**IST-4-027756 WINNER II****D6.12.1 V1.0*****Detailed WINNER II system trial plan for Phase III trials*****Contractual Date of Delivery to the CEC:** 30.11.2007**Actual Date of Delivery to the CEC:** 30.11.2007**Author(s):** Ari Hulkkonen, Juha Meinilä, Marko Leinonen**Participant(s):** EBITG**Workpackage:** WP6 System Concept**Estimated person months:** 1 pm**Security:** PU**Nature:** R**Version:** v1.0**Total number of pages:** 11**Abstract:**

This document shortly describes the trials plan for WINNER +, a project under CELTIC framework

**Keyword list:**

WINNER Phase III, CELTIC, Trials, Channel models

**Disclaimer:**

## **Executive Summary**

### **Background**

WINNER is a major European joint project under EU's 6th framework program. The project started in 2004 with its 1st phase, moved to the 2nd phase in the beginning of 2006 and is going to end at the end of 2007 after 4 years of intense co-operation between over 40 partners located in EU and other countries. Correspondingly, the phases have been called as WINNER I and WINNER II.

Originally, the project was planned to be a 3-phase and 6 years effort. The planning for the 3rd phase was carried out in high level during the project and a full project proposal was submitted to the EU commission in 1st call of FP7. The evaluation results were published in the beginning of July, 2007. The project proposal was not ranked high enough to get an invitation to a meeting (hearings) with the EU Commission. This means that WINNER project is going to end on the 31st of December, 2007 and there will not be continuation to the work within EU's 7th framework program.

### **Objectives**

The goal of the WINNER-project was to develop a single ubiquitous radio access concept, which is able to adapt itself to a comprehensive range of mobile communication scenarios from short-range (e.g. hot spots) to wide area coverage. The project work consists of defining the system requirements, system level design and simulations, radio channel modelling work and trials and evaluation of the concept.

Trials and evaluation work has been divided into three main parts:

- Implementation of selected WINNER functionality on a software defined radio platform
- Integration of the implementation to build a system
- Trials and performance evaluation

### **Summary and conclusions**

Detailed plan for the "Trials and Evaluation" work for the 3rd phase was defined as one of the deliverables of the "Trials and Evaluation" task in WINNER II.

As the EU made a rejective decision considering the continuation of the project, the detailed planning for WINNER phase III was not relevant any more.

This document describes a high level plan for the WINNER 3rd phase trials and evaluation work package as it was included in the full project proposal submitted to EU commission.

**Authors**

<b>Partner</b>	<b>Name</b>	<b>Phone / Fax / e-mail</b>
EBITG	Ari Hulkkonen	Phone: +358 40 344 2108 Fax: +358 8 551 4344 e-mail: ari.hulkkonen@elektrobit.com
EBITG	Juha Meinilä	Phone: +358 40 344 2301 Fax: +358 8 551 4344 e-mail: juha.meinila@elektrobit.com
EBITG	Marko Leinonen	Phone: +358 40 344 2270 Fax: +358 8 551 4344 e-mail: marko.leinonen@elektrobit.com

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## 1 Introduction

This deliverable concentrates on specifying the trials work to be conducted in the continuation project of WINNER II. During the project it became evident that there will be no direct continuation project. However, the work is planned to continue in WINNER+, a project proposed to be conducted in CELTIC framework. Therefore the contents may finally be different. However, this deliverable has been written using the current understanding of the coming project. It is therefore assumed that the results and equipment can be used as a starting point for the trials work in the coming project. The current work has been described in the WINNER II deliverables D6.12.2 - D6.12.4.

The objective for Trials task T12 for this deliverable is: "Preparation of a plan for the full WINNER system trials to be performed in Phase III". It includes the following subitems, targeted as goals during phase II:

- Phase III targets: The experience and direct products in Phase II trial can be used directly or indirectly for planning Phase III full trials
- trial implementation
- validation concept

The main idea in planning the continuation project is to use the information gained in WINNER Phase II, including the software and equipment, when appropriate. Therefore we can use the Trials equipment of WINNER II as a starting point and specify additional functionalities on top of the existing ones. In addition, some new features will be specified to fulfil the requirements stated in the coming project.

The realization of these goals could be here evaluated as follows: The phase III target is that many parts of the existing code base can be used for the possible continuation of the project, e.g. the LDPC codec and code related to adaptivity. The code base has been built with parametrizability in mind, so it will be able to support changes in the MAC/PHY.

The trial implementation for phase III can be found in the WINNER+ proposal for the CELTIC program. Details on this can be found in [WINPLUS]. In addition, the implementation will be described in section 3 of this document. The validation concept developed in the PHY trials would allow validation for certain aspects of link adaptivity, with approaches explained in chapter 2.

## 2 Work Package Trials for the Phase III

The Work Package 5 and an overview of the work in the WP5 are described shortly in this section. Later there are separate sections for all three tasks of the WP5.

### 2.1 Trials WP definition

In Phase III the trials work is planned to be performed in Work Package 5 of CELTIC Project WINNER+. The details of the WP are shown below.

WP5	WP - Title: Trials	
WP Start date	1.1.2008	WP End date 31.12.2009
Description		
WP5: Trials creates a trial equipment by which it performs simulations in laboratory and test runs in the field. WP5 also generates channel models for the simulations and updates and simplifies the current WINNER Channel models. Trial equipment are used also for demonstrations of the WINNER+ concept. WP5 will also participate in the work for specifying the evaluation methodology for IMT-Advanced.		
Expected results (deliverables)		
Partners (WP-leader first): Elektrobit Corporation, Valtion Teknillinen Tutkimuskeskus, University of Oulu		
Milestones and delivery dates: M2: WINNER+ Trials Specification, 30.4.2008 M10: D5.1, WINNER+ Interim Validation Results, 31.12.2008 M17: D5.2, WINNER+ Final Validation Results , 30.11.2009 M17: D5.3, WINNER+ Final Channel Models, 30.11.2009		

WP5, Trials Partners	Country:	Effort allocation (PM)
Elektrobit Corporation (WPL)	Finland	120
Valtion Teknillinen Tutkimuskeskus	Finland	35
University of Oulu	Finland	30

Deliverables (D) and milestones (M) Indicate title or short explanation	Type (report, software)	Due date (m/y):
M2: WINNER+ Trials Specification	Report	4/2008
M10: D5.1, WINNER+ Interim Validation Results	Report	12/2008
M17: D5.2, WINNER+ Final Validation Results	Report	11/2009

M17: D5.3, WINNER+ Final Channel Models,	Report	11/2009
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## 2.2 WP5 work summary

WP 5 focuses on validation of the developed concept with hardware based prototypes. The work consists of implementing selected functionality of the concept on a software defined radio (SDR) platform utilised by the Work Package partners, measuring and analysing the system and link performance both in laboratory and real environments, and analysing the upper layer system performance with computer simulations performed by the Work Package partners.

In addition to the system and link level performance validation, radio channel modelling is carried out to fine-tune, update and validate the radio channel models for IMT-Advanced and to provide the needed models for laboratory emulation to be used as part of the system validation.

The starting point for the work is based on the results obtained during the WINNER project. Figure 2.1 presents the concept utilised in WP 5. The concept comprises radio channel measurements and modelling to get understanding of the radio channel environment, performance evaluation with a real SDR based air interface test equipment and radio channel emulators and, in addition to laboratory tests, field measurements to get deeper understanding on the link / system performance in real life.

The idea of the field tests includes the performance measurements, e.g. via BER measurements, at the same time as performing the channel measurements. By this the performance can be correlated with the channel state.

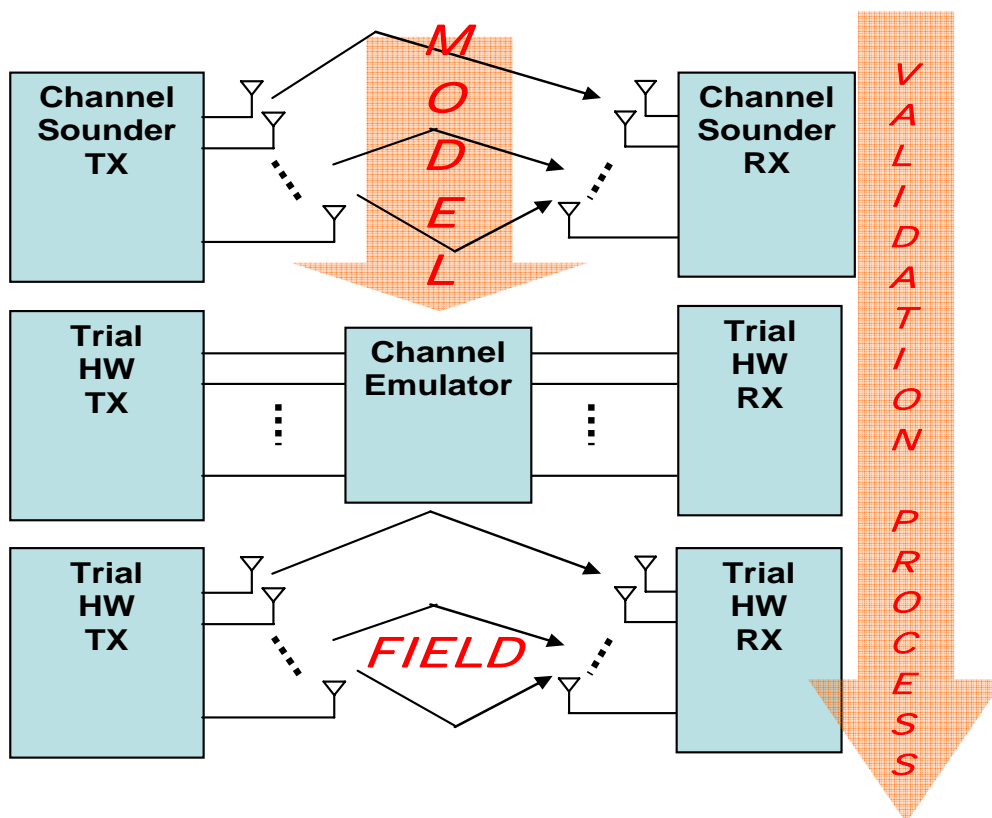


Figure 2.1: Principle of bringing the propagation environment to lab and comparison with field trials.

## 2.3 Objectives

The radio interface concept specified and developed in WINNER and WINNER+ is validated using selected parameters and functionality. An SDR based evaluation environment is used both in the laboratory as well as in the field in selected environments, and the results are analysed for the radio functionality and channel model part. The laboratory test results are compared to the results from the field. Performance is related to the channel conditions. According to the measurements the channel models are then updated, if needed. In addition, showcases are prepared and conducted in this work package. WP 5 also contributes to the IMT-Advanced work of WINNER+ together with other WPs.

The detailed objectives of WP 5 are:

- Validation of selected WINNER+ functionalities by HW based laboratory and field tests.
- Showcases
- Generation and validation of channel models for laboratory emulation purposes.
- Participation in ITU-R IMT-Advanced process.
- Simplification and updating of WINNER channel models for simulation and standardisation, taking into account the decisions made in the World Radiocommunications Conference 2007 in Geneva [WRC07].

## 2.4 Work break-down

The work is divided in four Tasks

T5.1 Implementation

T5.2 Channel Modelling

T5.3 Concept Validation

Break-down of the work is performed in the following sections

### 2.4.1 T.5.1: Implementation (EBIT 64 PM, VTT 30 PM, UOULU 10)

The Task comprises of specifying and implementing selected algorithms and functionality that represent the most fundamental and critical parts of the system concept. In addition to the implementation work, trials and performance evaluation are carried out. In addition to implementation of signal processing, the work includes upgrading the used HW platform, when necessary. The results of the task are reported in IR5.1. The implementation work can be divided into the following Activities:

Activity A.5.1.1 Concept specification is performed to specify the trials concept including functionality specification, parameter selection, signal processing architecture design and HW architecture design.

Activity A.5.1.2 DSP implementation comprises the necessary programming and debugging of the selected and required algorithms. The work is carried out using the most effective tools and methods available. This activity takes most of the work allocated to the task

Activity A.5.1.3 HW implementation includes the design and implementation of necessary upgrades to the existing EB4G platform to provide the necessary RF and DSP functionality and services.

Activity A.5.1.4 SW implementation is required to provide necessary functionality and interfaces between different sub-systems such as RRM, graphical user interface and others.

### 2.4.2 T.5.2: Channel Modelling (EBIT 38 PM, UOULU 20 PM)

The channel modelling work is required to provide the necessary channel models for the validation and performance evaluation and SW system simulation. In addition to the modelling work, existing and new models that are targeted for IMT-Advanced are validated during the project.

The generic goals for the channel modelling are:

- Adapting WINNER II channel models to a HW emulator
- Reducing the complexity of the channel models (e.g. for standardisation, simulation and validation purposes.)

- Participation in the IMT-Advanced work of WINNER+ by upgrading the WINNER channel models to IMT-Advanced channel models.
- Limited validation of the channel models and modelling process.
- Creating models for lab tests.
- Updating the channel models according to the decisions in WRC'07.

The channel modelling work is divided in the following Activities:

Activity A.5.2.1 Channel measurements are carried out with a MIMO radio channel sounder equipment provided by UOULU. At the same time, measurements are performed with Elektrobit's measurement platform, to be able to analyse the channel parameters simultaneously with link performance measurements from the received signal. In addition, measurements to support IMT-Advanced modelling will be performed. Possible measurement scenarios are moving networks case and limited measurements below 1 GHz.

Activity A.5.2.2 Data post-processing is then applied to extract MIMO channel parameters such as DoA, Doppler, number of paths, impulse responses etc. from the measurement data.

Activity A.5.2.3 Model implementation is carried out to generate discrete models out of the post-processed data for system simulations and standardisation purposes

Activity A.5.2.4 Model simplification is required to make the created models compatible with existing radio channel emulators. The simplified models are then used in the validation and performance evaluation task.

Activity A.5.2.5 Model validation is performed to verify that the existing and new channel models really work as they should and that the results obtained in the laboratory performance measurements utilising the channel models match with the performance measured in the field trials.

### **2.4.3 T.5.3: Concept Validation and Performance Evaluation (EBIT 18 PM, VTT 5 PM)**

The purpose of the validation work is to analyse the performance of the WINNER+ concept with selected parameters and functionality. The features included in the trials will also be specified, when starting the WINNER+. Some possible examples are shown below:

- Mode concept (LA, MA, WA)
- Adaptive MIMO mode selection based on CSI
- Impact of channel models on link performance
- The impact of using Relays in the Micro-cellular environment.

Most of the validation work will be performed in the laboratory. However, experiments will be performed in the field, measuring at the same time the relevant channel characteristics. Both results will be compared, and based on that the operation of the used features will be approved (or rejected). At the same time the channel models are validated, as giving practically same (or different) results in the laboratory and on the field. Outcome will then be a field proven system concept and corresponding parameters.

The trials equipment is also used for showcase purposes. For this reason there shall be several, at least two, transceiver equipments available. The equipment will evolve from the WINNER II equipment to the WINNER+ equipment gradually in the course of the project.

The validation work can be divided into the following Activities:

Activity A.5.3.1 Laboratory performance evaluation is performed to systematically evaluate and analyse the link and system level performance in a controlled environment using the defined radio channel models (Task 5.2). The evaluation is performed using Elektrobit's software defined radio platform that has been programmed (Task 5.1) to provide the selected WINNER+ functionality. The results of the laboratory performance evaluation are published in D5.2. The goal is the validation of system parameters, system/link performance and link adaptivity by link-level and small-scale system-level simulations. At the same time the channel modelling process and channel model parameters are validated.

Activity A.5.3.2 Field trials are performed to get additional information and understanding of WINNER+ performance also in a real environment. Selected system parameters and functionality are used. The environments will be specified finally when starting the WINNER+ project. This depends on that

WINNER+ trials and are based on WINNER II that will come to an end at that time. However, the following environments could be considered:

- Outdoor-to-Indoor
- Indoor
- Urban micro-cell
- Base coverage urban and
- High-speed.

Another point of view is that the trial cases should conform to the test cases specified in the WINNER+ Deliverables D5.1.3.1 and D5.1.3.7. The results are published also in D.5.2.

Activity A.5.3.3 By means of several selected showcases, the results will be presented to a selected audience. (Milestones M5.1 – M5.3).

### 3 References

- [WIN2D6122] IST-4-027756 WINNER II, "D6.12.2 Report on validation and implementation of WINNER physical layer", November 2007
- [WINPLUS] WINNER+, CELTIC Full Project Proposal (FPP) – Call 5, 21.09.2007.
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