MOBILEMAN

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Mobile Metropolitan Ad hoc Networks

MOBILEMAN

Intermediate Evaluation Report

Deliverable D4

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Abstract: The aim of this deliverable is to document and review the first year of the MOBILEMAN project. Specifically, it documents the project self-assessment procedure: i) to verify the alignment with the project goals; ii) to control the quality of what is produced; and iii) to identify and manage the project risks. To this end it takes as inputs the results produced and compare them with the project success criteria.

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SUMMARY

The aim of this deliverable is to document the first year of the MOBILEMAN project. During this first year, the partners successfully fulfilled to the major promised project goals.

This deliverable presents the achieved project goals for the first year. Furthermore, it introduces the evaluation criteria for the second year, as enhancement of the project goals (as defined in the deliverable D2 "*Project Plans*") and the first year experience.

Related to that, it shows how the project dynamically adapts itself to new and external ideas and findings, in order to continue to produce relevant and innovative results. Thus, this document introduces the changes to the original design and plans that the consortium decided to adopt for the MOBILEMAN project in order to continue to drive the research in this field and reach innovative and valid results.

1. MOBILEMAN AT WORK

The project, through the analysis and research of major Mobile Ad hoc NETwork (MANET) characteristics, is developing a metropolitan area, self-organizing, and totally wireless network that gives name to the project: *Mobile Metropolitan Ad hoc Network* (MobileMAN).

In this document we analyze the work done during the first year to verify if and how the project success criteria were met. Details of the activities performed by the project partners are described in the *First Year Progress Report*. In this period, the work was mainly conducted from technical standpoint.

To date, all workpackages started, but WP4 (Integration, Evaluation and Social Analysis) and WP5 (Dissemination and Exploitation). They produced results according to the defined milestones.[1] In particular, five deliverables were produced in the project first year:

- D1 *Project web-site set up*
- D2 *Project Plans,*
- D3 *Dissemination and Use Plan*
- D4 *MobileMAN intermediate evaluation report*
- D5 *MobileMAN architecture, protocols, and services- first report.*

In addition we produced a "*Project Presentation*" that summarizes the project scope, methods, and expected results. All of them are made publicly available at the web site of the project (http://www.iit.cnr.it/mobileman).

MobileMAN results already started to be disseminated in different international forum. In fact, the innovative approach of MobileMAN to architectural analysis and design produced original and relevant results, and thus accepted for publication in several conferences and journals (as illustrated in the *First Year Progress Report*, and in the project web site).

[1] The details of each WP activities, and the temporal diagram of each activity are reported in the Annex 1 "Work Description".

2. MOBILEMAN OBJECTIVES

MobileMAN's full objectives are listed and discussed in deliverable D2: "*Project Plans*".
Among them, during this first year, we mainly worked for the development, validation, implementation, and testing of the architecture, and related protocols, for configuring and managing a MobileMAN. We also started to build the basement for the validation of the self-organizing paradigm from the social standpoint. The creation of an environment for promoting new business activities and processes (economic standpoint) is expected to enter later in the project's activities.

More specifically, some of the main expected final results of the project started to be achieved:

- The study and analysis of protocols and mechanisms at different layers (in some case even with measurements on real testbeds).
- The analysis, measurement and design of effective solutions for the relevant technical issues of self-organizing networks: routing and forwarding, location, medium access control protocol, power management, security and cooperation.
- The identification of possible applications and, consequently, of the trials scenario.
- The design of a social methodology for analyzing the impact of MobileMAN.

More details of these activities and results are reported in the next section, and in the *First Year Progress Report.*

3. FIRST YEAR OBJECTIVES

In this section, we recall the success criteria we have identified for assessing project success during the first year in terms of project execution and stable results, and we report, more in details, what we really achieved.

Moreover, after the first year experience, we were also able to better detail the criteria for the second year. The updated success criteria for the third year of the project will be reported in the last *Project intermediate evaluation report* (i.e., deliverable D9).

3.1 First Year Evaluation Criteria

The objectives reported below constitute the criteria for evaluating the success of the first year of the project.

MobileMAN architecture definition

- Definition of the complete MobileMAN architecture with the communication flows among different activities and the integration of vertical issues as co-operation and energy awareness.

New applications and services

- Identification of existing applications (or classes of applications) that can become a customer advantage, when run on top of MobileMAN, compared to traditional technologies. Define the services that we need to provide for efficiently supporting some of these (classes of) applications.

Middleware

- Comparative analysis of existing middleware solutions for mobile environment (Xmiddle, Jxta, Lime, etc.). The aim of this comparison is the identification of the best solution(s) for the MobileMAN environment.

- Definition of new solutions for P2P information delivery. This will be done by selecting some of the resilient mechanisms that have emerged in the p2p community (such as CAN, Chord, Pastry, etc.), and then introducing location information and scope information so that content is initially placed and requests are routed to copies that have proximity on a number of QoS axes.

Co-operation Model

- Design of models and mechanisms that encourage users to behave as “good citizens”.

Networking services

- Design of location and packet forwarding schemes suitable for MobileMAN.

- Comparison of routing protocols for ad hoc networks utilizing simulation studies, and, whenever possible, measurements on real testbeds.

- Development and testing of a few hops ad hoc network implementing a minimal set of functionalities (routing, forwarding, and location).

Wireless Technologies

- Analysis of the limits of the existing solutions (based on IEEE 802.11) for constructing multi hop ad hoc networks. The analysis is performed by simulation and measurements;

- Design of an enhanced MAC protocol for ad hoc networks. The new MAC protocol must be compatible with the IEEE 802.11 and provide a better channel utilization;

- Comparative analysis of existing chipsets to identify the best solution for implementing the MobileMAN enhanced NIC.

Socio-economic Model

- Develop a methodology for evaluating social, anthropological, and economic potential of MobileMAN.

3.2 First Year Achieved Objectives

MobileMAN partners achieved the following objectives:

MobileMAN architecture definition

- Definition of the complete MobileMAN architecture with the communication flows among different activities and the integration of vertical issues as co-operation and energy awareness.

New applications and services

- Identification of existing applications (or classes of applications) that can become a customer advantage, when run on top of MobileMAN, compared to traditional technologies. Define the services that we need to provide for efficiently supporting some of these (classes of) applications.

Middleware

- Comparative analysis of existing middleware solutions for mobile environment (Xmiddle, Jxta, Lime, etc.). The aim of this comparison is the identification of the best solution(s) for the MobileMAN environment.

- Definition of new solutions for P2P information delivery based on resilient mechanisms that have emerged in the p2p community (Pastry), and then introducing location information and scope information so that requests are routed to copies that have proximity on a number of QoS axes.

Co-operation Model

- Design of a model that allows studying the cooperation in MANETs.

- Design of a mechanisms that encourage users to behave as “good citizens”.

Networking services

- Design of a location schemes suitable for MobileMAN.

- Study of a packet forwarding schemes suitable for MobileMAN.

- Comparison of routing protocols for ad hoc networks utilizing measurements on real testbeds.

- Development and testing of a few hops ad hoc network implementing a minimal set of functionalities (routing, forwarding, and location).

Wireless Technologies

- Analysis of the limits of the existing solutions (based on IEEE 802.11) for constructing multi hop ad hoc networks. The analysis is performed by simulation and measurements;

- Design of an enhanced MAC protocol for ad hoc networks. The new MAC protocol is compatible with the IEEE 802.11 and provides a better channel utilization.

- Comparative analysis of existing chipsets to identify the best solution for implementing the MobileMAN enhanced NIC.

Socio-economic Model

- Develop a methodology for evaluating social, anthropological, and economic potential of MobileMAN.

4. LESSONS LEARNED AND PROJECT PLANS

First year lessons gave us the elements to better understand how to advance during the second year. More precisely, as already presented to the IAB during the Cambridge meeting in July (and approved by them), we decided to enhance the reference model of MobileMAN in order to integrate the new view of "cross-layering" (see Deliverable D5). Figure 1 and Figure 2 illustrate the original reference model and the enhanced one, hereafter, referred to as new reference model.

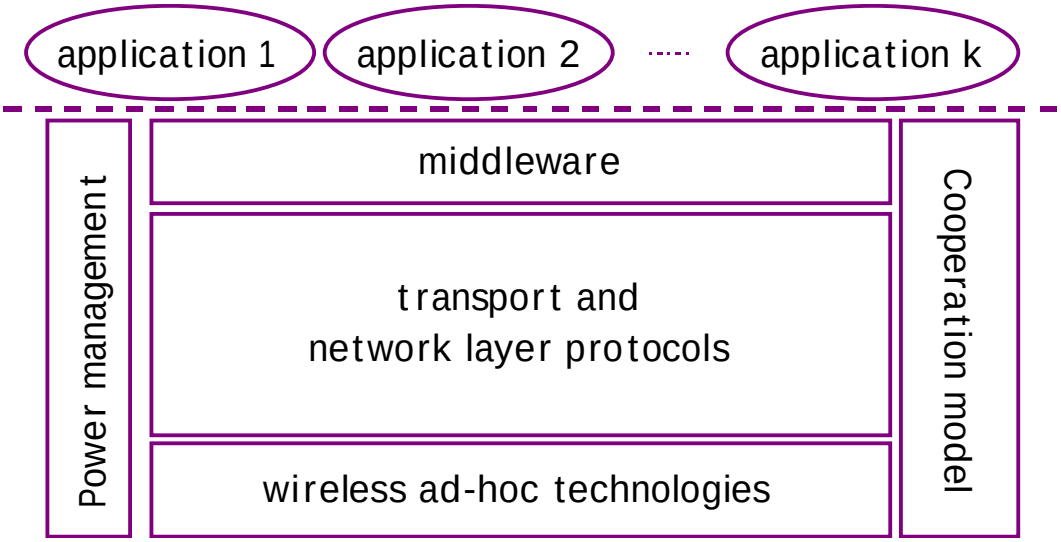

Figure 1: MobileMAN original Reference Model

The new reference architecture, where parameters and information are exchanged among services and protocols by means of a widely accessible component was introduced (in line with current evolution of wireless research) to achieve better performance in the MobileMAN network (see Deliverable D5). As a consequence of this, we decided to activate the task T2.9 *Domain model refinement and risk reduction*. The objective of task T2.9 is the refinement of the domain model to take into account the impact of cross layering on the MobileMAN architecture and protocols. More precisely, we will investigate the goodness and feasibility of an architecture based on a cross-layered approach. This implies that some information will be shared among layers, allowing a more performing and adaptive behaviour of the ad hoc nodes. However, as pointed out in the Deliverable D5, as we are pioneers in this area, to reduce the risks, we will explore both (1) an integral (or quite integral) cross-layering, which implies the re-design of all (or some) protocols, and (2) information-based cross-layering, where protocols are not touché (or minimally) and only the information is shared.

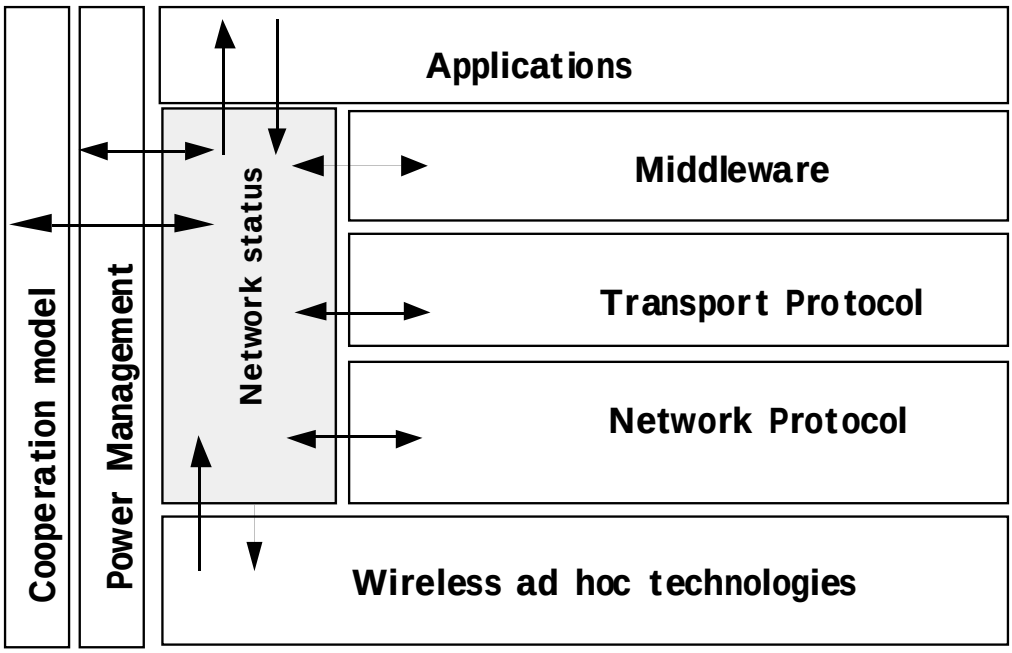

Figure 2: MobileMAN cross-layering Reference Model

4.1 Second Year

Thus, with the goals defined in D2 in mind, we defined the criteria for evaluating the success of the second year of the project.

The goals defined in D2 are:

- The software implementation of the solutions defined and studied during the first year, except the MobileMAN enhanced NIC.
- The integration of the developed solutions in a fully functioning testbed.
- Preliminary measures of the users' satisfaction of the ad hoc networking paradigm. These measures will be mainly done by *empirical research based on forms to be filled*. In addition, some measurements with a small group of users (on a simplified testbed) will be also performed.
- To investigate market-based mechanisms for exploiting the self-organised paradigm. This will take into account both the users' satisfaction and the advantages provided by the MobileMAN environment to some class of applications.

The objectives reported below are the detailed criteria for evaluating the success of the second year of the project.

MobileMAN architecture implementation

- Implementation and validation of the MobileMAN architecture as defined during the first year (see D5) considering both the original and the new reference model.

New applications and services

- Include the cross-layering view at application layer.
- Adaptation of existing applications (or classes of applications) identified, during the first year, as ones that can become a customer advantage, when run on top of MobileMAN, compared to traditional technologies.

Middleware

- Adaptation of Pastry middleware for the MobileMAN environment to exploit cross layering.
- Development of new solutions for P2P information delivery based on Pastry.

Co-operation Model

- Implementation and validation of the cooperation models and mechanisms defined during the first year.

Networking services

- Include the cross-layering view at network/transport layer
- Design of packet forwarding schemes suitable for MobileMAN.
- Implementation and validation of location scheme defined during the first year.
- Development and testing of a complete ad hoc network

Wireless Technologies

- Include the cross-layering view at datalink layer.
- Design and implement a full datalink layer that includes the enhanced MAC protocol for ad hoc networks as designed during the first year.

Socio-economic Model

- Apply the developed methodology for evaluating social, anthropological, and economic potential of MobileMAN, and provide the results for improving the technical parts.

4.2 Third Year

At the moment, the goals of the third year remain unchanged.

- The hardware implementation of the MobileMAN enhanced NIC.
- A large-scale testbed with a large users' community.
- Measures, on the real testbeds, of the users' satisfaction of the ad hoc networking paradigm.
- Exploitation of the MobileMAN solutions for the creation of start-ups and novel business processes