3GPP TSG RAN#28 **Tdoc RP-050376**

Quebec, Canada, 1st –3rd June 2005

The WINNER project, and related resources available to 3GPP

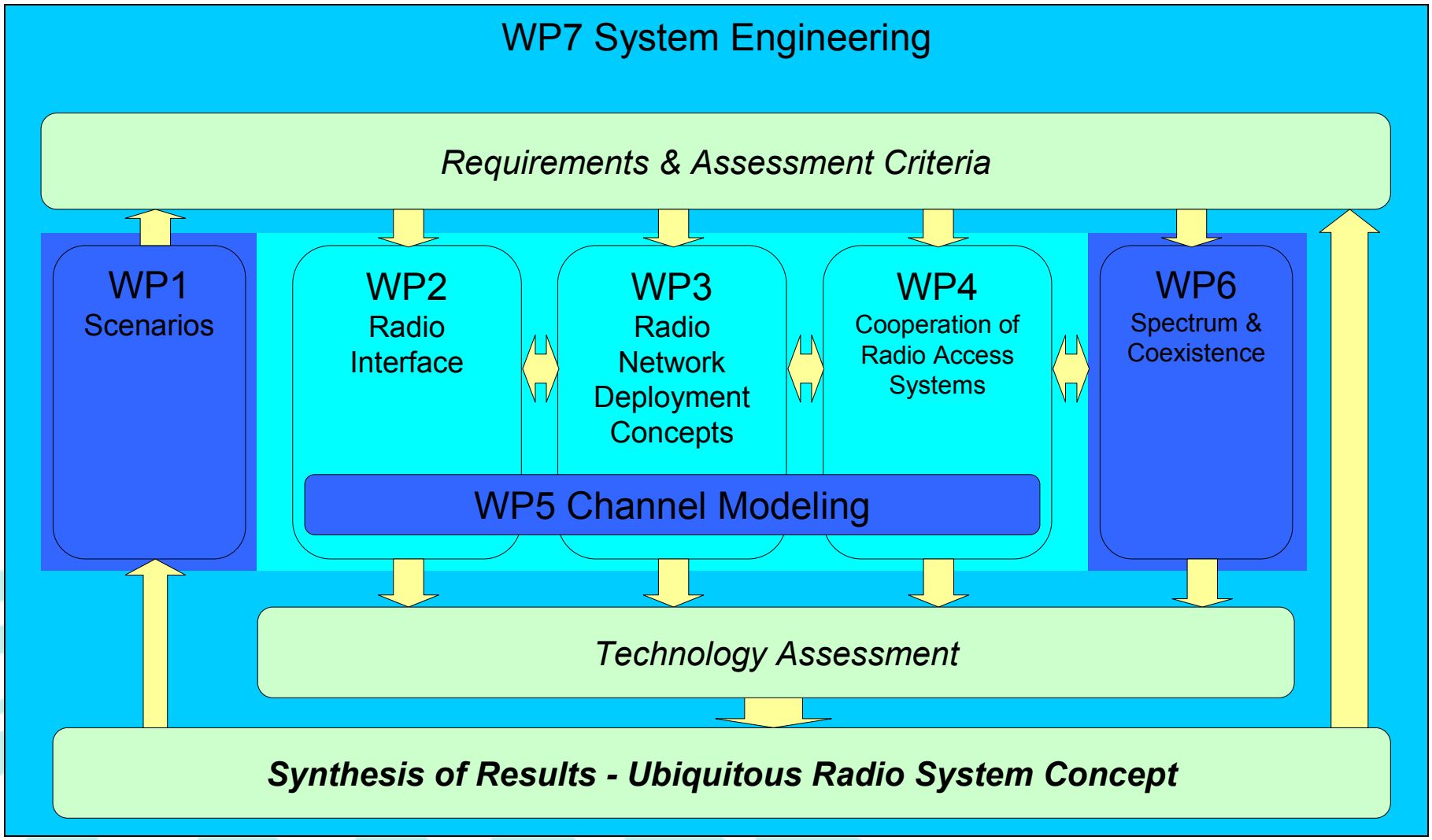
The WINNER project

- Collaborative research project
  - Radio access network technologies and system concepts for future Wireless World
  - Established under European Commission 6th Framework IST programme
  - Global participation
    - Academic organisations
    - Research institutes
    - Commercial organisations
  - Active since January 2004
  - Projected to run until end 2009
  - Part of Wireless World Initiative

The WINNER project

- Scope
  - Technologies and system concepts for Radio Access Networks applicable in a timeframe ~2015
  - Terrestrial mobile and nomadic
    - Including short range hotspot and ad hoc/peer to peer, but not BAN/PAN
  - User centric approach and outlook
  - Flexible concept which can adapt to user demands, deployment scenario and technology options
  - Improved performance across wide range of parameters
    - User bit rates, delay, range, spectral efficiency, …
  - Overlapping aims with 3GPP LTE
    - But longer timescale, larger ambition

WINNER project structure



Some relevant WINNER outputs

- Extension of 3GPP Spatial Channel Model for use with bandwidths up to 100 MHz
- More advanced channel model(s) for wide bandwidth and multiple antenna use
- Deliverables comparing state of the art techniques in the context of future radio access networks

  Access methods, multi-carrier and multi-antenna techniques, deployment concepts, RRM and multi-system cooperation mechanisms, …

Further information

- WINNER website

  https://www.ist-winner.org/
- Wireless World Initiative

  http://www.wireless-world-initiative.org/
- EC 6th Framework

  http://fp6.cordis.lu/fp6/home.cfm
- Contacts
  - Project coordinator: Werner Mohr (werner-mohr@siemens.com)
  - Project Manager: Ludwig Hiebinger (ludwig.hiebinger@siemens.com)

3GPP TSG RAN WGs Long Term Evolution **Tdoc REV-05077**
Quebec, Canada, 30th – 31st May 2005

Agenda item: 4.1

Source: Philips, Siemens, Alcatel, Elektrobit, Ericsson, France Telecom, Nokia Corporation, Telefonica, Vodafone

Title: The WINNER project, and related resources available to 3GPP

Document for: Information

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1. Introduction

This document introduces the project Wireless World Initiative New Radio (WINNER)[1], explores the synergies between this project and the 3GPP LTE activity[2], and highlights areas where WINNER has resources available which can be of benefit to the 3GPP LTE activity.

2. The WINNER project

The Wireless World Initiative New Radio (WINNER) project is a pre-competitive research project running within the 6th Framework of the European Commission[3]. It commenced in January 2004 and is projected to run for a total of six years.
The main aim of the WINNER project is to research technologies for future radio access networks, and concepts to combine these effectively into systems for the wireless world, with an anticipated timescale of around 2015. The scope of the project encompasses ubiquitous access across multiple domains, such as evolved cellular systems beyond 3G, hot spot and hot zone access and short range and ad hoc connections. Satellite, and body-area- and personal-area-networks are considered outside of the scope of the WINNER project. It is intended to investigate a flexible system concept, which can unify these multiple domains, built upon a common technology basis.
A user-centric approach is being taken to requirements setting and analysis within the project, but it is a-priori recognised that it is necessary to provide a significant performance improvement to current systems in many areas, such as user bit rates, latencies, spectral efficiency, deployability, mobility support etc.

The WINNER project is organised into three phases, each of two years. The first, and current, phase is focused more on investigating individual technologies, and building a knowledge base of the possible technologies, and their relative strengths and weaknesses, and the scope to further enhance their performance. The second phase will bring these together within a coherent and balanced system concept, which will be further enhanced and validated within the third and final phase.

During the first phase, work is organised into seven technical work packages, plus a management activity. Additionally ad hoc groups are formed to address issues spanning multiple work packages.

The seven main work packages focus on the following areas:

WP1: User Scenarios
This work package aims to identify use cases for future radio systems, driven from the user perspective, not technical capabilities, from which it derives those capabilities which should be addressed within the project.
WP2: Radio Interface
This work package focuses on the lower layers of a radio access network, with techniques such as multi-carrier modulation and multiple antennas.
WP3: Radio network deployment concepts
This work package focuses on deployment concepts for cost efficient radio coverage. The main investigations are on relay based deployment concepts and related technologies and protocols.
WP4: Cooperation of radio access systems
Given the proliferation of multiple legacy and future radio systems, this work package aims to identify methods to allow mutually beneficial coexistence, and further cooperation between WINNER based radio systems and other radio systems.
WP5: Channel modelling.

This work package addresses the identification and pragmatic modelling of the radio environments within which WINNER should carry out its technical investigations.

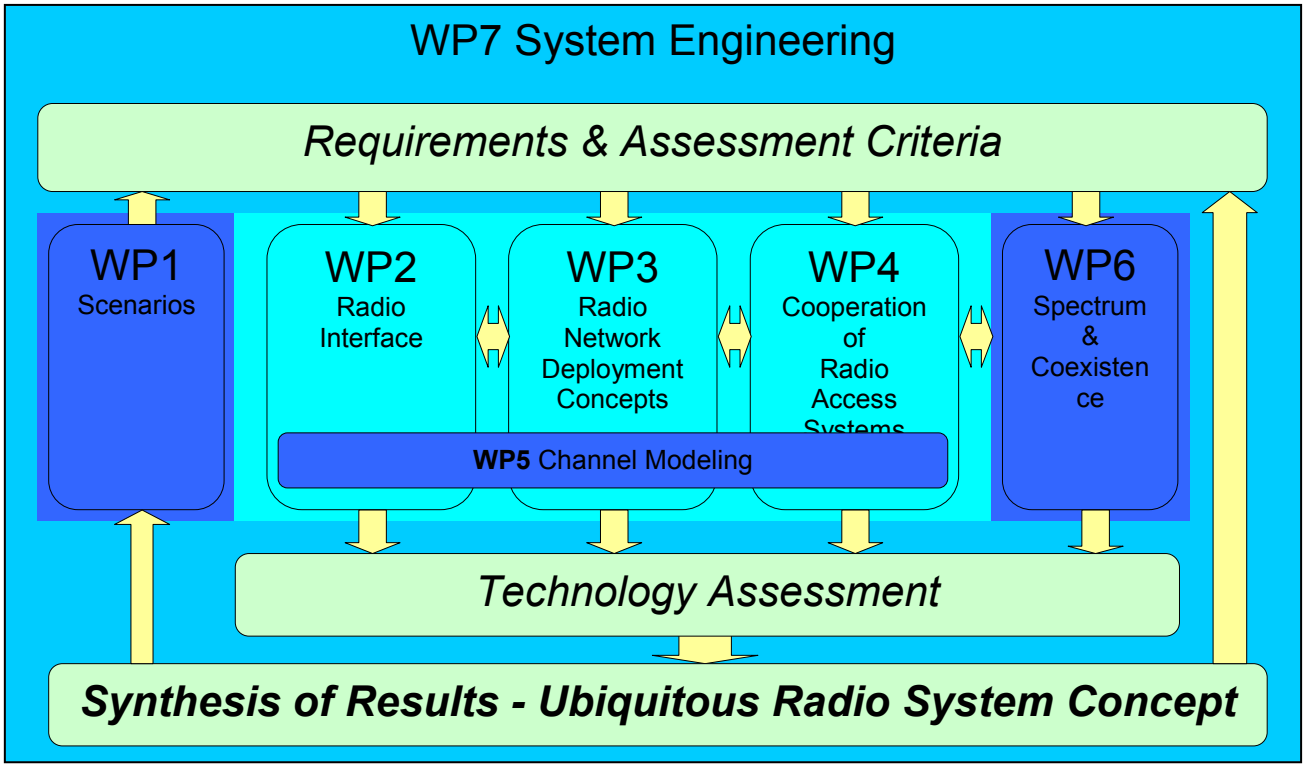
WP6: Spectrum and coexistence

WP6 addresses the requirements for new spectrum to support future radio systems, such as those designed from the WINNER principles, and is cooperating with the ITU to develop a methodology and resources to identify such spectrum.

WP7: System engineering

WP7 is the central work package, which sets the common direction across the other work packages, and integrates their results to create a ubiquitous radio access system concept.

The relationship of the work packages can be shown diagrammatically:



The WINNER project is a part of the Wireless World Initiative (WWI)[4].

3. The WINNER consortium

The WINNER consortium comprises 15 manufacturers, 5 operators, 13 universities, 4 R&D centers and a project administration partner. This consortium contains many of the major industrial players from the manufacturer and operator domains as well as highly respected research institutes and universities, from across Europe and also Asia and North America. The full list of consortium members is included in ANNEX II: List of WINNER partners.

4. WINNER resources available to 3GPP

The initial technical activities of WINNER, to identify, catalogue and compare promising technologies for future radio access systems is creating a wide ranging library of results. The WINNER consortium believes that this could form a valuable resource to the 3GPP LTE activities, providing independent results, which have been developed without regard to any particular positions in response to the requirements currently being defined within 3GPP.

Additionally, a number of enabling activities are taking place, which may provide useful tools and processes for 3GPP.

Annex I: List of WINNER deliverables provides an annotated list of the WINNER deliverables which are already available, or which will become available within the timescale of the LTE Study Item. All of the publicly available deliverables can be freely downloaded from the WINNER website[1]. Whilst other deliverables are not directly publicly available, WINNER will consider making available selected contents, or reclassification of deliverables, upon request.

Of the enabling activities, it is considered particularly valuable to 3GPP that work has been ongoing on channel modeling. As a result of this, new channel models have been developed, appropriate for use with variable channel bandwidths, up to 100MHz, and with double directional characteristics for analysis of multiple antenna techniques. These channel models include

- an extension to the 3GPP SCM model to wider bandwidths
- a set of advanced channel models for WINNER purposes

The first model will be published at the end of May[5], and the second will be detailed in a public deliverable later this year[6].
Other possible synergies between the two activities should be further considered, where they can be mutually beneficial.

5. References

[1] https://www.ist-winner.org/
[2] 3GPP RP-040461, Study Item: Evolved UTRA and UTRAN, December 2004.
[3] http://fp6.cordis.lu/fp6/home.cfm and http://www.cordis.lu/fp6/whatisfp6.htm
[4] http://www.wireless-world-initiative.org/
[5] D. S. Baum, J. Hansen, J. Salo, G. Del Galdo, M. Milojevic, P. Kyösti, "An Interim Channel Model for Beyond-3G Systems: Extending the 3GPP Spatial Channel Model (SCM)", Proc. IEEE Vehicular Technology Conference 2005 Spring, Stockholm, May 2005
[6] WINNER Deliverable D5.4 Final report on link level and system level channel models, September 2005

6. Acknowledgement

This contribution is based on work performed in the framework of the IST-WINNER project. It presents the agreed view of all partners submitting the contribution.

7. Contact details

For further information on the WINNER project, please contact:
Project coordinator: Werner Mohr (werner-mohr@siemens.com)
Project Manager: Ludwig Hiebinger (ludwig.hiebinger@siemens.com)

Annex I: List of WINNER deliverables

D2.1 Identification of radio link technologies
D2.2 Feasibility of multi bandwidth transmissions
D2.3 Assessment of radio-link technologies
D2.4 Assessment of adaptive transmissions for broadband RI
D2.5 Duplex arrangements for future broadband radio interface
D2.6 Assessment of multiple assess technologies
D2.7 Assessment of advanced beam forming and MIMO technologies
D2.8 Assessment of key enhanced radio protocols
D2.9 Implementation impact of candidate key technologies – complexity estimation
D2.10 Final report on identified radio interface key technologies, system concept, and their assessment
D3.1 Description of identified new relay based radio network deployment concepts and first assessment by comparison against benchmarks of well known deployment concepts using enhanced radio interface technologies
D3.2 Description of identified new relay based radio network deployment concepts and first assessment by comparison against benchmarks of well known deployment concepts using enhanced radio interface technologies
D3.3 Concept and criteria for coordination across base stations to improve the mutual interference situation
D3.4 Definition and assessment of relay based cellular deployment concepts for future radio scenarios considering 1st protocol characteristics
D3.5 Proposal of the best suited deployment concepts for the identified scenarios and related RAN protocols
D4.1 Identification and Definition of Cooperation Schemes between RANs - first draft
D4.2 Impact of cooperation schemes between RANs (incl. complexity estimate) - first draft
D4.3 Identification, definition and assessment of cooperation schemes between RANs - final deliverable
D4.4 Impact of cooperation schemes between RANs - final deliverable
D4.5 Assessment of cooperation schemes in systems context
D5.1 A set of channel and propagation models for early link and system level simulations
D5.2 Determination of Propagation Scenarios
D5.3 Interim report on link level and system level channel models
D5.4 Final report on link level and system level channel models
D1.1 First Economic and Technical Evaluations per Scenario
D1.2 Intermediate Requirements per Scenario
D1.3 Final Usage Scenarios
D1.4 Final Requirements
D6.1 WINNER Spectrum Aspects: Methods for efficient sharing, flexible spectrum use and coexistence
D6.2 Methodology for estimating the spectrum requirements for "further developments of IMT-2000 and systems beyond IMT-2000"
D6.3 (project internal)
D6.4 WINNER Spectrum Aspects: Assessment report
D6.5 Spectrum requirements for WINNER System Concepts
D6.6 Spectrum requirements for "further developments of IMT-2000 and systems beyond IMT-2000"
D7.1 System Requirements
D7.2 System Assessment Criteria Specification
D7.3 Initial System Concept Description
D7.4 Inputs to Standardisation and Regulation Activities
D7.5 Initial System Concept Complexity Estimates
D7.6 Winner System Concept Description
D7.7 Winner System Concept Complexity Estimates
D7.8 Performance Assessment of the Winner System Concept
D7.9 Wireless World Validation Plan

D2.1 Identification of radio link technologies
Date of completion: June 2004
This document lists candidate link-level technologies with potential to enable the visions and requirements of the WINNER air interface. The proposed techniques constitute a first selection of existing state-of-the-art technologies taking the current initial system design and parameter assumptions of the WINNER project into account. The intentions of the document are twofold; to provide a basis for further link-level technology studies, refinements and selections, and to provide input to the iterative overall WINNER system concept definition process.

D2.2 Feasibility of multi bandwidth transmissions
Date of completion: October 2004
This deliverable discusses the feasibility of multi-bandwidth and variable-bandwidth transmissions from a base-band processing and radio-frequency (RF) front-end design point of view.

D2.3 Assessment of radio-link technologies
Date of completion: February 2005
The content of this document aims at providing an in-depth analysis of the best candidate technologies for what have been identified as potential key WINNER physical layer modes. The performance of different link layer techniques is compared and their suitability to specific channel conditions is discussed.

D2.4 Assessment of adaptive transmissions for broadband RI
Date of completion: February 2005
This document contains a first assessment of adaptive transmission schemes and how these fit to different Winner scenarios. It focuses on adaptation to channel properties that may vary in time, in frequency or with respect to the selected antennas, in an OFDM-based air interface. Detailed designs, assessed and evaluated by analysis as well as link and multi-link simulations, are presented of adaptive transmission feedback systems for the WINNER FDD and TDD physical layer modes.

D2.5 Duplex arrangements for future broadband radio interface
Date of completion: October 2004
This deliverable considers candidate duplex schemes for the WINNER air interface. The capability of each scheme in supporting advanced radio techniques for the envisaged applications and service requirements is discussed. Interference management issues, terminal complexity and network deployment constraints arising with the different schemes are analyzed. The feasibility of coexistence of multiple duplex schemes is addressed. Finally, a suggestion for the most promising duplex mode is derived for each of the envisaged WINNER deployment scenarios.

D2.6 Assessment of multiple assess technologies
Date of completion: October 2004
In this deliverable a first assessment of wireless access/multiple access technologies for the WINNER system concept is presented. Basic technologies and combinations of technologies are evaluated and compared, in order to identify the most promising strategies and combinations.

D2.7 Assessment of advanced beam forming and MIMO technologies
Date of completion: February 2005
This document contains a first assessment of spatial transmission schemes regarding performance and complexity. The evaluation is based on a review of state-of-the-art techniques, development of new and adapted methodologies for simulation and assessment in the WINNER context, simulative investigations, as well as conceptual work.

D2.8 Assessment of key enhanced radio protocols
Date of completion: February 2005
This deliverable provide results on the identification and assessment of key radio protocol techniques that should be employed in the design of the WINNER air interface. The focus is on five areas: retransmission protocols; medium access control (MAC) protocols; scheduling algorithms; link adaptation protocols and self-organized radio resource management. A common retransmission protocol framework that can meet the identified requirements due to the WINNER relaying concept is proposed. The proposed framework for different operational scenarios is assessed and usage scenarios have been identified.

D2.9 Implementation impact of candidate key technologies – complexity estimation
Date of completion: June 2005

D2.10 Final report on identified radio interface key technologies, system concept, and their assessment
Date of completion: December 2005

D3.1 Description of identified new relay based radio network deployment concepts and first assessment by comparison against benchmarks of well known deployment concepts using enhanced radio interface technologies
Date of completion: October 2004
In D3.1 the first concept for a WINNER radio network deployment mainly focused on relay based concepts are proposed. Further the concept of an radio and protocol architecture is presented that takes up the relaying approach as well as the idea of having different WINNER radio interface modes to serve different user and usage scenarios in an optimal manner. Thereby the presented protocol concept is based on generic and mode specific user an control plane functionalities, where the common functions for different modes are generalised and provide a common interface towards upper layer functions/protocols. Further some relaying concepts for urban hot area coverage including mesh networks are presented accompanied by promising simulation results. In addition to the relaying concepts benchmarks have been produced to allow a comparison of new concepts against today's systems.

D3.2 Description of identified new relay based radio network deployment concepts and first assessment by comparison against benchmarks of well known deployment concepts using enhanced radio interface technologies
Date of completion: February 2005
Following the WINNER vision of a ubiquitous radio system providing wireless access for a wide range of services and applications across all environments D3.2 has consequently continued the work of D3.1 towards a WINNER deployment concept. To cover the requirements of a WINNER RAN the flexible node architecture has been further elaborated. The envisaged WINNER modes are taken into account by multi-mode protocol architecture that allows to exploit commonalities between different modes leading to a very flexible protocol and a close integration of the WINNER modes.
The first steps towards concepts harmonisation are presented by categorising the large number of deployment concept proposals coming from D3.1 into logical groups. Further results on the comparison between single-hop and multi-hop are shown in D3.2 accompanied by the presentation and assessment of related routing strategies. Also the cooperative relaying concept has been driven forward and new results have been achieved in this field. Next to multi-hop, the single hop based deployment concepts have been elaborated partly with respect to new air interface technologies. Finally D3.2 describes a system level simulation methodology to simulate the deployment concepts based on the new WINNER air interface taking the agreed scenarios into account.

D3.3 Concept and criteria for coordination across base stations to improve the mutual interference situation
Date of completion: June 2005
D3.3 describes a first basic concept for the coordination across BSs to improve the mutual interference situation. The concept will contain approaches for conventional (single hop) systems and for relay based deployment concept and takes the characteristics of new radio interface technologies into account. The document provides the basis for a more detailed investigation of the coordination across BS issue

D3.4 Definition and assessment of relay based cellular deployment concepts for future radio scenarios considering 1st protocol characteristics
Date of completion: June 2005
D3.4 gives a more detailed description of the deployment concepts chosen for the identified scenarios. A first performance analysis of the chosen concepts is given and a reasoning for the choice.

D3.5 Proposal of the best suited deployment concepts for the identified scenarios and related RAN protocols
Date of completion: December 2005
D3.5 gives a concluding description of the identified scenario specific deployment concepts based on the performance evaluation of the system level simulation results and under consideration of the identified protocol characteristics which will be described of the assessed RAN protocol approach for identified relay based deployment concepts under consideration of the new radio interface requirements.

D4.1 Identification and Definition of Cooperation Schemes between RANs - first draft
Date of completion: June 2004

- State of the Art on the architecture for RAN cooperation: Combined RRM (Common RRM and Joint RRM), Concurrent RRM and Layered RRM

- Measurements and triggers for cooperation mechanisms
- Definition of Cooperation mechanisms: Handover, Admission Control, Load Control, Scheduling and QoS based management

D4.2 Impact of cooperation schemes between RANs (incl. complexity estimate) - first draft
Date of completion: February 2005
- Protocols and algorithms for cooperation between the WINNER and legacy networks (Intra and Intersystem Handover, Admission Control, Load Control and QoS based management)
- Needed measurements for the cooperation of the RRM algorithms on the different legacy systems, in particular, GSM/GPRS/EDGE, UMTS FDD and IEEE802.11
- First approach towards for a partially centralised cooperative architecture between the WINNER RAN and the legacy RANs

D4.3 Identification, definition and assessment of cooperation schemes between RANs - final deliverable
Date of completion: June 2005

D4.4 Impact of cooperation schemes between RANs - final deliverable
Date of completion: November 2005

D4.5 Assessment of cooperation schemes in systems context
Date of completion: December 2005

D5.1 A set of channel and propagation models for early link and system level simulations
Date of completion: March 2004
This report includes a list of channel models, which are intended for preliminary link and system level simulations. They are selected from existing channel models. The most suitable models are selected to ensure comparable simulations in the beginning of the project.

D5.2 Determination of Propagation Scenarios
Date of completion: June 2004
Propagation scenarios for channel modelling are determined. Scenarios are based on WP1 and WP7 scenario definitions. Frequencies, bandwidths, antenna architectures and environments are specified. Channel model requirements are also defined.

D5.3 Interim report on link level and system level channel models
Date of completion: February 2005
Interim report includes preliminary channel models for link level and system level simulations. Channel models are based on propagation scenarios determined in D5.2, and the models are preliminary versions of the models in the final report.

D5.4 Final report on link level and system level channel models
Date of completion: September 2005

D1.1 First Economic and Technical Evaluations per Scenario
Date of completion: June 2004
- Identification of scenario elements within external reference scenarios relating to fundamental user motivations and interesting user types
- Grouping of these scenario elements into generic applications and then analysis against service, user and technology aspects
- Identification of service classes and some reference traffic models

D1.2 Intermediate Requirements per Scenario
Date of completion: February 2005
- Description of the methodology used for the usage scenario analysis procedure
- Choice of the most promising scenario elements for further analysis
- From these, review of the service classes: definition of 18 service classes characterised by data rate, delay, traffic type and error rate
- Intermediate definition of traffic models: some reference traffic models have been adapted and the result of some new additional ones is presented

D1.3 Final Usage Scenarios
Date of completion: June 2005

- Business and economic analysis
- Analysis of WINNER system concept
- Final usage scenarios list after revising the scenarios and identification of new or precluded scenarios

D1.4 Final Requirements
Date of completion: September 2005

- Translation of service requirements into Radio Access System requirements
- The final requirements are presented for each scenario that will be considered during phase II for the optimisation of the WINNER system concept.
- Final description of the Traffic Models

D6.1 WINNER Spectrum Aspects: Methods for efficient sharing, flexible spectrum use and coexistence
Date of completion: October 2004
This document describes sharing and compatibility issues relevant to WINNER, reviews methods for flexible spectrum use and presents how thse could be taken into account in WINNER

D6.2 Methodology for estimating the spectrum requirements for "further developments of IMT-2000 and systems beyond IMT-2000"
Date of completion: December 2004
This document describes the methodology that was developed in WINNER. The basis of the deliverable are the contributions from WINNER to ITU-R.

D6.3 (project internal)

D6.4 WINNER Spectrum Aspects: Assessment report
Date of completion: December 2005
This document describes the WINNER spectrum requirements, gives an overview on sharing and compatibility issues relevant to WINNER, reviews methods for flexible spectrum use and presenta how all these have been taken into account in WINNER system concept and what has been gained.

D6.5 Spectrum requirements for WINNER System Concepts
Date of completion: December 2005
This document describes the WINNER spectrum requirements. It forms a basis for contributions(s) to the international regulatory process.

D6.6 Spectrum requirements for "further developments of IMT-2000 and systems beyond IMT-2000"
Date of completion: December 2005
This document describes spectrum requirements for "further developments of IIMT-2000 and systems beyond IMT-2000. The basis of the deliverable are the contributions from WINNER to ITU-R.

D7.1 System Requirements
Date of completion: June 2004
In this document the WINNER vision of a ubiquitous radio system concept is transformed into a set of technical requirements describing the envisaged capabilities. The derived consolidated set of technical requirements is presented structured along different categories, which describe the enhanced and general capabilities compared to current systems, supported services, interworking of WINNER with legacy systems, coexistence and spectrum of WINNER, and the requirements due to implementation complexity. The actual radio regulation on EMF is analysed and requirements due to EMF are derived.

D7.2 System Assessment Criteria Specification
Date of completion: June 2004
This deliverable describes the test environment for WINNER simulations in order to obtain comparable simulation results from different partners using different tools. This includes how WINNER proposals should be compared, which figures of merit that should be used, and under what common test conditions. All aspects of the test configurations are described in sufficient detail to allow implementation by the partners. Figures of merits are

defined covering the user experience, network performance and as far as possible complexity and cost implications.

D7.3 Initial System Concept Description
Date of completion: February 2005
This deliverable provides an initial view on the WINNER system concept based on the results generated within various work packages of the WINNER project until February 2005. The aim of this document is to provide a comprehensive overview on the WINNER radio access system. Since the work in the project is ongoing and final design decisions are yet to be taken in many places not all system aspects can be treated in the same level of detail.

D7.4 Inputs to Standardisation and Regulation Activities
Date of completion: June 2005
This document contains the collection of the contributions from all WINNER workpackages to Regulation and Standardisation bodies. The bodies that are relevant for WINNER are identified as well as the issues on which WINNER could and should contribute. Furthermore, the specific goals that WINNER wants to achieve with the contributions are explained.

D7.5 Initial System Concept Complexity Estimates
Date of completion: June 2005
Representing contribution from each system element in a suitable form, this deliverable will provide an initial estimate of the complexity of key components of the proposed WINNER system concept(s) which have strong impact on feasibility of some key components (like terminals) or overall system concept complexity (system cost). This comprises

- Support of different modes
- Implications of multiple-access selection on complexity
- Implications of different relay based deployment concepts on complexity of relay nodes (RN) and mobile terminals
- Power consumption modeling for the terminal
- Network cost estimation
- Identify challenges of baseband PHY processing

D7.6 Winner System Concept Description
Date of completion: September 2005
Architectural and functional description of the proposed WINNER system concept as a result of Phase I in order to fulfil the WINNER system requirements and as basis for Phase II.

D7.7 Winner System Concept Complexity Estimates
Date of completion: December 2005
Representing contribution from each system element in a suitable form, this deliverable will provide an initial estimate of the complexity of key components of the proposed WINNER system concept(s) which have strong impact on feasibility of some key components (like terminals) or overall system concept complexity (system cost).

D7.8 Performance Assessment of the Winner System Concept
Date of completion: December 2005
Representing contribution from each system element in a suitable form, this deliverable will provide an estimate of the overall performance of the proposed WINNER system concept(s)

D7.9 Wireless World Validation Plan
Date of completion: December 2005
Definition of the validation requirements, scenarios, trial plans in order to ensure future interconnectivity of validation platforms of the different WWI projects (WINNER, Ambient Networks, Mobilife, End-to-end-reconfigurability).

ANNEX II: List of WINNER partners

This list shows the full partners of WINNER phase I (2004/2005). Subcontracted project partners are not shown here.

- Siemens AG, Munich (Coordinator)
- Aalborg University, Aalborg
- Alcatel SEL AG, Stuttgart
- Carleton University, Ottawa
- Centre Technològic de Telecomunicacions de Catalunya, Barcelona
- Chalmers University of Technology, Göteborg
- China Academy of Telecommunication Research, Beijing
- Deutsches Zentrum für Luft und Raumfahrt e.V., Oberpfaffenhofen
- DoCoMo Communications Laboratories Europe GmbH, Munich,
- Elektrobit Testing Ltd, Oulu
- Ericsson AB, Stockholm
- Ericsson GmbH, Aachen
- European Institute for Research and Strategic Studies in Telecommunications GmbH, Heidelberg
- France Telecom S.A., Paris
- Fujitsu Laboratories of Europe Ltd, Hayes,
- Helsinki University of Technology, Espoo
- International Business Machines Research GmbH, Zurich
- Kungl Tekniska Högskolan (Royal Institute of Technology) – KTH, Stockholm
- Lucent Technologies Network Systems UK Ltd, Swindon
- Motorola S.A.S., Paris
- National Technical University of Athens, Athens
- Nokia Corporation, Espoo
- Nokia (China) Investment Co., Ltd., Beijing
- Philips Electronics UK Limited, Redhill
- Portugal Telecom Inovação S.A., Aveiro
- Poznan University of Technology, Poznan
- Rheinisch-Westfaelische Technische Hochschule Aachen, Aachen
- Samsung Electronics UK Ltd, Staines
- Siemens AG Österreich
- Siemens Ltd. China, Beijing
- Siemens Mobile Communications SPA, Milan
- Swiss Federal Institute of Technology Zurich, Zurich
- Technical Research Centre of Finland VTT, Oulu
- Technische Universität Dresden, Dresden
- Technische Universität Ilmenau, Ilmenau
- Telefónica Investigación y Desarrollo Sociedad Anónima Unipersonal, Madrid
- University of Oulu – CWC, Oulu
- The University of Surrey, Guildford
- Vodafone Group Ltd, Newbury