

**AROMA IST-4-027567****D17*****Economic evaluation of novel AROMA RRM/CRRM algorithms and solutions*****Contractual Date of Delivery to the CEC:** 30-10-2007**Actual Date of Delivery to the CEC:** 03-12-2007**Editor:** Robert Farotto (TI)**Author(s):** See list**Participant(s):** TI, TID, TEL**Workpackage:** WP2**Est. person months:** 7**Security:** PU**Nature:** R**Version:** 001**Total number of pages:** 68**Abstract:**

This deliverable describes the potential economic advantages of using specific AROMA RRM/CRRM algorithms and solutions. The economical analysis is carried out taking into account selected scenarios, also providing specific business case based on potential market demands.

Keyword list: CAPEX, OPEX, Techno-economic issues, CRRM algorithms, Mobile TV, MBMS, HSDPA

DISCLAIMER

The work associated with this report has been carried out in accordance with the highest technical standards and the AROMA partners have endeavoured to achieve the degree of accuracy and reliability appropriate to the work in question. However since the partners have no control over the use to which the information contained within the report is to be put by any other party, any other such party shall be deemed to satisfied itself as to the suitability and reliability of the information in relation to any particular use, purpose or application.

Under no circumstances will any of the partners, their servants, employees or agents accept any liability whatsoever arising out of any error or inaccuracy contained in this report (or any further consolidation, summary, publication or dissemination of the information contained within this report) and/or the connected work and disclaim all liability for any loss, damage, expenses, claims or infringement of third party rights.

DOCUMENT HISTORY

Date	Version	Status	Comments
2007-10-02	001	Int	First draft containing a proposed ToC
2007-10-31	002	Int	Second draft
2007-11-13	003	Int	Third draft
2007-11-28	004	Int	Final version for PCC approval
2007-12-03	001	Apr	Document approved and submitted to E.U.

Authors List

Andrea Barbaresi (TI)
Massimo Barbiero (TI)
Per Emanuelsson (TEL)
Robert Farotto (TI)
Giuseppe Minerva (TI)
Tarapiah Saed (TI Consultant)
Marco Tosalli (TI)
Avelina Vega (TID)

EXECUTIVE SUMMARY

This deliverable reports an analysis of the potential economic impacts tied to the RRM/CRRM solutions investigated within the AROMA project. The economical analysis is carried out taking into account specific exemplary scenarios, and also making use of potential market demands.

After giving some general information related to the methodology followed for the techno-economic evaluations, the document focuses on a couple of relevant study cases:

- the First one dealing with a selected CRRM algorithm based on a “fittingness factor” (it is a particular metric that helps in selecting the most suitable RAT/cell to be used in a heterogeneous scenario), whereas
- the second one is related to the mobile TV over MBMS versus HSDPA.

In both the case studies, the techno-economic evaluations have been carried out by assuming a short or medium term increase of data traffic and by analyzing the potential savings offered by the addressed solutions with respect to the total investment (CAPEX+OPEX) needed to increase the capacity of a pre-existing network. Notice that the analysis has not been based on revenues because they, often, are not proportional to the load generated in the network and rely on different mechanisms (marketing based) with respect to the technical ones.

More precisely, in the CRMM study case related to “fittingness factor” the savings offered by the CRRM algorithm with respect to the case when the algorithm is not present are evaluated, assuming that new investments are needed for upgrading the already existing UTRAN sites with the introduction of additional frequency carriers, in order to fulfill the assumed traffic increase for the next 5 years.

In MBMS case study, the target of the techno-economic analysis is to compare the different investments needed to enhance an existing 3G network, in order to fulfill the requirements due to the introduction of massive (in the long-term) services based on TV and video, on a mobile terminal, comparing two alternatives: 1) exploitation of HSDPA connections and 2) MBMS introduction to provide broadcast/multicast. The techno-economic analysis on MBMS is completed by a short but comprehensive overview of Mobile Operators strategies and market trends of TV Mobile services in Europe.

The document is organized as follows: After a brief introduction an overview of the (Common) Radio Resource Management solutions envisaged in AROMA is presented to select the most appropriate algorithms to be analyzed from a techno-economic viewpoint. Then the methodology to be followed in the analysis is presented and a complete techno-economic analysis for the two selected study cases (the CRRM “fittingness factor” and mobile-TV over MBMS) is done. Finally some conclusions are also addressed. The document also includes two annexes: one devoted to discuss the envisaged analytical model of the CRMM algorithm based on the fittingness factor framework, whereas the other is devoted to provide a dimensioning model for the mobile-TV scenario.

Table of Contents

1	INTRODUCTION	2
2	AN OVERVIEW OF AROMA RRM/CRRM ALGORITHMS AND SOLUTIONS	2
2.1	TABLE OF AROMA ALGORITHMS/SOLUTIONS AND INVESTIGATIONS	2
2.2	ECONOMIC IMPACT OF AROMA ALGORITHMS AND SOLUTIONS	7
3	CRRM AROMA ALGORITHMS AND SOLUTIONS	8
3.1	OVERVIEW OF AROMA CRRM ALGORITHMS	8
3.1.1	<i>Common congestion control</i>	8
3.1.2	<i>Coverage-based CRRM for Voice Traffic</i>	8
3.1.3	<i>Fittingness factor algorithm</i>	9
3.1.4	<i>CRRM perceived throughput</i>	9
3.1.5	<i>Opportunistic CRRM</i>	9
3.1.6	<i>CRRM Cost Function</i>	10
3.1.7	<i>MPLS based mobility management and IP QoS</i>	10
4	METHODOLOGY FOLLOWED FOR THE TECHNO-ECONOMIC EVALUATIONS	11
4.1	INVESTMENTS VERSUS REVENUES VALORIZATION	11
4.2	DEPENDENCE OF THE RESULTS FROM THE TIME BASED TRAFFIC HYPOTHESES	11
4.3	MARKET PENETRATION OF MULTI-MODE TERMINALS	12
5	TECHNO-ECONOMIC EVALUATION OF FITTINGNESS FACTOR CRRM ALGORITHM	16
5.1	INTRODUCTION	16
5.2	ALGORITHM DEFINITION	16
5.3	ALGORITHM MODELING AND MARKOV CHAIN DESIGN	18
5.3.1	<i>Flowchart of the CRRM algorithm</i>	18
5.3.2	<i>Analytical model of the CRRM algorithm</i>	20
5.4	SCENARIO AND QoS CONSTRAINS	21
5.4.1	<i>CAPEX and OPEX for UTRAN Carrier upgrade</i>	23
5.5	RESULTS	23
5.6	CONCLUSION	28
6	TECHNO-ECONOMIC EVALUATION OF MOBILE TV OVER MBMS	29
6.1	INTRODUCTION	29
6.2	DVB-H VERSUS MBMS FOR MOBILE TV	31
6.3	OVERVIEW AND MARKET TRENDS OF MOBILE TV SERVICE	33
6.3.1	<i>Mobile TV Market: European scenario</i>	34
6.4	METHODOLOGY FOR THE TECHNO-ECONOMIC EVALUATION OF MOBILE TV OVER MBMS	36
6.5	ECONOMIC IMPACTS OF MBMS	37
6.5.1	<i>Market Assumptions for Mobile TV services</i>	38
6.5.2	<i>Service mix</i>	38
6.5.3	<i>Usage</i>	38
6.5.4	<i>European users' forecasts at national level from 2008 to 2018</i>	38
6.5.4.1	Total annual traffic for the whole country	39
6.5.4.2	Traffic projection for an "average European town"	39
6.6	DIMENSIONING MODEL	40
6.7	CAPEX AND OPEX VALORIZATION	40
6.7.1	<i>Investment related to the upgrade of HSDPA and MBMS technology</i>	40
6.7.2	<i>Investment related to the deployment of new sites</i>	40
6.7.3	<i>Investments related to the introduction of the second UTRAN carrier</i>	41
6.8	RESULTS OF TECHNO-ECONOMIC EVALUATION	41
6.9	CONCLUSIONS	44
7	CONCLUSIONS	45
8	ANNEX A: ANALYTICAL MODEL OF THE CRRM ALGORITHM BASED ON THE FITTINGNESS FACTOR FRAMEWORK	46
8.1	ANALYTICAL MODEL OF THE CRRM ALGORITHM	46
8.1.1	<i>State characterization and Space State dimension</i>	46

- 8.1.2 Set of Events 47
- 9 ANNEX B: DIMENSIONING MODEL FOR THE MOBILE-TV SCENARIO 59**
 - 9.1 TRAFFIC BASED DIMENSIONING MODEL 59
 - 9.1.1 Evaluation of the number of second UTRAN carries and new nodeB 60
 - 9.1.1.1 Uplink 60
 - 9.1.1.2 Downlink 61
 - 9.1.1.3 Downlink transmission power requested for dedicated channels in downlink 62
 - 9.1.1.4 Mobile TV on HSDPA: downlink transmission power requested for HS-DSCH..... 63
 - 9.1.1.5 Mobile TV on MBMS: downlink transmission power requested for S-CCPCH 64
- 10 REFERENCES 66**
- ACRONYMS..... 68**