsson is a partner. Here METIS will be important in particular for the tested activities in RAMCOORAN, carried out at KTH and Ericsson.

6.7.4 Identification of knowledge transfer opportunities

The development of wireless communications technologies for systems beyond 2020 is an enormous research effort that by itself is a fantastic opportunity to be part of. In addition KTH has identified the following transfer knowledge opportunities:

- Opportunity #1: Joint patents with other METIS partners.



- Opportunity #2: Create novel courses on beyond 2020 technologies.
- Opportunity #3: Consultancy on the design, testing and evaluation of beyond 2020 wireless solutions.

6.7.5 Description of business/transfer opportunities

The opportunities identified above can be further developed as follows:

- Opportunity #1: Joint patents with other METIS partners.
 - Value proposition: companies pushing the standardisation process are heavily interested in getting new revolutionary ideas in the form of patents that could be defended in new standards. The know-how acquired by KTH in the framework of METIS could result in disruptive ideas that could create new business models.
 - Value creation: METIS consortium agreement allows the creation of joint side-ground resulting in joint patents. KTH could negotiate with other companies with capacity for defending the joint invention to share the revenues derived from the patent.
 - Revenue expectation: the revenues could be expected through the establishment of agreements between KTH and other companies sharing the invention.
- Opportunity #2: Create novel courses on beyond 2020 technologies.
 - Value proposition: further develop the training capabilities of KTH in the area of mobile and wireless communications, and in particular in beyond 2020 systems.
 - Value creation: by integrating the knowledge acquired in METIS in its Master and Doctoral studies.
 - Revenue expectation: by increasing the appeal of Master and Doctoral studies in telecommunications engineering, and increase the number of students.
- Opportunity #3: Consultancy on the design, testing and evaluation of beyond 2020 wireless solutions.
 - Value proposition: having access to unique know how which will increase the capacity of KTH to conduct state of the art research in beyond 2020 wireless solutions.
 - Value creation: this capacity, together with KTH's world leading expertise in wireless networks, will provide a great advantage for KTH to develop novel system solutions for the 5th generation of mobile networks.
 - Revenue expectation: the revenues could be expected through the establishment of research and consultancy contracts with telecom providers and manufacturers interested in further developing intelligent techniques to be incorporated in future standards.

6.7.6 Resulting SWOT analysis for exploitation

Table 5: Resulting SWOT Analysis for KTH

Strengths	Weakness
+20 years of Excellent Track record of research in wireless Close relation to Ericsson and numerous other companies in the Wireless communication area located in Stockholm, Sweden Close and long term relations to	Few examples of commercialised results



regulators and standardisation bodies Large group of researchers with long experience from both industry and academia	
Opportunities	Threats
Establish KTH as a leading player in 5G	Lack of junior resources due to difficulties in recruiting

6.7.7 First steps in the exploitation plan

According to the general exploitation strategy, short term actions comprise the following steps:

- Disseminate main research results in conference and journals.
- Make significant contributionsto the standardisation forums such as 3GPP and ETSI
- Identify new inventions that could be jointly patented.
- Adapt Master courses to include beyond 2020 technologies.
- Make periodic public announcements about KTH activities within METIS.

6.8 Individual exploitation strategy of RWTH Aachen University

6.8.1 Partner profile

RWTH Aachen University is one of Germany’s leading universities of technology founded in 1870. It offers degrees in the different engineering areas, natural sciences, and medicine as well as in humanities, business and economics. It is renowned for its strong orientation towards industrial applications and has a leading position among German universities in third party research funding for many years already. In the excellence initiative of the German Federal and State Governments, RWTH Aachen was selected as University of Excellence and awarded – after thorough evaluation by renowned international scientists - funding of three research clusters, one of them being a cluster with focus on mobile communication technology (UMIC). This cluster was the basis of today’s UMIC Research centre. In the focus of UMIC are ultra high-speed mobile information and communication systems supporting the demands of future mobile applications and systems. Being an academic research centre with strong links to wireless industry and mobile network operators, activities cover research on basics concepts and new paradigms, on key solutions and tools, the development of prototypes and demonstrators, and the technology transfer to industry. A major strength of the UMIC research cluster is the interdisciplinary research combining the expertise of more than 15 institutes from computer science and electrical engineering and covering all aspects from mobile applications, networks and terminals down to design and implementation of radio frequency subsystems and multi-processor systems on chip.

Two chairs of RWTH Aachen are engaged in METIS: Integrated Signal Processing Systems (Prof. Dr. Gerd Ascheid, ISS) and Institute for Integrated Analog Circuits and RF Systems (Prof. Dr. Stefan Heinen, IAS). Both chairs have strong expertise in the fields of wireless communication demonstrated by their publication records and involvement in numerous related research projects. In addition, both chairs have leading roles in the above mentioned research cluster on “Ultra high-speed Mobile Information and Communication (UMIC)”, covering fields matching the investigated aspects within the METIS project. Thus, the participation also creates strong ties between the UMIC Research Centre of RWTH Aachen University and the METIS project.

ISS is part of the Institute of Communications Technologies and Embedded Systems (ICE) and is jointly directed by Prof. Gerd Ascheid (Chair for Integrated Signal Processing Systems, ISS), Prof. Rainer Leupers (Chair for Software for Systems on Silicon, SSS), and Prof.



Anupam Chattopadhyay (Research Group MPSoC Architectures, UMIC Research Cluster), who collaborate closely in research and complement each other with their expertise.

The institute is structured into three tightly connected research groups (algorithms, architectures, and tools), thereby having the critical mass to cover all major aspects of system design. Eighty percent of the ISS's funds are from third partner projects from public sources as well as from partners in industry. In industry, the ISS has several collaborations (Alcatel Lucent, Huawei, Synopsys, ACE, Fraunhofer FKIE, and Deutsche Telekom).

Institute for Integrated Analog and RF systems (IAS) is headed by Prof. Dr. Stefan Heinen and Associate Professor Dr. sc. techn. Renato Negra. The research activities at IAS are focused on RF receivers, RF power amplifiers, integrated power electronics (DC-DC, PV systems) and also basic analog circuit design for Biomedical and Sensor read out Circuits. Most of the projects are funded by public sources like JU, BMBF, DFG, BmWi and also partners from industry (Infineon, Intel, TI, Fraunhofer and Cadence).

6.8.2 Business model

RWTH Aachen University is one of Germany's leading universities of technology with a funding of around 750 million Euros, where more than 300 Million Euros arise from third party funds. Major third party funding sources are the national science foundation (DFG), European Union and Industry partners.

6.8.3 Exploitation strategy

RWTH will address the exploitation strategy in the following aspects:

- Academic and research:
 - Research outcomes obtained by participating in METIS will be published in journals, conferences and workshops. Some of the technologies can be applied in academic activities, e.g. lectures and seminars.
 - The academic contributions can be achieved by developing our simulation platforms and joint research activities within the research clusters of partners from METIS.
- Industrial cooperation
 - Invention and patent possibilities can be evaluated and addressed together with industrial partners within METIS.
 - RWTH can acquire the opportunity to participate in the technical consultancy for operators, vendors and spin-off companies by our active involvement in METIS.

6.8.4 Identification of knowledge transfer opportunities

Having a thorough profile of theoretical and implementation-related knowledge is essential for coping with the complexity of future developments in mobile communications. In addition to the main research, it is important to push knowledge and communication designs derived from these research efforts into future standards and industry developments. UMIC Research Centre is an advisor for the Next Generation Mobile Networks (NGMN) alliance, an organisation of leading mobile network operators. As described before, RWTH is strongly connected to industry by projects and knowledge exchange, which facilitates future progressions in this part. In fact, there is a number of main business and knowledge transfer opportunities for RWTH in future:

- Opportunity 1: Consulting, development and project activities with industry in the field of future wireless technologies.
- Opportunity 2: Patents derived from the institute research.
- Opportunity 3: Toolchain fundament for PHY layer simulation and development.
- Opportunity 4: Knowledge transfer between kogLTE and METIS
- Opportunity 5: Knowledge transfer by academic teaching activities.



6.8.5 Description of business/transfer opportunities

The opportunities are specified as follows:

- Opportunity 1: Consulting, development and project activities with industry in the field of future wireless technologies.
 - Value proposition: The broad knowledge base of mobile communications at ICE in conjunction with its continuous research pioneering work makes ICE a valuable resource for industry partners and enables them by ongoing and future consulting and project work to benefit significantly in their business.
 - Value creation: Value is directly created through the yields of cooperative research efforts. In addition, indirect value is created by using further funds to facilitate future lines of research.
 - Revenue model: Industry cooperations directly generate revenue by consulting and project contracts.
- Opportunity 2: Patents derived from the institute research.
 - Value proposition: The research work of ICE during METIS and other projects yields patents in collaboration with industry partners.
 - Value creation: Value is created by the amount of patents. After METIS, in a possible standardisation process, industry partners can benefit from the property rights gained in the METIS collaborations.
 - Revenue model: Revenue is generated by patent fees.
- Opportunity 3: Toolchain fundament for PHY layer simulation and development.
 - Value proposition: For being able to cope with future developments in PHY layer waveform and transceiver design, it is paramount to have comprehensive
 - Toolchains,
 - Testbeds,
 - Optimised libraries, and
 - Simulation platforms, for enabling quick verification of new concepts during the component design process.
 - Value creation: Value is indirectly created by pursuing future opportunities and having an excellent fundament for research and development efforts.
 - Revenue model: Revenue is created by the research yielding future scientific outcome, e.g. knowledge, publications and hardware designs.
- Opportunity 4: Knowledge transfer between kogLTE and METIS
 - Value proposition: kogLTE is BMBF funded project (FKZ 16BU1210) where IAS is responsible for the RF front end design for cognitive LTE application. The knowledge transfer between kogLTE and METIS (WP2) will strengthen the concepts to adapt cognitive radio techniques for future radio systems.
 - Value Creation: Value is created by pursuing future opportunities and having excellent fundamentals for research and development efforts.
 - Revenue Model : No direct revenue is yielded by this opportunity, but scientific reputation and future projects and cooperation
- Opportunity 5: Knowledge transfer by teaching activities.
 - Value proposition: Knowledge acquisition is directly depending on the manpower available and requires a future-oriented excellence in teaching giving students and researchers access to state-of-the-art technologies and concepts.
 - Knowledge Value creation: Value is, as mentioned before, shown in the research and teaching concepts.
 - Revenue model: No direct revenue is yielded by this opportunity, but scientific reputation and future manpower are mandatory



6.8.6 Resulting SWOT analysis for exploitation

Strengths:

- Research staff with prior extensive experience in implementation aspects of digital processing algorithms including positive cases in tackling the barriers of mobile transceiver enhancement and cellular capabilities.
- Related research excellence in relevant fields with good scientific collaboration and publication record that enables knowledge transfer and sharing.
- Past participation in FP7 ICT and NEWCOM++ R&D activities in the topic of computing systems and architectural designs.
- Excellent ties to wireless communication industry and mobile network operators.
- Strong wireless industry and mobile network operator presence in region

Weaknesses:

- Commercial exploitation of results directly by University (e.g. through licensing)

Opportunities:

- Broader approach to problems of mobile communication 2020 by METIS induced partnering with other research groups.
- Extension of existing experimental platforms to encompass innovative ideas pursued in METIS.

Threats:

- Wireless industry moving out of Europe.

6.8.7 First steps in the exploitation plan

RWTH is planning to exploit preliminary METIS results in several ways:

- As a key element in educational exploitation, technical innovation will be integrated quickly not only into the mainstream of teaching curriculum in wireless communication systems but also to student thesis to facilitate competitive edge to graduate level students.
- Harmonising research activities at ICE/IAS to serve project goals and make sure that achievements and developments are carried to future projects, enabling broader acceptance of METIS research outcome.
- Organising seminars/tutorials and publishing magazine articles to spread METIS approaches to outside academic and industrial communities.
- Improve international visibility by publishing results in high-quality conferences and journals.

6.9 Individual exploitation strategy University of Athens

NKUA will disseminate its findings in terms of METIS project in international scientific conferences, journals and magazines. Furthermore, NKUA aims at actively contributing the project's outcomes in standardisation bodies and fora. The scientific knowledge obtained via participating in METIS will facilitate the production of PhD and master theses; whereas it will be directly fused to the university courses of NKUA. Internal workshops as regards the evolution of telecommunications beyond 2020 will be organised so as to stimulate the local research and the department's researchers to work towards these directions. Cooperation with other universities and companies will also take place so as to extent the obtained knowledge through collaboration and synergies especially in complementary scientific areas. Moreover, exploitable results will be targeted for product development through the group's spin-off company.

6.10 Individual exploitation strategy of University of Bremen

6.10.1 Partner profile

The University of Bremen(UB) was founded in 1971 and is among Germany's top universities regarding third-party funding. UB is the largest university in the region, with more than 19,000 students and 3,000 employees, including about 300 professors. In 2012 the University of Bremen was successful in the Excellence Initiative as one of eleven universities in Germany. The Department of Communications Engineering was founded in 1995, with Prof. Dekorsy newly appointed head in April 2010. The current staff published more than 200 research papers and consists of more than 10 researchers. The Department of Communications Engineering conducts research in the area of data transmission with thematic priority on wireless transmission systems, especially addressing next generation mobile communication systems and wireless sensor networks. The individual research projects can be assigned to the three areas of signal processing, transmitter and receiver structures, and resource allocation. Examples of current essential topics are: cooperative and distributed transmitter and receiver methods (relaying), joint optimisation of network coding and resource allocation, adaptive multi antenna concepts and the signal processing concept of compressive sensing/sampling. In addition to theoretical and conceptual studies, the research group develops methods and algorithms for future applications with performance verifications done by simulations and hardware implementations. The department owns a laboratory including a computer network and a hardware platform of Lyrtech Inc. Prof. Dekorsy is currently involved in a series of German government funded research projects and has long year experience in conducting European funded research projects like C-Mobile, WINNER+, ARTIST4G, and BeFemto.

6.10.2 Business model

As a public educational institution, the University of Bremen receives part of its funding from public authorities. In addition the University of Bremen is under the top 3 of universities in Germany regarding third-party funding from the German Research Council (Deutsche Forschungsgemeinschaft) and is top ranked in requiring third-party funding also from industry. On one hand the University of Bremen is organised by faculties mainly conducting the academic business. On the other hand research groups belong to internal research centres mainly focusing on technology transfer and applied research. The Department of CommunicationsEngineering is a member of the research centre "Technologiezentrum Informatik und Informationstechnik". The department performs its research activities in the field of signal processing and communication technologies. Approximately 80 percent of the department funds come from national and international research projects. It is worth noting that the department has taken part in many projects of different focus programs of the German Research Council, e.g. it is currently partner of the program "Communication in Interference Limited Networks (COIN)" dealing with advanced relaying concepts.

Besides conducting fundamental research, the department also focuses on the transfer of knowledge and expertise by collaborating with non-academic research institutes or industry partners. Major industry partners are Alcatel-Lucent, NTT DOCOMO, and Phoenix Contact. This transfer of technology has been carried out in diverse forms, which go from technical studies up to contracts of certain importance.

6.10.3 Exploitation strategy

University of Bremen has divided its exploitation strategy in two lines:

- Academic & research exploitation plans:
 - The Department of Communications Engineering publishes and disseminates its technical findings in various international conferences, respected journals and popular magazines, and also participates in organising workshops.



- The Department of Communications Engineering uses the research experience gained in projects for the advancement of knowledge, education, and training in the field. More precisely, the knowledge gained will be used to enhance lecture materials for both undergraduate and postgraduate courses (delivered to a wide spectrum of international and home students).
- The experience gained during the course of projects is used to identify new research challenges for on-going and future MSc and PhD projects.
- **Standardisation & industrial exploitation plans**
 - As member of the “Technologiezentrum Informatik und Informationstechnik” the Department of Communications Engineering is active in several (European) research fora such as the Net!Works platform, WWRF and will actively participate in the recently founded OneM2M forum in the near future. In this framework the Department offers its support to foster the evolution of communication technologies from a strategic perspective by its expertise in the communication technology business.
 - By conducting bi-lateral collaborations with industry partners the Department transfers its expertise and knowledge to support its partner in the exploitation of innovative concepts in standardisation and the industrial development of technologies.

6.10.4 Identification of knowledge transfer opportunities

The knowledge transfer opportunities of the Department are fully in line with the above mentioned exploitation plans. The knowledge relies to concepts, algorithmic and technical solutions in the area of signal processing and wireless communications. The work done is fundamental research as well as applied research belonging to the pre-standardisation phase of the development chain of a certain technology. Hence, UB can transfer such expertise to drive the evolution of technologies by disruptive innovative approaches. In particular, with this objective in mind the following transfer knowledge opportunities occur:

- Opportunity #1: publishing and disseminating its technical findings in international conferences, respected journals and popular magazines.
- Opportunity #2: Joint patents with other METIS partners.
- Opportunity #3: Create novel courses and projects on beyond 2020 technologies.

6.10.5 Description of business/transfer opportunities

The previously identified opportunities can be further developed as follows:

- Opportunity #1: Publications
 - Value proposition: Publications are a great platform for disseminating validated discovery. Peer-reviewed journals provide a powerful opportunity to communicate clearly with those working in the same field (social networking), and publications in general serve as the primary basis for the evolution of technologies, and, consequently for the socio-economic evolution of a society.
 - Value creation: Beyond all of this, publications allow you to connect with all players belonging to the value chain of a technology evolution enriching the understanding of products, their unique benefits, and a more thorough and comprehensive understanding of the technology process.
- Opportunity #2: Joint patents with other METIS partners.
 - Value proposition: companies pushing the standardisation process are heavily interested in getting new revolutionary ideas in the form of patents that could be defended in new standards. The know-how acquired by UB in the framework of METIS could result in disruptive ideas that could create new business models.
 - Value creation: METIS consortium agreement allows the creation of joint side-ground resulting in joint patents. UB could negotiate with other companies with



- capacity for defending the joint invention to share the revenues derived from the patent.
- Revenue expectation: the revenues could be expected through the establishment of agreements between UB and other companies sharing the invention.
- Opportunity #3: Create novel courses and projects on beyond 2020 technologies.
 - Value proposition: further develop the teaching capabilities of UB in the area of signal processing and wireless communications, and in particular in beyond 2020 systems.
 - Value creation: by integrating the knowledge acquired in METIS in its Master and Doctoral studies.
 - Revenue expectation: by increasing the appeal of Master and Doctoral studies in telecommunications engineering, and increase the number of students.

6.10.6 Resulting SWOT analysis for exploitation

Table 2: Resulting SWOT Analysis for UB

Strengths	Weakness
Innovative research paves the way for new technologies and offers to gain a thorough and deep understanding of these technologies. UB has long expertise in conducting research, the transfer of results, and keeping the education of students up to date with new technologies	Lack of commercial support by the Bremen government to establish and maintain non-professional teaching staff or senior researchers, respectively
Opportunities	Threats
METIS is the perfect project to transfer fundamental academic research concepts to applied research in order to foster the European industry by innovative, but applicable wireless communications concepts	Resources needed for the adequate maintenance and evolution of the UB capabilities

6.10.7 First steps in the exploitation plan

According to the general exploitation strategy, short term actions comprise the following steps:

- Disseminate main research results in conferences and specialised journals.
- Support the organisation of METIS Workshops (e.g. TPC membership).
- Identify patent capacities and try to summarise new inventions that could be jointly patented.
- Adapt Master and PhD projects to include beyond 2020 technologies. Make publicity about these courses using UB communication channels.
- Make periodic press releases about the activity of UB within METIS.



6.11 Individual exploitation strategy of University of Kaiserslautern

6.11.1 Partner profile

UKL was founded in 1970 and is today one of Germany's leading universities with a research focus in the areas on technology and natural science. It has about 13.000 students in twelve departments. The Chair for Wireless Communications and Navigation (CWCN) led by Professor Schotten has extensive experience in European and national research projects dealing with cellular systems and specialised wireless solutions for automotive, public transportation, industrial applications, transport and logistics, and cyber-physical systems.

In 2012, Professor Schotten was appointed Scientific Director at the German Research Center for Artificial Intelligence (DFKI) where he is responsible for developing "Intelligent Network" solutions for new industry domains.

The CWCN is member in ETSI, Net!Works, NEM, contributing to CEPT, and member of the Commercial Vehicle Alliance and the Ambient Systems Cluster (AMSYS).

6.11.2 Business model

As a public university, the University of Kaiserslautern receives parts of its funding from the State of Rhineland-Palatinate. In addition, the University of Kaiserslautern extensively acquires third party projects funded by EU programmes, German national research programmes, state and federal excellence initiatives, the German National Science Council (DFG), as well as from a wide range of industrial partners. In addition, the Department of Electrical and Information Engineering receives funding for collaborations in education with European and international partners by the Erasmus Mundus programme, European Networks of Excellence, the German excellence in education initiative, as well as trilateral German-French-African programmes.

6.11.3 Exploitation strategy

UKL will provide key findings of METIS to other projects as the German spectrum management project CoMoRa and its broad range of spectrum related collaborations with operators and administrations. Other areas where already existing collaborations and research projects will directly benefit are networks for dependable services and "beyond cellular" next generation network concepts.

UKL has divided its exploitation strategy in two lines:

- Academic & research exploitation plans:
 - UKL will support the dissemination of METIS results by publications and tutorials on key concepts and scientific results. Results of METIS will help to steer the research directions, Master and PhD work and it will be reflected in lectures.
- Standardisation & industrial exploitation plans
 - UKL is active in several (European) research and standardisation fora such as the Net!Works and NEM platforms and ETSI. In this framework and based on its association with the DFKI, the CWCN offers its support to foster the evolution of communication technologies from a strategic perspective by its expertise in the communication technology business.
 - By conducting bi-lateral collaborations and consulting with industry partners, UKL transfers its expertise and knowledge to support its partner in the



exploitation of innovative concepts in standardisation and the industrial development of technologies.

6.11.4 Identification of knowledge transfer opportunities

The knowledge transfer opportunities of the CWCN are in line with the above mentioned exploitation plans. The knowledge relies to concepts, algorithmic and technical solutions as well as evaluation methodologies and tools in the area of wireless communications and systems engineering. The following transfer knowledge opportunities occur:

- Opportunity #1: Publishing results in international conferences, respected journals and popular magazines.
- Opportunity #2: Filing joint patents with METIS partners.
- Opportunity #3: Creating novel courses and projects on beyond 2020 technologies,
- Opportunity #4: Contributing to regulatory and standardisation activities (CEPT, ETSI),
- Opportunity #5: Consulting industrial partners in new domains that need expertise in wireless.

6.11.5 Resulting SWOT analysis for exploitation

Table 7: Resulting SWOT Analysis for UKL

Strengths	Weakness
UKL has a long history in developing future wireless systems and extensive industry contacts. In recent years, several projects with industry players in automotive, public transportation, smart grids, PPDR, and automation allowed to build a broad background on specialised wireless solutions	IPR exploitation support at UKL is still limited
Opportunities	Threats
METIS is the perfect project to transfer fundamental academic research concepts to applied research in order to foster the European industry by innovative, but applicable wireless communications concepts	Resources needed for the adequate maintenance and evolution of the UKL capabilities

6.11.6 First steps in the exploitation plan

According to the general exploitation strategy, short term actions comprise the following steps:

- Publishing results in conferences and specialised journals.
- Support the organisation of METIS Workshops.
- Develop dissemination material as video clips that help to explain key METIS ideas.
- Introduction of seminars and courses on Beyond 2020 wireless infrastructure and 5G.
- Support METIS dissemination in regulatory bodies.

6.12 Individual exploitation strategy Universitat Politècnica de València

6.12.1 Partner profile

Universitat Politècnica de València (UPVLC) is a public, dynamic and innovative institution that is dedicated to researching and teaching. The UPVLC maintains strong bonds with its social environment and a strong presence abroad. Currently, the university community consists of over 42.000 people. Of these, nearly 37.800 are students, 2.600 are members of the teaching and research staff and 1.700 are administrative and services personnel. UPVLC is composed of 10 schools, 3 faculties and 2 higher polytechnic schools. University research institutes are highly valued centres devoted to either artistic, technical and/or scientific research. One of them, the University Institute of Telecommunications and Multimedia Applications (iTEAM) is a research centre integrated in the Polytechnic City of Innovation, the new scientific park located at the UPVLC. The iTEAM Institute performs its research and development (R&D) activities in the field of Information Society Technologies (IST). The iTEAM is integrated by 9 research groups recognised by UPVLC, joining more than 140 researchers, who cover all the scientific areas related to the Telecommunication Engineering field. The Mobile Communications Group of the iTEAM Institute will provide its expertise in the design of the Internet of the Future. iTEAM has a large expertise in the development of PHY and MAC layer protocols for the enhancement of end-user performance. Moreover, past experience in the external evaluation group for the ITU-R body makes iTEAM have a favourable position to go beyond 4G. iTEAM possesses a complete protocol stack implementation of both IMT-Advanced technologies, which allows migrating these capabilities towards the future system concept devised in 2020.

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6.12.2 Business model

As a public educational institution, the UPVLC receives part of its funding from public authorities. On the other hand, the Institute of Telecommunications and Multimedia Applications (iTEAM) is a research centre integrated in the Polytechnic University of Valencia with direct management of its funds. The Institute performs its research and development (R&D) activities in the field of the Information Society Technologies (IST). Within iTEAM, the former structure of small research groups in being transformed into Areas of Research. Fifty percent of the iTEAM's funds come from national and international research projects. It is worth noting that the iTEAM has taken part in project summons of I+D+I belonging to the National Plan from 1996 and the three last EU Framework Programs.

On the other hand, the iTEAM is also very close related to national and international companies and entities of the Telecommunications Sector. Collaborations with Motorola, Indra, Abertis Telecom, Teltronic, Vossloh, Vodafone Foundation, LG, Samsung and BMW are remarkable. This transfer of technology has been carried out in diverse forms, which go from technical studies up to contracts of certain importance.

6.12.3 Exploitation strategy

UPVLC has divided its exploitation strategy in two lines:

- Academic & research exploitation plans:
 - Pertinent knowledge must be disseminated through publications in journals and conferences and the participation in trials.



- UPVLC can make use of the new platform in other for a putting extreme value in its participation in high level research with manufacturers, operators and other industrial/research partners
- Standardisation & industrial exploitation plans
 - UPVLC is willing to take part of ITU-R and 3GPP forums. In this framework UPVLC can be seen as a valuable partner for other companies participating in these forums since our know-how about beyond 2020 technologies could help in the standardisation phase.
 - Development of the simulation capabilities of the group with the possibility of acting as external consultancy group for big operators and end companies interested in a fair evaluation of system performance.

6.12.4 Identification of knowledge transfer opportunities

The development of a wireless communications simulation platform for beyond 2020 technologies is by itself a large research effort that not many groups/companies can handle. In addition, the capability to simulate different use case scenarios can increase its industrial appeal. Moreover, UPVLC could find out some technical solutions that could disrupt the current technological evolution. In this context, the iTEAM laboratory at UPVLC has identified the following transfer knowledge opportunities:

- Opportunity #1: Licensing the use of the simulation platform.
- Opportunity #2: Consultancy on the design, testing and evaluation of beyond 2020 wireless solutions.
- Opportunity #3: Joint patents with other METIS partners.
- Opportunity #4: Create novel courses on beyond 2020 technologies.

6.12.5 Description of business/transfer opportunities

The previously identified opportunities can be further developed as follows:

- Opportunity #1: Licensing the use of the simulation platform.
 - Value proposition: the development of a complete heterogeneous simulation platform has been an important research asset for UPVLC since its beginnings. Its further extension to new test cases and beyond 2020 technologies, increases the research capabilities of the UPVLC in the area of mobile communication systems.
 - Value creation: the expected benefit is created by the possibility to accurately evaluate at the system level the user-perceived QoS in LTE/LTE-A and beyond 2020 systems. This provides the possibility to exhaustively investigate novel resource management techniques and algorithms.
 - Revenue expectation: as the developer of the simulation platform, UPVLC expects to increase the research and technological transfer contracts with industrial partners.
- Opportunity #2: Consultancy on the design, testing and evaluation of beyond 2020 wireless solutions.
 - Value proposition: having access to an important and calibrated wireless simulation platform increases the capacity of the UPVLC to conduct state of the art research in beyond 2020 wireless solutions.
 - Value creation: this capacity, together with its extended expertise in radio resource management, will provide advanced tools to UPVLC to develop novel system solutions for interference management, transmission and reception, which could not be exhaustively tested without having access to an advanced simulation platform.



- Revenue expectation: the revenues could be expected through the establishment of research and consultancy contracts with telecom providers and manufacturers interested in further developing intelligent techniques to be incorporated in future standards.
- Opportunity #3: Joint patents with other METIS partners.
 - Value proposition: companies pushing the standardisation process are heavily interested in getting new revolutionary ideas in the form of patents that could be defended in new standards. The know-how acquired by UPVLC in the framework of METIS could result in disruptive ideas that could create new business models.
 - Value creation: METIS consortium agreement allows the creation of joint side-ground resulting in joint patents. UPVLC could negotiate with other companies with capacity for defending the joint invention to share the revenues derived from the patent.
 - Revenue expectation: the revenues could be expected through the establishment of agreements between UPVLC and other companies sharing the invention.
- Opportunity #4: Create novel courses on beyond 2020 technologies.
 - Value proposition: further develop the training capabilities of UPVLC in the area of mobile and wireless communications, and in particular in beyond 2020 systems.
 - Value creation: by integrating the knowledge acquired in METIS in its Master and Doctoral studies.
 - Revenue expectation: by increasing the appeal of Master and Doctoral studies in telecommunications engineering, and increase the number of students.

6.12.6 Resulting SWOT analysis for exploitation

Table 8: Resulting SWOT Analysis for UPVLC

Strengths	Weakness
Big Simulation Capabilities in a Dynamic Platform with all Cellular Technologies (IEEE/3GPP) covered. Privileged position for the design of beyond 2020 technologies	Lack of commercial force. Strong bias of the manufactures towards research centres in northern Europe
Opportunities	Threats
METIS is a perfect showcase to demonstrate the UPVLC simulation and research potential. Develop and test advanced resource management techniques unique software simulation environment for the research of beyond 2020 wireless systems	Resources needed for the adequate maintenance and evolution of the UPVLC capabilities to maintain its competitive advantages in the fast evolving field of mobile and wireless communications

6.12.7 First steps in the exploitation plan

According to the general exploitation strategy, short term actions comprise the following steps:

- Complete a friendly interface for the simulation tool, most likely based on a web interface. Show this application in different forums, including iTEAM internal dissemination strategy.



Document: ICT-317669-METIS/D7.1

Date: 06/03/2013

Security: Public

Status: Final

Version: 1

- Make at least one significant contribution in standardisation forums in the framework of METIS to demonstrate the capabilities of UPVLC as associated partner.
- Identify patent capacities and try to summarise new inventions that could be jointly patented. Distribute the patent roadmap among main partners.
- Adapt Master courses to include beyond 2020 technologies. Make publicity about these courses using UPVLC communication channels.
- Make periodic press releases about the activity of the UPLVC within METIS.
- Disseminate the main research results in conference and specialised journals.