Enabler for Next Generation Service Delivery

IST-27437 STP

WP900: Project Management

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Dissemination level: RE

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PUBLISHABLE EXECUTIVE SUMMARY

MULTINET- Enabler for Next Generation Service Delivery

The MULTINET communication system provides the network and application functionalities so that multiple simultaneous networks can be seamlessly handled to optimise communications in multiple dimensions; while sustaining the existing wireless and mobile industry and attracting new business revenue. The capabilities provided facilitate wireless broadband multimedia communication services of high quality and functionality, with an optimum cost, tailored to the communication offer provided. The project aims to provide the necessary networks and application functionality enhancements for seamless data communication mobility. The MULTINET system allows users to benefit, without intervention, from ubiquitous access to broadband applications from simultaneous transparent network connectivity among the available access networks.

At A Glance: *MULTINET*

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Duration: *January 2006–March 2008*
Total Cost: *€ 3,57 m*
EC Contribution: *€ 1,9m*

Main Objectives

The project goal is to develop and validate on test-beds in France, Italy and Spain, an evolved MULTINET communication platform which provide mobility to users in the context of wireless (IP based) networks , without modifying, either the existing network or the user applications, and in a seamless and transparent way. The priority and focus has been on multi-homing intelligent user PC terminals, providing intelligent network selection and dynamic bearer modifications between WLAN-WLAN initially and progressing to WLAN-UMTS / WLAN-WiMAX.

To achieve this strategic objective, a harmonized technological RTD approach was implemented by providing:

1. Tools and protocol for seamless broadband multimedia session delivery across heterogeneous networks.
2. Middleware techniques for application layer service to adapt to underlying bearer characteristics.
3. Mechanism for bearer services to adapt to the changing nature of multimedia applications.

User Scenarios

Two user scenarios, which capture the broadband communication needs at work while on the move, were selected in order to increase the impact of the technology once demonstrated:

High-Tech Machinery Maintenance, and Utility Companies' Support Services.

Large enterprises and SMEs will obtain significant benefits through the new MULTINET-enabled multimedia services that permit managing their activities from anywhere, with reduced battery power consumption and better pricing conditions.

Technical Approach

The project began with analysis of the current start-of-the-art and future trends in Mobile and Wireless Data Communications technology. MULTINET then developed a communication system (a set of tools and protocols) to facilitate seamless and intelligent mobile broadband communication, providing mobility to users with

improved performance of connectivity technology, and in a transparent way for applications and users.
It investigated teleservices and supporting bearer services to adapt to the underlying time varying nature of radio channels. The application of the technology developed by MULTINET in the two selected scenarios was be examined with the aim of developing Reference Models for potential applications of different solutions.
The aim was to achieve the highest flexibility in the communications through several networks simultaneously, making business tasks more intuitive, quicker and cheaper for enterprises/SMEs.
These served to identify the specific SME needs to be created in relation to this communication technology. The needs defined the MULTINET technology concepts and enabled continuous mapping of the technology development to the business needs.

Key Components

i) Multihoming for Single Multimodal terminals

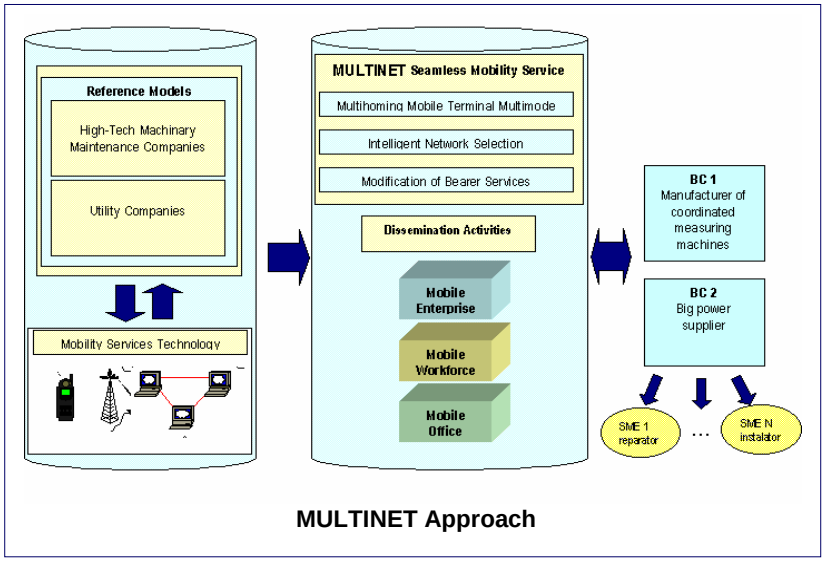
Provision of connectivity over a variety of heterogeneous networks is a major focus of B3G research. Thus far, most research has concentrated on either the application layer, for example using Session Initiation Protocol (SIP), or network layer connectivity, using techniques such as Mobile IP. However, each of these approaches has drawbacks. MULTINET takes a different approach by examining whether proposals for IP multihoming for enterprise networks could be adapted to supporting seamless session delivery to mobile devices over heterogeneous networks.

ii) Algorithms for Intelligent Network Selection

The use of a mobile device over heterogeneous networks is increasing, and therefore it is essential to have mechanisms that allow for intelligent network selection.
A user centric approach was be adopted for network selection, involving the use of different QoS metrics for decision-making, i.e.: delays, losses, available bandwidth, price, and battery power.

iii) Dynamic Bearer Modification

Provision of seamless teleservice delivery across wireless networks is impeded by the non-stationary nature of wireless links. A range of factors including distance from transmitter, shadowing, interference from other users, and meteorological conditions can affect the error rate associated with a radio channel. Thus, in order to support a particular constant bit-rate service with its associated QoS requirements, a radio system must be able to dynamically alter its bearer services such that changes in radio conditions are transparent to the supported teleservice.



MULTINET Approach

Expected Impact

From the potential user companies' view point, the expected result of the implementation of the MULTINET technology is: Cost reduction, Increased security of data, as simultaneous transparent network connectivity is allowed, Ad-hoc network use, through selection of the most suitable communication network, decreased latency by the modification of the bearer and Mobility.

From operators' point of view, impact will be: Increased services portfolio, Increased personnel efficiency, by the reduction of the response time in service delivery, Reduced support services time and Business process improvement.

1. PROJECT OBJETIVES AND MAJOR ACHIEVEMENTS DURING THE REPORTING PERIOD

This report is a summary of Activity Reports of the Project which collects activities and achievements from 1st of January 2006 to 31st of March 2008. The non-confidential information has been collected and summarized in public final report after the end of the project, and has been provided for informational purposes.

1.1 WP100

1.1.1 TASKS

During this period, the tasks carried out in WP100 were:

- Technical scenario description
- Non-technical scenario description
- Determine the potential business benefits

1.1.2 ACHIEVEMENTS

- Functional specification of Multinet scenario
- Applicability of Multinet in technical scenarios
- Summary of Network and QoS classes associated to each access network
- Mobility and multihoming protocols overview
- Access platform scenarios description

1.2 WP200

1.2.1 TASKS

- Examine the most recent developments in terms of application/service performance specification.
- Analyse the current multihoming techniques.
- Identify a portfolio of scaleable applications and services.
- Requirements for the problems to be addressed.
- Identification of possible Business Models

1.2.2 ACHIEVEMENTS

- Examined the use of SIP and BGP and their utility in multihoming
- Examined how to enable seamless connectivity in the face of TCP retransmissions
- Examined the applicability of QoS mechanisms
- Multihoming addressing issues
- The reference architecture of the system has been defined.
- The applications and services to be used in the architecture has been defined.
- Overall communications architecture was devised using multiple CoAs per mobile router. This solution avoids BGP scalability problem and ingress filtering problem.

1.3 WP300 – MULTIHOMING FOR SINGLE MULTIMODAL TERMINALS (THALES)

1.3.1 TASKS

During this period, the tasks carried out in WP300 were:

- Implementation of the software modules that compose the selected multihoming architecture;
- Implementation of a laboratory demonstrator to present the NEMO related part of the multihoming architecture during the project review;
- Integration of the modules that compose the multihoming architecture and provision of the resulting hardware/software to WP600.

1.3.2 ACHIEVEMENTS

As presented in the first PAR, the activity of this WP was divided into 6 sub-activities. Each of these sub-activities was carried out under the responsibility of a partner of the project and involved at least another partner. The contribution of each partner was adjusted according to its skills, and objectives and effort in the WP.

Activity #	Objective	Partners involved
1	Multihoming protocol investigation	**THAL**, USTR
2	Flow binding policies reception and enforcement module design and implementation	**THAL**, INNO
3	IPv4/IPv6 Gateway set-up	**EKT**, THAL, SOLZ
4	Personal Gateway hardware selection	**UPV**, EURE
5	Personal Gateway basic software integration	**INNO**, EKT, INNO, THAL, EURE, MAC, SOLZ
6	Home Agent definition	**USTR**, THAL

All the sub-activities lead to the implementation of software modules or the set-up of hardware platform that were integrated all together in a single WP300 package to form the multihoming solution.

The only noticeable deviation in this WP was experienced in the design and implementation of the IPv4 to IPv6 gateway that would allow the usage of non IPv6 application on the Multinet architecture. The consortium decided that the Multinet platform is going to be only IPv6. The main reasons to take this decision are that:

- there is not still a closed universal solution for translation, and
- the available ones are not applicable in Multinet scenario, in the timeframe of the project

Yet, once implemented and partly integrated (at WP300 scale), the multihoming package was delivered to WP600 with the associated documentation and support to be included in the projects demonstrators.

Besides this, was edited within this WPdeliverable D3.2 "A multilayer signalling protocol for wireless multihoming" that presents in particular the internals of the multihoming solution (and in particular, the design of the Policy Reception and Enforcement Module), the implication of Hetereogeneous handovers (e.g., WLAN-WiMAX, WLAN-UMTS).

1.4 WP400 – ALGORITHMS FOR INTELLIGENT NETWORK SELECTION (EUSKALTEL, INNO)

1.4.1 TASKS

During this period, the tasks carried out in WP400 were:

- Definition of QoS metrics.
- Network Selection Algorithm (NSA) definition.
- Definition of Communication architecture of NSA with the rest of the components of the MULTINET platform.
- NSA development.

1.4.2 ACHIEVEMENTS

- Network metrics analysis.
- Definition of preliminary inputs of the NSA.
- Start the definition and development of communication modules of the NSA with CRRM and PG.

Concerning the transmission of the traffic policy description file from the Network Selection Algorithm (WP400) to Personnel Gateway (WP300), the usage of an interface based on the Web Service technology was agreed on. The developments of this transmission module and NS Algorithm itself are finished and communications are performed correctly with the rest of the modules.
The algorithm was developed and policies applied following the heuristics defined in Deliverables D4.1 and D4.2.

1.5 WP500 – DYNAMIC BEARER MODIFICATION (EURECOM)

1.5.1 TASKS

WP500 addresses the QoS control of Multimedia applications.
During this period, the tasks carried out were in the framework of activities:

- T510 Perceived QOS
- T520 Bearer Utilisation Prediction

The definition of the prototype supporting the bearer adaptation techniques was also undertaken.

1.5.2 ACHIEVEMENTS

Concerning the algorithmic part of WP500 the following results have been achieved:

- Definition of perceived QoS parameters for various service patterns (parameters were defined at different layers of the protocol stack)
- Definition of the QoS Metrics
- Definition of algorithms to measure and predict traffic load and bandwidth usage
- Definition of QoS based bearer adaptation techniques

Concerning the prototype definition, WP500 modules supporting QoS have been defined. These modules are to be integrated in the Multinet Personal Gateway.
Main achievements were:

- Specification of the modules capturing the measurements, taking decisions based on the measurements.
- Specification of interfaces between the modules.
- Development of the necessary modifications in CRRM and RRM-WLAN for the MULTINET project
- Integration with the rest of components

1.6 WP600 – INTEGRATION, TESTING, ASSESSMENT & OPTIMISATION (INDRA)

1.6.1 TASKS

WP600 addresses the integration, testing, assessment and optimisation of the MULTINET System.
During this work package time period, the tasks carried out were in the framework of activities:

- T610 – Integration and testing.
- T620 – Assessment.
- T630 – Optimization and forecast.

1.6.2 ACHIEVEMENTS

Concerning T610 following results have been achieved:

- MULTINET modules have been correctly integrated at Eurecom's testbed. As leader of this work package, INDRA has defined and coordinated all tasks aimed at integrating modules developed by different partners in a full MULTINET prototype placed at Eurecom premises. Incompatibilities between modules have been detected and then solved, INDRA

was in charge of identifying this kind of problems and resolving them supported by developers. D6.1 collects all the information regarding MULTINET System integration process.

- MULTINET System has been tested technically at Eurecom's testbed. INDRA, supported by developers, defined the testing process of the MULTINET System and produced all the documentation detailing test scenarios and how to carry out such tests. INDRA also gave remote support to Eurecom technicians while performing these tests. These tests results and a description of the resulting system have been included in D6.2.

Concerning T620 following results have been achieved:

The testbed performed at Eurecom, was analysed in order to generate a report (D6.2) were some minor issues could be identified and improved. This tasks, provided feedback to the testing phase at T6.1 in order to have a more stable system.

D6.2 deliverable provides information on the performance observed as part of the pilot carried out over the EURECOM platform.
The aim of the assessment of the prototype , is to see the system working at daily operation in the real environments, providing real figures about the business capacities achieved by the implementation of the new system.

Concerning T630 following results have been achieved:

Based on assessment, reports for the optimisation of the methodology and the solution will be carried out. Work on these tasks started during year 2007, but will be finished after the Final Review. The idea is to provide some suitable recommendations and possibilities of improvement to the system based on the observations made on the EURECOM platform.

1.7 WP700 – DEMONSTRATION (MAC)

1.7.1 TASKS

WP700 developed the Demonstrators and Implementation for the two Business Cases, with the aims of (a) applying the MULTINET protocols, tools, middleware techniques and services in the two established Business Cases, and (b) To complete detailed analysis of the resulting innovation and specification of the parameters for each Business Case, following the Methodology Reference Model.
During this period, the tasks carried out were in the framework of activities:

- T710 - Demonstrators development
- T720 - Demonstrators implementation

At the two testbed demonstration sites in Ivrea and Bilbao, running the Trimek Machine Support application and the WIND Utility Miantenance application, which address the two chosen business cases.

1.7.2 ACHIEVEMENTS

Based on the integration of the MULTINET system in WP600 on the EURECOM testbed, in WP700:

- The two MULTINET demonstration testbeds were assembled in Bilbao and Ivrea.

- The complete MULTINET system was moved from the Eurecom site to run on both sites.
- The two business cases,Trimek SME Machnine Maintenance and WIND Utility Support applications, were ported to run on the MULTINET system and made operational.
- Demonstration Guidelines were developed, agreed and implemented.
- The user demonstration trials were completed during the extension period of the project to March 2008.
- Deliverable D7.1 "MULTINET Demonstrators - Technology Show Cases" describing this work was completed and submitted.

1.8 WP800 – DISSEMINATION & EXPLOITATION (INNOVALIA)

1.8.1 TASKS

During this period, the tasks carried out in WP800 were:

- Web site redesign, including Commission Area, deliverables requesting area and Knowledge database section
- Two newsletter design, presenting the results achieved by the project up to completion of two different phases
- Papers presentation at different conferences
- Industrial potentials identification
- Organization of MULTINET workshop.

1.8.2 ACHIEVEMENTS

- Web site redesign available in www.ist-multinet.org
- Newsletters done and sent to a list of potential interested contacts.
- Strategy described to reach a wider dissemination, and the best possible market approach for a further exploitation campaign.
- Papers presented in some conferences and dissemination done in the assisted events.
- Organization of MULTINET workshop in Antwerp, in the Broad Band Europe Conference, with a pre-registration of 25 people and with the presentation of 8 papers related to:
    - Advanced Qos and RRM techniques for next generation wireless systems,
    - Advanced Networking Technologies and Protocols (NEMO, Multihoming…),
    - Converged Service Platforms,
    - Advanced Network Deployment & Piloting Experiences,
    - Advanced Services for the Mobile Worker.

1.9 WP900 – PROJECT MANAGEMENT (EUSKALTEL)

1.9.1 TASKS

During this period, the tasks carried out in WP900 were:

- Global & Financial Co-ordination.

- Management of the official project meetings and the required technical ones.
- First review period reporting
- Contract amendment to inform about the merge of Soluziona into INDRA group.

1.9.2 ACHIEVEMENTS

- All activities on track
- All the scheduled deliverables submitted into the expected period.
- Audio conferences, consortium and technical meetings management.
- Participation on the activities programmed by the IST Communication and Network Technologies area.
- First period reporting for the review, including audited cost statements and technical progress of the work.
- Second period reporting for the review, including audited cost statements and technical progress of the work.
- Third period reporting, including this document and all technical deliverables closed including comments from last review meeting.

The EC Recommendations analysis and the decisions that must be taken to follow up this recommendations implies some delays in the development phase and associated to it, to integration phase. Some deliverables were delayed in order to introduce the information required by reviewers correctly and Integration phase started slightly later than planned. For this reason, the development phase has been closed but the integration phase is still in progress. We have to recovered this delay before the review meeting of the Project Period 2 (3rd of March 2008).

1.10 SUMMARY OF ACHIEVEMENTS

WP	Description
WP100	- Establishment of a questionnaire for SMEs data collection - Open Discussion about reference models and technical SoA by partners – Contribution to deliverable. - D1.1 main deliverable reported to EC. - Reference model defined in Nice – To be refined and further described in D2.3 (draft by end of June)
WP200	- Analysis of existing relationships between the SoA technologies and Multinet Platform (D2.3) drafted for end of June. - Design of preliminary architecture and building blocks for the solution. Reported in D2.3 - Definition of supported services and applications. - Definition of data Model used for development. - Last version of D2.3 sent to EC including: o Definition of supported services and applications o Definition of data Model used for development o Design of preliminary architecture and building blocks for the solution. o General overview of the business cases

WP	Description
WP300	- Proposal for Personal Gateway solution (Functional architecture and potential devices) - Mobility and multihoming proposal: Mobile Network Basic Support Protocol and Multiple Case-of-Address registration - Multihoming solution implemented and validated on a demo testbed (laptop based) - Include WiMAX and UMTS analysis of implications within architecture existing in D3.2 after the review in March - D3.2 closed and sent to EC
WP400	- Draft proposal of validation parameters to be used in Network selection - Definition of the Scenarios - Definition of interfaces between NSA and CRRM - Definition and development of an XML based communication library for interfaces between different modules and NSA - Definition and development of the algorithm - Prototype for network selection techniques development - Include WiMAX and UMTS analysis of implications within architecture existing in D4.2 - D4.2 closed and sent to EC
WP500	- Proposal for QoS monitoring system to implement in Multinet - CRRM analysis and location - Wimeter solution developed and tested - Include WiMAX and UMTS analysis of implications for including them in existing architecture in D5.2 - D5.2 closed and sent to EC
WP600	- Design of the system platform at Eurecom - Selection of applications and services representative of system capabilities (FTP, VoIP, Videostreaming,etc) - Initial Integration plan discussions – Early May 2007 - Preparation of the testbed at Eurecom's premises (network setting, equipment HW and SW configuration) May-June 2007 - Partial Integration performed, tests for end-to-end integration performed - D6.1 sent to EC - Testings performed at Eurecom's premises (October-December 2007) - D6.2 drafted for EC review - D6.3 closed after EC review
WP700	- Desk research of the 2 demonstrators realized - Preparation of the equipment and network requirements for demonstrators - Preparation of the 2 business case user applications - Preparation of User demonstration guidelines document for Trimek and Wind - Demonstrations run with user applications in Ivrea and Bilbao. - D7.1 documenting the demonstration trials was completed and delivered.
WP800	- Abstract sent to calls for papers for events in 2007 - Papers sent to events and to a journal (See chapter 3) - Presentations related to accepted papers done (See chapter 4) - Organization of the MULTINET Workshop in Antwerp in December 2007 – Broadband Europe2007 - Fourth version of D8.5, D8.3 and D8.4 released to EC

WP	Description
WP900	- Activities kept in line with planning, except for Integration task which has taken longer than expected - Demonstrator for review has also included some delays and it has bee suggested to change venue in order to be able to show results on site - MULTINET Review Response report of consortium decision about EC recommendations elaborated and sent to EC. - First and second project amendments and extensions realized - Payments and administrative management of the resources of the project adequate - Follow-up meetings held very tightly to keep detailed track of the project progress - Timely information to EC on any change in the project progress

1.11 REFERENCE ARCHITECTURE

The Multinet project will take as reference architecture the system represented in the next figure. The user is supposed to be Nomadic, in this case the different available access networks will be located in Location1. The Location2 is included in order to consider a next step in which mobility would be also provided. Nomadic user does not suppose a big difference with a mobile user (which could be studied by the end of the project), as handover issues are also considered; it can be triggered either by coverage losses or application QoS requirements.

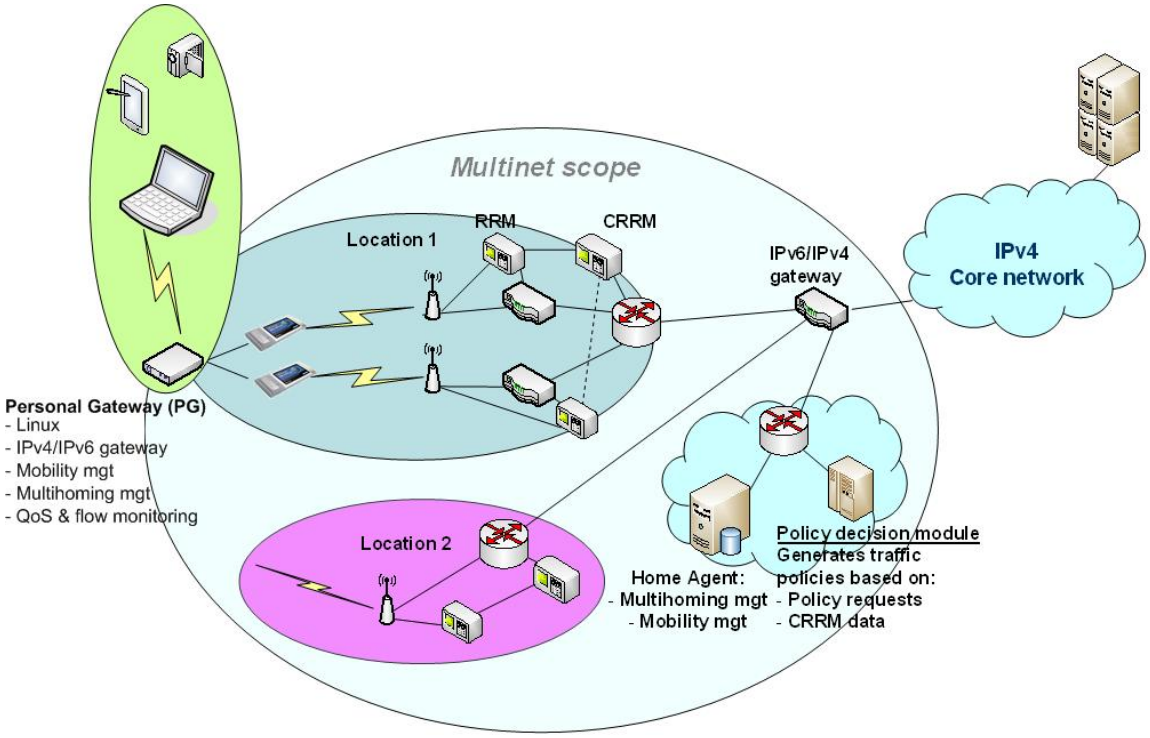
The user that is going to use Multinet belongs to the personal staff of large companies, but is a non-technical user, which means that it does not have to know how the communication system works; perhaps it can make some kind of basic troubleshooting, but very simple and automatized. Besides, the applications must be maintained unchanged.

The access device is split into two devices:

- the user device. The user device tends to be a simple device, a common computer or laptop where changes in the applications are avoided or minimized. This allows the use of a Windows platform and common applications. The network driver also runs a common IPv4.
- the personal gateway (PG). The PG is the complex part of the access device, as it has to provide facilities to the user device and interact with IPv6 access network.

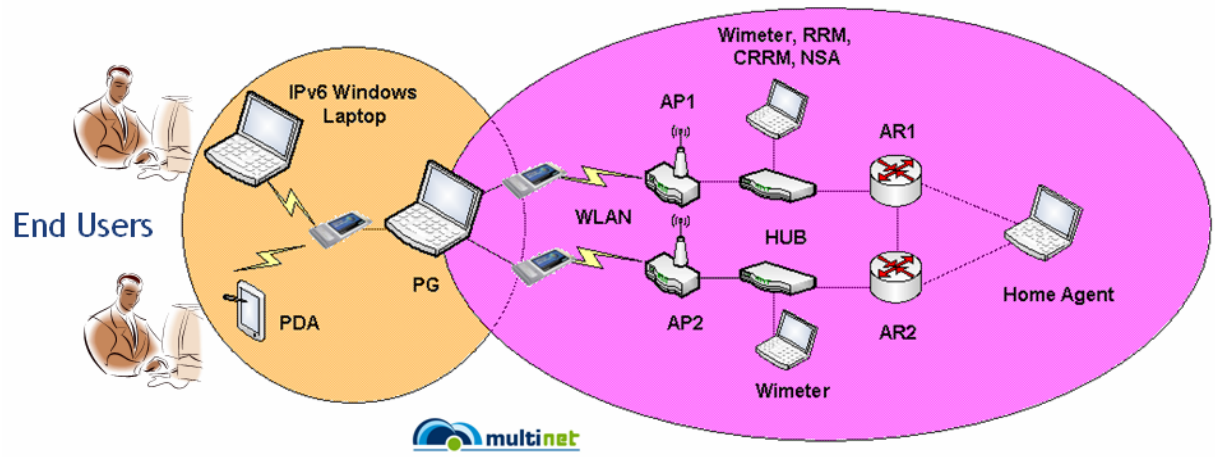
The Multinet system is composed of several *access network (AN)*, all of them are based on wireless technology, such as WLAN, WiMAX and UMTS. Due to difficulties in providing all three technologies completely integrated in Multinet, the implementational approach will start with WLAN and then move to WiMAX and UMTS. The choice order is related to the current test beds (and future demonstrators) deployed in the Multinet partners facilities (Euskaltel and Wind). Besides, WLAN and Wi-Fi are much more 'IP-friendly' than UMTS, which has a different and complex protocol stack, where IP networks are not natively introduced, or at least only partially.

RRM & CRRM modules are part of the infrastructure responsible of network measurements that are going to be used as input for the Network Selection Algorithm (NSA). NSA is included into Policy decision module. The NSA takes a decision which is going to reinforce the handover triggering and offer the Always Best Connected (ABC) paradigm.



1.12 INTEGRATED PLATFORM AND DEMONSTRATOR (INDRA,MAC)

As main outcome for the second period is the integrated and running MULTINET system. The MULTINET Platform Release 1 from the WP600 integration and verification on the EURECOM testbed[1] is as follows:



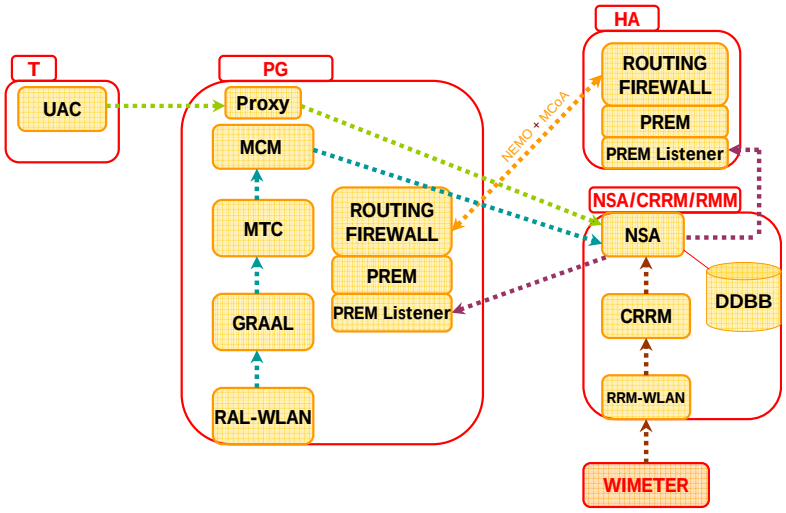
[1] See D6.1, D6.2 and D6.3, "Eurecom's Testbed testing manual" internal report, and "MULTINET Installation Guide" internal report.

The previous testbed assumes one Operator Domain composed of 3 subnets, the Core Network and two Accesses Networks which are two overlapping "hot spots" of the operator, and one User Domain composed of one Personal Gateway (PG) and several user devices which, together with the PG, comprise a Personal Area Network (PAN).

The Core Network is the "Home Subnet" providing a Home Address to any mobile router. A mobile router (upgraded to works as PG) is equipped with two radio extensions and is able to attach to the two hot spots simultaneously. The PG is also composed of a Measurement Collector Module (MCM) which reports information to the NSA about the signal quality of both wireless links between the PG and the Core Network. In each hot spot a machine "Wimeter" sniffs the radio interface to report measurements to the Radio Resource Manager (RRM). One RRM per radio technology and per domain is responsible to aggregate the measurements. One Common Radio Resource Manager (CRRM) per domain reports information to the Network Selection Algorithm (NSA) about the traffic conditions of all hot spots.

The NSA shall decide on the best route for traffic flows based on CRRM info, MCM info and user QoS preferences.

The main modules of the MULTINET Platform are:

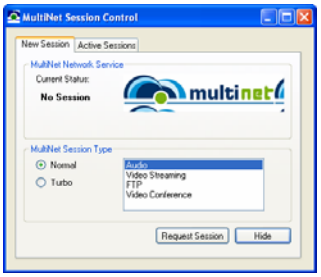


The User Application Controller (UAC) installed in each user device is in charge of capturing, transporting and passing user information and requests to the PG, so that they can be passed through the PG Proxy module to the NSA.

RAL-WLAN, GRAAL and MTC modules are in charge of collecting radio links signal quality measurements and passed them to MCM from where they will be passed to the NSA. Wimeter, RRM-WLAN and CRRM modules are in charge of reporting information to the NSA about the traffic conditions of all hot spots as previously explained.

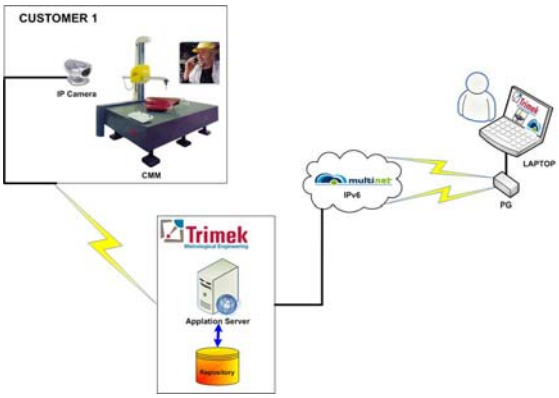
The NSA module manages a local data base where mainly relevant information about the MULTINET network status is stored. This information is consulted during the execution of the

Network Selection Algorithm which will work out the best route for traffic flows. Known this route, the NSA sends corresponding traffic policies to HA and PG machines if necessary. These policies are received by each PREM Lister module and then enforced by its corresponding Policy Reception and Enforcement Module (PREM), as a result, user applications traffic flows are allocated to the most suitable wireless link.



In WP700 demonstration of the MULTINET system was based on trials with users' applications and communications services to show end-users and network operators in a simple and straightforward way the real business benefits that the MULTINET system can provide. So that users will be willing to pay for and sustain the MULTINET service, and network operators invest in its provision.[2]

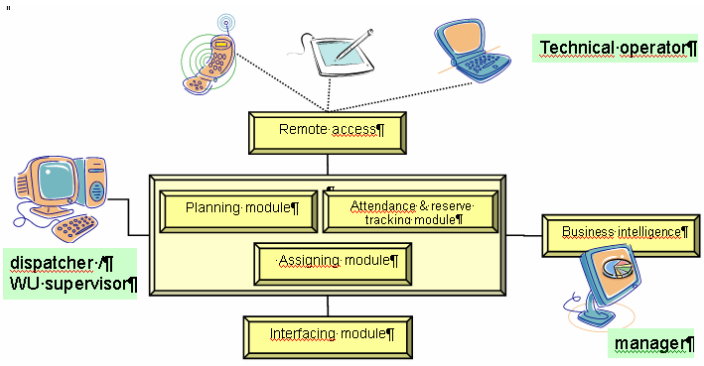
To demonstrate its benefits the MULTINET system was trialled with two very different user applications running on testbeds in two diverse network operator environments. The first is a machine maintenance application running on the Euskaltel testbed in Bilbao, Spain, focused on the needs of an SME, and the second is a large company work force management system on the WIND testbed in Ivrea, Italy.



The SME demonstrator from Trimek provides multimedia support and interactions to technicians in their customer on-site maintenance of high-tech machines anywhere in the world. The main components of the Trimek application are:

- FTP Server for downloading and uploading files.
- IP camera for the video transmission.
- Trimek maintenance application
- MULTINET Network

The large company application from WIND is its Workforce Management (WFM) system based on a group of applications and functional modules that involve rich multimedia content and interaction with remote technicians by means of portable PCs and/or PDAs; in addition cellular phones with some browsing capabilities can be used.



Demonstration Guidelines (as described in D7.1) were developed to record user reactions in a structured way to these 2 applications running with MULTINET on the 2 testbeds in Bilbao and

[2] See D7.1 v0.8 "Demonstrators – Technology Show Cases"

Ivrea. The trials involved recording user observations and feedback while operating their application with and without MULTINET, and then with MULTINET in Normal and Turbo Quality of Service (QoS) modes, and in the wider context of lightly loaded, heavily loaded and fault network conditions. Each trial recorded:

1. Users' comments on use of the system in their work – in particular, do they notice an improvement for which they would be willing to pay ?.
2. The users' perceived impact on applications functions that require videoconferencing, videostreaming, VoIP or FTP, as these are key broadband services in the applications.
3. Key response time measurements, and observations of quality.
4. Conclusions

In all cases users were impressed by the control and quality improvements afforded by MULTINET to video media in particular. The show case trials demonstrated the potential business benefits of MULTINET to both end-user companies and network operators, and thus begin the successful commercialisation of the MULTINET system.

2. WORKPACKAGE PROGRESS OF THE PROJECT

The figures included in table bellow with respect to person months used are only drafted, as some of the deliverables are not in final versions and some adjustments to PM are expected by the end of the project.

2.1 TABLE 1: DELIVERABLES LIST FOR THE PROJECT

Del. no.	Deliverable name	Work package no.	Date due	Actual / Forecast delivery date	Lead contractor
D1.1	Reference Models	WP100	M4	M4	WIND
D2.1	SoA on Seamless Mobility	WP200	M4	M4	USTR
D2.2	SoA on Multimode Terminals	WP200	M4	M4	USTR
D2.3	Req. Analysis, Business Cases and MULTINET concept	WP200	M4*	M6, M10, M14	UPV
D3.1	D3.1- Investigation into Person-level Multihoming	WP300	M10	M10	THAL
D3.2	A Multi-layer Signalling Protocol for Wireless Multihoming	WP900	M15	M15	THAL
D4.1	Report with the specification, modelling and evaluation of the heuristics and algorithms to perform the intelligent network selection.	WP400	M10	M10	INNO
D4.2	Prototype for network selection techniques	WP400	M15	M15	EKT
D5.1	Report with definition of the perceived QoS parameters and estimation of a range of potential traffic mixtures.	WP500	M10	M10	EURE
D5.2	Prototype for dynamic bearer modification techniques	WP500	M15	M15	EURE
D6.1	MULTINET Full Prototype Testing Report	WP600	M18	M18	SOLZ
D6.2	MULTINET Full Prototype Assessment report	WP600	M21	M25	TRIMEK

Del. no.	Deliverable name	Work package no.	Date due	Actual / Forecast delivery date	Lead contractor
D6.3	MULTINET Solution Optimisation & recommendations report and Technology Development Forecast	WP600	M23	M27**	INDRA
D7.1	MULTINET Demonstrators - Technology Show Cases	WP700	M22	M27**	MAC
D8.1	Website and newsletters	WP800	M4, M15, M22, M24	M4, M15, M22, M27**	INNO
D8.2	Project presentation (leaflet)	WP800	M12, M24	M12, M27**	INNO
D8.3	Papers Presentation at Conferences	WP800	M18	M18	EKT
D8.4	Knowledge Database Structure Definition	WP800	M18	M18	INNO
D8.5	Plan for using and dissemination of Knowledge	WP800	M4, M9, M18, M24	M4, M9, M18, M24, M27**	INNO
QMRv1	Quarterly Monitoring Report 1	WP900	M3	M3	EKT
QMRv2	Quarterly Monitoring Report 2	WP900	M6	M6	EKT
QMRv3	Quarterly Monitoring Report 3	WP900	M9	M9	EKT
QMRv5	Quarterly Monitoring Report 5	WP900	M15	M15	EKT
QMRv6	Quarterly Monitoring Report 6	WP900	M18	M18	EKT
QMRv7	Quarterly Monitoring Report 7	WP900	M21	M21	EKT
D9.1	Project Activity Report	WP900	M12	M12	EKT
D9.2	Project Management Report	WP900	M12	M12	EKT
D9.3	Report on distribution of the advance payment	WP900	M12	M12	EKT
D9.4	Cost Statements	WP900	M12	M12	EKT
D9.5	Project Activity Report	WP900	M24	M24	EKT
D9.6	Project Management Report	WP900	M24	M24	EKT
D9.7 ***	Report on distribution of the advance payment	WP900	M24	M24	EKT
D9.8	Cost Statements – Final Report	WP900	M24	M27**	EKT

Del. no.	Deliverable name	Work package no.	Date due	Actual / Forecast delivery date	Lead contractor
D9.9	Report on Raising Public Participation and Awareness	WP900	M24	M27**	EKT
D9.10	Report on distribution of the final payment	WP900	M24	M27**	EKT

***) Updated in First project Amendment**
****) Updated in Second project Amendment**
*****) Included in D9.6**

2.2 DESCRIPTION OF DELIVERABLES CONTENTS

We do not include management reports contents in this section, as they are provided by EC guidelines.

- **D1.1 Complete description of Reference Models**

This deliverable provides an overview of the main topics related to MULTINET project. The objective is to illustrate a state of the art that is going to be used for the model definition and as starting point for the next deliverables.

This document contains a specification of the application scenario; a tight definition of the technical and non-technical scenario is required for a suitable platform development. MULTINET platform users' definition, multihoming architectures, seamless mobility or UMTS, WLAN and WiMAX network characteristics and their QoS requirements are included in this specification.

The network resource efficiency involves different questions:

- Access network scenarios.
- QoS profiles.
- Multihoming
- Traffic engineering; load-balancing, more appropriate access point selection…

Multihoming concept is going to be approached in another deliverable but according to the objective of this deliverable, an initial research is developed and applied in the design of the logical architecture of the MULTINET access platform.

The access platform scenarios are also considered, where the interconnection between different access networks adds functionality to the Multinet middleware. Depending on the used access networks (WLAN, WiMAX or UMTS) the requirements and QoS profiles vary. The possible applications in MULTINET (some of them will be implemented practically and others only theoretically) and the existing QoS levels to offer these applications requirements.

The deliverable also defines a general business model. The main targets that need to be obtained, a possible market approach strategy and existing risks are explained. The involved parties and their roles are also identifies to obtain a clearer sketch.

- **D2.1 State of Art of Techniques and Protocols for Seamless Mobility**

Deliverable D2.1 reviews the state of the art in terms of enablers for seamless mobility.

Provision of seamless mobility is problematic for 2 main reasons:

1. Radio links are notorious error prone and generally have lower bandwidths than their wired counterparts;
2. Node mobility often causes a change in point of attachment to the network (handover).

The low bandwidth of wireless links has the effect of reduced throughput for wireless applications. This is exacerbated by the error prone nature of the links which often result in retransmissions both at the link layer and the transport layer. This is particularly problematic for

services operating over TCP, since retransmission will cause the congestion window to be reset. Thus the end application itself will throttle back its output, degrading performance still further. To counter this, a number of solutions have been proposed; this deliverable provides an overview of some of the most promising including I-TCP and Snoop. Given that the Multinet platform may be required to deliver a range of applications to the end user, a solution to the TCP problem may have to be implemented in the demonstration. This deliverable recognices that Snoop is a potential candidate.

Handover can occur in response to node mobility or other traffic engineering reasons. Many systems employ a break-before-make approach whereby the node relinquishes its current wireless link prior to the establishment of a new one. This causes an outage in connectivity during which packet losses may occur. When a node hands over to a new access point it must first attach to that access point (which may include network address assignment) before it can inform any corresponding nodes of its new address. Thus, during this intervening period packets will be sent to the wrong location. Although Multinet is principally concerned with nomadic communications, changes in point of attachment may still occur. These changes could be triggered for traffic engineering reasons:
load balancing, or selection of the most appropriate access point (and hence access technology). It is therefore incumbent on the consortium to consider protocols and technologies that can minimise the effects of handover. This deliverable presents a number of proposed approaches to this end.

The deliverable also examines the potential role of the Session Initiation Protocol (SIP) for QoS signalling and multihoming. Of particular interest is SIP's call control transfer which facilitates session handover.

Seamless QoS provision in UMTS networks is also considered, including an overview of vertical handover. Finally, a range of seamless mobility initiatives are reviewed.

- **D2.2 State of the Art of Service to Multimode Terminals over a Range of Access Networks**

Deliverable D2.2 provides a literature review on QoS aspects related to multihoming techniques. The objective is to gain insight into the technical challenges to be address and suggest the direction to potential solutions.

Based on the notion of Always Best Connected (ABC), and the role multihoming will play in its support, it is necessary to produce a working definition of the term multihoming in the context of the research programme.

The term Multihoming has a number of interpretations:

1. A device connected to multiple access networks via multiple interfaces using a single network address.
2. A device connected to multiple dissimilar access networks via multiple interfaces using a separate network address for each network.

The former approach is more familiar to the Internet community, whereby network robustness and load balancing can be applied without undue disruption of ongoing sessions. TCP or UDP sessions are preserved by virtue of maintaining a single IP address across physical interfaces.

The latter approach is more closely associated with the cellular industry whereby a device has a number of interfaces (e.g. cellular and WiFi), but each is used relatively independently. However, in this example the interfaces are merely relaying data for each other and cannot be viewed as parallel streams. The Multinet platform will require such a device to utilise both interfaces in parallel to deliver multimedia applications to the device.

The deliverable examines Internet-based QoS mechanisms such as Differentiated Services (DiffServ) and Integrated Services (IntServ). It is noted that IntServ is not particularly suited to mobile applications since reservations between source and destination would have to be regularly torn down and reset-up. The scenarios are consistent with a nomadic approach to mobility management. Therefore, the DiffServ approach is still deemed most appropriate. The form of QoS signalling mechanism to the utilised within Multinet is still under consideration: application layer or network layer signalling?

QoS provision within GPRS systems has been investigated. Although GPRS supports QoS provision, it does so only on a static basis. The QoS is negotiated at session set-up and lasts for the duration of the session; it cannot be modified. It is also not possible to negotiate QoS on a session-by-session basis. Within the network, the use of tunnelling protocols presents serious problems for the use of DiffServ or RSVP. For DiffServ, the DS Field is not visible to routers due to packet encapsulation employed in the tunnel. Similarly, RSVP cannot reserve paths since is cannot see the routers due to the tunnelling mechanism.

The deliverable also assesses the issue associated with multihoming scalability from the perspective of the Border Gateway Protocol. A concise overview of BGP operation, including message types and parameters is provided. It is recognised that multihoming may be inhibited by BGP.

The issue of multihoming is also explored from a general perspective (i.e. not just BGP scalability); it is noted that ingress filtering by autonomous systems may present a barrier to successful multihoming deployment. The ability of IPv6-enabled nodes to have multiple addresses give rise to the notion of an algorithm within the node which must select the most appropriate address to use for a particular session. This presents a problem for multihoming since the algorithm may select a source address that is incompatible with the destination address: the shortest path between source and destination may be through an intermediate network that will not forward packets from the source address due to ingress filtering.

- **D2.3 Requirements Analysis, Business Cases and Multinet Model and Solution Concept (UPV)**

The deliverable D2.3 of WP200 is titled *Requirements analysis, business cases and Multinet model and solution concept*. However, most of the requirements analysis and business cases have been already described in D1.1 of WP100, so the main focus of D2.3 relies on the description of the Multinet system, its architecture analysis and the demonstrators proposed as solution models. Note also that, whereas the requirements analysis is necessary at startup project, the business cases might be adapted or modified at later stages of a research process, once the project has shown to be useful as a whole.
The main topics targeted by D2.3 are:

- **A short overview of Multinet**. This chapter describes what is Multinet and the starting reference model.
- **End-user requirements analysis**. This chapter analyses the requirements demanded by end-users. In the case of Multinet, end-users are TRIMEK and ENEL (Wind), which are also

partners within the Multinet Consortium. The requirements are classified according to different groups, such as Application and Terminal (AT), Traffic transport and Service (TS), Mobility and Moving (MM), Session (SS), Access Control (AC), Application Control (AP), Data Recording (DR), User Profile (UP), Security (SE), Internet Access (IA), Overall System (OS) , Timing (TM). Moreover, requirements have also been classified into general and specific for both companies (TRIMEK and ENEL). Due to the large list of requirements, they have been grouped into comprehensible tables for a better understading.

- **Multinet architecture study**. This chapter makes a description of the components of the Multinet system, focussing on the main important one: the Personal Gateway. CRRM is also considered as monitoring entity. Besides, network configuration is also analysed as crucial topic for a multihomed environment.
- **Multinet functional architecture**. This chapter makes a description of the whole process of communication between a mobile node and the end user, and the necessary interaction with the system intelligence of Multinet. This module is the Network Selection Algorithm (NSA). A key challenging aspect of Multinet is the capacity of performing a handover between access networks. This topic is also analysed in this chapter, as well as an overview of the necessary entities for mobility management.
- **Multinet testbed roadmap**. This chapter explains in great detail the starting point of Multinet and how it is evolving to achieve the demanded requirements. The chapter is explained as a roadmap, stating that the handover process is of critical importance and identifying the available partial test beds from some partners of the Multinet consortium. The Universisty of Strathclyde provides a MIPV6 platform, Thales provides a Nemo testbed and Eurecom provides a UMTS platform. From the three choices, the Nemo test bed is more adequate for the demonstrator, which is also described as a simplification of the Multinet platform. Finally, the Multinet platform is described comprising three scenarios or pilots: Euskaltel, Wind and Eurecom. This final platform will target a WLAN scenario for practical and timing reasons.

- **D3.1 Investigation into Person-level Multihoming**

Considering the output of WP100 and WP200, and especially the requirements in terms of mobility and multihoming and the capabilities of the targeted end-user devices, the partners agreed on an architecture based on the emerging IETF approach for NEtwork MObility (NEMO) Basic support (RFC 3963).

Using NEMO in Multinet is particularly relevant for two main reasons:

- First, enhanced with the IETF WG MONAMI6 (Mobile Nodes and Multiple Interfaces in IPv6) proposals, the Home Agent based NEMO architecture allows to set-up an IP-level (Physical layer agnostic) multihoming solution which fulfils the requirements of the Multinet usage scenario. This solution allows the registration of multiple care of address (MCoA) for a single device (one per interface of the device) and specifies a syntax to define what flow should be distributed on a given interface (flow binding policies).
- Second, this architecture introduces the concept of *Personal Area Network (PAN)*. With this approach, a mobile user is equipped with a small multimodal embedded router, so-called *Personal Gateway (PG)*. The PG is the key element of the Mobile Network, which is composed of the IP devices and sensors the mobile worker uses to carry out his tasks (webcam, PDA, laptop…). The PG is also responsible for ensuring the connectivity to the Internet and providing transparent and seamless mobility to the connected devices. Finally, the PG is in

charge of managing the multiple connections (Wifi, UMTS, Wimax…) that may be available at any moment of time. Using a PAN allows to concentrate all the mobility and multihoming specific-functions and processing in a single equipment - the PG - leaving all the users' devices and applications unmodified which is one of the major objectives of the Multinet project.

This solution is widely described in deliverable "*D3.1 – Investigation into personnel level multihoming*".

Once agreed, WP300 objective was redefined as:
"*Providing a physical/access-technology independent multihoming solution for a single multimodal terminal (the PG) based on NEMO and MCoA[3] that can enforce flow binding policies specified using the XML schema defined by the MONAMI6 WG[4]*".

- **D3.2 Investigation into Person-level Multihoming (Thales)**

Considering the output of WP100 and WP200, and especially the requirements in terms of mobility and multihoming and the capabilities of the targeted end-user devices, the partners agreed on an architecture based on the emerging IETF approach for NEtwork MObility (NEMO) Basic support (RFC 3963).

Using NEMO in Multinet is particularly relevant for two main reasons:
- First, enhanced with the IETF WG MONAMI6 (Mobile Nodes and Multiple Interfaces in IPv6) proposals, the Home Agent based NEMO architecture allows to set-up an IP-level (Physical layer agnostic) multihoming solution which fulfils the requirements of the Multinet usage scenario. This solution allows the registration of multiple care of address (MCoA) for a single device (one per interface of the device) and specifies a syntax to define what flow should be distributed on a given interface (flow binding policies).
- Second, this architecture introduces the concept of *Personal Area Network (PAN)*. With this approach, a mobile user is equipped with a small multimodal embedded router, so-called *Personal Gateway (PG)*. The PG is the key element of the Mobile Network, which is composed of the IP devices and sensors the mobile worker uses to carry out his tasks (webcam, PDA, laptop…). The PG is also responsible for ensuring the connectivity to the Internet and providing transparent and seamless mobility to the connected devices. Finally, the PG is in charge of managing the multiple connections (Wifi, UMTS, Wimax…) that may be available at any moment of time. Using a PAN allows to concentrate all the mobility and multihoming specific-functions and processing in a single equipment - the PG - leaving all the users' devices and applications unmodified which is one of the major objectives of the Multinet project.

- **D4.1 Report with the specification, modelling and evaluation of the heuristics and algorithms to perform the intelligent network selection**

This document describes the different key elements in the architecture of the Network Selection Algorithm (NSA), their components and interfaces with the various components in the system, since NSA is a central element of the MULTINET system as it is in charge of QoS and Routing

[3] Multiple Care-of Addresses Registration (draft-ietf-monami6-multiplecoa-01.txt)
[4] A Policy Data Set for Flow Distribution (draft-mitsuya-monami6-flow-distribution-policy-02.txt)

policy generation. Furthermore, the document provides some information on some data formats employed for data exchange.

The document also presents the evolution of the NSA features through the various innovation cycles, analyses and define the signalling flows and protocols used to set up, deploy and apply the QoS and routing strategies and proposes the overall policy management framework. Finally, some conclusions are drawn and further work identified.

- **D4.2 Prototype for network selection techniques (EKT,INNO)**

The Network Selection Algorithm (NSA) is a central element of the MULTINET system as it is in charge of QoS and Routing policy generation. Hence, the NSA is the element, which interfaces with the various components in the system and handles the complexity of the system. This document describes, following the description of the different key elements in the architecture in D4.1, the development of the components and interfaces of NSA with the rest of the components of MULTINET architecture. Furthermore, the document further elaborates the information on data formats employed for data exchange provided in the previous deliverable (D4.1).

This document is organised as follows. Section 2 presents the high level specifications to be included in public version of the deliverable, with short description of the NSA features. The development of the algorithm has been splitted into two sections, in order to facilitate the development work assignment. These are: Core of algorithm (decision heuristics) and Communications with the rest of the modules.

Next, section 3 will concentrate in the description of the heuristics of the algorithm, from both parts, the Core and the Communications modules, analysing and defining the signalling flows and protocols used to set up, deploy and apply the QoS and routing strategies. The approach to the development of both parts is described in Section 4. We have also included a section about the simulation models for the scenario where load with several user could be considered. Finally, Section 6, 7 and 8 collect the information about how MULTINET solution could be implemented in heterogeneous networks, from the point of view of the implications on NSA. A brief summary of conclusion is collected in Section 9.

- **D5.1 Report with definition of the perceived QoS parameters and estimation of a range of potential traffic mixtures**

The aim of this document is threefold. First, we target to identify the perceived quality of service parameters which will be the interest of the Multinet project. We focus on the four applications that are expected to be supported by the Multinet system; namely file transfer-sharing and browsing, video-conference, voice over IP, and video-steaming. The QoS parameters are identified at each communication layer going from the application layer to the physical layer.

Second, we define the different metrics which are gathered by the radio resource management module of the Multinet system which are the available bandwidth and the link quality at each base station visible by the mobile station. Third, based on the collected measurements, we introduce Multinet proposals for cross-layer adaptation mechanisms at the MAC layer, optimal selection of access points, link-layer adaptation.

- **D5.2 Report with definition of the perceived QoS parameters and estimation of a range of potential traffic mixtures (EUR)**

The aim of this document is threefold. First, we target to identify the perceived quality of service parameters which will be the interest of the Multinet project. We focus on the four applications that are expected to be supported by the Multinet system; namely file transfer-sharing and browsing, video-conference, voice over IP, and video-steaming. The QoS parameters are identified at each communication layer going from the application layer to the physical layer.

Second, we define the different metrics which are gathered by the radio resource management module of the Multinet system which are the available bandwidth and the link quality at each base station visible by the mobile station. Third, based on the collected measurements, we introduce Multinet proposals for cross-layer adaptation mechanisms at the MAC layer, optimal selection of access points, link-layer adaptation.

- **D6.1 MULTINET Full Prototype Testing Report (INDRA)**

Comprises the testing report of the results after full integration of the MULTINET modules setting a stable prototype. Test results of the full prototype testing phases are to be used for the methodology actualisation. This deliverable describes how MULTINET technology has been incorporated into Eurecom's platform and which functionalities are offered by the resulting system to the end-user

Once the developments have been completed, they must be integrated to form a prototype that will be tested, afterwards assessed by end-users and finally optimised. The result of all those processes IS the MULTINET System; this process is explained at this document, as well as the tests performed.

- **D6.2 MULTINET Full Prototype Assessment Report (TRIM)**

In this report, an analysis of the technical requirements is carried out and feedback provision to system architecture is given.

This deliverable provides information on the performance observed as part of the pilot carried out over the EURECOM platform and about the testing and verification of the prototype, in the daily operation in the real environments, taking into account the need and requirements of final users. This information is used for measurement of the business benefits achieved by the implementation of the new system, as well as for the definition of the necessary refinements.

- **D6.3 MULTINET Solution Optimisation & Recommendations (INDRA)**

Based on the MULTINET solution assessment, the goal of this report is to provide some guidelines and recommendations to improve the system giving the possibility of increasing MULTINET functionalities and other possible uses in the future. It also collects recommendations based on feedback collected during the trials to enhance system features.

Thus, this deliverable identifies a technology-development forecast, so MULTINET system can evolve as technologies and networking protocols will do, just as user needs increase.

- **D7.1 Demonstrators – Technology Show Cases (MAC)**

This report describes the demonstration trials and user benefits of using the MULTINET system with two very different applications running on testbeds in two diverse network operator environments. The first is the Trimek Machine Maintenance Application running on the Euskaltel testbed in Bilbao focused on the needs of an SME, and the second is a large company work force management system on the WIND testbed in Ivrea. These are the outcomes of the WP700 Demonstration workpackage of the MULTINET project.

Demonstration Guidelines were developed to record user reactions in a structured way to the two demonstration MULTINET trials on the 2 testbeds in Bilbao and Ivrea. The trials involved recording user observations and feedback while operating their applications with and without MULTINET, and then with MULTINET in Normal and Turbo Quality of Service (QoS) modes, and in the wider context of lightly loaded, heavily loaded and fault network conditions. In all cases users were impressed by the control and quality improvements afforded by MULTINET to video media in particular.

The show case trials demonstrated the potential business benefits of MULTINET to both end-user companies and network operators, and thus begin the successful commercialisation of the MULTINET system, as the key output from WP700 and the project overall.

- **D8.1 Project web-site and newsletters (INNO)**

The aim of these deliverables is to inform the research community about the progress of MULTINET project and to raise awareness about the research carried out. Two different ways are considered:

- MULTINET web-site. The MULTINET web-page is designed as a site for the dissemination of project and for information exchange between partners, between the consortium and the Commission and also with other interested people, through the Knowledge database. The web-page link is www.ist-multinet.org

- MULTINET newsletter. Two deliveries have been done in the second period:
  - The second one, sent in March 2007, summarizes the results of the project from the perspective of the three main components of the MULTINET system: policy enforcement, network selection algorithm and measurement and estimation system.
  - The third one, sent in December 2007, explained the activities carried out inside the project for the integration of the three main components of the MULTINET system: policy enforcement, network selection algorithm and measurement and estimation system; and also the first trials and scenarios defined by the final users of MULTINET

- **D8.2 Project presentation (leaflet)**

A leaflet was designed, showing the main objectives of the project and the achieved results up to half of the project. The leaflet gathers information about the main components of MULTINET solution, the reference architecture, the vision, the application scenarios and financial figures of the project.

- **D8.3 Paper presentations at Conferences - (EKT)**

The main objective of this document, is to collect a summary of major publications from the Project in different events and conferences. Only the abstract of the papers is included, as they have copyright protection and this is a public report.

As the deliverable was due Month 18th, the rest of publications from the 30th of June 2007 till the end of the project (and afterwards) will be included in the final version of D8.5 (report on Usage and Dissemination of Knowledge).

- **D8.4 Knowledge Database structure definition - (INNO)**

This document shows the importance of including a Knowledge database as one of the results of the project both for the consortium and the research community in general.

The MULTINET knowledge database is a way of having a repository of related information classified in three different fields: technological information, similar products from the competitors, and related standards.

The deliverable presents the internal design of the Knowledge database, the way of operation and the main information selected and classified until now through keywords.

- **D8.5 Plan for using and dissemination knowledge (INNO)**

The Plan for using and dissemination knowledge is a living document that is being updated according to the progress of the project. This document describes the strategy defined to reach the wider dissemination, and the best possible market approach for a further exploitation campaign. The focus in on the outcoming exploitable results from the MULTINET project, moving the results from the research phase into industrial exploitation.

The third version of the document has been produced in this period, including preliminary drafts of the future commercialization plan of MULTINET solution, from the point of view of Euskaltel, operator and leader of the project; and the updating of the dissemination activities.

Final version will be produced for the end of the project in which applicable results will be considered for future exploitation by all partners, after validating them with end users.

2.3 TABLE 2: MILESTONES LIST

List of milestones associated to this first period, giving date of achievement and any proposed revision to plans:

Milestone no.	Milestone name	Workpackage no.	Date due (month)	Actual/ Forecast delivery date	Lead contractor
MS1	Final Specification of business cases and MULTINET model	WP100 / WP200	12	12	WIND / USTR / UPV
MS2	Definition of the prototype solution for multihoming	WP300	15	16	THAL
MS3	Definition of the prototype solution for Intelligent Network Selection	WP400	15	16	INNO
MS4	Definition of the prototype solution for dynamic bearer modification techniques.	WP400	15	16	EURE
MSEC1	Mid-Term Review with EC	WP900	15	14	EKT
MS5	MULTINET system performed and testing overcome	WP600	18	26	INDRA
MS6	Demonstrations in the users' sites	WP700	22	26	MAC
MS7	1st versions of the project web site and the project presentation, 1st version of the Plan for Using and Disseminating Knowledge.	WP800	9	9	INNO
MS8	3rd version of the Plan for Using and Disseminating Knowledge	WP800	18	18	INNO
MS9	4th versions of the Plan for Using and Disseminating Knowledge, final version of the Technology development forecast.	WP800	24	27	INNO
MSEC2	Final Review with EC	WP900	24	26	EKT
MS10	End MULTINET Project	WP900	24	27*	EKT

***Due to 2nd Amendment**

3. CONSORTIUM MANAGEMENT

Two weekly technical meetings EKT-INNO calendar was established in the beginning of the project, for the definition of technical issues and contents to provide to Active WPs and Deliverables. These meetings have been hold in Innovalia and Euskaltel premises in Bilbao, alternatively.

Apart from **two weekly meetings of EKT-INNO**, these are meetings held during first period:

Date of the meeting	Location	Topics	Participants
2006.01.10-11	Bilbao, Euskaltel premises	Kick-off meeting	All consortium
2006.02.03	Audioconference	ToC of main deliverables D1.1, D2.1, D2.2 and D2.3	All consortium
2006.03.03	Audioconference	Contributions to main deliverables D1.1, D2.1, D2.2 and D2.3	All consortium
2006.03.21-22	Brussels, EC premises	Concertation meeting, Presentation of MULTINET Project and prospection of clustering opportunities	EUSKALTEL, INNOVALIA and SOLUZIONA
2006.04.07	Audioconference	ToC of main deliverables D1.1,D2.1,D2.2 and D2.3	All consortium
2006.04.27-28	Nice, Eurecom premises	Consortium meeting	All consortium
2006.05.05	Audioconference	Cancelled due to proximity to consortium meeting	-
2006.06.02	Audioconference	Contributions to main deliverables D1.1, D2.1, D2.2 and D2.3	All consortium
2006.06.29	Glasgow, USTR premises	Parallel Meeting IP addressing and architecture refinement. Discussion about D3.1, D4.1&D5.1 deliverables.	USTR, MAC, UPV, INNO, EKT
2006.07.07	Audioconference	Cancelled due to proximity of parallel meeting	
2006.07.27	Ivrea, WIND premises	Parallel Meeting WIND testbed and D3.1, D4.1, D5.1 deliverables status following	WIND, MAC, USTR, INNO, EKT
2006.08.04	Audioconference	Cancelled due to proximity of parallel meeting	

Date of the meeting	Location	Topics	Participants
2006.09.05	Parallel Meeting Valencia, UPV premises	Contributions to main deliverables D1.1, D2.1, D2.2 and D2.3	UPV, Soluziona, EKT, Thales, INNO
2006.09.19	Audioconference	Technical discussion about NEMO proposal and final architecture	EURE, Thales, UPV, USTR, INNO, EKT, MAC
2006.09.25	Audioconference	Technical discussion about NEMO and CRRM	EURE, Thales
2006.10.03-04	Brussels, EC premises	Concertation meeting Presentation of MULTINET Project and prospection of clustering opportunities	EKT, INNO
2006.10.05-06	Bilbao, Innovalia premises	Consortium meeting	All consortium (Except WIND)
2006.11.06	Madrid, Soluziona premises	Parallel Meeting Contributions to main deliverables D1.1, D2.1, D2.2 and D2.3	UPV, Soluziona, EKT, EURE, INNO
2006.11.27	Audioconference	Technical discussions about WP300 & WP400 work distribution and interfaces between them.	INNO, Thales, EKT
2006.11.28	Brussels, EC premises	4th IST Coordinators Day on Project Management	EKT
2007.01.23	Paris, TCF	Follow-up meeting	TFC, EUR, INNO, , IND, UPV, USTR, MAC, EKT
2007.02.15	Bilbao, INNO	Follow-up meeting	TFC, EUR, INNO, TRIM, IND, UPV, USTR, MAC, EKT
2007.03.06	Brussels, Basque Delegation	First review preparatory meeting	All consortium
2007.03.07	Brussels, EC premises	First review meeting	All consortium (except INDRA)
2007.03.20-21	Brussels, EC premises	Concertation meeting, Participation in clustering activities and reporting	EUSKALTEL and INDRA
2007.04.12	Audioconference	Analysis of Recommendations report from EC	All consortium
2007.05.23	Nice, EURE premises	Integration kick-off follow up meeting	TFC, EUR, INNO, UPV, USTR, INDRA, MAC, EKT

Date of the meeting	Location	Topics	Participants
2007.07.04-06	Nice, EURE premises	Integration follow up meeting	TFC, EUR, INNO, UPV, USTR, INDRA, MAC, EKT
2007.07.17	Audioconference	Integration follow up	TFC, EUR, INNO, UPV, USTR, INDRA, MAC, EKT
2007.09.04-06	Nice, EURE premises	Integration follow up meeting	TFC, EUR, INNO, UPV, USTR, INDRA, MAC, EKT
2007.09.20	Audioconference	Integration follow up	EUR, INNO, UPV, USTR, INDRA, MAC, EKT
2007.09.25-26	Brussels, EC premises	Concertation meeting	EKT
2007.09.26-28	Nice, EURE premises	Integration follow up meeting	TFC, EUR, INNO, UPV, USTR, INDRA, MAC, EKT
2007.10.04-06	Bilbao, EKT premises	Consortium meeting	All partners
2007.10.31	Valencia, Ciudad de las Ciencias y de las Artes	Telecom I+D	INDRA, EKT
2007.11.05	Madrid, Indra premises	Demonstration Kick-off meeting	EUR, INNO, UPV, USTR, INDRA, MAC, EKT
2007.11.14	Brussels	eMobility General Assembly	EKT
2007.11.27	Audioconference	Workshop preparation and Demonstration Follow-up	EUR, INNO, UPV, USTR, INDRA, MAC, EKT, WIND
2007.12.05	Antwerp, Hotel Astrid Park, Belgium	Consortium meeting and BBEurope 2007 Workshop preparation	INNO, Thales, EKT
2008.01.08	Audioconference	Demonstration follow up meeting and Review meeting Demo preparation	EUR, INNO, UPV, USTR, INDRA, MAC, EKT, WIND
2008.01.18	Audioconference	Demonstration follow up meeting and Review meeting Demo preparation	EUR, INNO, UPV, USTR, INDRA, MAC, EKT, WIND
2008.01.28	Audioconference	Demonstration follow up meeting and Review meeting Demo preparation	EUR, INNO, UPV, USTR, INDRA, MAC, EKT, WIND
2008.02.08	Audioconference	Demonstration follow up meeting and Review meeting Demo preparation	EUR, INNO, UPV, USTR, INDRA, MAC, EKT, WIND

Date of the meeting	Location	Topics	Participants
2008.02.18	Audioconference	Demonstration follow up meeting and Review meeting Demo preparation	EUR, INNO, UPV, USTR, INDRA, MAC, EKT, WIND
2008.03.02	Brussels, St. Katherine Ibis Hotel	Meeting for preparation of Review	All partners

Table 5: Workpackages - Plan and Status Barchart

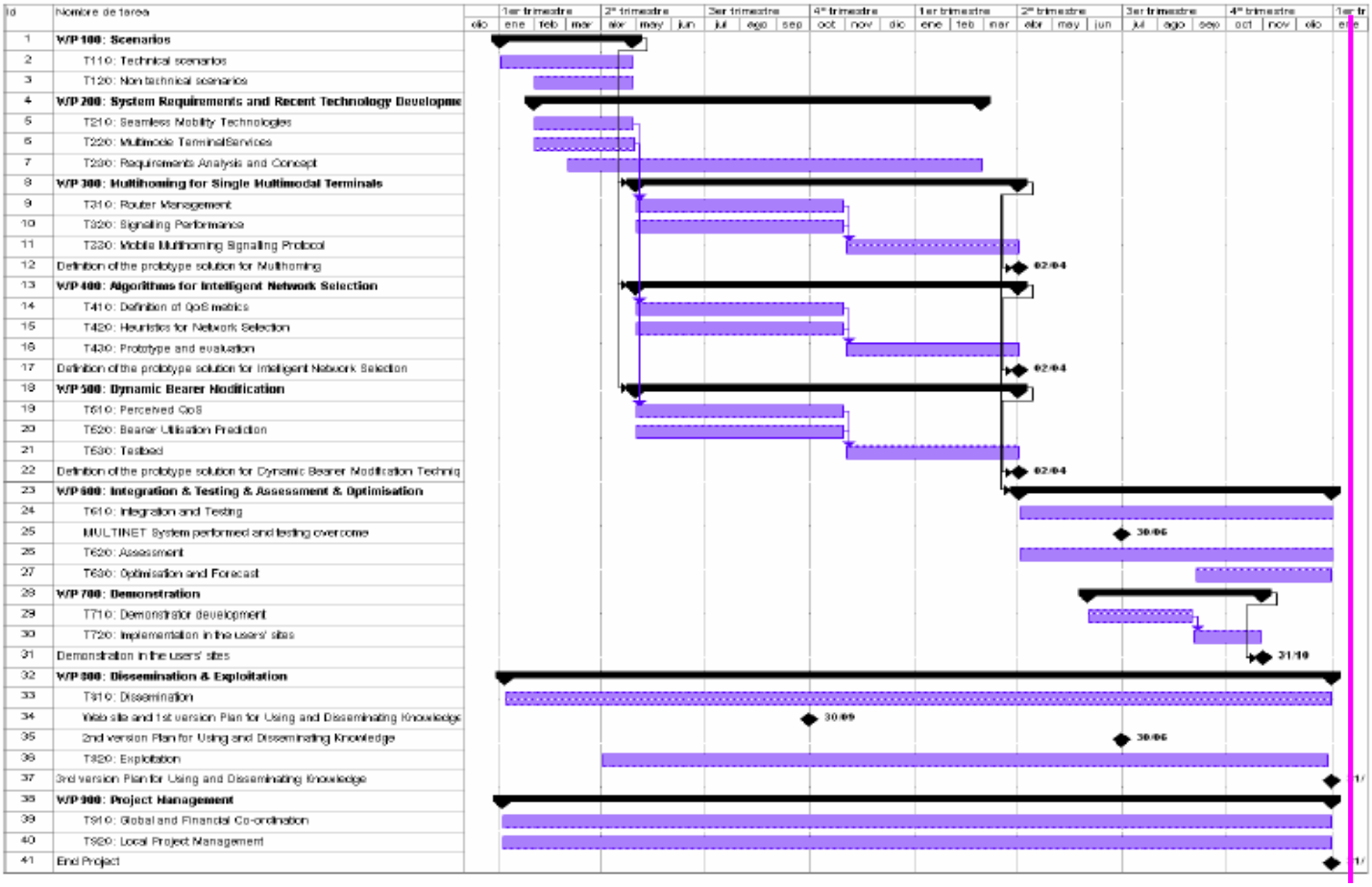


Figure 7. MULTINET Gantt scheme

4. DISSEMINATION AND EXPLOTATION (EKT, INNO)

4.1 EVENTS & PAPERS

Following a summary of papers submitted to conferences is included:

CONFERENCE	STATUS	PLACE OF CELEBRATION	DATE OF CELEBRATION
WWRF 2006	Paper presented	HEIDELBERG (D)	15-17 NOVEMBER 2006
TELECOM I+D 2006	Paper presented	MADRID, BARCELONA BILBAO, VALENCIA (E)	29 NOVEMBER TO 1ST DECEMBER 2006
BROADBAND EUROPE 2006	Poster presented	GENEVA (CH)	12 DECEMBER 2006
VTC - IEEE SOCIETY 2007	Paper presented	DUBLIN (IRL)	23-25 APRIL 2007
IST MOBILE SUMMIT 2007	Paper presented	BUDAPEST (HU)	1-5 JULY 2007
IFIP - IEEE MWCN 2007	Paper presented	CORK (IRL)	19 - 21 SEPTEMBER 2007
eCHALLENGES 2007	Paper presented	THE HAGUE (NL)	24-26 OCTOBER 2007
BROADBAND EUROPE 2007	Poster presented	ANTWERP (B)	5-7 DECEMBER 2007
CDN UPGRADE 08 workshop - HPDC symposium	Paper accepted	BOSTON, MA (USA)	23-27 JUNE 2008
ICT MOBILE SUMMIT 2008	Paper submitted	STOCKHOLM (S)	10-12 JUNE 2008

4.2 PUBLICATIONS

- Q. Wang, T. Hof, F. Filali, R. Atkinson, J. Dunlop, E. Robert, and L. Aginako, "QoS-Aware Network-Controlled Architecture to Distribute Application Flows over Multiple Network Interfaces", (Springer) Wireless Personal Communications, in press (DOI: 10.1007/s11277-007-9424-7), 28 pages.
- Q. Wang, R. Atkinson, and J. Dunlop, "Design and Evaluation of Flow Handoff Signaling for Multihomed Mobile Nodes in Wireless Overlay Networks", accepted for publication in (Elsevier) Computer Networks.

4.3 OTHER PUBLICATIONS

Other events, in which MULTINET Project results have been introduced, are:

- Euskaltel Internal News (April 2006), Bilbao (Spain)
- Euskaltel Internal News (April 2008), Bilbao (Spain)

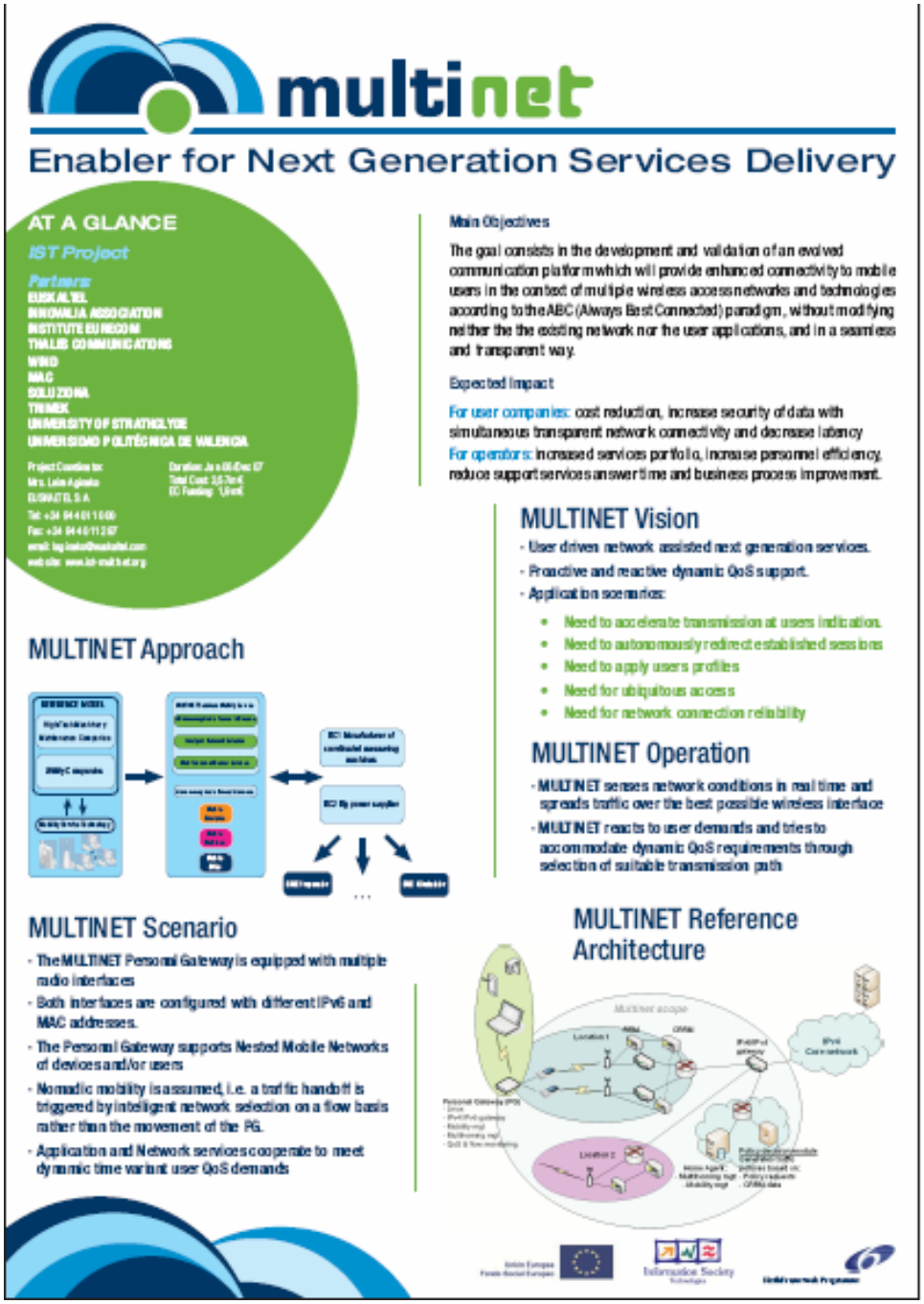
4.4 BBEUROPE2007: WORKSHOP 06/12/2007 (ALL PARTNERS)

MULTINET workshop on Multihoming and mobility was held on the 6th of December 2007, co-located to the BBEurope 2007, in Antwerp Belgium. More than 25 attendees were registered, and presentations where made from research activities in the field of IP network mobility, QoS measurement and guarantee techniques, multihoming solutions for Broadband access in Rural Areas (chaired by EKT, leader of MULTINET project), white paper on Mobile Services Platform Cluster and Research activities in Broadband for all during FP6 and challenges for FP7.

The programme is published and presentations will be available under request through the MULTINET website (www.ist-multinet.org) or in the web site of the conference (http://www.bbeurope.org/).

4.5 POSTER

A poster was also desinged and printed, which was used in different dissemination actions during the project, such as internal meeting from INNOVALIA GROUP in December 2006, Broadband Europe 2006, Broadband Europe 2007 and Demonstration platform internal guided visits in Euskaltel.


multinet
Enabler for Next Generation Services Delivery
AT A GLANCE
IST Project
Partners:
EUSKALTEL
INNOVALIA ASSOCIATION
INSTITUTE EURECOM
THALES COMMUNICATIONS
WINGS
MAC
SOLUZIONA
TRIMEK
UNIVERSITY OF STRATHCLYDE
UNIVERSIDAD POLITÉCNICA DE VALENCIA
Main Objectives
The goal consists in the development and validation of an evolved communication platform which will provide enhanced connectivity to mobile users in the context of multiple wireless access networks and technologies according to the ABC (Always Best Connected) paradigm, without modifying neither the the existing network nor the user applications, and in a seamless and transparent way.
Expected Impact
For user companies: cost reduction, increase security of data with simultaneous transparent network connectivity and decrease latency
For operators: increased services portfolio, increase personnel efficiency, reduce support services answer time and business process improvement.
MULTINET Vision
- User driven network assisted next generation services.
- Proactive and reactive dynamic QoS support.
- Application scenarios:
• Need to accelerate transmission at users indication.
• Need to autonomously redirect established sessions
• Need to apply users profiles
• Need for ubiquitous access
• Need for network connection reliability
MULTINET Approach
MULTINET Operation
- MULTINET senses network conditions in real time and spreads traffic over the best possible wireless interface
- MULTINET reacts to user demands and tries to accommodate dynamic QoS requirements through selection of suitable transmission path
MULTINET Scenario
- The MULTINET Personal Gateway is equipped with multiple radio interfaces
- Both interfaces are configured with different IPv6 and MAC addresses.
- The Personal Gateway supports Nested Mobile Networks of devices and/or users
- Nomadic mobility is assumed, i.e. a traffic handoff is triggered by intelligent network selection on a flow basis rather than the movement of the PG.
- Application and Network services cooperate to meet dynamic time variant user QoS demands
MULTINET Reference Architecture
Information Society